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Managing Circular Business Models

Essays on Customer Value Creation, Dynamic Capabilities and Value Networks in the Circular Economy

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Nykyiset tuotanto- ja kulutuskäytännöt rakentuvat vahvasti uusiutumattomien luonnonvarojen käyttöön ja aiheuttavat samalla kielteisiä ulkoisvaikutuksia jätteen ja saastumisen muodoissa. Kiertotalouden mallit perustuvat jätteettömyyteen, ja tuotteet ja materiaalit tarjoavat optimoitua arvoa takaisinkierrätyksellään. Vastatakseen tulevaisuuden haasteisiin liiketoimintamallit on yhdistettävä kiertotalouden malleihin. Sen toteuttamiseksi tarvitaan käsitteellinen viitekehys, joka mahdollistaa yrittäjille ja johtajille kiertotalouden liiketoimintamallien muotoilun. Väitöskirja pyrkii tarjoamaan jäsennettyä tietoa kiertotalouden liiketoimintamallien kehittämistä ja toimeenpanoa mahdollistavista mekanismeista. Ensin tarjoamme kokonaisvaltaisen kuvauksen kiertotalouden liiketoimintamalleista, määritelmän ja ohjaavat periaatteet (essee I). Toiseksi tarkastelemme kolmen pääelementin kokoonpanoa, eli (1) asiakasarvon luomisen, (2) dynaamisten kyvykkyyksien sekä (3) arvoverkostojen piirteitä ja ominaisuuksia liiketoimintamallien muutoksen yhteydessä kohti kiertotaloutta (esseet II, III ja IV). Havainnot antavat oman lisänsä teoreettiseen kirjallisuuteen kiertotalouden liiketoimintamalleista. Käytännössä tämä integroitu viitekehys mahdollistaa johtajille ja yrittäjille arvoa tuottavien mekanismien uudelleenmäärittelyn kiertotalouden periaatteiden valossa.

Asiasanat

Kiertotalous, kiertotalouden liiketoimintamallit, kestävyys, asiakasarvon luominen, arvoverkostot, dynaamiset kyvykkyydet

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Abstract
Our current production and consumption patterns heavily rely on limited natural resources and simultaneously produce negative externalities in the shape of waste and pollution. In order to become future-fit, business models need to integrate these increasing pressures and become aligned with a circular economy blueprint, in which waste is designed out and products and materials provide optimized value though their recirculation. In order to do so, we need a conceptual framework that enables entrepreneurs and managers to design their circular business model. Consequently, the dissertation seeks to provide articulated knowledge on the mechanisms enabling the development and implementation of circular business models. We do so, first by providing an integrated characterization of circular business models, definition and guiding principles (essay I). Second, by looking at the configuration of three main elements, namely the features and characteristics of (1) *customer value creation*, (2) *dynamic capabilities* and (3) *value networks* in the context of business model transformation towards a circular economy (essays II, III and IV). The findings contribute to the emerging theory building literature on circular business models. In practice, the outcome of this integrated framework allows managers and entrepreneurs to redefine their value creation mechanisms in light of circular economy principles.

Keywords
Circular economy, circular business models, sustainability, customer value creation, value networks, dynamic capabilities.

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"You never change things by fighting the existing reality. To change something, build a new model that makes the existing model obsolete." — Buckminster Fuller

Planet Earth is facing a climate emergency. Responding to this crisis requires major transformations in the ways our global society functions and interacts with natural ecosystems. In this emerging surge of concern, governmental bodies are making climate emergency declarations. Schoolchildren are striking. Grassroots citizen movements are demanding change. As a response, the business community is slowly waking up, making announcements on transitioning to renewable energy, reducing emissions or cutting water use. But beyond declarations, there's a strong necessity to rethink how businesses can design and implement new business models that are future fit. This dissertation aims to contribute to this transformation by focusing on the conditions that enable business model renewal, using circular economy as a framework for change.

Similar to business model innovation, this research is the result of a long process of trial and error, testing new ideas, bridging existing concepts, and exploring how novel knowledge can provide shared value for society. Even though the production of a dissertation is a solitary process, its outcome is always the result of multiple interactions: academic discussions with colleagues and peers at university or in conferences, multiple exchanges with practitioners, entrepreneurs and managers who shared their concrete visions and strategies to walk the talk.

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Last but not least, I would like to thank my wonderful children Milla and Maël. They are the reason why a concerned father and researcher wakes up every morning. To work for a better future. A future where each child feels empowered to live well, prosper and flourish in a preserved ecological balance.

Erwan Mouazan
Vaasa, 25 November 2019.

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Abbreviations

CE	Circular Economy
SBM	Sustainable Business Model
CBM	Circular Business model
DC	Dynamic Capability
VN	Value network

Glossary of terms

Bio-based material

A material that is partially, or entirely made of biomass.

Biodegradable material

A material which microorganisms can break down into natural elements (i.e. water, biomass, etc.).

Biological nutrients

Organic materials derived from and developed to re-enter the natural environment.

Biomimicry

Taking inspiration from nature to solve human challenges.

Blue economy

Movement for solutions being determined by their local environment characteristics, emphasizing gravity as the primary source of energy (Pauli, 2010).

Business model

The rationale on how to create deliver and capture value (Osterwalder & Pigneur, 2010)

By-product

A material or substance created when processing or manufacturing something else.

Cascading

Extracting maximum value from a material through alternative uses across value streams.

Circular Economy

An economy that is restorative and regenerative by design, in which waste is designed out and the economic value of materials is optimized over time (Ellen MacArthur Foundation,2015).

Closed loop

Materials, components and products are ‘technical or biological nutrients’ circulating in

closed loops, where nothing is wasted but instead channeled to different processes depending on remaining properties and characteristics of the materials, components and products.

Closed-loop recycling

Recycling a product and manufacturing it into the same product again and again.

Compostable materials

Materials that can be disposed with biological materials and decay into nutrient-rich material..

Cradle-to-Cradle®

A design framework focused on "eco-effectiveness" and positive impact of the product while reducing the negative impacts (McDonough and Braungart, 2002).

Decoupling

Breaking the link between economic growth and natural resource consumption.

Dematerialization

Delivering a product using a percentage or none of the mass compared to the conventional product.

Downcycling

Use of secondary materials that results in a lower economic value of that material that cannot be recovered.

Durability

Product characteristic that determines the length of time over which it maintains its value or functionality.

Dynamic Capability

The firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments (Teece, 1997)

Eco-design

Design principle that calls for the minimization of negative environmental and health impacts across a product or service's life cycle.

Eco-efficiency

The economic value of a product or service compared to its natural capital costs.

End-of-life

The life cycle stage during which a product no longer has value to its original owner and is then disposed of.

Industrial ecology

The study of material, energy and water flows through an industrial system and their effect on the environment, economy and society.

Industrial symbiosis

The mutually beneficial exchange of waste and by-products between three or more parties.

Leasing

A service model in which the customer pays for continuous access to a product over an agreed period of time.

Life cycle

All of the stages that a product goes through in its lifetime: raw material extraction, processing, manufacturing, use, end-of-life and transportation.

Life cycle thinking

Approach of accounting for economic, environmental and social impacts across all stages of a product or services life cycle.

Lifetime extension

Product characteristics that lengthen the time over which that product continues to serve its originally intended function.

Local materials

Materials that are extracted and processed within the same region they are being purchased. Specific distances depend on the material, process and objectives.

Loop

A structure, series, or process, the end of which is connected to the beginning.

Natural capital

The stock of renewable and non-renewable resources (e.g. plants, animals, air, water, soils, minerals) that combine to yield a flow of benefits to people.

Open loop recycling

Recycling product A and manufacturing it into product B.

Performance economy

Service model in which payment is tied to the quantity or quality of service the customer receives.

Planetary boundaries

The environmental limits within which humans can safely live *(*Rockström et al., 2009).

Planned obsolescence

Business strategy to shorten the consumer's ownership period in order to increase sales volume. This is accomplished through poor quality manufacturing, an accelerated product succession timeline or compelling marketing campaigns.

Raw materials

Crude or virgin materials that are used in product manufacturing or processing.

Reclaimed materials

Discarded materials that are recovered and used in another process or product, requiring only minor alterations and or refinishing.

Recovery

Process of extracting material, energy or water from the waste stream for reuse or recycling.

Recyclable materials

Materials that can be recycled.

Recycled content

The portion of a product that is made from recovered and recycled materials.

Recycling

The collection, sorting and processing of disposed materials for use in another manufacturing process.

Refurbished materials

Discarded materials or products that are topically repaired, refinished and sanitized to serve their original function.

Regenerative economy

An economy in which products and services replenish their own sources of energy, water and materials in a closed-loop system.

Remanufacturing

Process of recovery, disassembly, repair and sanitizing components or parts for resale and reuse.

Renewable resources

Materials, energy and water sources that replenish themselves after human extraction within a finite amount of time.

Resource efficiency

A percentage of the total resources consumed that make up the final product or service.

Resource productivity

The economic value created per unit of resource.

Resource value optimization

Maximizing the economic value that is created per unit of resource, over multiple lifetimes.

Reuse

Using a product or material again, either for the same or an alternative function.

Reverse logistics

Process of collecting and aggregating products, components or materials at the end-of-life for reuse, recycling and returns.

Waste materials that are recovered, recycled and reprocessed for use as raw materials.

Sharing model

Business model based on the sharing of under-used assets as a service.

Sustainably sourced bio-materials

The procurement of forestry and agricultural products from suppliers that minimize environmental impacts and protect and enhance nature and biodiversity.

Systems thinking

An approach that accounts for the interdependence and evolution of system elements.

Take-back program

An initiative to collect used products or materials from consumers and reintroduce them to the original processing and manufacturing cycle.

Technical nutrients

Man-made materials designed to be long-lasting and reused.

Upcycling

Use of secondary products, components or materials that results a higher economic value of that material.

Value proposition

The promise of the benefits delivered to customers.

Value network

A set of connections between organizations and/or individuals interacting with each other to benefit the entire group

Waste

Any substance or object which the holder discards or intends or is required to discard.

Waste hierarchy

The priority order available for managing wastes, ranked in descending order of preference, based on the best environmental outcome across the lifecycle of the material. (1) Prevention, (2) Reduce, (3) Reuse, (4) Recycle, (5) Incineration, (6) Landfill.

Waste to energy

Process of treating waste that creates energy in the form of electricity, heat or fuel.

Zero waste

Program to divert all (at least 95%) waste from landfill. The scope of zero waste may or may not include incineration depending on reference.

Essays

1 INTRODUCTION

1.1 Study background: the necessary transition to a Circular Economy

Our global economy is currently dominated by a "take make dispose" linear approach in which products are manufactured from raw materials, sold, used and discarded as waste. If this model has allowed our economies to reach high level of growth in the past 50 years, this growth has systematically been coupled with negative externalities, from extended waste production to a large increase of carbon emissions resulting in the rise of climate perturbations (Meadows et al, 2004, WBCSD, 2010, IPCC, 2018).

A critical look at our current system confirms several challenges and new pressing issues that should be tackled if we intend to reach more sustainable production and consumption patterns in line with our planetary boundaries (Rockström, 2009, Jackson, 2009). Our current economic system is currently not optimized: in Europe, a very small amount of material waste is currently valorized, resulting in large amount of value uncaptured. Existing assets such as cars, parking spaces or office rooms are not used optimally. At organizational level, companies face increasing risks related to the decreasing supply of raw materials and the higher volatility of commodity prices. The linear model, exploitative by nature, also impacts our natural capital: non-renewable sources of energy are depleting, natural ecosystems are being degraded resulting in loss of biodiversity, ocean pollution and land degradation (Brondizio et al., 2019). In the long term, the environmental impact of this linear approach may also influence negatively our current economic growth forecasts.

In this context, the need to look for alternative models of development has been taken more and more seriously, at institutional, business and academic levels. One model, the circular economy, has attracted increased interest in the recent years. If the concept is still ill-defined, borrowing characteristics from a variety of sustainability management strategies (eco-efficiency, servitization, cradle to cradle, biomimicry..) it can be understood as an economy that is restorative and regenerative by design and aims to keep products, components, and materials at their highest utility and value at all times (EMF, 2012). Circular economy is conceived as a continuous positive development cycle that seeks to preserve and enhance natural capital, optimize resource yields, and minimize system risks by managing finite stocks and renewable flows. Ultimately, this new economic model

seeks to decouple global economic growth from finite resource consumption (MacArthur, 2015).

1.1.1 Circular Economy in a nutshell

The concept of circular economy as a theoretical construct is not new and some scholars argue that it is in itself a refurbished concept (Reike et al., 2018). Ghisellini et al. (2016) attribute the introduction of the concept to Pearce and Turner (1990) which described how natural resources influence the economy by providing inputs for production and consumption as well as serving as a sink for outputs in the form of waste. Earlier literature has however addressed the same issues using similar concepts. Boulding's (1966) work, for instance, described the earth as a closed and circular system with limited assimilative capacity, concluding from this that the economy and the environment should coexist in equilibrium. 10 year later, Stahel and Reday (1976) introduced initial features of the circular economy that form the basis of our current understanding of the concept. In their seminal report, they conceptualized a loop economy to describe industrial strategies for waste prevention, regional job creation, resource efficiency, and dematerialization of the industrial economy. Following the work of Ellen MacArthur Foundation (EMF, 2012), circular economy is known to borrow different features and contributions from a variety of concepts that share the idea of closed loop systems. As an umbrella concept, circular economy includes relevant theoretical influences such as cradle-to-cradle (McDonough and Braungart, 2002), regenerative design (Lyle, 1994), industrial ecology (Graedel and Allenby, 1995), performance economy (Stahel, 2010), biomimicry (Benyus, 2002), or the blue economy (Pauli, 2010).

Geissdoerfer et al (2017) define the circular economy as "*a regenerative system in which resource input and waste, emission, and energy leakage are minimized by slowing, closing, and narrowing material and energy loops. This can be achieved through long-lasting design, maintenance, repair, reuse, remanufacturing, refurbishing, and recycling"*. Circular economy is not merely perceived as a preventative approach, reducing pollution, but also aims to repair previous damage by designing better systems within the entity of the industry itself (Murray et al, 2017). Closely associated with the concept of sustainable development, it aims to demonstrate new concepts of system, economy, value, production, and consumption leading to sustainable development of the economy, environment and society (Wu, 2005). According to Prieto-Sandoval et al. (2017), four relevant components frame the concept of Circular economy: 1) the recirculation of resources and energy, the minimization of resources demand, and the recovery of

value from waste, 2) a multi-level approach, 3) its importance as a path to achieve sustainable development, and 4) a close relationship with the way society innovates.

Circular economy as an emerging topic is currently attracting increasing academic interest. Research has addressed the concept in its historical development (Murray et al, 2017), focused on its definitions (Kirchherr et al, 2017), its approach to product design (Bakker et al., 2014), its connections with closed loop value chains (Schenkel et al., 2015), business models (Lewandowski, 2016), its position within the sustainability discourse (Geissdoerfer et al, 2017) or its theoretical limitations (Korhonen et al, 2018), to name a few papers.

1.1.2 From linear to circular: closing the circularity gap

A report presented at Davos World Economic Forum in 2018 states that our world economy is only 9.1% circular, leaving a massive 'Circularity Gap' (Circularity Gap Report, 2018). This alarming statistic on the other hand offers room for action. A fully circular economy could both reduce global natural resource use by 28 percent and cut greenhouse gas emissions by 72 percent, thereby supporting the UN Sustainable Development Goals and the Paris Climate Agreement. How do we get there?

The transformation to a circular economy is systemic in its nature. Interventions at micro (business level), meso (industry level) and macro levels (societal level) are simultaneously necessary to scale up the shift (Yuan et al., 2006). At macro level, different initiatives (EU, national and regional level) are being initiated to set up regulatory schemes and incentives facilitating the expected transformation (Brennan et al., 2015): Circular Economy Package at EU level (European Commission, 2014), national circular economy strategies (i.e. SITRA, 2016), regional roadmaps and action plans. These interventions provide new policies, objectify targets and set up monitoring frameworks. Funding schemes are also adapted to support research and innovation both a technological and socio-technical levels. At meso level, different initiatives are being set up (plastics, textile, furniture industries among others) to explore further the necessary actionable measures to implement.

Yet, at business level, if more and more companies are being aware of the need to take actions, the practical guidance and management know-how on how to proceed further is still in its infancy. The adoption of circular economy around the world is still in its early age, especially at the micro-level, which is mainly focusing on recycling rather than reuse (Ghisellini et al., 2016). Tools and transformation

methodologies remain too often general and rarely concrete enough. Existing publications do not yet make distinctive strategic alternatives based on the variety of circular strategies available. Guidance appears at sectoral/industry level, but fail to focus on single firm strategic renewal. Most importantly, the transformation process detailing how companies have successfully implemented change is lacking. At academic level, we are missing frameworks explaining how companies willing to become circular adapt their existing business model or create a new one (Urbinati, 2017).

Moving towards circular business models (CBM) requires a fundamental change that runs through the whole organization and also involves other stakeholders (Ritzen, 2017). The expected transformation is of high complexity as materials and energy, product design, manufacturing, service and distribution processes, data management and customer value among others have to be taken into account. In this dissertation, we aim to contribute to these research gaps by focusing on the micro level of circular economy transformation and identify which micro-lenses should be taken by managers aiming at developing circular business models.

1.2 Positioning of the study: A micro-level perspective on Circular Economy transformation using Business Model as a Marketing concern.

1.2.1 Business Models as a systemic lens to describe an integrated transformation

Several studies have intended to identify barriers to the transformation of businesses from linear to circular. Barriers are financial, structural, operational, attitudinal and technological (Ritzen, 2017). They are also characterized by a need to increase integration between a number of different perspectives and domains in industry: lack of integration of sustainability concerns throughout the various departments in companies, lack of systems perspective between functions resulting in silo thinking between the different operational levels, lack of integration throughout the value chain. One approach to address these interconnected challenges is to use a more systemic lens allowing identifying which dimensions of businesses are in tension when shifting from linear to circular strategies. In that respect, we argue that the business model construct can be relevant as an analytical tool.

The most commonly used definition of a business model is as follow: "*A business model describes the rationale of how an organization creates, delivers, and*

captures value" (Osterwalder & Pigneur 2009). It is a conceptual tool by essence as it contains a set of elements (value proposition, activities, resources, etc…) and their relationships, the goal being to outline the business logic of a specific firm. It aims to describe the value a company offers to one or several segments of customers and the architecture of the firm and its network of partners for creating, marketing, and delivering this value and relationship capital, to generate profitable and sustainable revenue streams (Osterwalder, 2005).

Using business model as a unit of analysis to support the transformation of companies from linear to circular can reveal new insights as business models are multi-dimensional, systemic and integrative by essence. Business models provide a systemic overview of the interconnected processes that require some adaptation in order to meet the challenges of a transformation to a circular-fit business model.

1.2.2 Business Models as a Marketing concern

The dissertation is rooted in the marketing discipline, specifically in marketing management. Marketing can be defined as "the activity, set of institutions, and processes for creating, communicating, delivering, and exchanging offerings that have value for customers, clients, partners, and society at large" (AMA, 2013).

A major consistency in business model literature is that they are involved with the creation, capture and delivery of value. It would appear that there is significant synergy in respect of the creation and delivery of value as a core purpose of marketing and a central theme in the business model literature (Coombes and Nicholson, 2013). We argue, in line with Coombes and Nicholson (2013) that the creation, delivery and communication of business models are concerns of the marketing discipline.

Marketing management is the process of setting marketing goals for an organization (considering internal resources and market opportunities), the planning and execution of activities to meet these goals, and measuring progress toward their achievement (AMA, 2013). Creating new value for customers and surrounding stakeholders by implementing circular economy principles should therefore be managed accordingly, as a marketing management concern. Subsequently, we aim to address the question of business model transformation towards circular economy by taking a marketing stance, therefore using specific marketing constructs that can synergistically support the identification of conditions enabling circular business model transformation.

1.2.3 Purpose of the thesis and research questions

As stated above, the transformation to a circular economy is associated with the need to implement innovative business models (Ruggieri et al., 2016). However, the adoption of such models in the industry has been limited (Linder and Williander, 2017, Witjes and Lozano, 2016). From a solution provider perspective, it seems essential to move away from incremental solutions that encourage business-as-usual thinking and instead build sustainable business models congruent with the principles of circular economy. There is however a lack of frameworks supporting business model transformation and especially renewed value proposition in the context of circular economy (Antikainen and Valkokari, 2016).

The existing literature on circular economy lacks contributions focusing on the firm as a unit of analysis and taking the business model as an analytical lens (Urbinati, 2017). The emerging analysis of circular business models in recent literature demonstrates that that there has been on one hand a lack of consideration toward circular design and innovative strategies to slow material and resource loops (Merli et al., 2018). On the other hand, several scholars have also stressed the lack of appropriate tools and a shared language in the context of circular business model innovation (Antikainen and Valkokari, 2016; Lewandowski, 2016).

Moreover, fundamental paradigmatic questions of CE conceptualization remain unsolved (Reike et al. 2018). Blomsma and Brennan (2017) point out that "theoretical or paradigmatic clarity regarding the concept of CE has yet to emerge".

Our motivation to explore circular business models in this dissertation is twofold. First, we argue that providing a better understanding of the circular business model construct can advance its diffusion in academic circles as well as in practice. Second, by focusing on the critical conditions enabling a successful transformation, we seek to provide relevant managerial insights that can empower managers to renew their business models and associated strategies in order to become more sustainable. Table 1 summarizes the general research gaps in the literature and the intended contribution of the dissertation.

Table 1. Research gaps and intended contribution

Research gap	Intended Contribution
Lack of shared understanding of circular business models. Need for clarity regarding the concept of business model in its relation to circular economy (Urbinati, 2017, Merli et al., 2018)	Integrated CBM typology detailing value creation mechanisms inherent to each category of business model fitting CE.
Lack of framework supporting business model transformation in Circular Economy (Antikainen and Valkokari, 2016, Lewandowski, 2016)	Descriptive Business model transformation framework detailing marketing conditions supporting circular business model transformation

From this current understanding of existing research gaps it is relevant to focus our contribution on discerning and describing the conditions that enable companies to transform their business model from a linear to a circular one. First, it is important to provide clarity on the circular business model construct. There is a need to identify and characterize the various business model approaches supporting the emergence of a circular economy. Second, our contribution aims at providing a framework that facilitates the understanding of supporting conditions allowing for a successful transformation of business models towards a circular economy. In that respect, this dissertation consists of one general research question complemented by three specific research questions.

General Research question: *What are the critical mechanisms enabling circular business models transformation?*

One premise of this dissertation is that circular business models differ in their development from traditional business models as the dynamics of value creation, value delivery and value capture rely on different enabling mechanisms. Indeed, when companies intend to transform their existing value proposition and its inherent value architecture to meet circular economy principles, several tensions can be identified, as summarized in table 2.

Table 2. Identified tensions when designing a circular business model

Business model mechanism	**Linear business model**	**< tension >**	**Circular business model**
Value proposition	Static, organization driven value proposition	*Creating shared value for the customer, the shareholders and the society at large*	Dynamic, multi-faceted, user-driven value proposition
Value creation	Resources: exploitative approach	*Adapting/ reorganizing resources to support the transformation to a circular business model*	Regenerative approach to resources. Increased know-how on identifying intangible resources supporting the circulation of tangible resources.
	Actors: linear value chain	*Creating and managing a network of complementary relationships supporting the circular flow of resources*	Value network with dynamic shifting actors roles
Value delivery	passive consumer	*Engaging the customer to be part of a circular value ecosystem*	Prosumer, co-creation

The overarching challenge is to understand how these tensions can be tackled when designing or transforming a business model to meet the principles of a circular economy. Addressing these tensions leads to the identification of critical conditions enabling the transformation towards circular business models.

Prior to addressing these tensions, it is however relevant to frame the business model construct in the context of a circular economy. Existing typologies have been developed in the recent years, mainly from the grey literature (Pauli (2010), Beltramello et al. (2013), Accenture (2014), Bisgaard et al. (2012), Clinton and Whisnant (2014) Nguyen et al (2014), Van Renswoude (2015), Kiørboe et al (2015), Wrap (2016)). Often these typologies are not systematically developed from overarching circular economy principles. Clarifying existing categorizations into an integrated typology constitutes therefore a preliminary task supporting the process of transformation from linear to circular economy. By doing so, we clarify the end point of the transformation and define what the notion of circular business models truly entails.

Moreno et al. (2016) point out that whilst there is not an 'ideal' business model that is preferable to achieve true circularity; tailored approaches are recommended for the successful transition into a circular economy. An integrated typology of circular business model highlighting distinctive characteristics leading to circular value creation, delivery and capture can support the development of tailored strategies supporting the transformation to circular business models. Based on this reasoning the first research sub-question of this dissertation can be postulated as follow:

RQ1: How can we classify and characterize existing circular business models?

Once this question is clarified, it is possible to frame the body of knowledge related to circular business models. It becomes then relevant to explore further the enabling conditions facilitating the transformation of business models from linear to circular.

First, as the business model construct is multi-faceted and takes into account specific mechanisms bridging a value proposition and its value creation and delivery mechanisms, it is necessary to take a multiple lens focusing first on the customer value proposition, before addressing its supporting value creation architecture.

Piscicelli and Ludden (2016) argue that influencing consumer acceptance is essential to scale up circular business models into the market. Indeed, circular economy products and services offerings challenge the prevalent role and behavior of the customer, as existing notions of ownership and product life cycles flows are revisited in the context of circular business models. We argue that taking a customer value creation lens to determine which dimensions of customer value address the customer acceptance challenge of circular products and services, is an

essential first condition in order to develop a business model that is strategically fit between the circular offering and customer needs. Hence the second research question:

RQ2: Which Customer Value Creation mechanisms are enabling the implementation of circular business models?

Second, in order to enable the development of a new circular value proposition that meets customer needs, we argue that the current value architecture of the existing business model needs to be reconfigured. As the existing resource base of the firm (including both tangible and intangible resources) may fall short, we posit that internal and external competences need to be reconfigured. Defined as "the firm's ability to integrate, build and reconfigure internal and external competences, in order to address rapidly changing environments" (Teece et al., 1997), Dynamic Capabilities refer to an intentional and systematic effort to change the resource base of the firm through micro-processes (Ambrosini and Bowman, 2009). The development of a specific set of new competences and dynamic capabilities are necessary conditions enabling the design and implementation of a renewed business model.

Hence the third research question:

RQ3: Which dynamic capabilities are enabling the implementation of circular business models?

Third, as circular business models are characterized as networked by essence (Antikainen & Valkokari, 2016), taking a network perspective to circular business models can shed some light to the creation and management of new business relationships enabling circular value creation. Value networks allow the exchange of physical resources and raw materials, but they also allow to think more holistically about information, skills and other intangible resource flows. We posit that specific value network mechanisms enable the design and implementation of circular business models.

Hence the fourth research question of this dissertation:

RQ4: Which attributes of a value network perspective can support the development of circular business models?

Each of these four research questions is explored keeping in mind the interconnections between the supporting theoretical constructs through which each question is addressed: 1) Value Proposition and Customer Value Creation, 2) Value Creation and Dynamic Capabilities; 3) Value Delivery and Value networks.

A conceptual model presented at the end of the next chapter constitutes the foundation through which the general research question will be answered with the support of each individual essay, and form the theoretical construct through which the discussion at the end of the dissertation will be addressed.

1.2.4 Research process and structure of the dissertation

This dissertation meets its general purpose through four individual essays as illustrated in Figure 1.

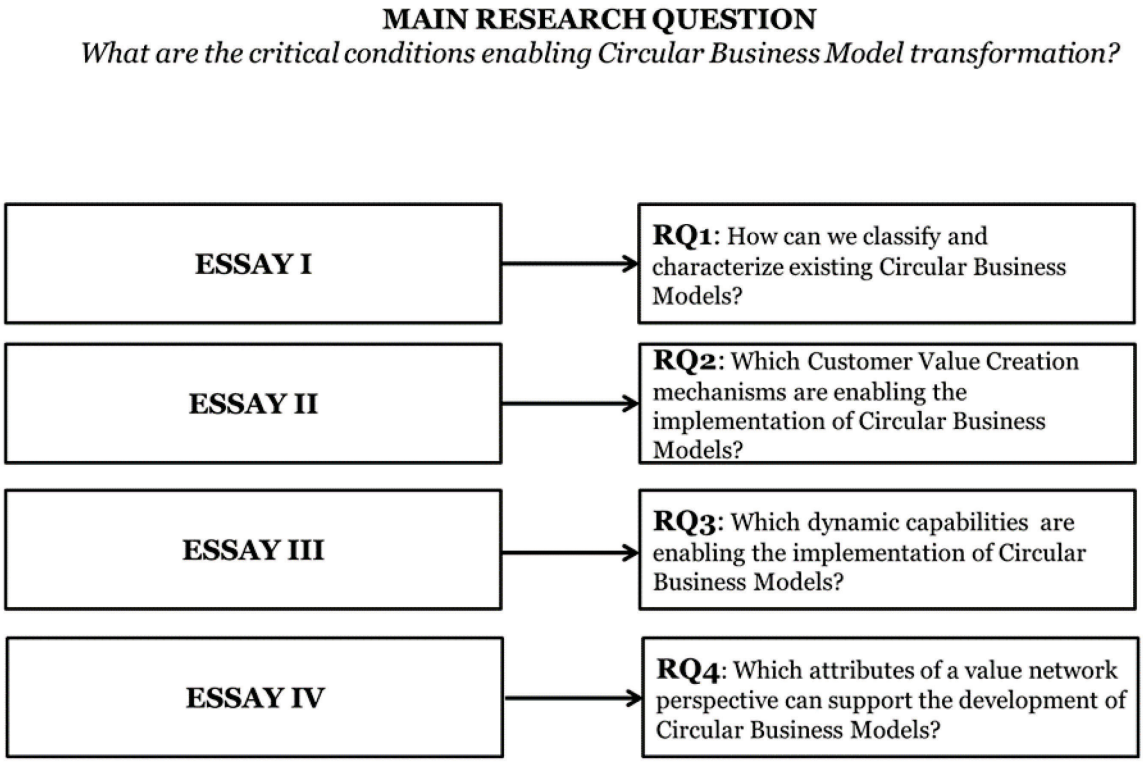

Figure 1. Overview of the dissertation research questions

The dissertation is structured in five chapters (see figure 2). The first chapter, the introduction, familiarizes the reader with the background of the study, the research problem, the study's purpose and research questions, before providing an overview of the research design, the research process and the structure of the dissertation.

The theoretical background in chapter two discusses the theoretical concepts used in the four individual essays. This first includes an overview of the business model construct. A synthesis of circular business models emerging literature clarifies the contextual focus of the dissertation.

The business model construct is then bridged with 3 marketing management constructs - Customer Value Creation, Dynamic Capabilities and the Value Network constructs, which are hypothesized as the three enabling constructs supporting the implementation of a business model. The chapter highlights relationships between these theoretical constructs and an integrated conceptual model summarizes the starting theoretical point of the dissertation.

The next chapter details the methodology and describes the study's research, design, method and analysis. Chapter four introduces and summarizes the four essays that are part of this dissertation. Chapter five consolidates the findings and theoretical contributions of the dissertation before highlighting promising research avenues. The four essays are included in the appendix.

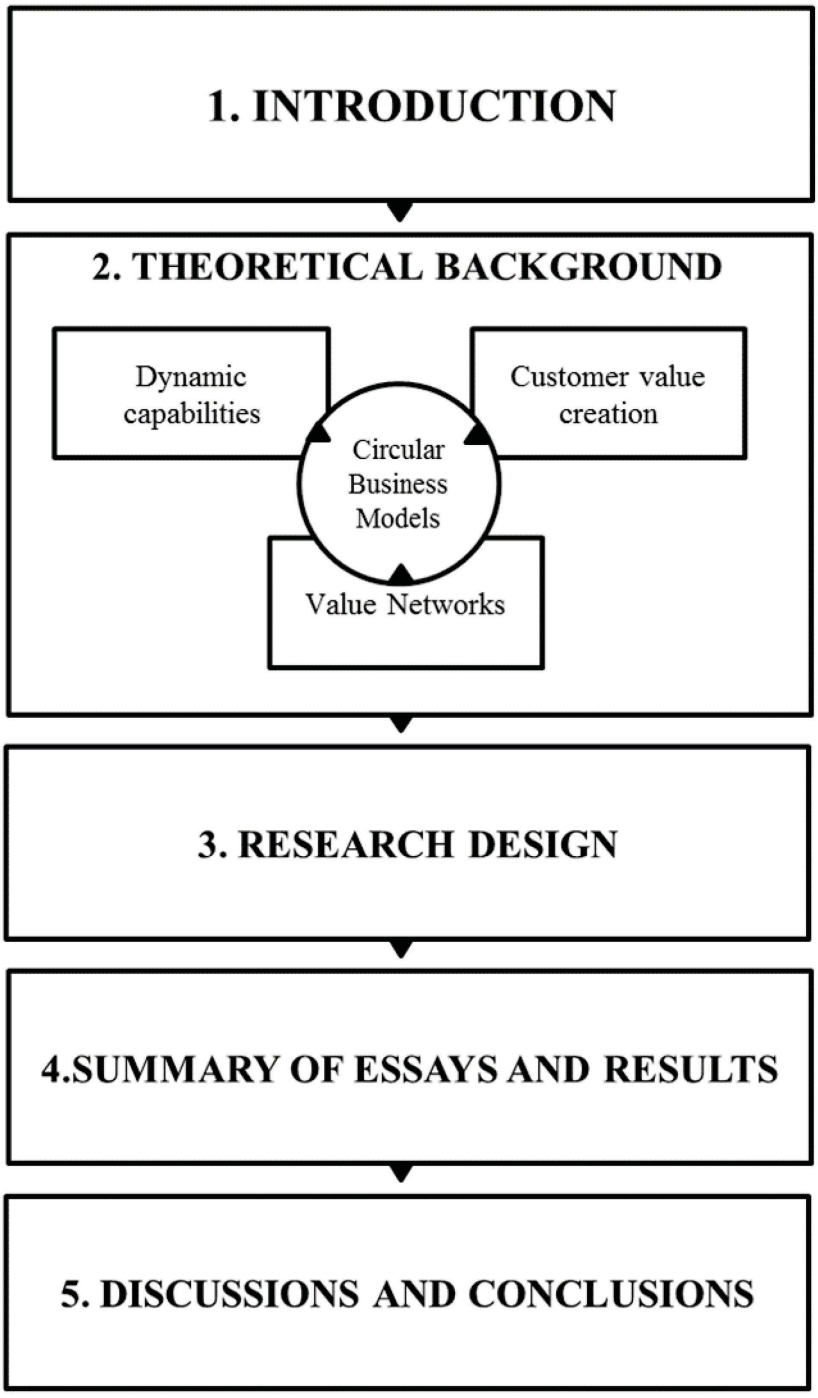

Figure 2. Structure of the dissertation

2 THEORETICAL BACKGROUND

This chapter provides an overview of the literature that serves as the theoretical foundation for the essays of this dissertation. Figure 3 below provides and overview of the theoretical constructs used in individual essays.

Essay I is built upon the existing literature surrounding sustainable and circular business models. Essay II takes a customer value creation theoretical lens to circular business models. Essay III explores which dynamic capabilities support circular business model transformation. Essay IV takes a value network perspective on circular business models.

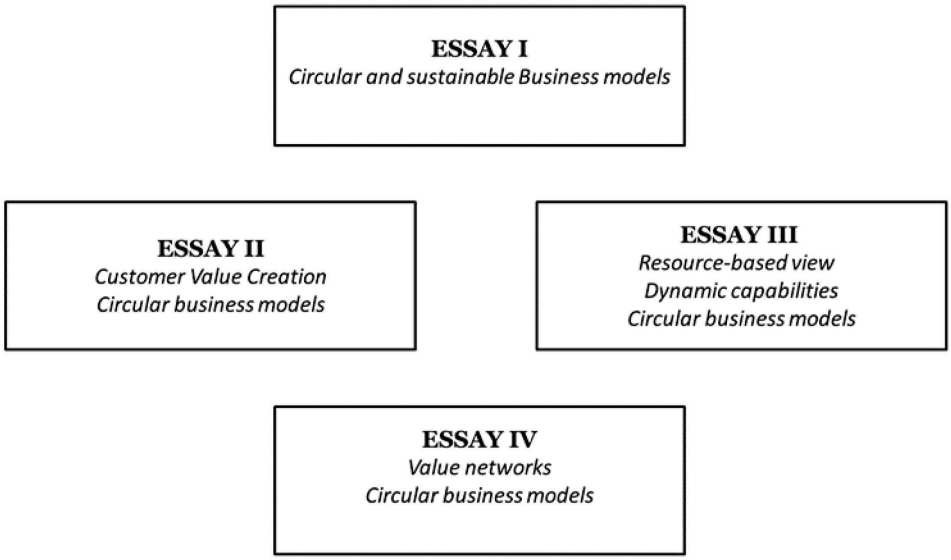

Figure 3. An overview of the theoretical constructs used in the four essays

The structure of this chapter is as follow: first, we explore the business model theoretical construct as discussed in the literature. Second, we provide an overview of business models in the context of the circular economy. Third, we describe the three distinctive marketing lenses that will be used to explain the conditions enabling circular business model transformation: 1) Customer Value Creation, 2) Dynamic Capabilities, 3) Value Networks.

Finally, we provide an integrative perspective highlighting interrelations between the different constructs (business model, customer value creation, dynamic capabilities and value networks). The integrated literature review allows us to build a model that supports the overall reasoning of the thesis.

2.1 The Business Model construct

According to Ghaziani and Ventresca (2005), the public discourse on 'business models' originated in the early 1970s and rose to prominence halfway the 1990's, with the emergence of the digital economy. Many definitions of business models have emerged since then without a general consensus (Zott et al., 2011). The concept has been depicted as a framework, a set of interlocking elements, a design of organizational structures or an architectural representation. The business model construct has been applied in studies as a basis for classification, as a factor for performance or as a focal point for innovation (Lambert & Davidson, 2013). It has been used in different contexts (such as start-ups or established companies), in relation to different types of innovation (social or technological innovation) and in for-profit and not-for-profit contexts. This variety of uses may explain the lack of agreement regarding a common definition. Table 3 provides an overview of some of the prominent definitions found in the literature.

Looking at the variety of the definitions, recurring elements can help us clarifying the concept. A consistent number of researchers focus on the value logic inherent in business models, in terms of creating, delivering and capturing value (e.g., Chesbrough, 2006; Johnson, 2010; Osterwalder & Pigneur, 2010; Teece, 2010). Without explicitly describing the term "value", several definitions however specifically refer to customer value (i.e. value for the customer) (Afuah, 2004; Dubosson-Torbay et al., 2002; Osterwalder& Pigneur, 2010; Teece, 2010).

Business models are generally characterized by different compositional elements – building blocks - describing what a business model is made-off. Put together, these distinctive elements and their relationships constitute the basis of a business model framework (e.g., Gordijn et al., 2005). Examples of business model frameworks include the Business model Canvas (Osterwalder & Pigneur, 2010) and its associated ontology in which the elements are grouped into four pillars: customer interface (segments, relationships and channels), product (value proposition), infrastructure management (activities, resources, and partners) and financial aspects (revenues and costs). The Four-Box Business Model (Johnson, 2010) provides an alternative approach which stresses the interdependencies between the elements in terms of consistency and complementarity. The following elements are interconnected: the Customer Value Proposition, the Profit Formula, the Key Resources, and Key Processes. Chesbrough and Rosenbloom (2002) developed a framework that shows similarities to the Business Model Canvas and the Four-Box Business Model. The authors do however explicitly mention the value network as one of the core elements, (which includes customers, suppliers,

and competitors). The elements are: Value proposition, Market segment, Value chain, Cost structure & profit potential, Value network, Competitive strategy.

Table 3. Overview of definitions of business models

Author	Definition	Themes
Linder and Cantrell (2000)	"A business model, strictly speaking, is the organization's core logic for creating value."	Value logic
Amit and Zott (2001)	"A business model depicts the content, structure, and governance of transactions designed so as to create value through the exploitation of business opportunities."	Value proposition, Structure, Governance.
Chesbrough & Rosenbloom (2002)	"The business model provides a coherent framework that takes technological characteristics and potentials as inputs, and converts them through customers and markets into economic inputs. The business model is thus conceived as a focusing device that mediates between technology development and economic value creation."	Coherent framework, Mediating construct, Technology, Economic Value.
Osterwalder, (2004)	"A business model is a conceptual tool containing a set of objects, concepts and their relationships with the objective to express the business logic of a specific firm. Therefore, we must consider which concepts and relationships allow a simplified description and representation of what value is provided to customers, how this is done and with which financial consequences."	Relationships, customer value, financial consequences
Teece (2010)	"A business model articulates the logic, the data, and other evidence that support a value proposition for the customer, and a viable structure of revenues and costs for the enterprise delivering that value."	Value proposition, structure of costs
Osterwalder and Pigneur (2010)	A business model describes the rationale of how an organization creates, delivers, and captures value.	Value logic

Morris et al. (2005) when analyzing existing business model frameworks point out that the most frequently cited are the firm's value offering (11), economic model

(10), customer interface/relationship (8), partner network/ roles (7), internal infrastructure/connected activities (6), and target markets (5). Items often overlap (such as target markets being part of the customer block, or networks aspects being included in the organizational architecture. Al-Debei and Avison (2010) propose a unified business model conceptual framework with four dimensions: value proposition, value architecture, value network, and value finance. Fielt (2014), taking all these elements into account following its review on business models literature, defines business model as "*the value logic of an organization in terms of how it creates and captures customer value and can be concisely represented by an interrelated set of elements that address the customer value proposition, organizational architecture and economics dimensions*".

In the remainder of this dissertation, and in the context of circular business models, we focus exclusively on three of the four dimensions[1] described by Al-Debei and Avison (2010). 1) the Value Proposition (which embeds the notion of Customer Value Creation at its core); 2) the Value Architecture (which is specifically supported by the firm's Dynamic Capabilities), 3) the Value Network. These foundations and the current state of the arts in literature will be presented in the coming sections.

As we acknowledge the basic dimensions of the business construct discussed in the literature, we however need to delineate the content of these dimensions in the context of Circular Economy. The following section discusses the emerging body of knowledge related to circular business models.

[1] Though we acknowledge the importance of the value capture dimensions in business model, we explicitly leave out the economic dimension of the construct in our analysis in order to focus on the Value Proposition- Value Creation – Value Delivery triad.

Table 3. Business model dimensions

Business model dimensions	Description	Theoretical foundation
Value Proposition dimension	The way the focal company articulates its offerings (value proposition) to meets customer needs and/or to each party involved while providing a set of associated benefits.	Customer value creation
Value Architecture dimension	The way in which the focal company organize its capabilities and resources to allow the provisioning of products and services	Resource-based view and Dynamic capabilities
Value Network dimension	the way in which the focal company enables transactions through coordination and collaboration among parties and multiple companies	Value networks

2.2 Business Models in a Circular Economy

Sustainable business models (SBM) and circular business models (CBM) are closely related literature streams and CBM can be understood as one sub stream of sustainable business model (Bocken et al., 2014). Sustainable business models aim at improving the economic, environmental, and social effectiveness of companies by corporate strategy planning, effective stakeholder management, and enhanced operational efficiency (Geissdoerfer et al. 2016). Both SBM and CBM focus on value creation that seeks more than economic profit but extend to societal - social and environmental - value creation (boons et al., 2013), though the social dimensions of circular economy is often neglected in the CE literature. Linder and Williander's definition of a circular business model refers to "*a business model in which the conceptual logic for value creation is based on utilizing the economic value retained in products after use in the production of a new offering*". Den Hollander and Bakker (2016) complete this definition by stressing that the business rationale of CBM needs to be designed in such a way that it prevents, postpones or reverses obsolescence, minimizes leakage and favors the use of

'presources' over the use of resources in the process of creating, delivering and capturing value.

In contrast to linear business models, in which a product is commonly discarder after a single use phase and its embedded value is lost, circular business models support the development of product-service systems that incorporate strategies to preserve the embedded value of products, parts and materials at the highest possible level of utility (Stahel, 1994). Circular business models thus aim to reconcile commercial value creation with adoption of circular strategies that can prolong the useful life of products and close material loops (e.g. recycling) (Nußholz, 2017).

Circular business models are networked in essence. One company cannot individually solve all challenges related to circular economy operations (Uusitalo and Antikainen, 2018). Consequently, CBM have to consider whole supply chains and related stakeholders, including consumers, to be able to identify and address relevant economic, environmental, and social sustainability issues. When adopting circular business models, several interventions in existing business models are required: a compelling value proposition for the customer providing additional value for other stakeholders, a higher degree of cooperation between companies and customers as well as within the circle of actors of the value network (Uusitalo and Antikainen, 2018).

Taking a general focus on the main elements of a business model – *Value proposition, Value creation and delivery and value capture*, existing literature has been highlighting specific features of circular business models.

Circular value propositions are designed to create products or services which directly or indirectly maintain, maximize or recover economic and environmental value embedded in products, parts and materials. In that respect, material flows associated with a specific market offering are recirculated to support resource efficiency and ultimately design out waste (EMF, 2012). These circular value propositions aim to meet identified customer needs through the delivery of a particular product or the function associated to that product. Products may be designed and marketed using renewable or recycled materials (Mcdonough and Braungart, 2002). Value propositions may highlight the long-lasting high quality features of the products (Bocken et al, 2016), or focus on delivering services instead of products (Stahel, 2010). Subsequently, circular value propositions do not necessarily require any transfer of ownership from the provider to the customer and can take the form of use-oriented, result oriented or performance based solutions (Tukker, 2004), which can in turn support circularity.

Value creation in circular business models can be dealt with at a micro-level (single company) or at a meso-level (value network) in which actors of the network pool complementary resources to support the circularity of the market offering. Value creation mechanisms require shift in key activities (i.e. improving resource efficiency, product design, develop remanufacturing or recycling processes), acquisition of new key resources – both tangible and intangible (from existing or new suppliers), and value networks reconfigurations.

Value delivery in circular business models necessitate an increased engagement with identified market segments (key customers) through customer-centric practices and co-creation, and through the establishment of reverse logistics infrastructure.

Value capture in circular business models can be addressed through several strategies. Value capture mechanisms can focus on products: revenues derivated from the sales of refurbished, repaired or remanufactured products, sales of high-quality products with a longer lifespan (Bocken et al, 2016), maximization of revenue streams through increased utilization rate of products (i.e.: platform economy solutions allowing sharing of assets between multiple users). Value capture can additionally be realized through the offering of additional services (i.e.: maintenance services), revenues can also be generated from recovering material or creating new business lines from former waste streams (Fraccascia, Magno and Albino, 2016). Borrowing from the product-service systems literature (Tukker, 2004) value can also be captured from developing new contractualization configurations (i.e.: payments for use-oriented, results-oriented services, performance-based solutions). Non-monetary benefits can also be captured, such as brand image improvements or increased reputation. These additional revenues have to be balanced out with potential additional cost streams such as higher labor costs to recover used products or materials.

Despite the emerging normative requirements aiming at framing the construct of circular business models, many fundamental questions remain unanswered. For instance, As Nußholz (2017) points out, questions such as which elements, features, or contributions to changing resource flows make a business model circular, and how can it be distinguished from a linear business model, remain without clear answers. The remainder of the dissertation will provide new insights to these issues. In the subsequent sections, we unravel marketing constructs closely related to the business model construct (customer value creation, dynamic capabilities and value networks). These theoretical lenses support the identification of enabling conditions facilitating the transformation to a circular business model.

2.3 Customer Value Creation

This section introduces the customer value creation construct as the main building mechanism enabling the framing of the business model's *Value proposition*.

A value proposition is an explicit promise made by a company to its customers that it will deliver a particular bundle of value creating benefits (Buttle, 2009). A firm's offering consists of products and services targeted to fulfilling the needs of the customer. These services and products often deliver several types of value, as perceived by the customer. Customer value can thus be defined as a "customer's perceived preference for an evaluation of those product attributes, attribute performances, and consequences arising from use that facilitate (or block) achieving the customer's goals and purposes in use situations" (Woodruff ,1997).

To develop and manage customer value, companies need to create quality and service that customers can perceive. According to Osterwalder and Pigneur (2013) customer value is created when an organization provides a product or service which relieves "pain" (e.g. costs/undesired situations) or create "gains" (e.g. desired benefits) for the customers. Customer value is created when fit between what a company offers (value proposition) and what their customers want (customer segments) is achieved.

The concept of customer value is multi-faceted with several meanings and connotations: customer value can be addressed from an individual perspective (Sheth et al., 1991), from a utility perspective (Woodruff, 1997), or in the dyad relation between consumption and business (Holbrook, 2005). Several authors have attempted to characterize customer value. Holbrook (2005) points out that customer value is 1) interactive; 2) relativistic, 3) embodies preferences; 4) is attached not to the object itself but rather to the relevant consumption experience. Researchers have also been attempting to develop conceptualization, framework, or typology of customer value. Early works from Park, Jawarski, and MacInnis (1986) attached customer value creation to e three basic consumer needs that reflect distinct value dimensions—functional needs, symbolic needs, and experiential needs. Functional needs motivate the search for products that solve consumption-related problems. Symbolic needs are met through products that fulfill internally generated needs for self-enhancement, role position, group membership, or ego-identification. Experiential needs are met through products that provide sensory pleasure, variety, or cognitive stimulation. Sheth et al. (1991) extended these three dimensions to describe five values influencing market choice behavior: functional value, social value, emotional value, epistemic value and conditional value. Customer value creation can also be defined depending on a

particular context. In B2B relationships, Ulaga (2003), for example, identifies eight categories of value: product quality, delivery, time to market, direct product costs (price), process costs, personal interaction, supplier know-how, and service support. Heard (1993) conceptualized customer value in relation to basic value-chain activities (design, production, and marketing). In that respect, three factors support value creation: product characteristics, delivered orders, and transaction experiences that reflect where value is created within organizations. Taking the various conceptualizations into account, Smith and Colgate (2007) developed a customer value creation framework identifying four major types of value that can be created by organization: functional/instrumental value, experiential/hedonic value, symbolic/expressive value, and cost/sacrifice value. The framework also identifies five major sources of value—information, products, interactions, environment, and ownership—that are associated with central value-chain processes. The relevance of these constructs haven't been explored in the context of circular value propositions.

In the context on increasing inter-organizational collaboration in value creation, the traditional roles of suppliers and customers are becoming more complex and intertwined. Customer value creation therefore needs to be apprehended from a value network perspective. This construct is explicated in the next section.

2.4 Value Networks

While business models are expected to extend innovation activities beyond processes, products, or organizational aspects (Baden-Fuller and Haefliger, 2013), an unexplored area lies on the systems level where multiple actors interact (Breuer and Lüdeke-Freund, 2014). Business model innovation within value networks becomes a relevant lens of analysis (Calia et al., 2007).

Lusch et al., 2010 define a value network as a "spontaneously sensing and responding spatial and temporal structure of largely loosely coupled value proposing social and economic actors interacting through institutions and technology, to: (1) co-produce service offerings, (2) exchange service offerings, and (3) co-create value" (Lusch et al., 2010). Each actor of the value network has competences (used to offer and provide service to others), relationships (with customers and suppliers—output and input relationships and governance), and information that is shared through common standards and protocols (Lusch et al., 2010). Value propositions are then used to connect the focal firm with its network of suppliers and customers (Lusch et al., 2010). The network perspective shifts the focus of a resource-based view of the firm to a perspective in which examination of

resource dependency, transaction costs, and actor-network relationships is critical. The most valuable resources are those that center on competences and relationships (Normann and Ramirez, 1993; Vargo and Lusch, 2004) and information (Lusch et al., 2007). Value networks actors collaborate to create, develop, foster, and integrate these resources. Firms exist to integrate and transform their competences into complex value propositions with market potential. To accomplish this, however, firms must recognize and act on value creation in the context of networks.

The business network perspective has attracted an increasing amount of research in the last two decades, with a specific focus on their emergence and their capacity to be managed. Existing literature around networks in industrial marketing either view networks as borderless, self-organizing systems that emerge in a bottoms-up fashion from local interactions (Håkansson and Ford, 2002) while others describe networks as intentionally created , containing a specific set of organizations with agreed roles (Möller and Svahn, 2003). In other words, networks on one hand are characterized by their self-organizing features which lead to think they cannot be managed by any single company. In this approach, networks are perceived as complex adaptive systems, comprising of interacting sets of organizational and social relationships in which each actor is pursuing its own goals (Stacey, 1996). On the other end of the spectrum, other scholars argue that networks are deliberately created structures, with negotiated roles and goals which can and indeed have to be managed in order to be efficient (Dyer and Singh, 1998). The key issue is maybe not whether networks can or cannot be managed but what kind of governance or managerial solutions are most suitable for different types of networks (Möller and Rajala, 2007).

Value Networks can indeed take several forms and in that respect be characterized according to different dimensions: the structure of the network, (primarily vertical, horizontal or diagonal) the objectives pursued within the network; the way resources are either integrated or combined, the position in the market introduction (pre-market vs market position) and their value creation logic Möller and Rajala (2007).

Möller and Rajala define three generic value networks types or “strategic nets”: ‘current business nets’, ‘business renewal nets’, and ‘emerging new business nets’. Current business nets are trying primarily to achieve efficiency gains through demand–supply coordination. Business renewal nets are looking for local business process improvements by incremental innovation and change. Emerging new business nets are seeking to create more effective technological applications and business concepts by means of radical innovation and business system change

Several types of actors in a value network that affect the ability of a firm to produce and deliver value to an intermediate or final customer or end consumer: suppliers, other customers, competitors, and complementors (Nalebuff and Brandenburger, 1997). Using a value network perspective, one must not only identify who the actors are, but also get an understanding of the types and extent of relationships involved. All business firms are part of a value-creating network. Some play important roles and have influence in shaping the network, while others play minor roles and are shaped by the network (Kothandaraman et al, 2001).

The transition to a circular economy goes beyond the borders of a single organization and stimulates cooperation among different actors within a logic of the deconstruction of the value chains, and the reconstruction of new ones, over networks (Ruggieri et al., 2016). In its essence, a circular business model could be a form of inter-organizational and networked environmental and sustainability management (Korhonen et al., 2018). A challenge in redesigning business networks is to find win-win-win solutions that seek balance between the self-interests of the actors of the network and the common purpose of the network (Antikainen et al.2013).

Although collaboration are highlighted in circular business model innovation (Geissdoerfer et al., 2016; Gorissen, Vrancken and Manshoven, 2016), currently there is lack of research in this area. Characteristics of circular value networks are not clearly defined and their connections with business model transformation require further investigation.

2.5 Resource-based view of the firm and Dynamic Capabilities

Value creation mechanisms in business models are supported by the *value architecture* built within the firm. This value architecture defines how a company manages its resources and the unique ways it adapts and changes according to the external environment. In this context, the Dynamic Capabilities construct is a foundational element of the *Value architecture* dimension of business models. This section summarizes the literature around Dynamic Capabilities.

Dynamic capabilities derive from the resource-based view of the firm (RBV) inspired by the work of Penrose (1959) which focused on the internal factors explaining a firm's competitive advantage. According to RBV, the difference of performance between business organizations stems from differing degrees and scope of control over valuable, rare, inimitable and non-substitutable resources

(VRIN criteria). If all these criteria are met, it becomes possible for the firm to achieve and sustain competitive advantage (Barney, 1991).

Resources can be categorized as physical capital (plant and equipment, technology, access to raw materials); human capital (training, experience, relationships, insights of the individual managers and workers in a firm) or organizational capital (formal and informal planning, controlling, coordinating systems, informal relationships among groups within a firm). Resources can also be classified as tangible (labor, raw materials and stock of capital) or intangible (knowledge and abilities, brand recognition, organizational culture). Resource-based view regards these intangible resources as a main source of competitive advantage.

The approach has however been criticized for being a static model (Eisenhardt and Martin 2000), unable to explain competitive advantage in turbulent times. Limitations include lack of distinction/relationship between deliberateness and ad-hoc opportunities; the exclusive interest of a single firm, taken out of the industrial context; or the fact that some resources may become devalued over the long-term (De Toni and Tonchia, 2003). Based on these limitations, Teece, Pisano and Shuen (1997) underlined the need to develop a new approach and proposed the dynamic capabilities view, with depart from a static view and focuses on strategic renewal, adaptation, life cycles and evolutionary paths. Dynamic capabilities have been defined and characterized from different perspectives (see table 5). Dynamic capabilities represent the firm's capacity to purposefully create, extend or modify its resource base (Helfat et al., 2007). The dynamic capability view focuses on the dynamic processes of generating, developing, and accumulating a firm's resources, as inputs into the firm's value chain (Eisenhardt and Martin, 2000). Dynamic capabilities are thus "*strategic routines by which firms achieve new resource configurations as markets emerge, collide, split, evolve and die*". Wang and Ahmed, (2007) describe them as a result of the organization's constant conscious orientation toward change.

Table 4. Definitions of dynamic capabilities

Author	Definition
Teece et al., 1997	"The firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments."
Zollo and Winter, 2002	"A dynamic capability is a learned and stable pattern of collective activity through which the organization systematically generates and modifies its operating routines."
Winter, 2003	"..are those that operate to extend, modify or create ordinary capabilities."
Helfat et al., 2007	"The capacity of an organization to purposefully create, extend, or modify its resource base"
Wang and Ahmed, 2007	"The firm's behavioral orientation constantly to integrate, reconfigure, renew and recreate its resources and capabilities and, most importantly, upgrade and reconstruct its core capabilities in response to the changing environment to attain and sustain competitive advantage"

A certain hierarchy exists between resources and capabilities. Wang and Ahmed (2007) conceptualized an order level of resources and capabilities in organizations: *Resources* (zero-order) – considered fundamental for a firm's existence, they constitute a base upon which organizational routines, processes and capabilities can be developed and can be a source of temporary competitive advantage if they meet the VRIN criteria; *Operational and functional capabilities* (first-order) - considered necessary to renew a firm's competitiveness or to sustain existing income streams, they convey the ability to allocate resources in order to achieve an objective; *Strategic capabilities* (second-order) integrate resources and lower-order capabilities with reference to the adopted strategy; *Dynamic capabilities* (third-order) which are built on cyclical strategic renewal of the resource base as well as of strategic capabilities. Derived from this hierarchy, dynamic capability can be characterized as the organization's ability to transform resource base in an indirect way through strategic, functional and operational capabilities as a response to environmental changes. The essence of dynamic capabilities lies in changing how resources, routines, processes and capabilities are organized (Wójcik, 2015).

The dynamic capabilities perspective, as an extension of the resource-based view, posits that achieving and sustaining competitive advantage is built upon a cyclical transformation of resources, processes and capabilities as a response to environmental changes. Ambrosini et al. (2009) make the distinction between incremental, renewing and regenerative dynamic capabilities. Incremental dynamic capability leads to increased operational efficiency, while renewing and regenerating – through implementing major organizational changes – lead to a change in how the organization performs activities or its business.

Dynamic capabilities can be categorized according to whether they support *sensing, seizing, or transforming*. *Sensing* and *seizing* refer to the mobilization of requisite resources and organizational infrastructure and strategy to address an opportunity, namely to capture value from so doing. Transforming refers to continuous renewal, aimed at maintaining a sustainable competitive advantage (Teece, 2007).

Scholars are increasingly addressing the importance of applying dynamic capabilities in the context of sustainability strategies, as linking sustainability into business requires actions to deal with complex situations involving rapid and unpredictable change (Hart and Dowell, 2012). In that context, "sustainability dynamic capabilities' have recently emerged as a research topic, to characterize the firm's ability to adapt to the changing sustainability environment by integrating, building and reconfiguring competencies and resources to balance economic, social and environmental business objectives (Chen and Chang, 2013; Dangelico et al, 2017; Strauss et al., 2017). In the context of circular business models, circular dynamic capabilities however, have not yet been investigated.

2.6 Relations between Business Models, Customer Value Creation, Dynamic Capabilities and Value Networks

The theoretical constructs presented in the previous sections allow us to frame the dissertation and attempt to explain the marketing mechanisms enabling value creation as an outcome of business model transformation. Business model transformation can be defined as a change in the perceived logic of how value is created by the company, from one point of time to another. , In our case, the business model transformation investigated is focusing on the transformation towards a circular business model.

While each theoretical construct shed some lights to critical mechanisms supporting business model transformation, it is relevant to highlight the limitations of these theoretical frameworks arguing that they offer only a

partial explanation of value creation, delivery and capture. We therefore acknowledge the need of an integrative framework. Similarly, literature on value creation analyzes the issue according to different levels (individual, organizational and network levels). However, this topic requires an overlapping perspective between the different analytical levels since the source of value creation can be spread through people (customers), firms or networks (Della Corte et al., 2014).

Voelpel et al. (2004) states that a business model is incarnated by the business's core *value proposition for customers*; its configured *value network(s)* to provide that value, which consists of internal *strategic capabilities* as well as other capabilities met in the network, to continually sustain and reinvent itself to satisfy the multiple objectives of its various stakeholders. Customer value creation, Dynamic Capabilities and Value Networks can therefore be considered as the three interconnected marketing mechanisms enabling business model transformation. In the following sub-sections, we describe interrelations between each theoretical constructs. A generic model will then be developed illustrating these relationships in section 2.7 (see figure 4).

2.6.1 Business Model transformation and Dynamic Capabilities

The design and operation of business models are dependent on a firm's capabilities (Teece, 2018). Business model transformation necessitates a specific set of orchestrated components that not only create and capture value but also opens way to diagnose, re-assess and improve existing business models and if necessary reinvent new ones. In that respect, business model and dynamic capability are fundamentally intertwined (Teece, 2010). Dynamic capabilities are theoretically highly applicable in business model transformation for two interconnected reasons. On one hand, dynamic capabilities and business models are conceptually woven to each other (Teece, 2010): business model is a micro-foundation of firm's dynamic capabilities and on the other hand business model transformation can be seen as a strategic process based on the firm's higher order capabilities (Winter 2003) in a context of rapidly evolving business landscape (Eisenhardt and Martin, 2000; Teece, Pisano and Shuen, 1997).

Business model transformation goes beyond strategic planning and decision making and instead can be perceived as a systematic procedural strategic activity that is critically depending on the firm's ability to sort, evaluate, refine and rearrange its diverse resources and capabilities. Dynamic capabilities include the sensing, seizing, and transforming needed to design and implement a business model (Teece, 2007). As shown in table 6, Dynamic Capabilities can support value creation the main constituent of the business model construct.

Table 5. Activities conducted to create value organized by dynamic capabilities (Source: Katkalo et al., 2010)

	Sensing	**Seizing**	**Transforming**
Creating value	Spotting opportunities; Identifying opportunities for research and development; conceptualizing new customer needs and new business models	Investment discipline; commitment to research and development; building competencies; Achieving new combinations	Achieving recombinations

Following this reasoning, we thus postulate the following statements:

(1) *Dynamic Capabilities of a focal firm are constraining Business Model transformation.*

(2) *Business Model transformation reconfigures the Dynamic capabilities of a focal firm*

2.6.2 Business Model transformation and Value Networks

Value networks and inter-organizational management have become increasingly important contexts for Business Model transformation (Breuer and Lüdeke-Freund, 2014). Organizations do not operate in a vacuum. They do not have all the necessary resources they need to compete in the rapidly changing business environment. In order to capture opportunities that arise from discontinuities, firms need to form networks where each participating member allocates its resources such as knowledge, expertise, capital (Voelpel et al, 2004).

Business Model as a system of value creation, delivery and capture can therefore be apprehended as a networked structure consisting of suppliers, focal firms, retailers, customers and all components involved in creating, capturing and delivering elements of value (Zott and Amit 2008, Chesbrough and Rosenbloom 2002). From an ecosystem perspective, therefore, the strategy focus of a focal firm

is to co-shape and co-perform with the other players in the value Network and to build co-opted capabilities in the ecosystem (Leibold et al, 2002).

In that respect, the business network needs to be included as well as it plays a critical role in creating and capturing customer value (Fielt, 2014) The business model construct can become a new level of analysis positioned between the firm and the network level (Zott et al., 2011).

Following this reasoning, we postulate the following statements:

(3) Value networks support the Business Model transformation of a focal firm

(4) Business Model transformation of a focal firm reconfigures its Value Network

2.6.3 Business Model transformation and Customer Value Creation

The most important alignment in business model implementation is between the company offerings and customer needs (Teece, 2018). Thus, the business model has to be aligned with customer's value preferences, and in order to be able to reconfigure its business model the firm has to have innovation capabilities (Chung et al., 2004). If business model transformation allows to create whole new bundle of customer value and wealth (Kim and Mauborgne, 2004), it is however crucial to have a mechanism that connects the customer value to the business model (Thomke and Von Hippel, 2002). Customer-driven business model transformation helps firms to continuously develop technology and business in alignment with current and emerging customer needs. This is an iterative process that goes on whenever customer preferences, enabling technologies, and infrastructures change (Pynnönen et al, 2012).

Following this reasoning, we postulate the following statements:

(5) Business Model transformation reinforces Customer Value Creation

(6) Customer value creation drives Business model transformation

2.6.4 Dynamic Capabilities and Value Networks

The generation of new dynamic capabilities or their development and improvement can be generated from micro-level origins, both individual and organizational, but can also be influenced by the networks dynamics (Della Corte

et al, 2014). Dynamic capabilities are built upon an in-depth analysis of the firm's resource base (including all tangible and intangible assets engaged) and their position in the value network. Dynamic Capabilities, generating from external stimuli, are after recombined to transfer the external acquired knowledge inside the firm.

Following this reasoning, we postulate the following statements:

> *(7) Dynamic Capabilities of a focal firm support Value Networks reconfigurations*
>
> *(8) Value networks reconfigure Dynamic Capabilities of a focal firm.*

2.6.5 Dynamic Capabilities and Customer Value Creation

Similarly, there is a clear link between Dynamic Capabilities and value creation as dynamic capabilities are the process during which value is created (Ambrosini and Bowman, 2009). Martelo-Landroguez, Barroso-Castro, and Cepeda-Carrión (2011) posit that organizations are able to increase customer value by identifying and effectively fostering adequate combinations of Dynamic Capabilities. A firm's external and internal organizational capabilities are of vital importance for increasing the value created for the customer. It is a managerial imperative to focus on improving those capabilities which view the customer as its key component, in order to maximize the value created for them. Normann & Ramirez (1993) point out "successful companies do not just *add* value, they reinvent it."

Following this reasoning, we postulate the following statements:

> *(9) Dynamic Capabilities support the creation of higher customer value*
>
> *(10) Customer Value Creation determines the need for renewed Dynamic Capabilities*

2.6.6 Value Networks and Customer Value Creation

The aim of the Value Network is to collectively create value for the customer and the involved stakeholders (Al-Debei et al., 2013). Taking a network perspective, customer value creation can be characterized as being systemic and dependent on more than one attribute, and possibly on more than one firm (Pynnönen, Ritala & Hallikas, 2011).

Actors in a Value Network produce value together through rethinking their roles and interrelationships. Therefore, value creation is not just adding value step after step but reinventing it by means of a reconfiguration of the roles and relationships among actors of the value creating system (Ramirez and Wallin, 2000). It should be highlighted that it is the customers who, through their buying and consuming activities define the value of the offer produced by the value network. In fact, as pointed out by Vargo and Lusch (2004), customers are always co-producers of value.

Following this reasoning, we postulate the following statements:

(11) Value Networks of a focal firm enable Customer Value Creation

(12) Customer Value Creation reinforces Value Networks

In the next section, we articulate these 12 statements into an integrated framework.

2.7 Marketing mechanisms enabling business model transformation: An integrated framework.

Based on the identified relationships between the different theoretical constructs described in the previous sections, we propose the following conceptual model describing the interrelations between Dynamic Capabilities, Customer Value Creation and Value Networks in the context of Business Model transformation towards circular business models (Figure 4).

This model constitutes the theoretical foundation for the dissertation. In the context of circular economy transformation, our general aim is to explore which characteristics of these enabling mechanisms influence Circular Business Model transfomation. We acknowledge that other enabling mechanisms may support business model transformation towards a circular business model, we however intentionally limit the scope of our model to marketing constructs.

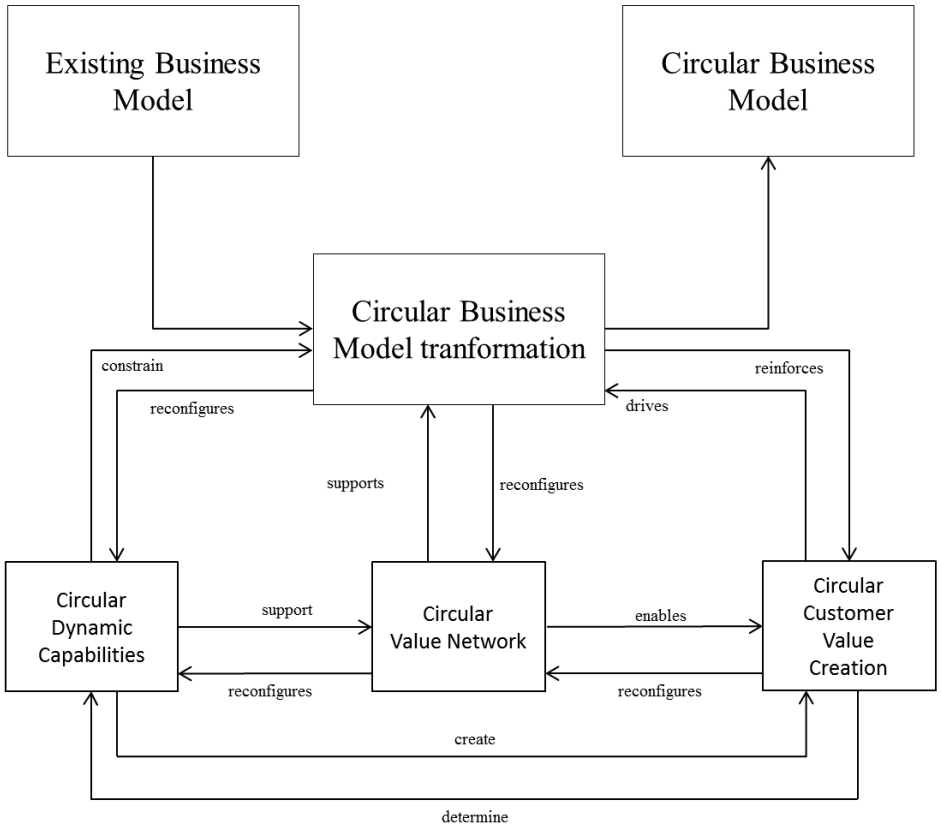

Figure 2. Marketing mechanisms enabling business model innovation: A conceptual model

More specifically, we posit the following working hypothesis:

In order to successfully transform a business model towards circular economy, three enabling mechanisms need to be addressed:

- *a change in customer value creation processes,*
- *a renewal/reconfiguration of existing dynamic capabilities,*
- *an adapted value network managerial posture*

We also postulate that:

- *These enabling mechanisms should not be addressed individually but taken in a system perspective.*

In the remainder of the dissertation we explore further which features of these dimensions need to change to successfully transform one business model towards circular economy.

3 RESEARCH DESIGN

This chapter introduces the methodological and philosophical underpinnings of the research. The chapter begins with a discussion on the philosophical assumptions guiding the research. Next, the chapter discusses the methodological choices and introduces the selected research methods. Next, the data collection and analysis methods are discussed. Finally, the chapter ends with an analysis of the overall research quality.

3.1 Philosophical underpinnings of the dissertation

A research paradigm is "the set of common beliefs and agreements shared between scientists about how problems should be understood and addressed" (Kuhn, 1962). According to Guba (1990), research paradigms can be characterized through their ontology – *What is reality?,* epistemology – *How do you know something?, and* methodology – *How do you go about finding it out?*

The term *ontology* concerns what is said to exist in some world - that which potentially can be talked about. Wand and Weber (1993) frame ontology as "*a branch of philosophy concerned with articulating the nature and structure of the world*." It includes the set of terms and their associated definitions intended to describe the world in question (Uschold, 1995). Ontology shapes the way of seeing and studying research objects such as organizations, management and organizational artefacts, and how the researcher sees the world of business (Saunders et al., 2016). Ontological considerations are based on the question of the nature of social entities, ranging from objectivistic to subjectivist views (Creswell, 2014). According to the objectivist perspective, there exists an external world which is neutral. Thus, there exist true, observable facts. Researched phenomena are seen as objective entities that have a reality independent of social actors beyond research or influence (Bryman, 2012). In contrast, from the subjectivist viewpoint, the world is built on observations and interpretations of individuals (Eriksson and Kovalainen, 2008) according to which social phenomena are seen as social constructions built from the perceptions and actions of social actors.

The term *epistemology* describes "*the nature of human knowledge and understanding that can possibly be acquired through different types of inquiry and alternative methods of investigation*" (Hirschheim et al., 1995). Epistemology refers to making assumptions about human knowledge; its acceptability, validity and legitimacy and how this knowledge can be communicated (Saunders et al., 2016). The central tenet in epistemology is the consideration of the nature of the relationship between the researcher and the reality (Symon and Casell, 2012).

There are different epistemological stances that one can have as a research philosophy, ranging from positivism, realism, to interpretivism (Saunders et al., 2009). A positivist point of view helps researchers develop hypotheses that can be tested on a value free basis (Bryman, 2008). Realism defines reality by using our senses, therefore leading to the fact that objective reality can be viewed differently. Interpretivism is subjective in nature, meaning that it advocates that humans are different as social actors and that it is the responsibility of the researchers to capture the subjective meaning of a particular social act (Rubin & Babbie, 2014). In addition to these three proposed epistemological positions one can also adopt a combination of these, also known as pragmatism (Saunders et al., 2009). Pragmatism means that the different positions can be seen as complementary to each other instead of competing and contradicting.

Taking a specific epistemological assumption will lead to different implications in relation to the chosen methods, as well as the strengths and limitations of research findings (Saunders et al., 2016). In that respect, *methodological assumptions* refer to choices regarding the research logic, strategy, methods and research data, i.e., the "organizing principles guiding the research" (Eriksson and Kovalainen, 2008).

Deduction, induction, and abduction are three approaches a researcher can use when conducting research (Saunders et al., 2012). Deductive reasoning involves developing "*...hypotheses to be tested against the predictions implied...*" (Adams et al., 2007). The approach starts with general statements in order to find more concrete conclusions (Ketokivi & Mantere, 2013). On the other hand, induction goes from specifics to generalizations, making it the opposite of deduction (Ketokivi & Mantere, 2013). An inductive approach is defined by Saunders et al. (2012) as "*collecting data to explore a phenomenon and you generate or build theory*." In order to make generalizations, the researcher needs to be able to identify certain patterns and characteristics in the collected data (Blaikie, 2009). The third type of approach is the abductive reasoning that involves the researcher using elements from both the inductive and deductive approaches (Saunders et al., 2012). Abductive research is defined by Saunders et al. (2012, p. 145) as "*collecting data to explore a phenomenon, identify themes and explain patterns, to generate a new or modify an existing theory which you subsequently test through additional data collection.*" Figure 5 summarizes ontological, epistemological, methodological assumptions related to two main opposite positions.

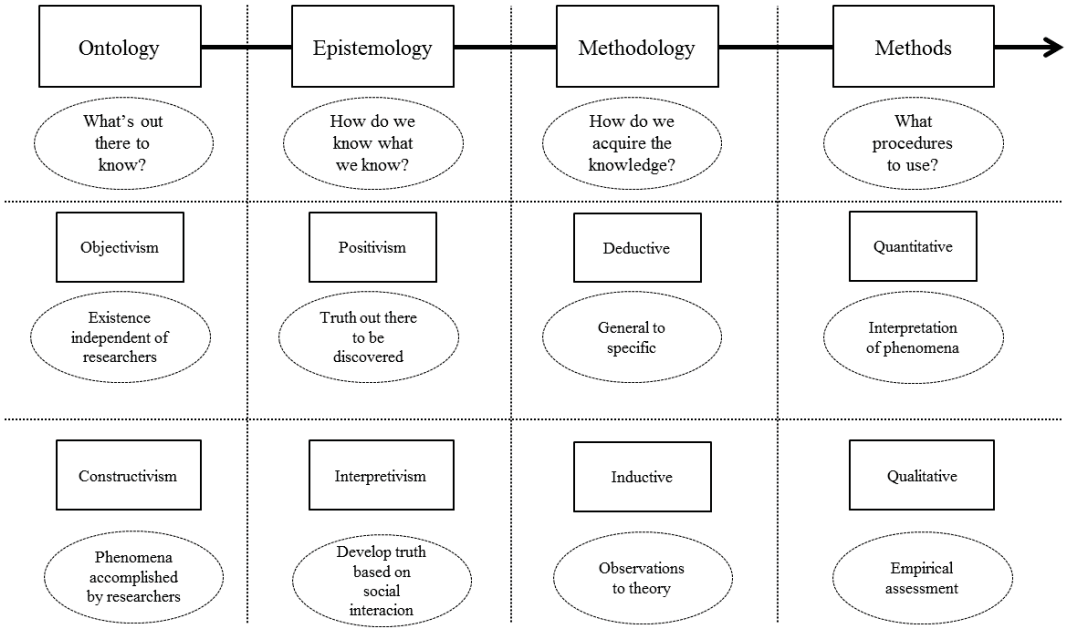

Figure 3. Overview of main ontological and epistemological considerations

In this dissertation, we follow a constructionist ontological stance. The research questions exhibit constructionist tendencies as it points to the fact that context specific individual's answers are needed to answer the question (insights from selected business representatives active in circular economy). Not only are we dependent on the social actors who are answering the questions but yet we are also dependent on ourselves as researchers and social actors. *Circular Economy* and *Circular Business Models* are social constructs developed by social actors (either academics or practitioners) in order to comprehend the world we live in, and develop specific actions leading to construct such reality.

Moreover, we believe that it is not possible to look at the context of business models and their transformation as a something that can be viewed from a strictly positivist scientific stance since business model are very context specific. Therefore, from an epistemological perspective, we pursue an interpretivist approach.

In this dissertation, we aim to explore the concepts of business models, circular economy and value creation mechanisms by going back and forth between developing new theory and supporting emerging ones. Thus, from a methodological perspective, an abductive research approach is pursued.

A qualitative research design is aligned with our epistemological and ontological assumptions. By using a constructionist epistemological approach and an interpretivist ontological approach it is only natural for us to conduct a set of qualitative studies in which we aim to gain insight into how circular business models are developed and which critical conditions enable their implementation.

3.2 Research design choices

The dissertation aims to gain a deeper understanding of the phenomenon of circular business models, where previous empirical research is sparse, motivating a qualitative, explorative approach (Yin, 2003). Qualitative research is typically exploratory, supports theory generation and provides a systematic approach to provide insights into "how" research questions. It is considered relevant to depart from abstraction inherent in quantitative studies and offer richer descriptions of studied phenomenon (Yin, 2004).

We thus follow a qualitative case study research strategy in order to create theoretical propositions inductively from case based empirical evidence (Eisenhardt & Graebner, 2007). Case studies research is considered a particularly useful approach through which to increase understanding of topics that are previously under-investigated (Gummesson, 2000), and in situations where there are complex and multiple variables and processes (Yin, 2003). Case studies emphasize the rich, real-world context in which the phenomena occur (Eisenhardt, 2007) and we believe, are perfectly suited to support theory-building in circular business model innovation.

Building theory from case studies is a research strategy that involves using one or more cases to create theoretical constructs, propositions and/or midrange theory from case-based, empirical evidence (Eisenhardt, 1989). The individual essays of the thesis follow the multiple-case study approach (essays II, III, IV), except for essay I, in which data was collected through a literature review. While single-case studies can richly describe the existence of a phenomenon, multiple-case studies typically provide a stronger base for theory building (Yin, 1994). Multiple cases enable comparisons that clarify whether an emergent finding is simply peculiar to a single case or consistently replicated by several cases (Eisenhardt, 1991). Multiple cases also enable broader exploration of research questions and strengthen theoretical elaborations. Collecting the data from multiple organizations involved in circular economy business modelling makes it possible to compare insights across cases and increases the generalizability of the results.

The details of the data collection and analysis for each individual study are described in section 3.3.

3.3 Empirical data collection and analysis

Case studies may include a rich variety of data sources, including interviews, archival data, survey data, ethnographies, and observations (Eisenhardt & Graebner, 2007). Typical of theory building research (Eisenhardt, 1989), we combined in this dissertation multiple data collection methods.

The primary method for the four essays is semi-structured interviews (Fontana & Frey, 1994). An interview guide laying out the main themes to be investigated was developed prior to each interview round. The semi-structured format allowed new ideas to be brought up during the interview as a result of what the informants expressed. In essay II, III and IV, all the interview data was carefully recorded and transcribed. In addition, the data included field notes of the interviews. Moreover additional data was collected for triangulation purposes which produced more accurate findings and a deeper understanding of the studied phenomenon and improves the validity of the results (Eisenhardt, 1989). Companies own publications (reports, website communication pages, blog entries), external publications (companies interviews) were integrated in the analysis. Selected case studies included both companies who innovated in their business model through a start-up creation or through a business model transformation.

3.3.1 Theoretical sampling of cases in the essays

Theoretical sampling means that cases are selected because they are particularly suitable for illuminating and extending relationships and logic among constructs. Cases may be chosen because they are unusually revelatory, extreme examples, or because they provide opportunities for unusual research access (Yin, 1994). The choice is based less on the uniqueness of a given case, and more on the contribution to theory development within the set of cases (Eisenhardt & Graebner, 2007). Multiple cases are chosen for theoretical reasons such as replication, extension of theory, contrary replication, and elimination of alternative explanations (Yin, 1994). In Essay II, following the development of a database of 65 circular business models, 5 specific cases were selected as they represented typical illustrations fitting with the developed circular business model typology developed in Essay I. In essay III, which was written in the context of a European project exploring circular business models in one specific sector – the furniture industry (www.furn360.eu), cases were selected as they represented a selection of circular

businesses considered as forerunners at European level. In Essay IV, the sampling included distinctive representative cases of the circular business models typology developed in Essay I. Author of the dissertation also had personal contacts with company representatives from previous project developments. The overall process of data collection and analysis within each individual essay is discussed next.

3.3.2 Data collection and analysis of the case studies

Table 7 summarizes the data collection and analysis methods of each publication.

Table 6. Data collection and data analysis in individual essays

Publication	Data collection	Data analysis
Essay I: an integrated circular business model typology based on consolidated circular economy principles	Existing theoretical and empirical research on circular business models	Literature review and conceptual framework development
Essay II: Customer value creation in circular business models: insight from case studies	Analysis of existing reports, business website and publications 5 semi-structured interviews of case representatives and CE experts.	Literature review and conceptual framework development Conventional content analysis based on recorded and manually transcribed material.
Essay III: Managing skills and capabilities in circular business models: insights from the European furniture industry	30 semi-structured interviews	Conventional content analysis based on recorded and manually transcribed material.

Essay IV: A Value Network Perspective On Circular Business Models: lessons from five case studies	5 semi-structured interviews, secondary data (reports, webpages, articles)	Conventional content analysis based on recorded and manually transcribed material.

Essay I is extensively relying on existing literature and analysed existing categorisations attempts developed in peer-reviewed and practitioner-oriented publications. The paper proposes a consolidated categorisation alternative that directly links circular economy principles with their inherent business model declinations. For data collection, the paper used a systematic review approach to formalize a typology of circular business models. The following academic databases were used for the literature search: Scopus, Science direct. Searching keywords included variations (e.g. plural, singular) on terms such as *circular business model, circular economy business models, sustainable business model, green business model*. The resulting literature, as well as its references, was scanned for explicit mention of categorizations and classification of cases studies and examples of circular business models. Due to the limited amount of results from academic publications, a review of secondary literature was also conducted. Reports including categorization attempts and case studies on sustainable and circular business models were selected. In total, 19 references were selected for review as shown in table 5.

Essay II, focusing on the customer dimensions of circular business modelling, is built upon a multiple case study approach. Cases were first chosen from existing databases focusing on circular economy business examples (Ellen MacArthur Foundation (August 2016), Plan C (September 2016), Norden (2015) and Circle economy (November 2016). The cases were further elaborated using secondary data collection from web pages of the companies studied, and other articles/press releases, in order to enable a comprehensive picture of each case study and to avoid reporter bias. In order to overcome possible limitation of using case studies derived from these secondary data sources, the data collected and findings deduced were further validated, where available, through direct interactions with organizations who published them, with circular economy business platforms and with a selection of companies directly studied. The quantity of information

collected through the use of this methodology together with the accuracy of interpretations made, confirmed by a range of consulting experts, was considered similar to undertaking first hand case study research and justified the deductions made. Following that approach, 65 cases were selected, out of which 5 representative cases were used to provide illustrative highlights. Outcomes from the multiple case studies were compared (Yin, 2009). Practical and theoretical evidence was used to make connections, differentiate findings and reach conclusions. Findings were classified according to the circular business model categorization. In a final phase, deductions were validated and amended by existing circular economy experts: practitioners from some of the case studies analyzed as well as consultancy/academic experts.

Essay III, focusing on skillsets and capabilities supporting circular business model innovation similarly used a multiple case study approach. The research took place in the framework of FURN360, a European Erasmus+ project involving 6 different partners from four different European countries (Finland, Belgium, Germany and Spain). The project aimed to develop a new training curriculum in circular economy with a special focus on the furniture industry. When selecting companies, researchers first focused on national best of class examples in each partner's countries and completed the selection with a number of recognized European examples available in additional countries (UK, France, Sweden, Denmark and Italy). The selection led to a preliminary identification of thirty five cases. A refinement to twenty five to was done in order to have a fair distribution of cases among the distinctive categories of circular business models. The objective was to address cases focusing on clean loop approaches (focus on renewable materials, recycled materials), short loop approaches (focus on repair/reuse), Access loop approaches (focus on leasing solutions), long loop approaches (using recovered material from existing furniture) and cascading loop approaches (multiple value creation from different uses of product/materials). The timeframe for the data collection was from February 2018 to May 2018. Semi-structured interviews took place either at the firm's facilities or through skype messenger. An interview guide was drafted to support the data collection. Questions led the informant to describe their circular business model, the transformation pathways that happened from linear to circular business. A specific set of questions focused on skills and competences that were developed or used for the company to successfully transform into a circular business model. If data collection was primarily done through interviews, secondary data (company internet webpages, reports, articles in media) was used to triangulate the results. In total, twenty five informants were interviewed in 7 different countries. Interviewees were mainly CEOs or sustainability managers. Interviews lasted around one hour, were systematically recorded and transcribed.

Essay IV, focusing on characterizing circular value networks, used an explorative, empirical research approach by selecting cases of circular business models to identify in practice how focal companies develop and manage a value network enabling the implementation of their circular business model. In the study we selected five companies which are actively engaging in developing circular business models taking a strong emphasis on adopting a value network perspective. In-depth, semi-structured interviews were chosen as a data collection method. The approach enabled data collection of individual participants' perspectives, in their own words, of the circular value network characteristics discussed. To augment the interview data and achieve triangulation, secondary information was collected though desk research from multiple sources, including company publications, reports, web pages and other publications. The transcribed interviews were coded and refined into categories associated to an analytical framework developed during the literature review phase. Codes were derived from the interview data based on the actual words or terms used by the interviewees or by summarizing the concepts discussed by the interviewees into themes. Pattern-matching techniques were used to identify patterns throughout the different cases and relate them to constructs of value networks and circular business models, using a cross-case analysis. In particular, the elements of the framework were used for pattern-matching. However, we did not restrict our investigation to these elements but also looked for additional patterns.

3.4 Quality of the research

The best-known evaluation criteria for the evaluation of the quality of academic research are reliability, validity and generalizability (Erikson and Kovalainen, 2008). In the context of qualitative research the credibility, transferability, dependability and confirmability are the four main categories to address the trustworthiness of the research (Lincoln and Guba, 1985). Table 8 below summarizes the actions taken to support the research quality of the dissertation.

Table 7. Research quality

Criterion	Justification
Credibility	Close interaction with informants. Review of interpretations.
	Data triangulation: multiple data types and sources
	Close interaction with research project partners
	Presenting the results for academic audiences in conferences and through peer-reviewed journal articles
Transferability	Careful selection of cases (theoretical sampling)
	Cases represent multiple industries and organization types
	Informants represent multiple expertise areas relevant to the research topic
	Providing details of case selection in each publication
Dependability	Recording and transcription of data
	Storing data in a collective database
	Detailed (written) descriptions of the research processes
Confirmability	Multiple data sources
	Systematic data gathering procedure and clear documentation
	Illustrative data excerpts, e.g., original quotes

Research *credibility* refers to the consideration of the credibility and believability of the research results from the informant's perspective. This supposes that the interpretations of the data (observations and conclusions) are in line with the informants' views. In the context of this research, research credibility was supported by the following actions: first, the research was conducted in close interaction with representatives of the case companies. This helped also to confirm that the results of the case-study reflected the reality as far as possible (Creswell and Miller, 2000). Second, data triangulation was used to ensure a comprehensive view of the issue (Yin, 2009). Multiple types of data were exploited,

including data, e.g., from interviews, literature, secondary publications. Third, within each individual essay, the data was collected from multiple sources, and the data was also checked by other researchers. The credibility of the results was finally enhanced by presenting the research results in different academic conferences.

Transferability refers to the transformation or generalizability of the findings from the research sample into other contexts or settings. In this dissertation, first the selection of the cases (industries, companies and informants) was based on theoretical sampling. The careful theoretical sampling used in most of the individual essays of this thesis increased the transferability and trustworthiness of the research. Second, the case companies represented many different industries and types of organization (essay II and IV), which increased the transferability of the results. Informants were selected due to the relevancy of their expertise and work position in the research topic.

Dependability refers to quality control of the study, and details the researcher's transparency to offer information about the research process. This approach ensures the replicability of the research and details the logical aspect of the process which should be well documented and traceable (Eriksson and Kovalainen, 2008). To ensure the dependability, interview data for each publication (essays 2, 3, 4) was recorded, transcribed and stored carefully. Detailed notes were made during the interviews. Detailed descriptions of the research process within each individual study are provided in the essays.

Confirmability means in general that the results should be based on gathered data, and the links between the findings and conclusions are understandable to others. The empirical data was gathered in a systematic manner from several sources. The findings were reported in a way that the reader can easily follow the logic of the interpretations made. Moreover, extracts of the data were provided, including quotes from the interviews. These original and detailed examples of the data were used to provide proof of the findings.

4 SUMMARY OF PUBLICATIONS AND RESULTS

This chapter introduces the primary findings of the thesis by summarizing the key results and contribution of each individual essay. Table 9 summarizes the research gaps and research topics addressed in individual essays. The next sections present a summary of the findings and discuss their relationship with the theoretical background of the thesis.

Table 9. Summary of publications

Essays	Addressed gap and research topic
Essay I: An integrated circular business model typology based on consolidated circular economy principles.	Provide a clarified understanding on the relationships between circular economy principles and circular business models categorizations.
Essay II: Customer value creation in circular business models: insight from case studies.	Understand which dimensions of customer value creation are highlighted in the distinctive circular business models categories.
Essay III: Managing skills and capabilities in circular business models: insights from the European furniture industry.	Uncover the skillsets and capabilities associated with circular business models.
Essay IV: A Value Network Perspective On Circular Business Models: lessons from five case studies	Characterize value networks in distinctive circular business models. Offer better understanding of the managerial implications related to the emergence and management of circular value networks.

4.1 ESSAY I: AN INTEGRATED CIRCULAR BUSINESS MODEL TYPOLOGY BASED ON CONSOLIDATED CIRCULAR ECONOMY PRINCIPLES

4.1.1 Background and objectives

This paper aims to unify academic understanding of the circular economy principles in one hand and consolidate on the other hand business models configurations built from these principles. More precisely, the paper aims to contribute to the ongoing theoretical discussion on the classification of circular business models by linking systematically circular economy principles with associated business model strategies. By doing so, it opens avenue for future research on the different mechanisms inherent to each circular business model and allows specifying distinctive tensions attached to their development and implementation. The outcomes facilitate research on circular business model innovation based on a common understanding of circular business models underlying principles.

4.1.2 Main findings

Starting from circular economy definitions and its core features, we clarified generic principles associated with the concept, based on existing schools of thought. Taking a micro-level perspective focusing on business model innovation, we highlighted recognized definitions on sustainable business models and framed circular business models as a subset of sustainable business models. The analysis showed that there is a gap between the current understanding of CE (definitions and principles) and subsequent circular business model emerging theory. In order to reduce this gap, we formalized a set of guiding principles which bridge general CE theory with circular business models. Seven guiding principles are identified: *regenerating loop, narrowing loop, slowing loop, intensifying loop, dematerializing loop, cascading loop* and *closing loop* principles. We also recognized that beyond these guiding principles, circular business models can be classified based on (1) the business model orientation (*material – product – service*) (2) the focus taken by the business model on the product lifetime phases (pre-use, use, post-use), and lastly (3) its circular value dynamics (*retain value, optimize value, recover value*). The development of these criteria allowed us to build an integrated typology using existing categorization attempts from 19 publications and consolidate circular business models into five distinctive categories. The integrated typology describes five generic circular business models: (1) *clean loops business models, (2) short loop business models, (3) access*

loops business models, (4) cascading loops business models and (5)long loops business models. Each business model is described with a focus on its value proposition and associated business model components (value creation, value delivery, value capture).

4.1.3 Main contributions

Circular economy can be considered as an ideal state, and by extension, it is acknowledged that 100% circular business models do not exist (yet) (Renswoude et al, 2015), one key reason being related to the limits of thermodynamics (Korhonen et al., 2018). The classification exercise done in this integrated typology allows however to serve as a more robust foundation to explore further the specific mechanisms taking place in circular business models, in relation to value creation. Second, the outcome of the article (consolidated typology and associated criteria) allows us to consolidate the definition of circular business models as *the rationale of how a company creates, deliver, retain, optimize, capture, and recover superior sustainable value by regenerating, closing, narrowing, slowing, intensifying, dematerializing and cascading resource loops within its value network, thus supporting its stakeholders without undermining the functioning of the biosphere or crossing any planetary boundaries*. This definition reinforces the links between circular business models and sustainable business models (the former being a subset of the latter, but sharing a similar overall objective) while at the same time characterizing the specific principles guiding the implementation of circular economy at business level.

At managerial level, the typology developed in this paper provides a basis for comparison and communication that can support companies when trying to position themselves in the circular business models map. This provides companies a starting point to explore new avenues and promising implementations of innovative sustainable business models.

4.2 ESSAY II: CUSTOMER VALUE CREATION IN CIRCULAR BUSINESS MODELS: INSIGHT FROM CASE STUDIES

4.2.1 Background and objectives

The aim of the article is to explore which dimensions of customer value creation are emphasized in circular business models (CBM). More specifically, the paper aims to specify the combination of value dimensions that appeal to customers and

end users based on the different existing categories of circular business models. The paper also attempts to provide empirical illustrations of customer value propositions in circular business models based on an analytical framework - the circular value creation compass. By applying the framework to a selection of 65 circular business models, it provides a set of insights and recommendations for managers and company owners on how to design their value proposition to bridge circular principles with customer needs.

4.2.2 Main findings

Results of the research allow us to draw specific insights on customer value creation in circular business models. Depending on its position on the value chain, the circular company will highlight distinct value combinations. When active on the downstream side (clean loop business models focusing on renewable supplies or cascading loops focusing on multiple value creation through resource symbiosis), the customer value proposition will generally be built from a traditional combination of functional value (green features, improved energy or resource efficiency, better outcome) with cost/benefit value (cost savings). On the other hand, the closer the business model is to the end customer, the better chances other value dimensions are included (experiential value to ease the customer journey, and symbolic value to meet customers inner values). The myriad of combinations highlighted in the illustrative cases allow us to posit that customer value creation in circular business models is a multifaceted construct that goes beyond resource conservation or environmental concerns. We further argue that based on the type of selected business model, a combined focus on two to three distinctive dimensions are necessary to create a relevant value propositions meeting customer's needs. Most importantly, as the products and services circulate through the diverse constituents of the value network of the focal company, it is expected that roles and behaviors of these constituents evolve over time. The customer/user targeted by the initial value proposition from the focal company may shift his role and later on turn into a supplier of the focal company. In short loops business models for instance, the user of a product will become supplier of the focal company when his product becomes defect and is sent back to the focal company for remanufacturing purposes. The same dynamic shift emerges in long loops business models, as companies recover materials from their initial customers for recycling purposes. This shift in roles throughout the life cycle of a product/service bears strong consequences on the initial value proposition of the company. It is expected that the primary value proposition evolves over time in order to accommodate the new expectations of the initial customer as his role and status changes. Therefore, companies embracing circular economy principles in

their business models are expected to develop dynamic customer value propositions which will respond to the changing status of the constituents of their value network.

4.2.3 Main contributions

With this essay, we contribute to the research on circular business models by focusing on the customer value proposition. We clarify our understanding on the key dimensions of value creation that may be relevant to the customers of circular products and services. We fill a research gap by developing a framework that supports the evaluation of circular value propositions.

The design, implementation and management of circular business models requires both new mental models, tools and methodologies. The circular customer value creation compass tool can be used to assess the strength of a customer value proposition from a circular business model and constitutes a visual checklist of aspects to consider for managers willing to transform their value proposition. Illustrations throughout the article provide practical examples to redesign clear circular value propositions based on the type of circular business model innovation investigated. As implied in the findings, a key managerial focus area should be on the iterative search for the right configurational fit between the various customer value dimensions.

4.3 ESSAY III: MANAGING SKILLS AND CAPABILITIES IN CIRCULAR BUSINESS MODELS: INSIGHTS FROM THE EUROPEAN FURNITURE INDUSTRY

4.3.1 Background and objectives

Implementing circular economy principles at business model level often leads to strategically rethink the types of resources being used (shifting from fossil fuel energy to renewables, increase the share of resources should adapt to external changes (from the ever growing responsible consumer unmet needs, to the tighter resource and climate oriented legislative framework). Above all, internal innovation processes need to be challenged to build new resources and competences (both at internal and external level) fitting into a renewed business model meeting sustainability and circularity requirements. Understanding how dynamic capabilities can support this transformation can therefore improve the theory related to circular business model innovation and provide useful

managerial implications for companies in the process of strategic renewal towards circular economy. The aim of this paper is first to understand how do Business Model Innovation (BMI) and Dynamic Capabilities (DC) interconnect in the context of a circular economy, and second to highlight which new dynamic capabilities are required to design and sustain over time a successful circular business model.

4.3.2 Main findings

In the essay, we first identified specific routines and processes relevant to reconfigure the most relevant aspects of business model components for furniture companies to embrace circular economy principles. Each of these routines and processes are supported by a set of skills and capabilities which facilitate the transformation of companies to become circular. Beyond the different dimensions of the business model innovation and the associated skills analyzed, we identified recurring skillsets that help shape the circular business model of the companies. These second-order capabilities influence and bridge several dimensions of the business models of these companies. Four second-order capabilities are presented *sustainability capabilities (1), entrepreneurial capabilities (2), systems capabilities (3) and user-centered capabilities (4).*

In between operational capabilities at business model level, and second-order capabilities at meta level, we highlighted a third layer – dynamic capabilities – which allow the firm to pool, integrate and reorganise these existing resources, to seamlessly design a successful business model. Three circular dynamic capabilities were identified: Co-*Sensing, Co-seizing, and Co-reconfiguring*.

4.3.3 Main contributions

From a theoretical perspective, we contribute to the literature on circular business model by taking a skills and capabilities lens. Dynamic capability is an established field of research in strategy and management, it is however scarce in sustainable and circular business model literature. Through an empirical analysis of 25 circular business models from one specific industry, we identified the main capabilities relevant for circular business model innovation.

Our research highlights the interconnections between organizational routines/processes and their associated skills relevant to each key aspect of the business model construct and the higher order capabilities supporting the transformation to circular business models. More specifically, our research

developed a new frame that bridges higher order capabilities in sustainable business model innovation (*sustainability skills, user centered skills, systems skills and entrepreneurial skills*) with operational skills, through a dynamic capability lens. Further, we emphasize the dynamic processes taking place when co-*seizing, co-sensing and co-reconfiguring* existing internal and external resources of the firm in order to frame a successful business model.

From a managerial perspective, our research aims at providing managers with a framework to enable the identification of existing skills and competences inside the company and in its value network and address the missing links in their business model innovation process. The illustrations from the analyzed business cases of the furniture industry also provided practical examples on how to identify and develop new skills to facilitate the transformation.

4.4 ESSAY IV: A VALUE NETWORK PERSPECTIVE ON CIRCULAR BUSINESS MODELS: LESSONS FROM FIVE CASE STUDIES

4.4.1 Background and objectives

As new business models are identified as a powerful transformative tool towards the circular economy paradigm, new knowledge on designing circular business models is needed to foster a successful implementation of the circular economy. Literature focusing on inter-organizational relationships in a circular economy context has mainly focused on remanufacturing, closed-looped and reverse supply chains, without necessarily taking a holistic systemic approach. There is indeed only a limited understanding on how circular value networks emerge and are maintained, and more specifically on the expected roles of focal companies when actively developing networked circular business models. Taking a value network perspective on circular business models can thus offer relevant insights on how value creation occurs within circular business models. The goal of this paper is to contribute to the ongoing discussion related to the theoretical foundations of circular business models, by adopting a value network perspective. In this paper, we posit that value creation mechanisms in circular business models need to be vested in a value network perspective. We therefore aim to answer the following research question: *which attributes of a value network perspective can support the development of circular business models?* As circular business models can be classified according to specific distinctive typologies, we also posit that the circular business model configuration influences the way the value network is emerging

and organized. Through a multiple case study approach, the paper aims to uncover the distinctive value network configuration approaches implemented by focal companies in light of their distinctive circular business models archetypes while highlighting common features characterizing circular value networks.

4.4.2 Main findings

The results of the study allow us to highlight specific characteristics defining circular value networks: first, the studied cases all display a purpose alignment from all actors involved in the network. This feature can be considered as the foundation of a circular value network. Concretely, addressing a wicked resource problem that requires complementary tangible and intangible resources pooled together in a symbiotic fashion is the main driver leading to the emergence of a circular value network. Shared mindsets from multiple actors involved in concomitant sectors consolidate the forming of circular value networks. When analyzing business model components of focal firms embedded in circular value network, we can highlight the following characteristics. Looking at the *value proposition* component, focal companies design their own value proposition in light of other actors' needs in the network, and strive to offer multiple complementary benefits to the network. Consequently, the focal company value proposition can be described as a nested component of the whole value network proposition. Looking at *value creation and delivery* mechanisms, we highlight that value creation is built upon a systematic value leakage assessment at network level which is turned into a new value opportunity. For the focal firms, providing adaptive and locally attuned responses aiming at dynamically build symbiotic relationships support value creation at network level. Taking a circular economy network perspective, value capture at network level not only benefits the focal firm with profit making realization, it extends to the capture of societal and environmental benefits that go beyond the collaborative network of direct stakeholders.

A closer look at the five circular value networks investigated in the study allows us provide generic characteristics of circular value networks. Circular value networks can be characterized by a *high level of embeddedness* (i.e. the measurement of a firm's relation to its environment through an aggregate measure of the quality and quantity of firm ties), displaying *tight interconnections* between a core set of complementary actors which act in *reciprocal interdependence* (i.e. the output of one unit provides input for another and vice versa). Circular value networks are built on a *heterogeneous set of actors*, often spanning through multiple sectors, which rely on *symbiotic service provision*. Often created from an *intentional*

perspective strongly associated to the grand challenges they aim to tackle, circular value networks as they formalize, display some *emergence* features (i.e. the arising of novel and coherent structures, patterns and properties during the process of self-organization in complex systems (Goldstein, 1999)). Value networks are like living organisms and thus are constantly learning, evolving and adapting to changing requirements (Lusch et al., 2010).

Beyond these generic features, we highlight that circular value networks can take different forms and characteristics depending on where one's circular business model is positioned on the life cycle of a product-service. The shape or pattern of the circular business model built within a value network depends on the needs addressed within the network. It is possible to identify specific archetype roles for companies active in circular value networks: based on the position of the focal company in its value network, specific roles (*enablers, extender, optimisers, recoverer, integrators*) lead to associated value creation, delivery and capture mechanisms. The more integrated, the more modular and multi-functional the circular business model is. To successfully operate within a circular value network, specific capabilities can be highlighted: *Network scanning, network graspingg, network reshaping, network zooming, network marketing and network bridging* capabilities.

4.4.3 Main contributions

Beyond this attempt to characterize circular value networks, several managerial implications are inferred. The article illustrates through the five cases how adopting a value network perspective when engaging in circular business model innovation can bring new value opportunities. The circular value network framework used to analyze the cases can also provide a more systematic method to position oneself in one network depending on the business model archetype pursued. By highlighting specific roles and capabilities, the study also offers managers of circular economy-oriented companies relevant insights to support their managerial postures at network level.

5 CONCLUSIONS AND DISCUSSIONS

In this concluding chapter, we first summarize the main findings from the fours essays and integrate these learnings into a new theoretical framework supporting our research question.

5.1 Summary of the findings

In the introduction of the dissertation we highlighted the lack of existing framework supporting business model innovation in circular economy (Antikainen and Valkokari, 2016, Lewandowski, 2016) as well as lack of shared understanding of circular business model as a theoretical construct. The need for clarity regarding the concept of business model in its relation to circular economy (Urbinati, 2017, Merli et al., 2018) has led us to explore the construct further. More precisely, the lack of framework detailing the factors enabling business model transformation in circular economy as highlighted by Antikainen and Valkokari (2016) and Lewandowski (2016), provided a relevant research avenue for the development of this dissertation.

From this current understanding of existing research gaps, and given the marketing theory perspective taken by the author of this thesis, it proved relevant to focus our contribution on discerning and describing the marketing mechanisms that support companies to shift from a linear to a circular business model. First, by providing clarity on the circular business model construct, in order to identify and characterize the various business model pathways supporting the emergence of a circular economy. Second, by providing a framework that facilitates the understanding of mechanisms at play when business model transformation for a circular economy takes place.

In that respect, this dissertation consisted of one general research question complemented by three specific research questions.

> *RQ*: *What are the critical mechanisms enabling Circular Business Model transformation?*
>
> *RQ1: How can we classify and characterize circular business models?*
>
> *RQ2: Which Customer Value Creation mechanisms are enabling the implementation of Circular Business Models?*
>
> *RQ3: Which dynamic capabilities are enabling the implementation of Circular Business Models?*

RQ4: Which attributes of a value network perspective can support the development of circular business models?

Each of these four research questions were explored keeping in mind the interconnections between the supporting theoretical constructs through which each question is addressed.

The literature review on business model and its associated theoretical construct led us to develop a conceptual model constituting the foundation through which the general research question could be answered. By taking a multiple lens perspective focusing on the customer value proposition and its supporting value creation architecture (dynamic capabilities and value networks) we aimed to highlight first the value dimensions that are taken into account when designing circular value propositions meeting customer's needs. Second, we addressed the set complementary set of skills and competences necessary to support the transformation of a business model from linear to circular, taking a dynamic capabilities perspective. Third, we characterized the value creation and delivery process of circular business models taking a network perspective.

All the individual essays of the thesis had an important role in forming the overall contribution of the thesis. Table 10 contains a summary of the findings, contributions of each specific publication to the overall purpose of the thesis, and how the findings refine theoretical understanding of the subject.

Table 8. Summary of main findings

In the next section we discuss how these individual essays shed some light on developing an integrated framework explicating the critical mechanisms supporting circular business model transformation

5.2 Contribution from the individual essays to the main research question

Before describing the conceptual model based on the individual contributions from the four essays, it is relevant to take a critical perspective on existing attempts to frame business model transformation in the context of sustainability and circular economy. The next section provides an overview of existing tools and frameworks supporting sustainable and circular business model transformation.

5.2.1 Circular Business model frameworks

As stated in the introduction, in order to achieve a circular economy, one promising avenue is to develop business models in line with circular economy principles. In order to do so, business model innovation is necessary, to prototype, experiment, test and implement new value propositions and their associated value architecture. Business model innovation can be activated from a new business model architecture or reconfigured from an existing business model. From a strategic and managerial perspective, this transformation process should be supported by a systematic and generic process. Different tools and methodologies exist to facilitate this process (Antikainen and Valkokari, 2016).

The *business model canvas* (Osterwalder and Pigneur, 2010) is currently the most used tool to describe the different building blocks supporting value creation and delivery in new business models. It has been used extensively in practice-oriented consultancy and projects. In the context of sustainable business model innovation however, the framework shows limitations as it mainly fits business models fitting with linear principles. To overcomes its limitations, several frameworks using the business model canvas as a basis, have been designed to include essential elements characterizing sustainable business models, such as the *triple-layered business model canvas* (Joyce and Paquin, 2016) adding environmental and social layers to the original canvas, or the *sustainable business canvas* which includes negative and positive externalities to the value architecture (Sempels, 2014). The

Flourishing Business Canvas built upon principles from the Strongly Sustainable Business Model Ontology (Upward and Jones, 2016) takes a different direction. Following a more holistic approach, the canvas focuses on Value-process-people-outcomes while integrating external dimensions of the company (environment, stakeholders). Based on the extensive review of circular business model definitions, components, taxonomies, conceptual models, design methods, tools, and adoption factors, Lewandowski (2016) introduced a circular business model canvas model and added two additional components: the take-back system and adoption factors (Lewandowski 2016). The sustainable circular business model innovation framework (Antikainen & Valkokari 2016) integrates the business model canvas with the sustainability and circularity perspectives. The framework integrates elements from macro (global trends and drivers), meso (ecosystem and value co-creation) and micro (company, customers, and consumers) levels (Valkokari et al., 2014) while also including trends and drivers analyzing the business environment and scanning current trends. Furthermore, the impact of the business model is divided into sustainability costs and benefit, adding the perspective of a triple bottom line to business model development (Antikainen & Valkokari 2016). Other practitioner-oriented tools were also developed to meet similar purposes such as *the play-it forward tool* (Dewulf, 2010), or taking a more circular economy orientation, the *Circulab board* (Wiithaa, 2016), the *moonfish circular business model* (Moonfish, 2014) or the *circular business model board* (circular.academy, 2016) also attend to revisit the business model canvas tool to fit with circular economy principles.

Most of the tools and framework described above generally focus on a static picture of the future business model envisioned, depicting specific elements of the business model construct (such as new resources used, new activities performed or intended societal impact) without necessarily addressing the conditions enabling the transformation process. If their usefulness in the business model innovation process should not be undermined, the described tools and frameworks do not however bridge business model innovation processes with existing theoretical constructs salient in marketing theory. It is therefore relevant to clarify how these marketing constructs enable business model transformation in the context of a circular economy.

The next section summarizes the main takeaways from the dissertation and its individual essays to describe a framework of marketing mechanisms enabling circular business model transformation.

5.2.2 Marketing mechanisms enabling circular business model transformation

Taking an integrated perspective on the four essays constituting this thesis, we summarize and articulate our thinking into the following set of statements.

In its traditional understanding, a business model can be defined as the rationale on how a business creates, delivers and captures value. The construct is not static but rather dynamic, as ongoing external pressures force firms to iterate the mechanisms at the source of their value creation processes. Business model innovation - *the process of reconfiguring an existing business model or designing a new value architecture modeling the interactions between distinctive value components* – is deemed necessary in order to maintain or create additional value. The rising price of limited nonrenewable resources, the production of negative externalities embedded in current production patterns (waste production, pollution, rise of CO2 emissions) and a shift in customer perception towards more responsible products create additional pressure to transform existing business models or create new ones that fit with sustainability aims – achieving higher human well-being whilst ensuring that ecological systems are in balance. Circular economy, as an umbrella concept, aims to provide a strategic avenue to respond to these grand sustainability challenges. The construct positions itself as an alternative to our current linear system and broadly speaking, aims to be restorative and regenerative by design by keeping products, components, and materials at their highest utility and value at all times. In order to accelerate the transition to a circular economy, engaging in business model transformation by embedding circular principles in value creation processes can provide benefits for entrepreneurs and managers, as well as all other involved stakeholders. But what needs to change? What are the enabling mechasisms supporting this transformation? These two questions are the common thread through which this dissertation has been built.

In order to design a business model meeting the principles of a circular economy, our first assumption is that:

- *At general level, the circular business model should embed circular economy principles supporting the circulation of products, components and materials through extended and/or multiple life cycles.*

The circular principles explain how materials, components or products are *ideally* being circulated – or looped – into their system. The principles theoretically address the nature of the resources that circulate, the quantity of resources that circulate the speed of circulation, the usage intensity of the circulating resource,

the number of life cycle of the resource and the direction of circulation of the resource. *The regenerating loop principle* focuses on the nature of the resource circulating and promotes the use of bio-based, biodegradable, compostable, or renewable resources to regenerate natural capital *The Narrowing loop principle*, aims at reducing the quantity of resources used per product through Eco-efficiency or sufficiency strategies. *The Slowing loop principle* focuses on the speed of circulation of resources and promotes the design of long-life goods and product-life extension (i.e. service loops to extend a product's life, for instance through repair, remanufacturing). Through this principle, the utilization period of products is extended resulting in a slowdown of the flow of resources. *The intensifying loop principle* focuses on strategies leading to a more intense use of products during their lifetime, preventing the use of additional products to fulfil the same function (ie: a power drill rests idle most of the time) . *The dematerializing loop principle* focuses on the substitution of product utility by service and software solutions. The cascading *loop principle* maximizes resource effectiveness by using biomass in products that create the most economic value over multiple lifetimes. Finally, the *closing loop principle* details how through recycling, the loop between post-use and production is closed, resulting in a circular flow of resources.

In order to distinguish circular business models from traditional ones, we thus use the following definition.

- Circular business model can be defined as *the rationale of how a company creates, deliver, retain, optimize, capture, and recover superior sustainable value by regenerating, closing, narrowing, slowing, intensifying, dematerializing and cascading resource loops within its value network, thus supporting its stakeholders without undermining the functioning of the biosphere or crossing any planetary boundaries*".

Second, we propose that

- *The selection of one or more guiding circular principles determines the type of circular business model to pursue.*

Specifically following one or two circular principles as the basic mechanism shaping the new business model will result in a distinct circular business model. Beyond the selection of these guiding principles, the circular business model can be designed according to its product-service-material orientation, the position of its offerings in the life cycle of a product (pre-use, use, post use) and its associated value retaining strategy (maintain value, optimize value, recover value). The outcome may result in a variety of distinctive circular business models.

We deduce from this postulate that

- *Circular business models are not a homogeneous form of business models.*

"Ideal" forms of circular business models can be classified in a typology of five distinctive business models. *Clean loops business models* focus on the regenerative feature of the circular economy definition and thus adopt the regenerating loop principle focusing on integrating biobased, recyclable materials. The central circular value dynamic is to *retain value* of the materials used while maintaining the quality of the materials for many consecutive cycles *Short loops business models* adopt the narrowing loop principle and the slowing loop principle. On one hand, by producing long-lasting products these business models eliminate the need to extract additional virgin resources in order to replace existing products, thus reducing the amount of resources in circulation. On the other hand, by providing a full range of services aiming at extending the useful lifetime of products, they reduce the speed of circulation of materials and products. The central circular value dynamic is to *retain value* in the existing products for as long as possible during the *use phase* as well as in the *post-use* phase when recovering products to be remanufactured/refurbished. *Access loops business models* adopt two circular economy principles, the dematerializing loop and the intensifying loop. On one hand by focusing on the functional results rather than on the product associated to the solution, these business models dematerialize value creation through a focus on servitization. On the other hand, product use is intensified through an optimization of the value delivery, allowing multiple users to access one single product, therefore maximizing the use rate of the products. The central circular value dynamic is to *optimize value* during the *use phase*. *Cascading loops business models* adopt the cascading loop principle. In these process-orientated solutions, waste outputs from one process are turned into feedstock for another process or product line. The central circular value dynamic is to *recover value*. *Long loops business models* adopt the closing loop principle. Materials are recovered to be reprocessed into new components or products. The central circular value dynamic is to *recover value* in the post-use phase, focusing on the recovered materials.

If this typology offers help in understanding the underlying distinctive value creation mechanisms at play in circular business model innovation, in practice however, the analysis of existing business cases show that:

- *Circular business models are often designed using a hybrid perspective, combining one or two circular business model features to create a unique business model proposition.*

Depending on the underlying guiding principles and general characteristics of the business model envisioned, we posit that:

- *The value proposition, value creation, value delivery and value capture components of the existing business model have to be simultaneously reconfigured to make the business model circular.*

At general level:

- *The value proposition leading to a circular business model needs to shift from being a static proposition only aiming at meeting a single customer needs, to become dynamic and multifaceted, offering multiple benefits to a larger set of stakeholders, including the environment.*

- *The value creation and delivery mechanisms in circular business models are interdependent mechanisms leading to the provision of value through three distinct tactics: value maintenance, value optimization and value recovery.*

- *Value capture in circular business models extract net positive social, economic and environmental value.*

Depending on the choice of circular business model:

- *The circular value proposition and its value creation, delivery and capture mechanisms will be designed differently.*

Table 10 below details the value architecture according to the distinctive business models. Depending on the circular business model strategy adopted by the company, the business model reconfiguration will differ. The following table summarizes the various dimensions emphasized in the value architecture of circular business models, including *Value proposition, Value creation, Value delivery, Value maintenance, Value optimization, Value recovery*. Characteristics of the value architecture are organized according to the circular business model typology developed in essay I. Insights on the characteristics are acquired from the database of circular business models developed in the framework of Essay II, complemented by additional inputs from Essay III and IV.

The *Value proposition* highlights how the solution offerings provides customer value; the *Value creation* highlights key activities and processes, as well as the capabilities supporting value creation. *Value delivery* focuses on the targeted customers, and associated delivery processes and capabilities. *Value*

maintenance, Value optimization and Value recovery depict the circular focus of the business models, while *Value capture* details revenue and costs dimensions.

In order to facilitate the transformation to a circular business model we posit the following:

- *A systematic approach embedding three distinctive marketing mechanisms can enable firms to reconfigure their business model architecture.*

- *The customer value creation construct, the dynamic capabilities construct, and the value network construct simultaneously influence the outcome of business model transformation.*

    - *The circular value proposition is influenced by a redesign of the customer value creation mechanism in which user needs are translated into a constellation of functional, symbolic, experiential cost/sacrifice and co-creation values. The choice of each customer value dimension highlighted in the value proposition will differ according to the business model architecture and the selected circular guiding principles.*

    - *The identification and dynamic reconfiguration of new capabilities (sustainability capabilities, entrepreneurial capabilities, systems capabilities and user-centered capabilities) facilitate the value creation and delivery process of the circular business model. Through co-sensing, co-seizing and co-reconfiguring, the business model architecture is redesigned within and beyond the firm's boundaries.*

    - *Taking a system level perspective enables the development of new value creation mechanisms, by positioning the circular business model within a value network perspective in which heterogeneous actors, tied by reciprocal interdependence, intentionally exchange symbiotic service provision supporting a common purpose.*

Figure 6 below provides an overview of the marketing mechanisms at play in circular business model innovation.

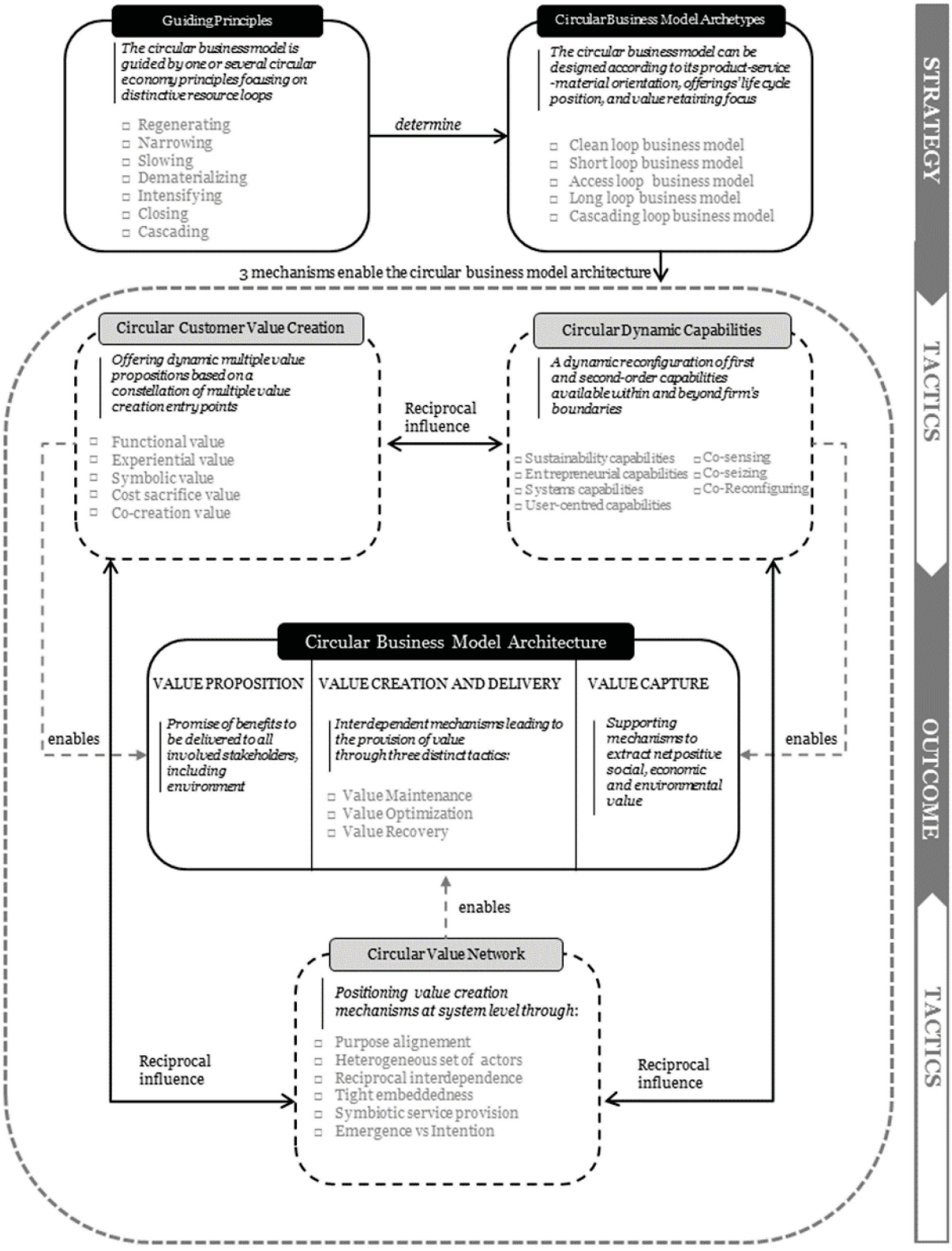

Figure 6. Marketing mechanisms for circular business model innovation: a theoretical framework

Table 11: Circular Business Models Value Architecture dimensions

Business model typology	Value proposition	Value Creation	Value Delivery	Value Maintenance	Value Optimization	Value Recovery	Value Capture
Clean loop	**Functional value:** fully renewable, recyclable, or biodegradable inputs and/or **Symbolic value:** product made from ecomaterial, green image	Replacing virgin materials and linear inputs. Focus on upstream value network (suppliers) Sustainability capabilities	Offering ecofriendly products to responsible customers Focus on quality-sensitive customers and green-sensitive customers User-centered capabilities	Use of recyclable material enabling reuse for next product life and/or value maintained through long lasting product	/	/	**Revenues:** price premium for quality product **Costs:** reduction of waste disposal costs
Short loop	**Functional value:** long-lasting, repairable products and/or **Cost/sacrifice value:** affordable remanufactured products	Designing long-lasting products, easily repairable products. Developing maintenance Services Focus on downstream value network (users as suppliers, retailers are enabling partners) User-centered capabilities	Offering long-lasting products and repair/maintenance service solutions Focus on quality- sensitive and/or cost-sensitive customers User-centered capabilities	Value maintained through long lasting products and/or Purchasing, refurbishing, remarketing and reselling of used products to maintain value of product	/	/	**Revenues:** price premium for long lasting and high quality products. Additional revenues from repair services **Costs:** Remanufacturing processing costs long term services, warrantee costs labor costs

Access loop	**Experiential value :** Focus on functionality and result of the solution; satisfy users' needs without needing to own physical products and/or **Functional value:** unlimited and individual access to a product (lease); limited and shared access to a product (renting); and/or **Cost/sacrifice value:** reduction of costs per unit of use.	Matching owners and users of underused assets through platform; Focus on downstream value network (users as suppliers sharing their overcapacities)	Switching from product sales to service access; Retaining product ownership. Providing results Focus on functionality-sensitive customers User-centered capabilities	/	Maximization of product use through multiple cycles and users / **Revenues:** Transaction fee leasing fee; rental fee payments per use; payments for functionality; payments for results payments per unit of service (e.g. time, number of uses); **Costs:** higher product maintenance costs; material cost reduction through reusability and sharing

Long loop	**Symbolic value:** products based on recycled waste; and/or **Cost/sacrifice value:** Value for reduced price	Waste collection; waste sorting; waste recycling Recycling of products, components, materials, waste Focus on downstream value network (users as suppliers, collectors as enabling partners) Systems Capabilities	Taking back used products, components, materials, or waste; Providing used products, components, materials, or waste Focus on cost-sensitive customers	/	/	Recapturing of waste; reusing of waste; cycling of material	**Revenues:** additional revenues from sales or use of recovered material into new products **Costs:** Waste handling, processing; Transportation and logicstics Reduction of energy and material costs
Cascading loop	**Cost/sacrifice value** cost reductions; supply risk reduction; elimination of third party waste;	waste as production input synergistic partnerships and collaborations Systems and entrepreneurial capabilities	Focus on cost-sensitive customers	/	/	Recovery and multiple use of material streams	**Revenues:** new streams of revenues from product diversification **Costs:** Waste as new by-product processing costs Reduction of inefficiencies

5.3 Theoretical and managerial implications

This section discusses the theoretical and managerial implications of the thesis.

5.3.1 Theoretical implications

Theoretical implications of the dissertation are manifold. On one hand, contributions offer new insights on the studied phenomenon – *business models in circular economy* – while on the other hand providing refined knowledge on the theoretical constructs used throughout the essays - *Customer Value Creation, Dynamic Capabilities, and Value Networks*. Last, the dissertation offers a descriptive framework on the interrelations between these three theoretical constructs in the context of business model transformation.

On Circular Business Models

The first essay, by developing an integrated typology of circular business models, advances current knowledge on circular business model characterization. It offers a more robust foundation to explore further the specific mechanisms taking place in circular business models, in relation to value creation. Moreover, the outcome of the article allows us to consolidate the definition of circular business models as "*the rationale of how a company creates, deliver, retain, optimize, capture, and recover superior sustainable value by regenerating, closing, narrowing, slowing, intensifying, dematerializing and cascading resource loops within its value network, thus supporting its stakeholders without undermining the functioning of the biosphere or crossing any planetary boundaries*". The definition reinforces the links between circular business models and sustainable business models (the former being a subset of the latter, but sharing a similar overall objective) while at the same time characterizing the specific principles guiding the implementation of circular economy at micro level.

On Customer Value Creation

Customer value creation in circular business models is a multifaceted construct that goes beyond resource conservation or environmental concerns. Based on the selected circular business model, a combined focus on two to three distinctive customer value dimensions are necessary to create a relevant value proposition meeting customer's needs. Most importantly, as the products and services circulate through the diverse constituents of the value network of the focal company, it is expected that roles and behaviors of these constituents evolve over time. This in turn, influences the primary value proposition of the focal company.

Therefore, companies embracing circular economy principles in their business models are expected to develop dynamic customer value propositions which will respond to the changing status of the constituents of their value network throughout the life cycle of the solution offering.

On Dynamic capabilities

Essay III contributes to the literature on circular business model by taking a skills and capabilities lens. Dynamic capability is an established field of research in strategy and management, it is however scarce in sustainable and circular business model literature. Through an empirical analysis of 25 circular business models from one specific industry, the essay identifies the main capabilities relevant for circular business model innovation. The essay highlights the interconnections between organizational routines/processes and their associated skills relevant to each key aspect of the business model construct and the higher order capabilities supporting the transformation to circular business models. More specifically, the study develops a new frame that bridges higher order capabilities in sustainable business model innovation (*sustainability skills, user centered skills, systems skills and entrepreneurial skills*) with operational skills, through a dynamic capability lens. Furthermore, it emphasizes the dynamic processes taking place when co-*seizing, co-sensing and co-reconfiguring* existing internal and external resources of the firm in order to frame a successful business model.

On Value networks

In essay IV, we analyzed business model components of focal firms embedded in circular value networks and highlighted several characteristics. Looking at the *value proposition* component, focal companies design their own value proposition in light of other actors' needs in the network, and strive to offer multiple complementary benefits to the network. Consequently, the focal company value proposition can be described as a nested component of the whole value network proposition. Looking at *value creation and delivery* mechanisms, we highlighted that value creation is built upon a systematic value leakage assessment at network level which is turned into a new value opportunity. For the focal firms, providing adaptive and locally attuned responses aiming at dynamically build symbiotic relationships supports value creation at network level. Taking a circular economy network perspective, value capture at network level not only benefits the focal firm with profit making realization, it extends to the capture of societal and environmental benefits that go beyond the collaborative network of direct stakeholders.

From a theoretical perspective, the essay details a set of features to describe circular value networks. These networks can be characterized by a *high level of embeddedness* (i.e. the measurement of a firm's relation to its environment through an aggregate measure of the quality and quantity of firm ties), displaying *tight interconnections* between a core set of complementary actors which act in *reciprocal interdependence* (i.e. the output of one unit provides input for another and vice versa*).* Circular value networks are built on a *heterogeneous set of actors*, often spanning through multiple sectors, which rely on *symbiotic service provision*. Often created from an *intentional* perspective strongly associated to the grand challenges they aim to tackle, circular value networks as they formalize, display some *emergence* features (i.e. the arising of novel and coherent structures, patterns and properties during the process of self-organization in complex systems).

Taking a value network lens to circular business models also allows us to detect and characterize circular value networks, a new set of value networks which can be described by their strong purpose alignment (solving grand sustainability challenges) and their position spanning through different sectors and industries.

On Circular business model transformation

Overall, the dissertation provides a first framework highlighting marketing mechanisms supporting circular business model transformation. By taking a multiple perspective including customer value creation, dynamic capabilities and value networks, the framework offers new insights on the marketing processes and elements that need to be reconfigured when choosing to engage in circular economy business models. Specific insights on the transformation process may depend on the generic characteristic of the new business model, following five distinctive business model categories.

5.3.2 Managerial implications

As the dissertation is grounded in the analysis of several business cases, the outcomes of the articles also provide different managerial implications to companies willing to engage in circular economy transformation. First, the typology developed in essay I provides a basis for comparison and communication that can support companies when trying to position themselves in the circular business models map. In that sense, it provides companies a starting point to explore new avenues and promising implementations of innovative sustainable business models.

Second, the design, implementation and management of circular business models require both new mental models, tools and methodologies. One outcome of Essay II - the *circular customer value creation compass* - can be used to assess the strength of a customer value proposition from a circular business model and constitutes a visual checklist of aspects to consider for managers willing to challenge their value proposition. Illustrative examples in the essay provide practical examples to redesign clear circular value propositions based on the type of circular business model innovation investigated. As implied in the findings, a key managerial focus area should be on the iterative search for the right configurational fit between the various customer value dimensions.

Essay III, from a practical perspective, provides managers with a framework to manage the identification of existing skills and competences inside the company and within its value network. The illustrations from the analyzed business cases of the furniture industry also provide practical examples on how to identify and develop new skills to facilitate the transformation.

In essay IV, beyond an attempt to characterize circular value networks, several managerial implications are also inferred. The essay illustrates through the five cases how adopting a value network perspective when engaging in circular business model innovation can bring new value opportunities. The circular value network framework used to analyse the cases can also provide a more systematic method to position oneself in one network depending on the business model archetype pursued. By highlighting specific roles and capabilities, the essay also offers managers of circular economy-oriented companies relevant insights to support their managerial postures at network level.

5.4 Limitations and future research

This section summarizes limitations of the four essays constituting the dissertation and offers research avenues to further the knowledge needed to address our research questions.

5.4.1 Limitations

Engaging in the transition to a circular economy is a complex process. It requires systems-level redesign, an acute engagement from customers and other actors of the value network, a pressing need for new skills and competences to be nurtured both at internal and external level. Business models fitting the circular economy are prone to even more dynamic changes than in conventional markets. Analyzing

circular business models through a multiple lens (Customer Value Creation, Dynamic Capabilities and Value Networks) can provide new insights on the mechanisms supporting a successful transformation. The approach is nevertheless not without limitations.

In essay I, the deductive approach used in consolidating the typology is not without flaws. As new business models in the circular economy constantly surface, a more iterative approach would be needed to revisit this typology on a regular basis. Business models examples can support the conceptualization of circular economy: describing good circular economy implementation examples can help sharpen the understanding of the circular economy concept both among scholars and practitioners. At the same time a strong concept of circular economy is needed to clarify what is a CE business model. This tension between practical examples on one hand and general concepts on the other hand is at the core of theory forming, which is still emerging in the context of circular business models. Thus, more extensive work is needed to refine the defined concepts and consolidate knowledge. Examples depicted in the existing literature also show that a single company can develop its business model using several principles and value creation mechanisms, thus developing hybrid combinations which raise the complexity of identifying specific characteristics associated with each category of the typology.

Essay II has several limitations that constitute relevant avenues for further investigations. First, no relation between business performance and circular customer value creation strategies were addressed in the research. Further quantitative study should support how certain value constellations provide a better competitive advantage and improved performance. Second, the study is static in its essence as it uses the business model as a construct to analyze the various business cases and only provides a snapshot description of the value proposition at a specific time. It does not take into account the evolution of the value proposition over time. Are mature circular business model tending to provide a more integrated value proposition? Are customer value propositions becoming more complex over time? These questions could be answered in further research.

In essay III, we attempted to provide a detailed view on the dynamic capabilities needed to support the development and implementation of circular business models. It however bears specific limitations. The research results reported here has focused only on examples of companies operating in the European furniture industry. Although this study highlights a number of patterns that can be generalized in other circular business models cases, our learning focuses on an industry that has its own specificities (predominance of a recyclable and renewable

material – wood, importance of design in the value proposition, emphasis on manual work, etc..), it is therefore questionable to see if the skillset and capabilities identified here could apply to any other industry. Further research is therefore required to test this framework in other sectors.

In essay IV, we took a value network lens to provide additional insights on circular business models. The analysis has however several limitations. First, the data collection for each case was limited to interviews and documents related to the focal actor of the value network. More in-depth studies including all actors involved in each value networks would create a richer understanding of each value network. Second, we used a sample of Finnish SMEs, and though they all have multinational customers and some operations abroad, the country-specific sample may limit external validity. Third, the study focused on the relationship between members of the value network at one point in time. Findings may be integrated with a more dynamic time- and process- oriented perspective, in which it is expected to see different roles and activities emerging as the value network matures. New research should address these limitations and pursue theory-building around circular business models in a network perspective. For instance, the tension between planning and emergence of circular value networks, the balance between autonomy and interdependence of focal firms are not directly addressed in this research and should require further investigation.

5.4.2 Suggestions for future research

The dissertation provides a first framework linking marketing mechanisms enabling circular business model transformation. This framework was built from integrating multiple analytical lenses, addressing different levels - from internal resources and capabilities at the focal company level, through dyad relationships between customers and the solution provider, to a systems perspective involving multiple actors of a value network. As the model is built from different insights taken from individual lenses, it would be relevant to test this integrated framework in a set of individual case studies experiments in which all lenses and associated tools could be tested and validated from a holistic perspective. Indeed more experimentation is required in circular and sustainable business model innovation to understand the successful mechanisms supporting the transformation. Consequently, additional research is needed to understand the 'business experimentation for sustainability' concept; ways in which such experiments can be implemented; and how it can help accelerate sustainability transitions in business. Experiments can indeed produce further knowledge about pressing

sustainability challenges and aim to generate evidence-based actionable knowledge (Fazey et al., 2018).

To activate these experiments, tools and methods are needed that simultaneously allow business to experiment with new business models while advancing understanding of the sustainability impacts achieved and building organizational capabilities for innovation and experimentation (Bocken et al., 2018; Weissbrod and Bocken, 2017). As some approaches and tools were developed throughout the dissertation, further research could be implemented to improve the efficiency and relevance of these tools in the context of business model experimentation.

In the dissertation, a strategic and organizational perspective has been adopted to describe business model innovation for a circular economy. In that focus, the role of technology to support the transformation has not been made salient. Depending on the industry, the role of technology as an enabler to facilitate the emergence of novel business models may take a central position. In order to provide a more comprehensive circular business model innovation framework it may be relevant to address this gap and further research how the role of novel technologies (big data, blockchain, cryptocurrencies to name a few) may support the development of disruptive circular business models.

5.5 Conclusions

Circular economy transformation is one of the growing trend supporting future-fit businesses in the context of climate change and resource scarcity. Similarly, advancements in the bioeconomy – encompassing production patterns based on renewable natural materials – and in the digital economy – using platform approaches and opportunities behind big data – will lead businesses to engage in more integrated approaches supporting sustainable value creation.

In this new economic and social order, most of our existing practices and structures are challenged. Business model innovation and experimentation addressing these emerging and mutually reinforcing trends will be more than needed in the coming future. By taking a systematic look at business models for the circular economy, this dissertation takes a first step in understanding where the global business community may be heading and paves the way for further research supporting a successful transformation of our economy, a thriving, socially sustainable economy aligned with our planetary boundaries.

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Essays

Mouazan, E. An integrated circular business model typology based on consolidated circular economy principles

Mouazan, E. Customer value creation in circular business models: insight from case studies

Mouazan, E. Managing skills and capabilities in circular business models: insights from the European furniture industry

Mouazan, E. A value network perspective on circular business models: lessons from five case studies

ESSAY I: An integrated circular business model typology based on consolidated circular economy principles

1. Introduction

Our current take make waste linear economy is increasing pressure on our ecosystems and accelerates environmental degradation: biodiversity loss, water, air, and soil pollution, resource depletion, and excessive land use (Meadows et al., 2004, Rockström et al., 2009, WBCSD, 2010). When searching for alternatives models, the circular economy concept, while not entirely new, has gained traction at business (EMF, 2012) and policy levels (EC, 2014), for its potential to operationalize the broader concept of sustainable development (Murray and al, 2017).

Circular economy can be defined as *"one that is restorative by design, and which aims to keep products, components and materials at their highest utility and value, at all times"* (Webster, 2015). At its core *is the circular (closed) flow of materials and the use of raw materials and energy through multiple phases"* (Yuan et al., 2008). The acknowledgment of the limits to planetary resource and energy use, and the importance of viewing the world as a "system" in which pollution and waste are designed out, lay at the foundations of circular economy thinking (Bocken, 2016).

This transformational approach requires new interventions at macro-level (cities, regions and nations), meso-level (business networks, industrial parks), and micro-level (individual businesses) (Ghisellini et al. 2016). The implementation of novel business models fitting with circular economy principles is considered a core aspect of this transformation (Brennan et al., 2015). In that respect, this paper focuses on the micro-level and specifically addresses the business model perspective on the transformation to circular econony. *"A crucial constituent in the achievement of a circular economy is business model innovation*", states De Angelis (2016).

The concept of circular economy has become a relevant field of academic research with a steep increase in the number of articles and journals covering this topic during the last decade (Geissdoerfer et al., 2017). However, circular business model literature is only currently emerging as a subset of Sustainable Business Model literature – which focuses on *business models "that create, deliver, and capture value for all its stakeholders without depleting the natural, economic, and social capital it relies on" (*Breuer and Lüdeke-Freund (2014). A large majority of research is relying on business cases identified from practice to identify definitions, ontologies, building blocks, and configurations supporting business model innovation. But to date, little

research has been done to compare and analyse the various approaches developed to create circular business model categorisations, on the exception of Lüdeke-Freund (2018), even though categorisation and clarification is a pre-condition to support knowledge generation.

Why do we need to categorize Business models? The general idea of business models is intimately linked with notions of taxonomies and 'kinds'. Business models describe typical kinds of organizations and behaviors by firms in such a way that we can label different kinds of behavior and then classify individual firms accordingly (Baden-Fuller and Morgan (2010). Their classification can be relevant for the possibilities they give us for not only defining but also for exploring characteristic similarities and differences as well as for developing understanding, explanation, prediction and intervention (Baden-Fuller and Morgan (2010). They can be used to address and help solve lack of knowledge (such as "why" and "how" each model is successful as a business, or why it is profitable). Business Models can also be used as models. They appear as generic in-between kinds-of-descriptions that are neither general theory nor full empirical descriptions. Finally they can also be used as recipes, suggesting why it works, because it embodies the essential elements and how they are to be combined to make them work. Hence, categorizing circular business models can provide new insights to support research on this emerging trend, which can in turn support companies and entrepreneurs on their transformation to more sustainable and circular value creation processes.

Objective of the paper

This paper aims to unify academic understanding of the circular economy principles in one hand and consolidate on the other hand business models configurations built from these principles. More precisely, this paper aims to contribute to the ongoing theoretical discussion on the classification of circular business models by linking systematically circular economy principles with associated business model strategies. By doing so, it opens avenue for future research on the different mechanisms inherent to each circular business models and allows specifying distinctive tensions attached to their development and implementation. The outcomes facilitate research on CBMI based on a common understanding of CBM underlying principles.

Structure of the paper

First, a review of circular economy definitions and circular economy principles from existing literature is performed to help developing a robust framework of circular principles. These principles allow delineating which business models can be considered circular. Second, a review

of the main tenets of business model research and in particular sustainable business model innovation in the context of circular economy is performed. Third, by analysing existing categorisations attempts developed in peer-reviewed and practitioner-oriented publications, the paper proposes a consolidated categorisation alternative that directly links circular economy principles with their inherent business model declinations. Results are discussed and synthetized in the final section. The findings can support future research on CBM but can also be considered useful for practitioners when positioning their value proposition with regards to the circular economy construct. Figure 1 below summarizes the overall structure of the paper.

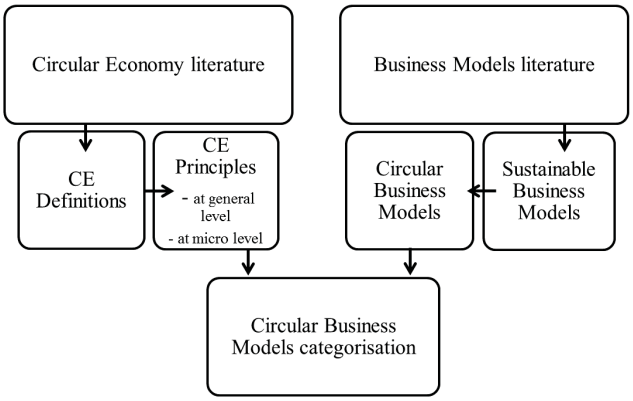

Figure 1: Overview of general paper approach

2. Underlying concepts

2.1 Circular economy: definitions and principles

This section synthetizes the insights from systematic literature reviews from Ghisellini et al. (2016) whose purpose is to grasp the main circular economy features and Kirchherr et al. (2017) whose purpose is to create transparency regarding the current understandings of the circular economy concept through the analysis of 114 circular economy definitions. It clarifies the central tenets of circular economy as an academic construct.

Circular economy definitions

If the concept of circular economy is reaching a certain momentum - illustrated by the rising number of academic and practitioner publications (see Kirchherr et al., 2017, Ghisellini et al. 2016, for systematic literature reviews) - it however remains blurry in its exact framing (Lieder and Rashid, 2016), certainly because, as an academic construct, it remains "a young field" (Murray et al., 2017). To date, the number of definitions among practitioners and academics exceeds 100 attempts and no consensus is being reached as "*there is no single group with the undisputed authority to define what [CE] means exactly*" (Gladek, 2017).

The conceptualization of circular economy can be addressed through its scope of analysis, its aims and its supporting principles. The review of existing definitions shows a diversity of focus and a strong lack of harmonization (Kirchherr et al., 2017). Indeed, the core concepts depicted in the existing understanding of the CE construct vary in their unit of analysis, whether it is at meta-level (global economy, territory, region), meso-level (industrial park) or micro-level (using a single company as the unit) making it challenging to develop a proper focus. When analyzing the content of 114 definitions, Kirchherr et al. (2017) point out that the definitions content has evolved over time. Starting from a focus on the 3R framework (reduce - reuse - recycle), the framing of the concept extended to a systems perspective - circular economy being understood as a "*system that is designed to be restorative and regenerative*" (EMF, 2012). If it is commonly understood that circular economy supports sustainable development goals, definitions of the concept however do not systematically link circular economy with the three dimensions of sustainability (environmental quality, economic prosperity and social equity) - the social dimensions is often left behind (Moreau et al., 2017) and the intergenerational dimension of sustainability also lacking. Table 1 provides a set of various definitions: the currently most used in the literature (EMF, 2012) the official EU definition (EC, 2015) and the integrative attempt from Kirchherr et al. (2017).

Table 12. Selected circular economy definitions

Author	Definition
Ellen MacArthur Foundation (2012)	Circular economy is an industrial system that is restorative or regenerative by intention and design. It replaces the 'end-of-life' concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which impair reuse, and aims for the elimination of waste through the superior design of materials, products, systems, and, within this, business models.
Preston (2012)	Circular economy is an approach that would transform the function of resources in the economy. Waste from factories would become a valuable input to another process –and products could be repaired, reused or upgraded instead of thrown away.
European Commission (2015)	The circular economy is an economy where the value of products, materials and resources is maintained in the economy for as long as possible, and the generation of waste minimized.
Kirchherr et al. (2017)	A circular economy describes an economic system that is based on business models which replace the 'end-of-life' concept with reducing, alternatively reusing, recycling and recovering materials in production/distribution and consumption processes, thus operating at the micro level (products, companies, consumers), meso level (eco-industrial parks) and macro level (city, region, nation and beyond), with the aim to accomplish sustainable development, which implies creating environmental quality, economic prosperity and social equity, to the benefit of current and future generations.

Based on their analysis, Kirchherr et al. (2017) argue that to be integrative, a proper definition of circular economy should include the following dimensions: A clear connection to the three sustainability dimensions as the end goal (1); a systems perspective through a multi-level focus (micro-meso-macro) (2); the waste hierarchy and the R's strategies (Reduce, reuse, recycle) as guiding frameworks (3).

Circular economy principles

As perceived in the multiple definitions of the concept, circular economy can be envisioned through different perspectives. Stahel (2010) argues that the circular economy should be considered as a framework. Den Hollander (2017) argues that Circular economy should be considered as an "ideal state" and is therefore guided by normative principles. As a generic notion, the circular economy draws on several more specific approaches that gravitate around a set of basic principles. Circular Economy as a meta concept is thought to be derived from different schools of thought (EMF, 2012): Cradle to Cradle (McDonough and Braungart, 2002), Performance Economy (Stahel, 2010), Regenerative Design (Lyle, 1994), Industrial Ecology (Ayres, 1994), Biomimicry (Benyus, 2002), and the Blue Economy (Pauli, 2010).

These schools of thoughts are directly linked to the core elements of the definition of circular economy and are complementary to each other (Lewandowski, 2015). *Industrial ecology* focuses on the transition from open to closed cycles of materials and energy to achieve less wasteful industrial processes (Frosch, 1992, Erkman, 1997) *Biomimicry* is an approach to innovation that seeks sustainable solutions to human challenges by emulating nature's time-tested patterns and strategies. The goal is to create products, processes, and policies—new ways of living—that are well-adapted to life on earth over the long haul (Benyus, 2002). *Cradle-to-cradle is* a framework for designing products and industrial processes that turn materials into *nutrients* by enabling their perpetual flow within one of two distinct *metabolisms*: the *biological metabolism* and the *technical metabolism*. *Cradle-to-cradle design* supports the creation of wholly beneficial industrial systems driven by the synergistic pursuit of positive economic, environmental and social goals (Braungart and al., 2007). *The performance economy* (Stahel, 2010*)* is characterized by a focus on utilization and performance in use, not manufacturing, an optimization of existing stock, and the selling of goods as services, where manufacturers retain ownership of goods and embodied resources, and internalize the cost of risk and of waste. The Blue economy (Pauli, 2010) is creating value from 'using the resources available in cascading systems, (…) the waste of one product becomes the input to create a new cash flow'. *Regenerative Design* (Lyle, 1994) is a system of technologies and strategies, based on an understanding of the inner working of ecosystems that generates designs to regenerate rather than deplete underlying life support systems and resources within socio-ecological wholes. If some of these approaches have made

important sustainability science contributions, the connection to the concept of CE is unclear and difficult to comprehend (Korhonen, 2018).

Table 2 below provides an overview of the various principles drawn from related circular economy schools of thought and consolidates them into eight circular economy principles.

Table 2: Consolidation of CE principles based on CE schools of thought

	SCOPE	Energy		Resource/Material				Process		
SCHOOLS OF THOUGHT	**Biomimicry (Benyus, 1997)**			Use life-friendly chemistry	Be resource efficient					
	Cradle to cradle (Braungart and McDonough 2002)	Use current solar income		Waste is food (biocycle)	Waste is food (technical cycle)					
	Performance economy (Stahel 2010)				Optimisation of existing stock		Extend product life		Focus on performance	Sell goods as services
	Industrial ecology (Erkman, 2001)	Energy must rely less on fossil hydrocarbon			Waste must be valorized	Loss caused by dispersion must be minimized	Economy must be Dematerialised			
	Blue economy (Pauli, 2012)				Be efficient (substitute something with nothing)			Be profitable (optimize & generate multiple cash flows)	Be innovative (create change, seize opportunities)	
	Regenerative design (Lyle, 1994)		Use Information to Replace Power	Letting nature do the work	Shape form to guide flow		Shape the Form to manifest the Process	Manage Storage		
	CIRCULAR PRINCIPLE	**Use Renewable energy principle**		**Use bio materials principle**	**Resource-efficiency principles**			**Cascading principle**	**Performance principle**	

SCHOOLS OF THOUGHT	SCOPE	Organisation			System		Context	
	Biomimicry (Benyus, 1997)	Evolve to survive	Adapt to changing conditions	Integrate development with growth			Be locally attuned and responsive	
	Cradle to cradle (Braungart and McDonough 2002)	Celebrate diversity						
	Performance economy (Stahel 2010)							
	Industrial ecology (Erkman, 2001)							
	Blue economy (Pauli, 2012)	Be abundant (satisfy all basic needs)			Be systemic (mimic nature)		Be local (use what you have)	
	Regenerative design (Lyle, 1994)	Seeking optimum levels for multiple functions	Provide Multiple Pathways		Aggregating not isolating	Seek common solutions to disparate problems	Consider nature as both model and context	Matching technology to need
	CIRCULAR PRINCIPLE	**Resilience principle**			**Systems thinking principle**		**Act local principle**	

Principles can be classified based on the levels of intervention, from a micro level (energy and resources) to meso (process, organization) and macro level (system and context), see Figure 1 below.

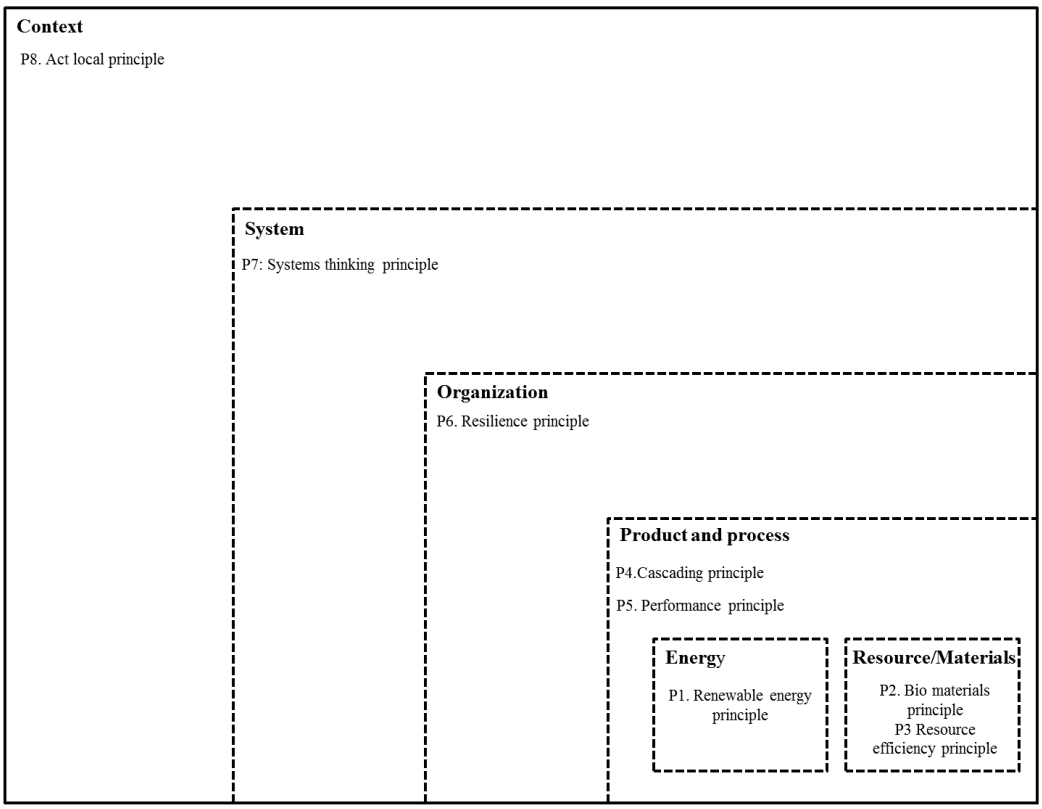

Figure 2: Circular economy principles

At energy level, the core principle is the use of renewable energy (McDonough and Braungart, 2002). At resource level, the two principles are *use of bio-materials* (Benyus, 2002; McDonough and Braungart, 2002) and *seeking resource efficiency* (McDonough and Braungart, 2002; Stahel, 2010; Lyle, 1994; Benyus, 2002; Pauli, 2010) in which the 3Rs framework is embedded. At product and process level, the focus rests on *cascading* (Pauli, 2010) and *performance principles* (Stahel, 2010). *Resilience thinking principle* and *Systems thinking principle* constitute the core principles at organization and system level respectively (Lyle, 1994, Pauli 2010, Benyus 2002, McDonough and Braungart, 2002). At context level, the *act local principle* drives (Benyus, 2002, Pauli, 2010, Lyle, 1994).

These eight principles remain rather broad and are often constituted of several sub-principles. For instance, according to Benyus (2002) in Biomimicry, the "Resource efficient" principle

includes *using multifunctional design* (meet multiple needs with one elegant solution); *using low energy processes* (minimize energy consumption by reducing requisite temperatures, pressures, and/or time for reactions); *recycling all materials* (keep all materials in a closed loop) and *fitting form to function* (select shape or pattern based on need). In the context of business model innovation, the first five principles constitute the starting point for circular business models principles development as outlined in section 3.

2.2 Business models

This section introduces business model as a research construct with a focus on its definitions and principles.

Business model definitions and principles

The business model construct "*draws from and integrates a variety of academic and functional disciplines*" (Chesbrough & Rosenbloom, 2002,). A business model describes the rationale of how an organization creates, delivers and captures value (Osterwalder and Pigneur, 2010). The literature offers different angles on the business model concept. It is defined as the organizational and financial "architecture" on how a firm does business, a "recipe" on how resources and capabilities are translated into economic value (Teece, 2010), a crossroad between competences and consumer needs (Sabatier, Mangematin, Rouselle, 2010). Osterwalder and Pigneur (2010) describe a business model as a series of interconnected elements: the value proposition (product/service offering), customer segments, customer relationships, activities, resources, partners, distribution channels, cost structure, and revenue model. These elements can be consolidated into three main categories: the *value proposition*, the *value creation* and *delivery system* and the *value capture* system (Richardson, 2008). Taking an activity-based approach, the business model synthetizes the '*What*' (selection of activities), the '*How*' (activity system structure) and the '*Who*' (actors performing the activities) (Zott and Amit, 2010).

Business model literature has been focusing on three streams of research: Technological, organizational, and strategic level (Wirtz, 2011). As a result of the internet booming in the early 90s, a large set of literature has focused on the adoption of new technologies forced firms to rethink their profits earning strategies (Timmers, 1998). At organizational level, business model has been addressed as a strategic management tool to improve a company's value chain (Tikkanen

et al., 2005) and organizational efficiency. At strategic level, the business model construct has been perceived as a tool to develop competitive advantage (Chesbrough, 2010).

Sustainable business models

The business model perspective is particularly relevant in the context of sustainability (Schaltegger et al., 2016) because it highlights the value creation logic of an organization and its effects and helps transcend narrow for-profit and profit-maximizing models. Schaltegger et al. (2016) define business model for sustainability (or sustainable business model – SBM) as one *"that helps describing, analyzing, managing, and communicating (i) a company's sustainable value proposition to its customers, and all other stakeholders, (ii) how it creates and delivers this value, (iii) and how it captures economic value while maintaining or regenerating natural, social, and economic capital beyond its organizational boundaries."* SBM can be conceptualized in various ways: as a narrative of sustainability practices; a description of features, attributes, and/or characteristics; a list of necessary and sufficient conditions; a representation of business processes; a firm-level description; a systems-level description; or some combinations of these (Stubbs and Cocklin, 2008).

What are the normative requirements of a sustainable business model? Boons and Lüdeke-Freund (2013), based on a literature review, developed basic normative requirements for the different elements of business models: The *value proposition* must provide both ecological or social and economic value through offering products and services, the *business infrastructure* must be rooted in principles of sustainable supply chain management, the *customer interface* must enable close relationships with customers and other stakeholders to be able to take responsibility for production *and* consumption systems and the *financial model* should distribute economic costs and benefits equitably among actors involved. Upward and Jones (2016), taking a "strongly sustainable" perspective, articulates four propositions: A strongly sustainable business model creates ecological, social and economic value throughout its value network, which implies an extended understanding of the value that is proposed, delivered and finally created.

Circular Business Models

This section provides an overview of circular business models definitions, distinct features and introduces specific variables aiming at supporting a classification approach.

Circular Business Models are often considered a subset of the broader group of sustainable business models (Bocken et al. 2014). Several definitions of circular business models can be found in the recent literature (Roos, 2014, Mentink, 2014, Linder and Williander 2015, Den Hollander and Bakker, Nußholz (2017) Smith-Gillespie, 2017), but currently no consensus has emerged on a generic definition. Mentink (2014) defines circular business model as *"the rationale of how an organization creates, delivers and captures value with and within closed material loops*" while Linder and Williander (2015) define a circular business model as "*a business model in which the conceptual logic for value creation is based on utilizing the economic value retained in products after use in the production of new offerings*". Surprisingly, definitions generally take an economic focus when looking at the value creation delivery and process, omitting the sustainability goals generally found in sustainable business models definitions (Boons and Lüdeke-Freund, 2013, Schaltegger et al., 2012, Stubbs and Cocklin, 2008, Evans et al., 2014). Some definitions offer descriptions on the strategies behind the value creation process, with a clear focus on resource flows and the goal to maintain products and materials at their highest value for a longer time while other remain at a very conceptual level, framing the rationale within closed material loops. Only Geissdoerfer et al. (2018) definition directly links Circular Business Models to Sustainable Business Models: "*CBMs can be defined as SBMs - which are business models that aim at solutions for sustainable development by creating additional monetary and non-monetary value by the pro-active management of a multiple stakeholders and incorporate a long-term perspective - that are specifically aiming at solutions for the Circular Economy through a circular value chain and stakeholder incentive alignment".* Table 3 below provides an overview of recent definitions found in the literature.

Table 3: Selected circular business models definitions

Source	Definition	Aim	Value creation focus	Strategy/ principles
Roos (2014)	"A circular value chain business model (or green business model) is one in which all intermediary outputs that have no further use in the value creating activities of the firms are monetised in the form of either cost reductions or revenue streams."	Monetarisation of resources through Cost reduction and extra revenue stream.	Economic value of underused assets	Not mentioned
Mentink (2014)	"A circular business model is the rationale of how an organization creates, delivers and captures value with and within closed material loops"	Not mentioned	Generic economic value	Focus on closed material loops
Linder and Williander (2015)	"A business model in which the conceptual logic for value creation is based on utilising the economic value retained in products after use in the production of a new offerings. Thus, a circular business model implies a return flow to the producer from users, though there can be intermediaries between the two parties [...and] always involves recycling, remanufacturing, reuse or of their sibling activities (e.g., refurbishment, renovation, repair)."	Not mentioned.	Economic value of product after use.	Focus on Reverse flow of resources
Den Hollander and Bakker (2016)	"A circular business model describes how an organization creates, delivers, and captures value in a circular economic system, whereby the business rationale needs to be designed in	that it prevents, postpones or reverses obsolescence, minimizes leakage and favours the use of 'presources'	Economic value	No principles integrated

	such a way that it prevents, postpones or reverses obsolescence, minimizes leakage and favours the use of 'presources' over the use of resources in the process of creating, delivering and capturing value.			
Nußholz (2017)	A circular business model is how a company creates, captures, and delivers value with the value creation logic designed to improve resource efficiency through contributing to extending useful life of products and parts (e.g., through long-life design, repair and remanufacturing) and closing material loops.	Improve resource efficiency	Generic economic value	Extending useful life of products and parts and closing material loops
Smith-Gillespie, 2017	A circular economy business model is one which creates, delivers, and captures value in a manner that is compatible with and enables regeneration of finite natural resources, and keeps products, components and materials at their highest value and utility within a relevant system boundary.	Enabling regeneration of finite natural resources	Generic value	Keeping products, components and materials at their highest value and utility
Geissdoerfer et al. (2018)	CBMs can be defined as SBMs specifically aiming at solutions for the Circular Economy through a circular value chain and stakeholder incentive alignment.	Solutions for circular economy	Not mentioned	Circular value chain, stakeholder incentive alignment

The weakness and inconsistency in describing the concept may add to the difficulty to clarify which business models are considered circular or not. When defining a circular business model, aims, principles and strategies should be described and aligned with the definition of circular economy. Despite this weakness, literature on circular economy is growing and addresses the circular business model topic from multiple perspectives (Lewandowski, 2015). Focus can be on

adoption factors (Laubscher and Marinelli, 2014), design and managerial tools (Van Renswoude et al. 2015, Joustra, 2013), or evaluation models (Scheepens et al, 2016). Several papers focus on categorizing circular business models, which will be extensively reviewed in section 4 of this paper).

How do CBM differ from traditional business models? Adopting a circular economy strategy requires several organizational and strategic shifts. Looking at the business model architecture including value creation, value proposition, value delivery and value capture, the following changes are required, according to Mentink (2014) cited in Lewandowski (2015). In the *Value Creation* (1) component, products have to be made in specific processes, with recycled materials and specific resources, which may require not only specific capabilities but also creating reverse logistics systems and maintaining relationships with other companies and customers to assure closing of material loops (Wrinkler, 2011). In the *Value proposition* (2) component :products should become fully reused or recycled, or firms should turn towards product-service system (PSS) and sell performance related to serviced products activities, processes, resources and capabilities. In the *Value delivery* (3) component: selling "circular" products or services may require prior changes of customer habits or, if this is not possible, even changes of customers. Last, in the *Value capture* (4) component: a shift would be required to sell product-based services charged according to their use. These general normative requirements however lack the precision needed to tackle business model innovation in each distinctive circular business model.

Characteristics supporting CBM categorizations

In this paper we argue that circular business models should primarily be characterized based on their adoption of circular economy principles (see next section). However other approaches may be relevant to differentiate existing circular business models strategies.

Circular business models can be characterized taking a product lifetime perspective (Den Hollander, 2017). Product lifetime can be defined as the timespan between the moment a product starts being used after manufacture, ending at the moment the product becomes obsolete beyond recovery at product level. Using this perspective, circular business models can be classified according to their position on three distinct phases: creating value *prior to the use* of the product (focus on the quality of materials to be used in the manufacturing process), *during the use* of the product (in one or several use cycles if the product is reused) or creating value *following the use* of the product (by recovering materials for future purposes).

The position of these business models according to the product lifetime also has consequences on the value dynamics being unfolded. During the *pre-use* and the *use* phases, circular business models primarily aim to *retain value:* in the *pre-use phase,* by designing long lasting products or products in which materials can easily be recovered and reprocessed for future use; in the *use phase* by offering services aiming at prolonging the use lifetime of the products. During the *use phase*, circular business models may also focus on strategies aiming at *optimizing value,* by maximizing the usage of the product *(*i.e. through sharing practices). Finally, during the *post-use* phase, circular business models may focus on *Recovering* value – that is developing operations to reverse material obsolescence.

Circular business models can also be classified based on the importance stressed on *materials, products,* or *services* associated to the product.

3. From general principles to circular business models guiding principles

The section introduces an integrated set of circular economy principles at micro level which support the classification of circular business models.

Several authors (Stahel 2016, Bocken, 2016, Geissdoerfer et al, 2018) have focused on translating the generic circular economy principles into more applicable principles guiding circular business model innovation. At the core of a CBM is the aim to create value from the (re) circulation of product and material flows. Researchers in circular economy often describe this goal taking a loop perspective – *that is a structure, series, or process, the end of which is connected to the beginning* (Oxford definition) – to clarify how value is created, as illustrated by the now famous Butterfly diagram (EMF, 2013).

Stahel (2016) distinguishes two fundamentally different types of loops: *reuse of goods*, and *recycling of materials*. "*Circular-economy business models fall in two groups: those that foster reuse and extend service life through repair, remanufacture, upgrades and retrofits; and those that turn old goods into as new resources by recycling the materials*". Building from Stahel (2016) and Braungart (2002), Bocken's (2016) classification approach distinguishes circular resource loops based on the speed of circulation of material flows, the closing features of material flows and the volume of materials flows circulating:

(1) *Slowing resource loops*: Through the design of long-life goods and product-life extension (i.e. service loops to extend a product's life, for instance through repair, remanufacturing), the utilization period of products is extended and/or intensified, resulting in a slowdown of the flow of resources.

(2) *Closing resource loops*: Through recycling, the loop between post-use and production is closed, resulting in a circular flow of resources.

(3) Resource efficiency or *narrowing resource flows*, aimed at using fewer resources per product.

Geissdoerfer et al (2018) extended this approach further and emphasized the importance of two additional loops:

(4) *Intensifying loops:* strategies leading to a more intense use phase.

(5) *Dematerializing loops*: the substitution of product utility by service and software solutions.

These five loops however fail to incorporate two main circular economy principles as recognized in the CE literature: the use of bio-based, biodegradable, compostable, or renewable resources to regenerate natural capitals - (6) *the regenerating loop*s – and the – (7) *cascading loops* – which maximizes resource effectiveness by using biomass in products that create the most economic value over multiple lifetimes. In *cascading loops*, the material is cascaded through further applications to extract additional value from the resource (Webster, 2017).

These two core characteristics are therefore integrated in our conceptual approach to support the categorization of circular business models. Table 4 below summarizes the distinctive characteristics of circular economy principles as opposed to linear economy.

Table 4: linear vs circular economy principles

Resource flow characteristics	Linear Economy	Circular Economy	
Type of resource	Finite resources	Renewable resources	**Regenerating loop**
Resource intensity	Resource intensive	Resource efficient	**Narrowing loop**
Speed of circulation	Fast speed	Slow speed	**Slowing loop**
Usage intensity	Low intensity	High intensity	**Intensifying loop**
Intangible resource intensity	Materialized	Dematerialized	**Dematerializing loop**
Number of lifecycles	Single lifecycle	Multiple lifecycles	**Cascading loop**
Direction	Linear	Circular	**Closed loop**

These seven loops constitute the guiding principles from which circular business models can be designed. Taking this into account the next section provides an overview of existing categorization of circular business models in the literature – using the seven principles listed above as a one of the classifying criteria.

4. An integrated classification of circular business models

The recognition of similarities and differences between business models and the development of classes of business models are central to business model research (Lambert, 2006). Indeed "*Theory cannot explain much if it is based on an inadequate system of classification"* (Bailey, 1994). In order to theorize further the concept of CBM, it is necessary to order or classify the objects within the concept as a good classification scheme forms the foundation of theory development. Classifications can be seen as a bridge between a simple concept and a theory. They help to organize abstract, complex concepts (Neuman, 2003) through the ordering of objects into groups or classes on the basis of their similarity (Bailey 1994).

One distinction in classification schemes is between *typologies* and *taxonomies*, although many researchers when developing classifications use the terms interchangeably. In typologies, the researcher conceptualizes the different types that are relevant to the research. These types form the cells of the classification scheme and each cell is labeled (named). Based on the scheme, the researcher identifies cases that possess the characteristics deemed essential to fit the cells, in a deductive approach. Typologies allow simplifying complex concepts by classifying objects according to a few criteria at a time. They provide a solid foundation for both theorizing and empirical research' (Bailey 1994). Taxonomies, in contrast to typologies, are generated from inductive research and derived empirically (Sokal and Sneath 1963). Unlike typologies whereby the categories are derived conceptually, taxonomic categories are derived through cluster analysis (Lambert, 2006). Taxonomy can be used to refer to a process and the end result. To date, research into business models has been conceptual and any empirical research has been deductive

(Lambert, 2006), therefore classifications have been mainly typologies. Following an deductive approach, the section below describes the methodology developed to support an integrated typology.

4.1 Methodology

Literature review

This paper uses a systematic review approach to formalize a typology of circular business models. The following academic databases were used for the literature search: Scopus, science direct. Searching keywords included variations (e.g. plural, singular) on terms such as *circular business model, circular economy business models, sustainable business model, green business model.* The resulting literature, as well as its references, was scanned for explicit mention of categorizations and classification of cases studies and examples of circular business models. Due to the limited amount of results from academic publications, a review of secondary literature was also conducted. Reports including categorization attempts and case studies on sustainable and circular business models were selected. In total, 19 references were selected for review as shown in table 5.

Defining characteristics for integrated typology

When developing our typology, we focused particularly on trying to achieve the following characteristics, based on typology characteristics defined by Weill (2005):

I. The typology should be intuitively sensible: it should capture the common intuitive sense of what a business model means by grouping together businesses that seem similar in their business approach, and separating businesses that seem different.
II. Similarities and differences should not just be at a superficial level: the typology should group together businesses at the deeper level of how their activities create value. The names of different categories should also be self-explanatory.
III. The typology should be comprehensive: it should provide a systematic way of classifying all businesses adopting circular economy principles
IV. The typology should be clearly defined. That is, it should define systematic rules for determining the business model(s) of a given company in a way that does not depend on highly subjective judgment.
V. The typology should be conceptually elegant. The concepts should be simple, and as self-evidently complete as possible.

Criteria identification for classification

- The circular business models categories should be classified according to the Circular Economy principles as previously defined.
    - 7 principles are used to define the business model, taking a resource loop perspective: regenerating loop, slowing loop, narrowing loop, intensifying loop, dematerializing loop, cascading loop and closing loop - based on Stahel (2016) , Braungart (2002), Bocken (2016) and Geissdoerfer et al (2018).
- The circular business models should be classified according to their position on the lifetime of the product (pre-use, use, post-use).
- The circular business models should be classified according to their material-product-service orientation.
- The circular business models should be classified according to the value dynamics associated with their (retain value, optimize value, recover value).

Integration of existing categories into a systematic classification

First, each categorization attempt is scanned and described based on the criteria selected. Second, individual classes that are redundant are grouped. Third, distinctive classes are reorganized based on the CE principles, the position on the product use cycle (pre-use, use, post-use) and the orientation of the business model (material, product or service focus). Finally, similar classes are clustered into integrated categories. The results describe each circular business model, highlighting aims, supporting principles, position in the product-use cycle, orientation and value creation mechanisms.

4.2 Analysis of existing classifications

19 categorizations from academic and practitioners were reviewed (see table 5) resulting in a database of 97 entries (see annex 1 for complete database). Academic papers included Tukker (2004), Braungart et al. (2007), Bakker et al (2014), Bocken et al. (2014), Mentink (2014), Albino and Fraccascia (2015), Bocken et al. (2016) , Planing (2015), Lüdeke-Freund et al.(2018). The practitioner literature included Pauli (2010), Beltramello et al. (2013), Accenture (2014), Bisgaard et al. (2012), Clinton and Whisnant (2014) Nguyen et al (2014), Van Renswoude (2015), Kiørboe et al (2015), Wrap (2016).

Table 5: Overview of papers classifying circular business models

Author	Publication name	Circular business model	Sustainable business model (including circular principles)	Novel business models (including circular principles)	Green business model (including circular principles)	Specific business model focus (Pss, IE, C2C)	Number of BM categories	Number of categories fitting with CE principles (sub categories)
Bocken et al. (2014)	A literature and practice review to develop sustainable business model archetypes		x				8	3 (22)
Bocken et al. (2016)	Product design and business model strategies for a circular economy	x					4	4
Albino and Fraccascia (2015)	The industrial symbiosis approach: A classification of business models.					x	6	6
Tukker (2004)	Eight types of product-service system: Eight ways to sustainability?					x	8	4
Bakker et al (2014)	Products that last: Product design for circular business models.	x					5	5

Author	Publication name	Circular business model	Sustainable business model (including circular principles)	Novel business models (including circular principles)	Green business model (including circular principles)	Specific business model focus (Pss, IE, C2C)	Number of BM categories	Number of categories fitting with CE principles (sub categories)
Planing (2015)	Business model innovation in a circular economy reasons for non-acceptance of circular business models.	x					9	9
Mentink (2014)	Circular Business Model Innovation: A Process Framework and a Tool for Business Model Innovation in a Circular Economy	x					8	7
Braungart et al., 2007	Cradle-to-cradle design: Creating healthy emissions – A strategy for eco-effective product and system design.					x	1	1
Lüdeke-Freund et al.,2018	A Review and Typology of Circular Economy Business Model Patterns	x					6	6

Author	Publication name	Circular business model	Sustainable business model (including circular principles)	Innovative business models (including circular principles)	Green business model (including circular principles)	Specific business model focus (Pss, IE, C2C)	Number of BM categories	Number of categories fitting with CE principles (sub categories)
Accenture (2014)	Circular advantage. Innovative business models and technologies to create value in a world without limits to growth	x					5	5
Van Renswoude (2015)	Circular Business Models Part 2: Overview and examples	x					6	6 (19)
Kiørboe et al (2015)	Moving towards a circular economy— Successful Nordic business models.	x					6	6
Wrap (2016)	Innovative Business Model Map			x			10	10
Beltramello et al. (2013)	Why New Business Models Matter for Green Growth.				x		9	3

Author	Publication name	Circular business model	Sustainable business model (including circular principles)	Innovative business models (including circular principles)	Green business model (including circular principles)	Specific business model focus (Pss, IE, C2C)	Number of BM categories	Number of categories fitting with CE principles (sub categories)
Bisgaard et al. (2012)	Green Business Model Innovation - Conceptualisation, Next Practice and Policy. Nordic Innovation, Oslo.				x		2 (9)	2 (9)
Clinton and Whisnant (2014)	Model Behavior – 20 Business Model Innovations for Sustainability.		x				20	6
Pauli (2010)	The Blue Economy: 10 Years, 100 Innovations, 100 Million Jobs					x	1	1
Nguyen et al (2014)	Remaking the industrial economy	x					4	4
Smith-Gillespie (2017)	Defining the Concept of Circular Economy Business Model	x					7	7

The analysis of the papers reflects different categorization methodologies, various scopes and focuses, which leads to lack of clarity and omissions as described below.

Categorization methodologies

Methodologies used to support the categorization of business models are diverse and not always consistent, when even clarified. When described, approaches follow a deductive or an inductive approach. Some categories start from a conceptualization process and are then illustrated through business cases fitting within the defined concept. Alternatively, some approaches start from a pre-identification of business cases which are then later clustered into distinctive categories (Albino and Fraccascia, 2015). Often the criteria for classification are not described (Accenture, 2014, Bisgaard et al., 2012), which lead to think the categorization was not objectively defined.

Different scopes

Some categorizations focus only on a subset of circular strategies (industrial ecology business models for Albino and Fraccascia, 2015, Product-Service Systems for Tukker, 2004), while others only categorize main approaches, while failing to define subcategories (i.e. Beltramello et al., 2013). Categorizations attempts in green/sustainable business models publications generally integrate business models relying on circular economy principles, but they often are diluted in other categories. For instance, in Bocken, (2014), business models addressing Circular economy principles can be found in 3 different sustainable business models archetypes – *create value from waste; deliver functionality rather than ownership substitute with renewables and natural processes*).

Integration vs multiplication

Some of the business model categories incorporate two or more potentially very distinct models, such as the business model 'Product Life Extension' including both remanufacturing and repair (Accenture, 2014) for which value creation processes and outcomes are very distinctive . At the other end of the spectrum, some categorizations attempts multiply the approaches resulting in a numerous typology (i.e. nineteen distinct business models identified in Renswoude et al., 2015)

Lack of clarity

Some categorization s mix production method (e.g. '3D printing') with business models (Van Renswoude, 2015); or use an enabling mechanism which doesn't necessarily characterize an entire business model (e.g. 'take back management'). Different labels are also used for the same concepts (e.g. "performance", "access", "products as a service" business models).

Omissions

Depending on the starting point, several categorization attempts seem to omit relevant CE principles (e.g. use of renewable energy or biomaterials) as a starting point, therefore missing a variety of business models fitting in the circular economy framework.

4.3 Results: an integrated typology

Based on the initial analysis of the paper, the clustering and integration resulted in the following typology presented in table 6. The typology aims to provide an integrated classification based on existing typologies attempts found in the literature, using a new set of criteria supporting the classification (CE principles, position in the product use lifetime, business model orientation, value dynamics) allowing to merge categories sharing similar characteristics and consequently separate other categories in distinctive categories. Five generic circular business models can be delineated as a result from the classification: "*Clean loop", "Short loop", "Access loop", "Cascading loop and "Long loop"* business models. The subsequent paragraphs provide a brief outline of these six business models, details characteristics and differences, while highlighting features of their value creation, delivery and capture mechanisms. As a result of the classification and integration, several business models also have sub-categories. The explanation for this level-2 classification is detailed in dedicated tables below.

Table 6: Circular business model typology

Circular business model	Description	CE principles /strategies	Position in the product use cycle	Business model orientation	Value dynamics
(1) Clean loop	Business model is designed around fully renewable, recyclable or biodegradable inputs	Regenerative loop	Pre-use	Material	Retain value
(2) Short loop	Business model is designed around products manufactured for extended life time and additional value is created through services supporting the maintenance of the product for the same customer (repair, upgrade), or different customer (reuse, remanufacture)	Narrowing loop, slowing loop	Use, Post-use	Product (Service)	Retain value
(3) Access loop	Business model is designed around offering access to a solution through leasing/hiring/renting products without change of ownership or through a platform allowing maximisation of utilisation.	Intensifying loop, dematerializing loop	Use	Service	Optimize value
(4) Cascading loop	Business model is designed to diversify the use of materials and products to create value from coproducts in multiple value chains within and between industries	Cascading loop	Post-use	Material (Product)	Recover value
(5) Long loop	Business model is designed based on recovering already used-resources in order to extend the value of resource through recycling	Closing loop	Post-use	Material (Product)	Recover value

Clean loops business models

Clean loops business models are built on "*Circular supplies*" (Accenture, 2014), "*Pure circles*" (Renswoude et al., 2015) "*Circular sourcing*" (Smith-Gillespie, 2017), "*Substitute with renewable and natural processes*" (Bocken, 2014) categories found in the literature. In these generic circular business models, value creation is designed around the use of materials that are renewable, recyclable or biodegradable. Clean loops business models focus on the regenerative feature of the circular economy definition (EMF, 2012) and adopt the regenerating loop principle. By using renewable and recyclable inputs, the business model rationale enables materials to be returned to either the technical or biological cycle and enables 100% closed material loops (Braungart, 2002). The central circular value dynamic is to *retain value* of the materials used while maintaining the quality of the materials for many consecutive cycles (Nguyen, Stuchtey and Zils, 2017). The *value creation* mechanism is based on the integration of materials in products during the manufacturing/production stage, prior to the use phase. The *value proposition* in these business models focus on the benefits attached to a product made of renewable/recyclable materials, which may appeal to target customers, whether they are quality-conscious customers or green customers. *Value delivery* is generally not differentiated on these business models (use of traditional distribution systems). *Value capture* is generally associated to additional product revenues (price premiums) associated to intrinsic quality of the product (i.e.: organic, fully recyclable and recycled). Table 7 below provides an overview of the level 2 categories in the clean loop business model.

Table 7. Clean loop business models

CLEAN LOOP (1)	**CE principle: Regenerating**
	Position in life cycle: Pre-use
Business model is designed around fully renewable, recyclable or biodegradable inputs.	**Value dynamics: Retain**
	BM orientation: Material

Category (level 2)	Description	Associated categories in literature
1.1 Biosourced loop	Value creation through the use of renewable materials	Circular supplies (Accenture, 2014), Substitute with renewables and natural processes (bocken, 2014), Product design (Kiørboe et al., 2015) Cradle to cradle (Braungart et al., 2007) Pure circles (Renswoude et al. 2015) Power of pure circles (Nguyen, Stuchtey, and Zils, 2014), Circular sourcing (Smith-Gillespie, 2017), organic feedstock (Lüdeke-Freund et al.,2018)
1.3 Recylable loop	Value creation through the use of fully recyclable materials	Circular supplies (Accenture, 2014), Product design (Kiørboe et al., 2015), Cradle to cradle (Braungart et al., 2007), Pure circles (Renswoude et al. 2015), Power of pure circles (Nguyen, Stuchtey, and Zils, 2014), Circular sourcing (Smith-Gillespie, 2017)
1.2 Recycled loop	Value creation through the use of recycled materials	Circular supplies (Accenture, 2014), Product design (Kiørboe et al., 2015),Cradle to cradle (Braungart et al., 2007)Pure circles (Renswoude et al. 2015), Power of pure circles (Nguyen, Stuchtey, and Zils, 2014), Circular sourcing (Smith-Gillespie, 2017)

Short loops business models

Short loops business models are built on, "Product life extension" (Accenture, 2014), "Extended product value" (Bocken, 2016), "Repair, reuse (Kiørboe et al., 2015)", "short cycles" (Renswoude et al. 2015), "Maintenance/ Repair/Redistribution/Upgrading/Remanufacturing" (Mentink, 2014), "hybrid model" (Bakker et al., 2014), "Gap exploiter model" (Bakker et al.,2014), "Incentivised return & re-use" (Wrap, 2016), "Power of the inner circle" (Nguyen, Stuchtey, and Zils, 2014), "Recondition" (Smith-Gillespie,2017), "Classic long life model" (Bocken, 2016), "Repair & maintenance/Reuse & redistribution /Refurbishment & remanufacturing" (Lüdeke-Freund et al.,2018) categories found in the literature.

In these generic circular business models, value creation is designed around products manufactured for an extended life time and additional value is created through services supporting the maintenance of the product for the same customer (Repair, upgrade), or different customers (reuse, remanufacture). As the circulation of resources remain in the form of a product in Short loop business models, the loop between the product provider and its users is considered "short" as opposed to Long loop business models (see below) in which the loop is focusing on materials which inherently extends the length of the loop, including the participation of additional agents (waste processing and material manufacturers) in the cycle. According to Stahel (2013), the smaller the loop the more profitable and efficient in resources use. That means that there is a hierarchy regarding the circularity of goods: from reusing, repairing, re-manufacturing (short loop) to recycling (long loop).

Short loops business models adopt two Circular Economy principles: the narrowing loop principle and the slowing loop principle (Bocken, 2016). On one hand, by producing long-lasting products these business models eliminate the need to extract additional virgin resources in order to replace existing products, thus reducing the amount of resources in circulation. On the other hand, by providing a full range of services aiming at extending the useful lifetime of products, they reduce the speed of circulation of materials and products. The central circular value dynamic is to *retain value* in the existing products for as long as possible during the *use phase* as well as in the *post-use* phase when recovering products to be remanufactured/refurbished. The *value creation* mechanism in place is based on designing long lasting products and on the other hand on using skills and competences supporting the maintenance, repair or upgrading of products for existing customers, or refurbishing/remanufacturing capabilities to recirculate products to new customers. The *value proposition* in the short loop business models focus on one hand on offering customers long lasting quality products, and on the other hand on a set of solutions supporting

the sustainable functioning of these products by offering services such as repair, maintenance, upgradability. *Value delivery* presupposes on one hand the introduction of take-back systems in order to link existing customers to repair centers back and forth, as well as dedicated distribution centers delivering reused/remanufactured/refurbished products. *Value capture* is generally associated to payments related to the service offered (repair/upgrade), or to the costs savings associated to resource savings when refurbishing/remanufacturing new products using recovered products/components. Table 8 below provides an overview of the level 2 categories in the Short loop business model.

Table 8. Short loop business models

SHORT LOOP (2)	**CE principle: Slowing, narrowing**
Business model is designed around products manufactured for extended life time and additional value is created through services supporting the maintenance of the product for the same customer (Repair, upgrade), or different customer (reuse, remanufacture)	**Position in life cycle: use, post-use**
	Value dynamics: Retain
	BM Orientation: Product (service)

Category (level 2)	Description	Associated categories in literature
2.1 long life	Value creation based on manufacturing high-quality, long-lasting products	Classic long life model (Bocken, 2016), Long life (Wrap, 2016)
2.2 Extended life (single user)	Value creation based on additional services extending the life of the product for the same user (maintenance, repair, upgrade), thanks to circular design.	Product life extension (Accenture, 2014), Repair/maintain (Planning, 2015), Recondition (Smith-Gillespie,2017), Repair & maintenance (Lüdeke-Freund et al.,2018)
2.3 Extended life (multiple users)	Value creation based on processes extending the life of the product for other users (reuse, remanufacture, refurbishing) thanks to circular design.	Extended product value (Bocken, 2016), reuse/refurbish/ redistribute/ Next- Life Sales (Planing, 2015),Incentivised return & re-use (Wrap, 2016), Remake (Smith-Gillespie, 2017), Reuse & redistribution (Lüdeke-Freund et al.,2018), Refurbishment & remanufacturing (Lüdeke-Freund et al.,2018)

Access loops business models

Access loops business models are built on "Access and performance model" (Bocken, 2016), "Product as a service" (Accenture, 2014, Clinton and Whisnant, 2014), "sharing platforms (Accenture, 2014)", "Functional sales and management services models" (Beltramello et al., 2013), "Incentive models" (Bisgaard et al., 2012), "Deliver functionality, rather than ownership" (Bocken, 2014), "Service and function based models" (Kiørboe et al., 2015), "collaborative consumption" (Kiørboe et al., 2015), "Access model / Collaborative Consumption" (Planing, 2015), "Performance model/Products as Services / Result-based models" (planing, 2015) "Pay per service unit/Product lease/Product renting or sharing/Functional result" (Tukker, 2004), "Dematerialized services" (Renswoude et al. 2015), "Performance model" (Bakker et al.,2014), "Product-service systems" (Wrap, 2016), "Dematerialized services" (Wrap, 2016), "Hire and leasing models" (Wrap, 2016), "collaborative consumption" (Wrap, 2016), "Performance" (Smith-Gillespie (2017), "Access" (Smith-Gillespie (2017) categories found in the literature.

In these generic circular business models, value creation is designed around offering access to a solution through leasing/hiring/renting products without necessarily a change of ownership (Product-Service systems), or through a platform allowing multiple users to maximize the rate of utilization of products (Platform business models).

Access loops business models adopt two circular economy principles, the dematerializing loop and the intensifying loop (Geissdoerfer et al (2018). On one hand by focusing on the functional results rather than on the product associated to the solution, these business models dematerialize value creation through a focus on servitization. On the other hand, product use is intensified through an optimization of the value delivery, allowing multiple users to access one single product, therefore maximizing the use rate of the products. The central circular value dynamic is to *optimize value* during the *use phase*.

The *value proposition* in these business models focus on providing the functions and benefits of the product instead of the physical product itself (Beltramello et al., 2013). The users' needs are met without them having to own physical products. On the other hand, these business models facilitate the sharing of overcapacity or underutilization, increasing productivity and user value (Accenture, 2014) *Value delivery* is performed through long-term contractual agreement between provider and customer (PSS) or through a market-place based approach allowing the sharing of goods and services (Platform). *Value capture* is generally associated to payments for function or results, payments per unit of service or through a time period (monthly fee). In this approach,

product longevity, reusability, and sharing are perceived are perceived as drivers of revenues and reduced costs (Accenture, 2014). Other value capture mechanisms include service fee or membership fees to access the associated platforms.

Table 9 below provides an overview of the level 2 categories in the Access loop business model

Table 9: Access loop business models

ACCESS LOOP (3)	**CE Principle: Dematerialising loop, intensifying loop**
Business model is designed around offering access to a solution through leasing/hiring/renting products without necessarily a change of ownership or through a platform allowing maximisation of utilisation.	**Position in life cycle: Use**
	Value dynamics: Optimize
	BM orientation: Service

Category (level 2)	Description	Associated categories in literature
3.1PSS	Value creation through delivering a function/use/ result rather than a product only. Products are used by one or many customers through a lease or pay-for-use or functional results value capture mechanisms.	Product as a service (Accenture, 2014, Clinton and Whisnant, 2014), Access and performance model (Bocken, 2016), Service and function based models (Kiørboe et al., 2015), Performance model/Products as Services / Result-based models (planing, 2015) Pay per service unit/ Product lease /Product renting or sharing /Functional result (Tukker, 2004) Performance model (Bakker et al., 2014), PSS (Wrap, 2016), Hire and leasing models (Wrap, 2016), Performance (Smith-Gillespie (2017), Access (Smith-Gillespie, 2017)
3.2 Platform	Value creation through a platform connecting product users (B2B or B2C), providing access to a product/service which allows to maximise product utilization.	Sharing platform (Accenture, 2014), Shared resources (Clinton and Whisnant, 2014), Collaborative consumption (Kiørboe et al., 2015, Wrap, 2016), Access model / Collaborative Consumption (Planing, 2015), Dematerialized services (Renswoude et al. 2015), Access model (Bakker et al., 2014), Asset management (Wrap, 2016)

Cascading loops business models

Cascading loops business models are built on "Waste exchange" (Albino and Fraccascia, 2015), "Coproduct generation" (Albino and Fraccascia, 2015), "Industrial symbiosis" (Beltramello et al., 2013, Bocken,2016), "life-cycle models" (Bisgaard et al., 2012), "Rematerialization" (Clinton and Whisnant, 2014), "Multiple cash flows/multiple revenues" (Pauli, 2010), "Cascades" (Renswoude et al.2015), "Coproduct recovery" (Smith-Gillespie, 2017), "Cascading and repurposing" (Lüdeke-Freund et al.,2018), "Organic feedstock" (Lüdeke-Freund et al.,2018) categories found in the literature.

In these generic circular business models, value creation is designed around a multiplication of uses of materials to create new value from coproducts in multiple value chains within and between industries.

Cascading loops business models adopt the cascading loop principle. In these process-orientated solutions, waste outputs from one process are turned into feedstock for another process or product line (Bocken et al., 2016). The central circular value dynamic is to *recover value*.

The *value creation* mechanism is based on recovering materials and energy from internal processes either to be reused internally or to be exchanged for the benefits of another industry. Cascading loops business models are inspired by the ecological principle called "waste is food" by Braungart and al. (2007). In order to be implemented, skills and competences are required to reprocess waste and recover value from energy and material flows. The *value proposition* in these business models focus on providing used resources to feed in another industry process or new products made from used resources to final consumers. Value proposition is considered multiple as with one set of resources, multiple customers from different industries and sectors can benefit from the solutions developed. *Value delivery* focuses on one hand on providing used materials, components or waste to be reprocessed by a third party, and on the other hand on taking back used components or materials to feed into own processes. *Value capture* is generally associated to additional revenues generated from the sale of materials or energy to be reused in other industries processes, as well as cost reductions from reusing materials and energy. Using the resources available in cascading systems, the waste of one product becomes the input to create a new cash flow (Pauli, 2010). Table 10 below provides an overview of the level 2 categories in the Cascading loop business model.

Table 10: Cascading loop business models

CASCADING LOOP (4)	**CE principle: Cascading**
	Position in life cycle: Post-use
Business model is designed to diversify the use of materials to create new value from sidestreams in multiple value chains within and between industries	**Value dynamics: recovery**
	BM orientation: Material (product)

Category (level 2)	**Description**	**Associated categories in literature**
4.1 Waste exchange	Value creation is based on reusing waste produced by a given production process as input by another production process internally or externally, allowing for multiple value creation from the same material source.	Waste exchange (Albino and Fraccascia, 2015) Waste regeneration systems (Beltramello et al., 2013) Energy recovery (Planing, 2015, Mentink, 2014)
4.2 Waste as new product	Value creation is based on a business enlargement strategy since new products are added to the ones currently produced by the company.	Coproduct generation (Albino and Fraccascia, 2015), Multiple cash flows/multiple revenues (Pauli, 2010), coproduct recovery (Smith-Gillespie, 2017), Cascading and repurposing (Lüdeke-Freund et al.,2018)

Long loops business models

Long loops business models are built on "Create value from waste" (bocken,2014), "Extending resource value" (Bocken, 2016), "Resource Recovery" (Accenture, 2014), "IS-based business oriented to product generation" (Albino and Fraccascia, 2015), "Waste regeneration systems" (Beltramello et al., 2013), "life-cycle models" (Bisgaard et al., 2012), "Closed-loop productions" (Clinton and Whisnant, 2014), "Recycling and waste management" (Kiørboe et al., 2015), Recycling (Mentink, 2014), "Resource recovery" (Smith-Gillespie, 2017), "Recycling" (Lüdeke-Freund et al.,2018) categories. In these generic circular business models, value creation is designed around recovering already used-resources from discarded products in order to extend the value of resource through recycling.

Long loops business models adopt the closing loop principle (Bocken, 2016). Materials are recovered to be reprocessed into new components or products. Long loop business models can provide downcycling solutions or upcycling solutions. In the latter, materials are reprocessed into higher-quality and value products, while downcycling generally decreased the embodied value of the recovered material (McDonough and Braungart, 2013). The central circular value dynamic is to *recover value* in the post-use phase, focusing on the recovered materials.

The *value proposition* in these business models focuses on offering new products based on recycled waste /recovered materials used as raw material, or developing higher-level competences to support customers in handling and processing recovered waste. The *value creation* mechanism is based on adopting waste handling and processing capabilities as well as reverse supply chains logistics allowing to take back used products or materials and recycle them for another lifecycle.

Value delivery in long loop business models is focusing on connecting suppliers of discarded material (companies or consumers) with new customers, with or without the use of intermediaries (waste management company acting as facilitator). *Value capture* is generally associated to the generation of additional product revenues. Table 11 below provides an overview of the level 2 categories in the Long loop business model.

Table 11: Long loop business models

LONG LOOP (5)	**CE principle: Closing**
	Position in the life cycle: Post-use
Business model is designed based on recovering already used-resources from existing products in order to extend the value of resource through recycling	**Value dynamics: Recovery**
	BM orientation: Material (Product)

Category (level 2)	**Description**	**Associated categories in literature**
5.1 Resource Recovery	Value creation through recovering resources from discarded products, and integrating these inputs into new material/new products	Create value from waste (bocken,2014), Extending resource value (Bocken, 2016), Resource Recovery (Accenture, 2014), IS-based business oriented to product generation (Albino and Fraccascia, 2015), Waste regeneration systems (Beltramello et al., 2013), life-cycle models (Bisgaard et al., 2012), Closed-loop productions (Clinton and Whisnant, 2014), Recycling and waste management (Kiørboe et al., 2015), Recycling (Mentink, 2014), resource recovery (Smith-Gillespie (2017), Recycling (Lüdeke-Freund et al.,2018)

5. Discussion and conclusions

In this article, we aimed to develop an integrated typology of circular business models. Starting from circular economy definitions and its core features, we clarified generic principles associated with the concept, based on existing schools of thought. Taking a micro-level perspective focusing on business model innovation, we highlighted recognized definitions on sustainable business models and framed circular business models as a subset of sustainable business models. The analysis showed that there is a gap between the current understanding of CE (definitions and principles) and subsequent circular business model emerging theory. In order to reduce this gap, we formalize a set of guiding principles which bridge general CE theory with circular business models. Seven guiding principles are identified: *regenerating loop, narrowing loop, slowing loop, intensifying loop, dematerializing loop, cascading loop* and *closing loop* principles .

We also recognize that beyond these guiding principles, circular business models can be classified based on (1) the business model orientation (*material – product – service*) (2) the focus taken by the business model on the product lifetime phases (pre-use, use, post-use), and lastly (3) its circular value dynamics (*retain value, optimize value, recover value*).

The development of these criteria allow us to build an integrated typology using existing categorization attempts from 19 publications and consolidate circular business models into five distinctive categories. The integrated typology describes five generic circular business models: (1) *clean loops business models, (2) short loop business models, (3) access loops business models, (4) cascading loops business models and (5)long loops business models*. Each business model is described with a focus on its value proposition and associated business model components (value creation, value delivery, value capture).

5.1 Theoretical implications

Circular economy can be considered as an ideal state, and by extension, it is acknowledged that 100% circular business models do not exist (Renswoude et al, 2015).

The classification exercise done in this integrated typology allows however to serve as a more robust foundation to explore further the specific mechanisms taking place in circular business models, in relation to value creation. Second, the outcome of the article (consolidated typology and associated criteria) allows us to consolidate the definition of circular business models as *the rationale of how a company creates, deliver, retain, optimize, capture, and recover superior sustainable value by regenerating, closing, narrowing, slowing, intensifying, dematerializing and cascading resource loops within its value network, thus supporting its stakeholders without undermining the functioning of the biosphere or crossing any planetary boundaries*. This definition reinforces the links between circular business models and sustainable business models (the former being a subset of the latter, but sharing a similar overall objective) while at the same time characterizing the specific principles guiding the implementation of circular economy at business level.

5.2 Managerial implications

The typology developed in this paper provides a basis for comparison and communication that can support companies when trying to position themselves in the circular business models map. In that sense, it provides companies a starting point to explore new avenues and promising implementations of innovative sustainable business models.

5.3 Limitations

The deductive approach used in consolidating the typology is not without flaws. As new business models in the circular economy constantly surface, a more iterative approach would be needed to revisit this typology on a regular basis. Business models examples can support the conceptualization of circular economy: describing good circular economy implementation examples can help sharpen the understanding of the circular economy concept both among scholars and practitioners. At the same time a strong concept of circular economy is needed to clarify what is a CE business model. This tension between practical examples on one hand and general concepts on the other hand is at the core of theory forming, which is still emerging in the context of circular business models. Thus, more extensive work is needed to refine the defined concepts and consolidate knowledge.

Examples depicted in the existing literature also show that a single company can develop its business model using several principles and value creation mechanisms, thus

developing hybrid combinations (i.e: clean loop+access loop business model) which raises the complexity of identifying specific characteristics associated with each category of the typology.

5.4 Research avenues

The classification presented above supports a better understanding of circular business models based on a clear recognition of associated principles, position in the life cycle and material -product-service orientation. However, the current classification does not yet inform on the mechanisms supporting a successful implementation of these circular business models. It would become relevant in future research to validate if specific distinctive mechanisms occur in each business model category when addressing for instance the interactions between the focal company and its customers – *which distinctive mechanisms support customer value creation in the different circular business models categories*? , the type of competences needed to support a circular business model – *Are there specific circular dynamic capabilities supporting the implementation of circular business models*? Or, as the circular economy is systemic by definition, the role of business networks in creating, delivering and capturing sustainable value – *how can circular value networks be created and managed to sustain circular business models?*

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ESSAY II: Customer value creation in circular business models: insight from case studies

1. Introduction

Most recently, the concept of circular economy has received much focus on the business agenda (Ellen MacArthur foundation 2012, 2014) and within public polies arena (European Commission 2014, 2015). Circular economy defines itself as an alternative to a traditional linear economy (make, use, dispose) in which resources are kept in use for as long as possible, with the goal of extracting the maximum value from them whilst in use, then recover and regenerate products and materials at the end of each service life, in order to extend value creation (WRAP 2016). The transformation from a linear to a circular economy can be grounded in material or technological innovation. However, taking a business model innovation perspective may bring an integrative solution to solve current pressing business challenges, such as the rise in commodity prices or the increase scarcity of specific resources (Schulte, 2013). With increasing resource constraints on one hand, and a growing concern from customers for sustainability-related business practices, revisiting value creation in the framework of a circular economy becomes more than relevant for businesses. Circular value creation can be defined as a set of closed-loop strategies aiming at creating, maintaining and extending value for a focal business and its value network and for society & the environment at large, while minimizing negative externalities throughout the lifecycle of the products/services delivered. It is a central tenet of circular business models literature, which aims at exploring the rationale of how an organization creates, delivers, and captures value from closed-loop/circular strategies (Mentink 2014). The concept of value, as defined in sustainability-oriented literature, incorporates economic, social and environmental benefits not only for the customer but also for society at large (Evans et 2017). However, little has been studied regarding value creation in circular business models from the customer perspective. The paper aims to fill this gap.

Customer value creation is recognized as a critical part of a business model strategy (Woodruff, 1997) and perceived as the fundamental basis for all marketing activity (Holbrook, 1994). First defined as a unidimensional concept referring to the trade-off between benefits received and sacrifices made to acquire a product or service (Monroe, 1990), the notion of customer value has since then been studied from a multiplicity of

dimensions, and its complex and dynamic nature has been often emphasized (Sheth, Newman and Gross, 1991). Indeed, customer value can be apprehended from various lenses of analysis, by focusing on functionality and performance or by exploring intangible features such as symbolic or hedonic value (Smith and Colgate, 2007).

If the concept of customer value creation has been well studied in traditional business models, it has seldom been framed in new business models focusing on sustainability or circularity. As the transition toward circular economy involves new values and consuming practices (Wells, 2013), understanding the consumers' willingness to engage in and accept different innovation pathways towards circularity is seen as a prerequisite to design successful circular strategies (Borello et al., 2017). Companies seeking to implement a circular business model thus need to redefine their customer value creation strategy accordingly, as conventional notions of ownership transfer, traditional pricing fees, or distinctive usage patterns are being challenged in the circular paradigm. Hence the research question: *Which customer value creation mechanisms are enabling the implementation of circular business models?*

More precisely, the aim of the article is to explore which dimensions of customer value creation are emphasized in circular business models (CBM). The paper aims to specify the combination of value dimensions that appeal to customers based on the different existing categories of circular business models. The paper also attempts to provide empirical illustrations of customer value propositions in circular business models based on an analytical framework - *the circular value creation compass*. By applying the framework to a selection of 65 circular business models, it provides a set of insights and recommendations for managers and company owners on how to design their value proposition to bridge circular principles with customer needs.

The paper is organized as follows: first, a brief review of the extant literature on customer value and circular business models is presented resulting in a framework development. Next, the research method (multiple case studies design, data collection) is described. Finally, the findings and implications are presented and the research contribution from a managerial perspective and directions for future research are outlined.

2. Literature review

The next section briefly summarizes the existing literature on circular business models (CBM) on one hand while introducing customer value creation literature on the other hand.

2.1 Circular business models (CBM)

In the literature, several authors have paid attention to the fact that the transition to the circular economy will require a strong shift in policy making at macro-level (EMF 2015). But in order for its principles to be adopted at business level, circular business model innovation needs to be better understood. Indeed, comprehensive knowledge on designing circular business models is needed to stimulate and foster implementation of the circular economy on a micro-level (Lewandowski 2016). If a business model (BM) can generally be defined as the rationale of how an organization creates, delivers, and captures value (Osterwalder & Pigneur, 2010), including circular economy principles in the definition raises issues as the circular economy concept and its definitions lack academic consistency. Different perspectives have been taken so far in trying to define circular business models. According to Linder & Williander (2016), a *circular business model* (CBM) is a business model in which the conceptual logic for value creation is based on utilizing economic value retained in products after use in the production of new offerings. A product for instance, instead of being discarded, can be recovered by the producer, disassembled and remanufactured to be resold. This definition however takes a limited scope omitting value creation from services. Mentink (2014) frames the general business model definition in a closed loop perspective and defines a circular business model as "*the rationale of how an organization creates, delivers and captures value with and within closed material loops".* However, this definition omits two distinctive features of circular economy: the importance of intangible resources as a source for value creation (such as the upcycling of skills) and the business ecosystem perspective in which value is created within a complex network of suppliers and customers interconnections (Antikainen and Valkokari, 2016). In this paper, we define CBM as *the rationale of how a company creates, deliver, retain, optimize, capture, and recover superior sustainable value by regenerating, closing, narrowing, slowing, intensifying, dematerializing and cascading resource loops within its value network, thus supporting its stakeholders without undermining the functioning of the biosphere or crossing any planetary boundaries.*

Circular business models share common principles: their value capturing and value distribution processes aim at creating value through resource and energy efficiency, product use maximization, product life extension, dematerialization through servicization and resource recovery. Circular business models are designed taking both a life cycle and a systemic approach in which the value network of the focal company combined with a user-centered approach support the value creation process. Circular business model goal of closing the material loop is not only realized within the boundaries of the focal business solution provider but more often within its value network (Bocken, 2014). Circular business model innovations are by nature networked: they require collaboration, communication, and coordination within complex networks of interdependent but independent actors/stakeholders (Antikainen & Valkokari 2016).

2.2 Classifying circular business models

Several attempts have been made in the literature to frame circular business models in specific distinctive categories (Damen 2012, Bakker 2014, Stahel 2013, Lacy 2014, IMSA 2015, Mentink 2014, Bocken 2016, Mouazan, 2016). In most cases, scholars describe the diversity of strategies taken to generate value through the circulation of resources flows during the life cycle of the product. Some categorizations focus on precise strategies, i.e. Tukker (2004) for the product-service systems category, others on the length (EMF, 2013) or the speed of the circulating flows (Stahel, 2013, Bocken, 2016). Several scholars (Moreno and al 2016, Lewandowski 2016, Mouazan, 2016) have reviewed these categories. In order to facilitate the classification of circular business models, we use the categorization by Mouazan 2016 following a loop perspective and relying on five specifics loops (clean, short, long, access and cascading loops).

The clean loop business model (1) focus on resource inputs. These inputs are either coming from biodegradable, renewable and/or recycled materials, with the aim of departing from the use of carbon-intensive, non-renewable resources. At the end of the product lifetime, materials in clean loops can easily be recycled or discarded with no harm to the environment while providing a restorative impact (Braungart and Mcdonough, 2002). Short loop business models (2) focus on strategies aiming at prolonging the lifetime of a product through repairing or reuse practices (Stahel, 2013). In this approach, products may circulate between user and supplier or between several users. In the access loop business models (3) the focus of value creation lies in the performance offered by the product rather than in the product itself. Product-service

systems (Tukker, 2004) in which solutions are leased or rented providing access to a certain performance without any ownership transfer, fall into this category. Long loop business models (4) aim at creating value from the recovery of materials at the end of the product lifetime. In this category, products are recovered at the end of their use life and recovered materials are reused to produce the same items or used for new purposes. In the cascading loop business model (5), multiple products are created from the same set of resources. Side-streams from production are used in different processes from the same company or in other companies belonging in the value network. Industrial symbiosis inspired business model are part of this category. The taxonomy is synthetized in the table below and will be used for the practical case analysis in the continuation of this paper. The next section introduces literature around customer value creation.

Table 13. Circular business model categories

Circular business model	Description	CE principles	Position in the product use cycle	Business model orientation	Value dynamics
(1) Clean loop	Business model is designed around fully renewable, recyclable or biodegradable inputs	Regenerative loop	Pre-use	Material	Retain value
(2) Short loop	Business model is designed around products manufactured for extended life time and additional value is created through services supporting the maintenance of the product for the same customer (repair, upgrade), or different customer (reuse, remanufacture)	Narrowing loop, slowing loop	Use, Post-use	Product (Service)	Retain value
(3) Access loop	Business model is designed around offering access to a solution through leasing/hiring/renting products without change of ownership or through a platform allowing maximisation of utilisation.	Intensifying loop, dematerializing loop	Use	Service	Optimize value
(4) Cascading loop	Business model is designed to diversify the use of materials and products to create value from coproducts in multiple value chains within and between industries	Cascading loop	Post-use	Material (Product)	Recover value
(5) Long loop	Business model is designed based on recovering already used-resources in order to extend the value of resource through recycling	Closing loop	Post-use	Material (Product)	Recover value

2.2 Customer Value Creation

Customer value creation can be perceived as a highly complex phenomenon which can be interpreted in various ways (Holbrook, 1994). According to Woodruff (1997), customer value can be defined as "*a customer perceived preference for and evaluation of those products attributes, attribute performances, and consequences arising from use that facilitate (or block) achieving the customer's goals and purposes in use situations*". Customer value can be approached in two distinctive ways. On one hand, desired value refers to what the customer expects from a certain product a service, in a pre-use phase. Perceived value, on the other hand will refer to the benefits acquired after the product or service is acquired (in use and post-use phase). Holbrook (2005) states that customer value is an "*interactive, relativistic preference and experience*". It will be dependent on a certain context and will be perceived subjectively by one single customer and will be subject to a dynamic feature. When addressing customer value creation, various tangible and intangible dimensions can be taken into account. Several scholars have attempted to clarify the different dimensions of value creation (Park, Jawarski, and MacInnis, 1986, Sheth, Newman, and Gross,1991, Heard 1993-1994, Ulaga 2003,). In 2007, Smith and Colgate reviewed existing frameworks with the intention of developing a comprehensive customer-value creation framework which relies on four main types of value: 1) functional value focuses on the attributes of the product/service itself and addresses the extent to which a product is useful and fulfills a customer's desired goal; 2) experiential value explores the extent to which a product creates appropriate experiences, feelings, and emotions for the customer; 3) symbolic value addresses the extent to which customers attach or associate psychological meaning to a product while 4) cost/sacrifice value incorporates in the value mix the cost or sacrifice that would be associated with the use of the product/service. Rintamäki, Kuusela, & Mitronen (2007) examined customer value dimensions specifically in the retail sector, and also included economic, emotional, functional, and symbolic value. O'Cass and Ngo (2011), characterized value-creation strategy by looking at four specific dimensions: performance value, associated with the product attributes and the attributes' performance; pricing value, which can refer to the fair price or the value price; relationship value which refers to the firm's efforts to create and deliver a hassle-free purchase and consumption experience and finally co-creation value in which customers play a more active role by influencing various parts of the business system to co-produce their unique purchase and consumption experience. This latest dimension reflects the various literature on customer co-creation that has emerged in the last 10 years with the seminal works of Prahalad and Ramaswamy (2004) as well as Vargo and Lush (2004) and that posits that "*value is now centered in the experiences of consumers*".

2.3 Integrative perspective

In the figure below, we present an initial attempt aiming at bridging existing knowledge on circular business models categorizations with customer value creation frameworks. This first integrative approach allows us to position where circular business models, based on their distinctive categories could be positioned. The matrix describes on the horizontal axis where circular business models generate their value for the business (Materials, Manufacturing, Product, Services). On the vertical axis, the circular business models are classified based on the various customer value dimensions as described in existing frameworks.

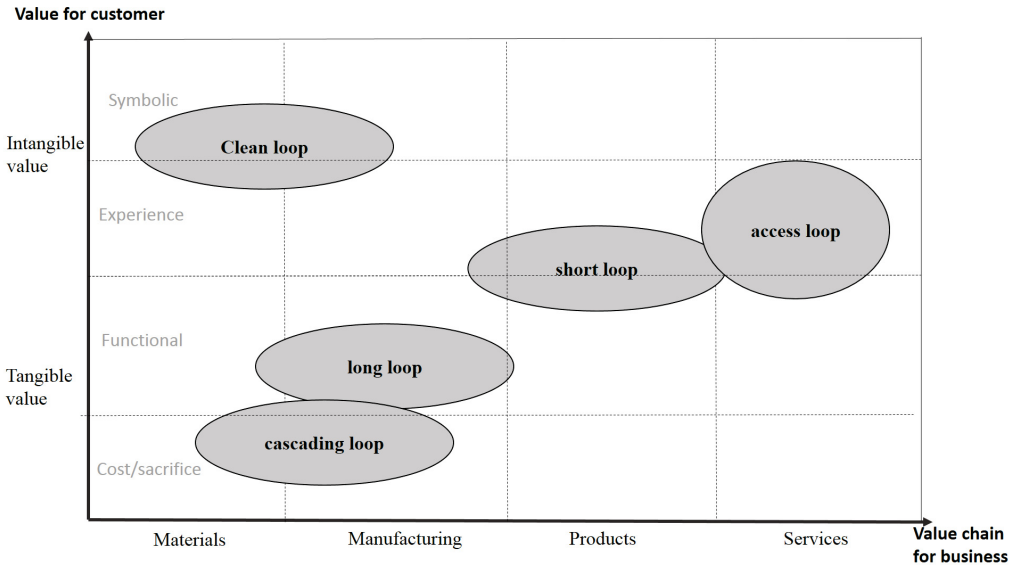


Figure 1: Integrating circular business models with customer value creation

Starting from this initial overview, the paper aims to clarify further how these specific customer value dimensions are interconnected in the five circular business models categories. The importance of each and every dimension should also be addressed. The next section describes the overall methodology used to answer the research questions.

2.4 Analytical framework development

In order to measure the importance of the various dimensions of customer value creation in circular business models, a *Circular Customer Value Creation Compass* was developed (see Figure 2). The compass aims to measure the importance of five different value dimensions and fifteen sub-dimensions. The tool combines four dimensions as described by Smith and Colgate (2007) – functional value, experiential value, cost/ sacrifice value, symbolic value, while adding a 5th

dimension - the cocreation value - following O'Cass and Ngo (2011) and 3 sub-dimensions (mass-customization, coproduction, platform).

Sub-dimensions associated to the first four value dimensions are organized and synthetized into 12 sub-dimensions: features, performance, outcomes, sensory, emotional, social-relational, self-expression, personal meaning, social meaning, economic costs, non-economic costs, risks. The compass allows to measure the importance of the dimension based on a five level scale as described in Table 2.

Table 2: Evaluation scale of the circular customer value creation compass

EVALUATION SCALE
0: no influence on value creation
1: fair influence on value creation
2: moderate influence on value creation
3: good influence on value creation
4: excellent influence on value creation

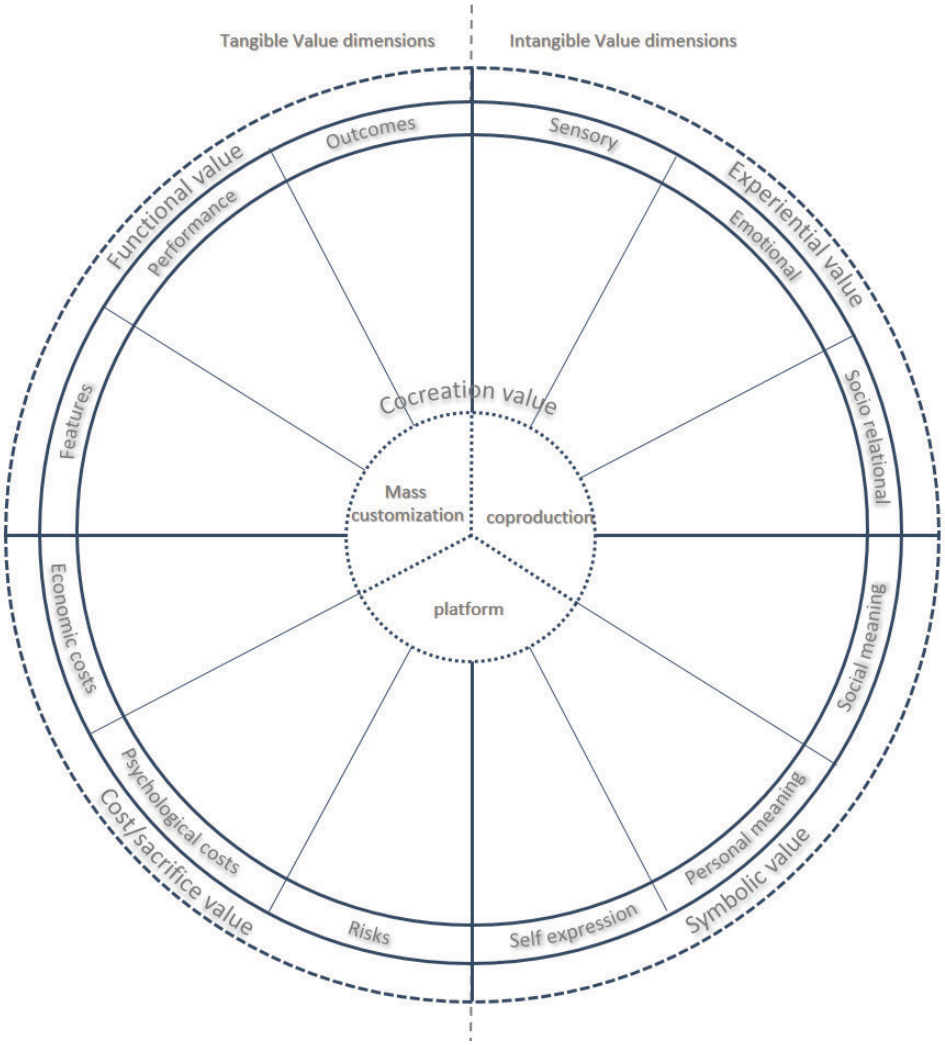


Figure 2: The circular customer value creation compass

The different value dimensions are described in the table below. Each value dimension encompasses three sub dimensions which as described. A circular business model example illustrates the sub-dimension to facilitate comprehension.

Table 3: Circular customer value creation compass dimensions

VALUE DIMENSION	SUB DIMENSION	DESCRIPTION OF THE DIMENSION	EXAMPLE IN CBM
FUNCTIONAL VALUE	*Features*	Product quality, durability, customization biosourced/recyclable material	Textile product made from 100% organic cotton in fair-trade conditions
	Performance	Energy or resource Efficiency, reliability	Solution that allows to save in electricity costs by offering customized natural light solution
	Outcomes	Effectiveness, operational benefits	A pair of 3d printed sunglasses produced from recycled material producing zero waste
EXPERIENTIAL VALUE	*Sensory*	Sensory value, appealing to the senses (aesthetics, ambiance)	A food retailer offering package free products allowing its customers to improve its relationship to food
	Emotional	Creates appropriate emotions (play, enjoyment , trust, solidarity)	A sharing platform in which products history is shared through a QR code providing details on former users.
	Social-relational	Creates a sense of relationship (community, support, bonding, commitment, network benefits)	A platform offering distribution of food to associations instead of being trashed.
	Self-expression	Offers a mean for self-expression (identity building, self concept)	An outdoor product associated to strong ecological values for hikers and nature lovers

SYMBOLIC VALUE	*Personal meaning*	Create personal meaning	A platform upcycling personal customer objects
	Social meaning	Competitive social meaning (prestige, status, image)	A company offering a subscription service to access the latest model of branded headphones, improving image of customer
COST/SACRIFICE VALUE	*Economic costs*	Economic value (low costs, value in use, life costs)	A company offering remanufactured product at a better price than new product
	Non-economic costs	Minimizing psychological investments of users (ease of use, simplicity, accessibility)	A customized service that takes care of the end of life of a product saving the customer time.
	Risks reduction	Minimising risks (warranty, take back option,)	A computer leasing solution offering a data wiping service at the end of contract life.
CO-CREATION VALUE	*Mass customization*	Allowing customer to choose individualized value proposition	Industrial solutions offering modular features meeting customer needs.
	Coproduction	Allowing customers to have a proactive role into producing product/service	A furniture company using old furniture from customer to redesign a new set of office appliances meeting customer requirements. Customer is involved in providing resources and specifying the specificities of the new furniture.
	Platform	Allowing skills, competences or assets from customer to be used to feed into it	A professional equipment platform allowing customer to share assets (trucks, tractors). Customer acts as service provider allowing other customers to access the assets.

The framework is used to analyse circular business models in the empirical part of the research.

3. Methodology

The section below describes the methodological approach used to answer our research question.

3.1 Case selection and data collection

Case study research is a suitable approach to build theories on a new topic concerning contemporary events (Eisenhardt, 1989 and Yin, 2009). In order to answer the research questions, a multiple case study approach was favored. Eisenhardt (1989) suggests that the selection of the cases to analyze should be based on a set of criteria resulting from a preliminary theoretical framework. The detection of the case studies was based on the following criteria:

(1) Case studies must exemplify a variety of circular business models. The circular economy business model categories (Mouazan, 2016) defining 5 different types of circular business models were used in that respect (clean loops, short loops, access loops, long loops and cascading loops).

Table 4. Distribution of cases per type of primary circular business model

CBM TYPOLOGY	NUMBER OF CASES
SHORT LOOP	**14**
LONG LOOP	**17**
ACCESS LOOP	**21**
CLEAN LOOP	**6**
CASCADING LOOP	**6**

(2) Case studies should illustrate applications of circular economy in a wide variety of products in different sectors. Case studies should also include servicization approaches.

Table 5. Distribution of cases per sector

SECTOR	NUMBER OF CASES
FOOD	**5**
TEXTILES	7
ELECTRIC AND ELECTRONIC EQUIPMENT	**12**
BUILDING, CONSTRUCTION AND DEMOLITION	**10**
FURNITURE	7
PACKAGING	**3**
MOBILITY	**5**
WASTE MANAGEMENT	**6**
CHEMISTRY	**2**
OTHER	**8**

(3) The analysis should also contain examples of business-to-business (B2B) and business-to-consumer (B2C) markets.

Table 6. Distribution of cases per type of business relationships

TYPE OF BUSINESS RELATIONSHIP	NUMBER OF CASES
B2B	**38**
B2C	**27**

(4) The analysis should include existing companies innovating with new business models as well as start-ups focusing solely on circular innovation.

Table 7. Distribution per type of business

BUSINESS FORM	NUMBER OF CASES
EXISTING COMPANY	**22**
START-UP	**33**

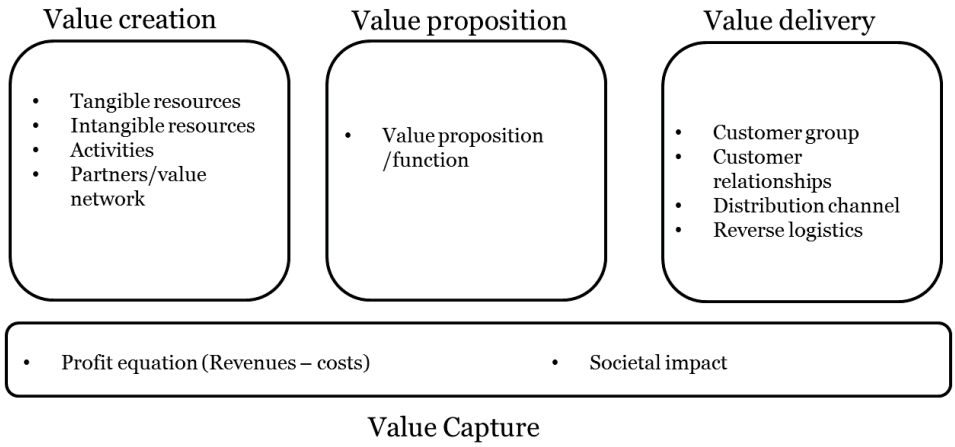
Cases were first chosen from existing databases focusing on circular economy business examples (Ellen MacArthur Foundation (August 2016), Plan C (September 2016), Norden (2015) and Circle economy (November 2016). The cases were further elaborated using secondary data collection from web pages of the companies studied, and other articles/press releases, in order to enable a

comprehensive picture of each case study and to avoid reporter bias. In order to overcome possible limitation of using case studies derived from these secondary data sources, the data collected and findings deduced were further validated, where available, through direct interactions with organizations who published them, with circular economy business platforms and with a selection of companies directly studied. The quantity of information collected through the use of this methodology together with the accuracy of interpretations made, confirmed by a range of consulting experts, was considered similar to undertaking first hand case study research and justified the deductions made. Following that approach, 65 cases were selected.

3.3 Data analysis

First, in order to understand each business model analysed, an adapted version of the Business Model Canvas framework, initially developed by Osterwalder and Pigneur (2010), was developed and considered suitable to analyse the content in a systematic manner, ensuring consistency across multiple case study analysis (Yin, 2009). Each case study was described to provide an understanding of each building block of the business model canvas. Certain distinctions were made to better describe business models in line with circular economy principles: The *resources* block were subcategorized into *Intangible* and *Tangible resources*: tangible resources may include technical or biological streams of materials, while intangible resources may include several skills and assets. The *distribution channel* block was extended to include *Reverse logistics*. Finally, *Societal impact* was added in the analysis to highlight environmental and social benefits delivered by the circular business model. Figure 3 below details the main blocks of analysis.

Figure 3 . Circular business models blocks (adapted from Osterwalder and Pigneur)



Second, each case study was analyzed through the circular customer value creation framework. A systematic analysis of each case highlighted which customer value creation dimension was considered when designing the business model value proposition. Initial results and deductions were drawn based on this double approach. Outcomes from the multiple case studies were compared (Yin, 2009). Practical and theoretical evidence was used to make connections, differentiate findings and reach conclusions. Findings were classified first according to the circular business model categorization. In a final phase, deductions were validated and amended by CE experts: practitioners from some of the case studies analyzed as well as consultancy/academic experts.

Table 8. List of experts validating findings

Organization	**Activities**
Circulaire vlanderen (belgium)	Circular economy platform
Circle economy (netherlands)	Circular economy platform
Ethica (finland)	Circular economy research and consultancy
Company a (clean loop – fashion accessories industry)	Founder
Company b (short loop), agriculture equipment	Remanufacturing manager
Company c (access loop – fashion industry)	Founder
Company d (long loop)	Founder
Company e (cascading loop- food indutry)	Founder

4. Findings

We highlight a number of key findings in this section. We first offer general observations and then specify which value creation constellations occur following the circular business models typology.

4.1 General findings

Towards an hybridization of circular business models

The analysis of the 65 cases show that many circular business models are often hybrids, in the sense that they actually can be considered in more than one category. A company focusing on a clean loop approach using renewable or organic materials may as well offer its range of products as a service (access loop), while a company providing repair services (short loop) may as well develop its business model further and recover some its products at the end of its useful life for further recycling (long loop). In the examples which have a longer business history, the circularity strategy becomes more complex over time, and models are often exploring various combinations. An organic jean manufacturer may for instance develop hand in hand its clothing as a service approach while simultaneously invest resources in the recycling of its worn out products (long loops) or partner with other members of its value network to create new products in new sectors (cascading loop). Despite this occurring hybridization, it is possible to identify patterns of value creation constellations related to specific categories of circular business models. The section 5.2 provides highlights on these distinctions.

Circularity as a by-product of customer value creation

In circular business models, the circularity and its associated societal impact (i.e. resource use maximization, waste reduction) is rarely placed as a central value creation driver but rather often presented as a side value creation driver, behind performance and/or cost/saving. Very little cases actually mention circularity in their customer value proposition but rather focus on the customer gains and the value associated with the use of the product/service.

A combination of tangible and intangible value dimensions

Circular customer value creation always includes a combination of functional cost/benefit values and other intangible values. In B2C for instance, while features of the product (attributes, performance) focus on the durability and quality of the solution, it also supports the production of social (increase of sense of community) or symbolic meaning (self-expression to fit in a sustainable lifestyle). These various values are not independent from each other. The presence of one value dimension can have a direct impact – both positive or negative –on other sources of value from the same product/service.

A certified organic product (strong symbolic and functional value) may for instance still be considered negatively from a cost-benefit value dimension (product perceived by customer as expensive high-class product).

The next section provides in-depth description of value creation constellations according to the typology used in the analysis.

4.2 Findings according to the circular business model categories

Findings for each category of circular business models is detailed below. For each category an illustrative example representative of the category is presented. The findings are discussed in line with existing literature. Without surprise, strong differences occur between B2B and B2C circular business models, in each subcategory. This is taken into account in the analysis.

4.2.1 Clean loop business models

Clean loops business models strongly focus on the nature of the supplies used to develop a circular product. In this model, fully renewable, recyclable or biodegradable materials are integrated in the commercial processes (Lacy, 2015).

By relying on renewable resources rather than on finite resources, companies strengthen their own resilience and reduce their value chains risks. From a customer perspective however, value creation is presented in a different approach. In the business to consumer perspective, the functional value is privileged, with a strong focus on the feature of the product. A mattress producer manufacturing mattresses from organic wool will highlight the health and comfort features attached to the materials of the product. This extra quality may come at an extra price, which is generally counterbalanced in the value creation constellation by the strong symbolic value associated with the purchase. Buying an organic product with a lower impact on the environment reinforces for some customers the strong social meaning associated with the purchase *("I consume green to save the planet")*.

The table below illustrates a clean loop business model. The company is a mattress producer offering organic mattress locally produced. Its value proposition highlights the natural materials used in the manufacturing process and its associated health benefits. The safety of the product is highlighted in combination with the responsible purchase dimension.

Table 9. Illustration for a mattress producer

VALUE DIMENSION	*SUB DIMENSION*	IMPORTANCE OF THE DIMENSION	ILLUSTRATION IN CBM
FUNCTIONAL VALUE	*Features*	Very high	Organic mattress made of natural sustainable renewable sources fibers, locally sources material
	Performance	High	Self-ventilating, comfortable mattress.
	Outcomes	Low	Healthy natural sleep
EXPERIENTIAL VALUE	*Sensory*	Medium	Soft material
	Emotional	High	Trust for safe and clean products
	Social-relational and epistemiological	Medium	Communication around babies/mothers safety.
SYMBOLIC VALUE	*Self-expression*	High	Personal choice to tell customer cares about environment and loved ones
	Personal meaning	Medium	Importance of health and natural materials for your closed ones
	Social meaning	Very high	Care for local production care for the environment
COST/SACRIFICE VALUE	*Economic costs*	Low	-
	Non economic costs	Low	-
	Risks reduction	Very high	More healthy sleep, less concentration of chemicals
CO-CREATION VALUE	*mass customization*	Low	-
	Coproduction	Low	-
	Platform	Low	-

In the Business to Business market, clean loop approaches do not generally highlight the symbolic value associated with the product. A strong focus of the value creation is related to the associated performance and features of the product. As an illustration, a Belgian company focusing on a bioconversion solution using larvae, offers on one hand a novel solution to valorise organic waste,

while at the same time providing alternative organic products for the chemical industry (fat or proteins, resulting from the larvae digestion of waste).

4.2.2 Short loop business models

Short loop business models focus on product life extension, through repair, reuse or reconditioning of goods (Stahel and Reday, 1976). In this business model approach the high value imbedded in the product remains preserved as long as possible.

From a customer value perspective, the repair services generally provide a high cost/benefits value, as in these business models, repairing an existing product will be more cost effective for the customer than having it replaced by a new one. Users benefitting from reconditioned products also take advantage from a better price than buying new products. Associated benefits such as warranty or access to spare parts improve the cost/sacrifice value by providing convenience and risk reduction.

In the B2B sector, the symbolic value may be of relevant importance if the customer can use this purchase as a way to increase its brand image as a part of its CSR policy. In the B2C sector, the value of using second-hand or repaired products is created when the user believes the solution fits with its sustainable lifestyle principles therefore creating a feel-good effect. In fashion for instance, a remanufactured item may suddenly become highly valuable from its uniqueness and non-reproductibility.

The table below illustrates the case of an office furniture provider who sells, repairs and repurchases its portfolio of products to other businesses.

Table 10. Illustration for an office furniture producer

VALUE DIMENSION	SUB DIMENSION	IMPORTANCE OF THE DIMENSION	EXAMPLE IN CBM
FUNCTIONAL VALUE	*Features*	High	Durability
	Performance	High	
	Outcomes	Medium	Convenience
EXPERIENTIAL VALUE	*Sensory*	Medium	
	Emotional	Medium	
	Social-relational and epistemiological	High	Novely of the solution
SYMBOLIC VALUE	*Self-expression*	High	Purchasing the solution allows user to meet their values related to responsability
	Personal meaning	Low	-
	Social meaning	High	As a client you participate in garbage reduction – brand enhancement
COST/SACRIFICE VALUE	*Economic costs*	High	Cost efficient solution through pay-back system
	Non economic costs	Medium	Time saving solution.
	Risks	Low	-
CO-CREATION VALUE	*mass customization*	High	Flexible solution that meets the customer needs
	Coproduction	Low	-
	Platform	Low	-

4.2.3 Access loop business models

Access loop business models generally provide a complementary mix of a product and its associated services. Product service systems (PSS) can be categorized in this category: By focusing on the customer needs and preferences, a solution is provided in the form of a product accessed in combination with additional services (Mont, 2002). A headphone manufacturer will for instance offer its customers access to a brand new headphone through a monthly subscription and include in the monthly fee a set of repairing services and the possibility to switch to newer models as they come. A fashion manufacturer focusing on toddlers clothing will provide clothing as a service and deliver baby clothes whenever the baby grows to a new size, saving parents time and resources. Access loop business models may also include value creation from goods and assets that are not directly owned by the solution provider but rather by the ecosystem of end users. Sharing economy business models focusing on collaborative consumption approaches provide such access to goods and services generally with the help of an online platform (Botsman, 2015). In both approaches, value creation from the customer perspective relies on a combination of functional value - the focus is on the performance and outcome rather than on the product itself (Stahel, 2002) and cost/benefits value (economic costs are more competitive in leasing/renting than owning, while the solution improves personal costs by reducing psychological burden).

In the Business to Consumer context, this value creation dyad is often complemented by a strong experiential value: either through the creation of social-relationships interactions (*"by becoming member of a kids clothing leasing solution, I also access a community of responsible parents willing to live a sustainable lifestyle and exchange tips and advices"*) or through epistemic value. Indeed, sharing economy business models generally benefit from the novelty effect which allows end users to experiment with alternative lifestyles ("*I access an expensive designer's handbag for the weekend that I would never be able to buy in a conventional approach"*). Several cases also benefit from the strong symbolic value associated with their solution which provides a self-expression support: *"you are what you can access"* (Belk 2014).

The table below illustrates the value creation constellation of a company offering a leasing solution for kids wear, through a subscription. The clothes delivered change as the kid is growing. In this example, the high performance of the clothes are highlighted (long lasting, durable products), in combination with strong sensory, emotional and socio-relational dimensions (novelty in a new service adapted to millennial moms). The value proposition is also built upon a strong symbolic value (self expression and social meaning) in which the role of the parents – as responsible and caring individuals - are highlighted.

Table 11. Illustration for a kidswear rental service solution

VALUE DIMENSION	SUB DIMENSION	IMPORTANCE OF THE DIMENSION	EXAMPLE IN CBM
FUNCTIONAL VALUE	*Features*	High	Designer kids clothes, organic and fair trade production
	Performance	High	Durability of clothes. Long lasting quality
	Outcomes	Medium	Multiple use of clothes, waste reduction
EXPERIENTIAL VALUE	*Sensory*	High	Aesthetics of the clothes
	Emotional	High	Solidarity with small designers, fair trade practices
	Social-relational and epistemiological	Very high	Novelty in trying a new service for millennial moms.
SYMBOLIC VALUE	*Self-expression*	Very high	You are what you rent
	Personal meaning	Low	Less attachment to clothes
	Social meaning	High	Part of community of responsible mothers
COST/SACRIFICE VALUE	*Economic costs*	Medium	Cost savings from buying clothes that are used a limited time
	Non economic costs	High	Time saving
	Risks	Low	
CO-CREATION VALUE	*Mass customization*	High	Personalization of the selection orders
	Coproduction	Low	
	Platform	Low	

4.2.4 Long loop business model

Long loop business model do not focus on product-life extension (short loop) but instead intend to maximize the useful life of materials by cycling them through new product/functions creation. In the b2b sector the value provided to customers is related to the quality of the service offered (high functional value) in combination with a strong costs/benefits value. Value associated to the reduction of risk may be prevalent when the solution provider offers a complete management solution related to the sorting and recycling of the materials. Experiential and symbolic value are mostly seen of lower importance.

B2B Customers might see value in honoring previous, publicly stated commitments to using recycled content and also see opportunities to use recycled content as a market differentiator, appealing to consumers who want recycled content. The illustration table below introduces the customer value dimensions of a company using demolition waste from the construction sector. The company offers deconstruction services, advices and consultancy and resells the salvaged material on an online platform.

Table 12. Illustration for a mechanical equipment producer (b2b)

VALUE DIMENSION	*SUB DIMENSION*	IMPORTANCE OF THE DIMENSION	EXAMPLE IN CBM
FUNCTIONAL VALUE	*Features*	High	Value creation from material about to be wasted. Expertise in life-cycle of building and techniques
	Performance	Medium	Negligible environmental impact
	Outcomes	High	Reduction of demolition waste. Preservation of features
EXPERIENTIAL VALUE	*Sensory*	Low	-
	Emotional	Low	-
	Social-relational and epistemiological	Medium	-
SYMBOLIC VALUE	*Self-expression*	Low	-
	Personal meaning	Low	-
	Social meaning	Medium	The practice may allow the customer to honour its engagement in responsible disposal of waste
COST/SACRIFICE VALUE	*Economic costs*	High	The solution helps its customers reduce costs from deconstruction processes. Recovered materials are sold at very competitive price.
	Non-economic costs	High	All in solution provided to large building owners
	Risks	Medium	The solution offers management of risks related to end of life of construction material
CO-CREATION VALUE	*mass customization*	High	Services are adapted based on the reality of the customer's project
	Coproduction	Low	
	Platform	High	The salvaged materials are sold on a platform

4.2.5 Cascading loop business model

Cascading loop business models involves sharing the use of resources and by-products amongst actors on a commercial basis through inter-firm recycling linkages. In industrial symbiosis, industries engage in an exchange of materials and energy, the waste of one company becoming another's raw material. The customer value creation will depend on the interactions between the provider of the resources/by products and the recipient. The illustration table describes the different value dimensions of a company producing mushroom from coffee waste. The mushroom growing kit (part of the value proposition) is sold to customers who get to experience with DIY agriculture.

Table 13. Illustration for a circular food producer

VALUE DIMENSION	*SUB DIMENSION*	IMPORTANCE OF THE DIMENSION	EXAMPLE IN CBM
FUNCTIONAL VALUE	*Features*	High	Certified organic mushroom growing kit using coffee waste
	Performance	Medium	Fast growing solution (10 days)
	Outcomes	High	Fast production of mushroom, waste reuse
EXPERIENTIAL VALUE	*Sensory*	High	Tasty food growing at home
	Emotional	High	Empowerment, satisfaction to be able to grow food by itself
	Social-relational and epistemiological	Very high	Novelty of the solution to share with family and friends
SYMBOLIC VALUE	*Self-expression*	High	The customer becomes producer
	Personal meaning	Low	
	Social meaning	High	The customer is part of a community of urban agriculture enthusiast
COST/SACRIFICE VALUE	*Economic costs*	Medium	
	Non economic costs	High	Simple user experience (open and water the kit)
	Risks	Low	
CO-CREATION VALUE	*mass customization*	Low	
	Coproduction	Very high	DIY approach. The customer is self-produce.
	Platform	Low	

4.3 Circular customer value constellations

The analysis of the various circular business cases in the study allows us to refine our initial perception of customer value creation in circular business models. Figure 3 below illustrates generic value constellations based on the five circular business models categories. The results illustrate the multidimensional features of customer value propositions in circular business models. Value creation occurs in multiple entry points throughout the value chain of the business and will require the company to design a combination of distinctive value dimensions in order to meet customer needs.

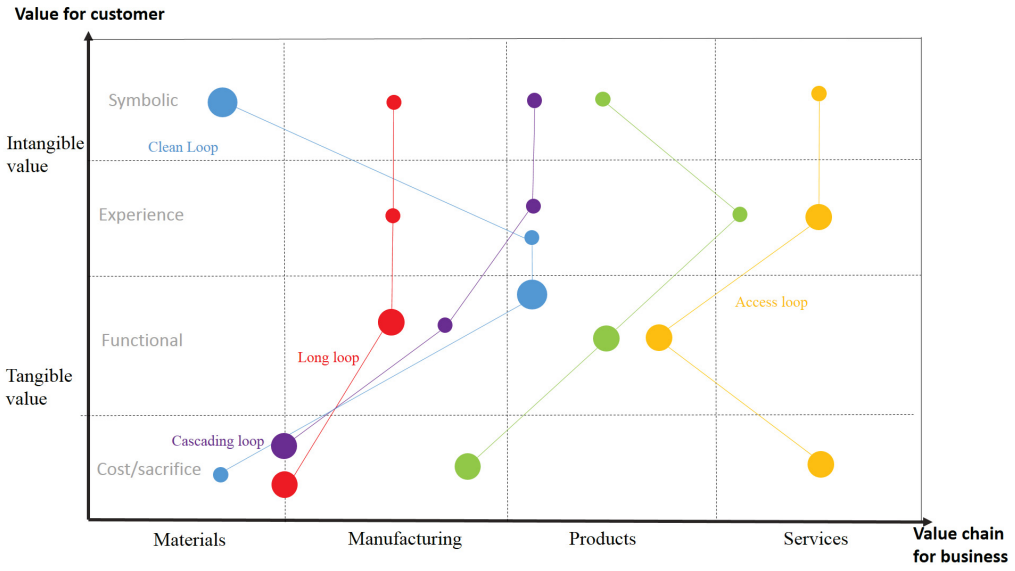


Figure 4: Circular customer value constellations

4.4 Dynamic circular value propositions

Circular value propositions are dynamic by essence. By adopting a life cycle approach for the products and services associated to the solutions offered by the company, the end users targeted by the company may change over time as well as their respective roles in the value network. A customer initially using a new product may become at a later stage supplier of product's part for other customers in the ecosystem to reuse after remanufacturing. Therefore, the initial value proposition of the focal company will need to adapt to these changing roles. As an illustration, a company selling agriculture equipment may first highlight in its value proposition the cost-effectiveness of its equipment (an energy-efficient tractor meeting the multiple needs of the farmer) but at a later stage in the life cycle of the product highlight the value related to remanufacturing specific technical parts of the tractor for other customers (cost savings related to use a remanufactured part versus a new

replacement part). Recovered materials at a later stage may be resold within the value network of the company to partners/subcontractors with another value proposition.

Table 15. Multiple value proposition for a remanufacturing company

LIFE CYCLE	STAGE 1	STAGE 2	STAGE 3
VALUE PROPOSITION	Durable, energy efficient multi-purpose tractor	A high quality remanufactured gearbox to repair existing product	Recovered material for reuse/recycling.
CUSTOMER	Farmer A	Farmer B	Manufacturing subcontractor
VALUE DIMENSIONS HIGHLIGHTED	Functional dimension: High performance/ Outcome	Symbolic dimension: Resource savings Cost/sacrifice dimension: cheaper replacement solution for similar performance	Cost/sacrifice dimension: lower price recovered material

This shift from a static value proposition to a dynamic one bears strong consequences from a company perspective. It will require an in-depth understanding of customers needs at each stage of the life cycle of the products/services while adapting the business model architecture of the company for each different stage (shift in suppliers/ partners, adapted customer relationships with distributors).

5. Conclusions

Incorporating circularity thinking in business models is perceived as a strong avenue to accelerate the transition to more sustainable patterns of productions and consumption. In this research, we focus on fostering understanding of customer value creation in circular business models. The theoretical implications of the research are threefold.

5.1 Contributions

First, we contribute to the research on circular business models by focusing on the customer value proposition. We clarify our understanding on the key dimensions of value creation that may be relevant to the customers of circular products and services. We integrate existing literature on Customer value creation to develop a framework that supports the evaluation of circular value propositions.

Second, applied to practical cases, the framework allows us to draw certain insights on customer value creation in circular business models. Depending on its position on the value chain, the circular company will highlight specific value combinations. When active on the downstream side (clean loop business models focusing on renewable supplies or cascading loops focusing on multiple value creation through resource symbiosis), the customer value proposition will generally be built from a traditional combination of functional value (green features, improved energy or resource efficiency, better outcome) with cost/benefit value (cost savings). On the other hand, when the business model is directly focused on end customers, additional value dimensions are included (experiential value to ease the customer journey, an/or symbolic value to meet customers inner values).

The myriad of combinations highlighted in the illustrative cases allow us to posit that customer value creation in circular business models is a multifaceted construct that goes beyond resource conservation or environmental concerns. We further argue that based on the type of selected business model, a combined focus on two to three distinctive dimensions are necessary to create a relevant value propositions meeting customer's needs. Most importantly, as the products and services circulate through the diverse constituents of the value network of the focal company, it is expected that roles and behaviors of these constituents evolve over time. The customer/user targeted by the initial value proposition from the focal company may shift his role and later on turn into a supplier of the focal company. In short loops business models for instance, the user of a product will become supplier of the focal company when his product becomes defect and is sent back to the focal company for remanufacturing purposes. The same dynamic shift emerges in long loops business models, as companies recover materials from their initial customers for recycling purposes.

This shift in roles throughout the life cycle of a product/service bears strong consequences on the initial value proposition of the company. It is expected that the primary value proposition evolves over time in order to accommodate the new expectations of the initial customer as his role and status changes. Therefore, companies embracing circular economy principles in their business models are expected to develop dynamic customer value propositions which will respond to the changing status of the constituents of their value network.

5.2 Managerial implications

The design, implementation and management of circular business models requires both new mental models, tools and methodologies. The circular customer value creation compass tool can be used to assess the strength of a customer value proposition from a circular business model and constitutes a visual checklist of aspects to consider for managers willing to challenge their value proposition. Illustrations found in the article provide practical examples to redesign clear circular value propositions based on the type of circular business model innovation investigated. As implied in the findings, a key managerial focus area should be on the iterative search for the right configurational fit between the various customer value dimensions.

5.3 Limitations and research avenues

The research has several limitations that constitutes relevant avenues for further investigations. First, no relation between business performance and circular value creation strategies were addressed in the research. Further quantitative study should support how certain value constellation support a better competitive advantage and improved performance.

Second, the study is static in its essence as it uses the business model as a construct to analyze the various business cases and only provides a snapshot description of the value proposition at a specific time. It does not take into account the evolution of the value proposition over time. Are mature circular business model tending to provide a more integrated value proposition? Are customer value propositions becoming more complex over time?

Third, the paper uses *perceptions of managers* involved in designing their customer value proposition, but does not directly ask customers about their own perception of the value dimensions highlighted in the value propositions. Additional research focusing on single company cases with a sole focus on customers perception could enrich the insights developed in this paper.

Fourth, the paper focuses on the customer perspective and analyses how value in circular business models is marketed to the end user. However, in CBM, value creation not only happens in the company-customer dyad but is also reflected in other interactions within the value network of the

company (suppliers, partners, local authorities). In that respect, further research should investigate the dynamics of value co-creation within strategic value nets in the context of circular business models.

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ESSAY III: Managing skills and capabilities in circular business models: insights from the European furniture industry

1. Introduction

Today more than ever the external environment of the firm is becoming turbulent. Commodity prices are getting more and more volatile, reserves of key resources (such as rare earth metals and minerals) are shrinking, material extraction costs are rising. This, coupled with growing tensions around geopolitics and supply risk leaves no room for business as usual. As the resilience of organizations is severely tested, circular economy offers a novel way to turns these environmental challenges into business opportunities by rethinking the value creation processes of the firm, looking at untapped opportunities behind resource efficiency to extend the useful life of products and materials.

If at micro-level, new greener and cleaner technologies will pave the way towards this transformation, radical innovations and disruptive business models are also needed in order to tackle the current challenges and move towards the circular economy model. The transformation towards a circular economy opens a new era of opportunities for emerging start-ups and their respective business models; it also creates new challenges for established companies. In some cases, it might even destroy the usefulness of their existing capabilities, networks, and business models (Antikainen and Valkokari 2016). How to innovate new disruptive business models when the whole business ecosystem and its dynamics are rapidly changing? How to manage resources in a dynamic environment to sustain competitive advantage? To answer these questions, looking at dynamic capabilities of firms offers new insights. Dynamic capabilities synthetize operational, marketing, human, social and managerial capabilities and form a complex system that enables firm to deploy its resources in a way that outperforms competition (Najmaei, 2011). These sets of meta-processes and routines allow firms to deal with dynamic markets.

Noori et al (2012) define dynamic capabilities as the ability for an organization to continuously recognize, integrate and leverage resources and connect them to the changing environment in order to create value. This definition shows strong similarities with the characteristics of the business model construct defined by Zott (2011) as "a system level concept, centered on activities and focusing of value". Dynamic capabilities and business model innovation are indeed two concepts fundamentally intertwined (Teece, 2010). Business model on one hand is a microfoundation of firm's dynamic capability (Teece, 2007) while on the other hand business model innovation can be seen as a higher order capability to support survival and competitiveness in the light of highly evolving business landscape. Despite these interconnections, both concepts remain rather sophisticated and their clear relationship is a challenging issue.

If the literature around business model innovation has been growing in the last 15 years, there is however a shortage of academic literature on the circular economy and more specifically on how it relates to business model innovation. Sustainable business models and circular business models are two closely related literature streams and should be approached as a subcategory of business models. If a business model can be defined as the rationale of how an organization creates, delivers and captures value, a circular business model can be defined as "the rationale of how an organization creates, delivers, and captures value with and within closed material loops" (Mentink, 2014). Implementing circular economy principles at business model level often leads to strategically rethink the types of resources being used (shifting from fossil fuel energy to renewables, increase the share of resources that are fully recyclable) in the internal processes of the firm, but also the way the organization needs to adapt to external changes (from the ever growing responsible consumer unmet needs, to the tighter resource and climate oriented legislative framework). Above all, internal innovation processes need to be challenged to build new resources and competences (both at internal and external level) fitting into a renewed business model meeting sustainability and circularity requirements. Understanding how dynamic capabilities can support this transformation can therefore improve the theory related to circular business model innovation and provide useful managerial implications for companies in the process of strategic renewal towards circular economy. Hence our research questions for this paper: 1) *How do Business Model Innovation (BMI) and Dynamic Capabilities (DC) interconnect in the context of a circular economy? 2) Which new dynamic capabilities are required to design and sustain over time a successful circular business model?*

After this introduction, we first clarify the concept of dynamic capabilities in relation to the resource-based view of the firm and provide a set of characteristics on Dynamic Capabilities. We highlight the relevance of bridging Dynamic Capabilities with Business Model Innovation. We provide a first overview of existing knowledge on Dynamic Capabilities in the context of sustainability-oriented business models. From that point we clarify the need to develop new knowledge on DC in the context of circular business models with the aim of developing a framework for circular dynamic capabilities. A selection of 25 circular business models from the furniture industry is investigated to support the identification of circular dynamic capabilities.

As a theoretically driven contribution, the purpose of this paper is to provide a first step in theory building by describing a conceptual model integrating several distinguished publications and conjoining them by condensing, summarizing similarities and pointing out differences. The paper ends with discussion and conclusion summarizing the findings and offering new avenues for future research.

2. Theoretical background

2.1 RBV and dynamic capabilities

According to resource-based view proponents, the competitive advantage of a firm lies primarily in the application of a bundle of valuable tangible or intangible resources at the firm's disposal (Penrose, 1959). These resources, when distinguished as valuable, rare, inimitable and non-substitutable will support the firm in building a competitive advantage (Kozlenkova, 2014). Clarifying the understanding of the resource-based approach, Amit & Schoemaker (1993) amended the construct of "resources" to divide it into resources and capabilities: while resources on one end are tradable and non-specific to the firm (i.e. production plant, worker's skills, reputation), capabilities are firm-specific and are used to engage the resources within the firm. Capabilities cannot be transferred easily as they have been built over time through learning and experience. One can consider them as "routines" developed to improve the deployment of resources.

As our current times become more turbulent (i.e. increasing life-cycle of products, exponential renewal of technologies, cumulative volume of information data), some scholar argue that there is a growing gap between the external environment rapid pace of change and the capacity for organizations to adapt and respond to uncertainty. Resource-based view has been criticized for being mainly static in explaining competitive advantages, and still falls short to explain how firms perform over time. As the external environment of the firm is rapidly changing, existing routines and competences may not be sufficient to respond efficiently to these growing pressures. Dynamic capabilities, defined as "*the firm's ability to integrate build and reconfigure internal and external competences to address rapidly changing environments*" (Teece et al, 1997) or as "*the organizational and strategic routines by which firms achieve new resources and configurations as markets emerge, collide, split, evolve, and die*" (Eisenhardt and Martin, 2000) are therefore more than needed to address the market turbulence and unpredictability. Operating at a meta level, dynamic capabilities function to "*extend, modify or create ordinary capabilities*" (Winter, 2003) and provide firms the capacity to purposefully create, extend or modify their resource base (Helfat et al, 2007). Dynamic capabilities are not simply processes, but they are embedded *in processes (Wand and Ahmed, 2007), it is the firm's potential to systematically solve problem* (Barreto, 2010).

How can dynamic capabilities be defined or systematically organized? According to Eisenhardt and Martin (2000) the common characteristics of dynamic capabilities across firms can be identified. Dynamic capabilities demonstrate the nature of "commonalities in key features, idiosyncrasy in details". Teece (2007) argues there are three classes of dynamic capabilities: sensing, seizing and transforming capabilities. Companies with strong dynamic capabilities go further than adapting to their business ecosystem, they shape them through innovation and collaboration with others. These capabilities are supported by a set of microfoundations that create a sustainable advantage. According to Wand and Ahmed (2007) the notions of dynamic capabilities can be analyzed according to three component factors: adaptive, absorptive and innovative capabilities. Adaptive capability

can be defined as a firm's ability to identify and capitalize on emerging market opportunities. It seeks the strategic flexibility of resources and the alignment between the firm's resources, its organizational form and constantly shifting strategic needs. Absorptive capability is the ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends. Firms with higher absorptive capability demonstrate stronger ability of learning from partners, integrating external information and transforming it into firm-embedded knowledge. Innovative capability refers to a firm's ability to develop new products and/or markets, through aligning strategic innovative orientation with innovative behaviors and processes. According to Ambrosini et al (2009) dynamic capabilities will differ according to the external environment of the firm and its level of turbulence. In stable environments, firms only use incremental dynamic capabilities, which will be simple and iterative. Renewing dynamic capabilities will be solicited when the external dynamic environment erodes the advantage of the firms. New resources need to be created or new resource combinations formed. In hyper environments, regenerative dynamic capabilities will not operate directly on the resource base but on the capabilities at incremental and renewing levels.

2.2 Linking Dynamic Capabilities and Business Model Innovation

Business models, dynamic capabilities, and strategy are interdependent: the strength of a firm's dynamic capabilities help shape its proficiency at business model design (Teece, 2017). The design and operation of business models are dependent on a firm's capabilities. Business model as a theoretical construct, goes beyond the mere profit and cost structures of the firm. It encompasses a large set of interconnected components which, when associated together seek to understand how a firm creates and capture value for its stakeholders (Chesbrough, 2007). It can as such be addressed to strategically understand how value is captured from firms' innovations. Johnson et al define four elements constituting the essence of the business model: the customer value proposition (CVP) summarizing the unique value offerings differentiating one firm from the other, the profit formula, describing how the firm manage costs and creates superior profit, key resources and key processes which enable the firm to create and capture value. In other words, the business model offers a simplified representation of the inter-locked mechanisms shaping the position of the firm in its environment. As a static construct depicting the firm's core logic to create value, business model however fails to address how the different elements need to be challenged to sustain profitability over time. As a result, business model innovation is considered a strategic priority; it enables firms to reconfigure their value proposition through a whole new bundle of customer value and wealth (Kim and Mauborgne, 2004). By rethinking the firm's value architecture, business model innovation opens ways to diagnose, re-assess and improve existing models or reinvent new ones (Najmaei, 2011). In order to avoid extinction, firm unquestionably have to become fluent in revising and reinventing their business model. They need to develop a clear set of meta-capabilities and specific

resources to perform this systematic strategic activity. Both DC and BMI are mutually interdependent: on one hand, business models are enabled by dynamic capabilities as a dynamically capable organization will be able to rapidly implement, test, and refine new and revised business models (Teece, 2017). On the other hand, the choice of a specific new business model will affect the development of dynamic capabilities currently in place.

2.3 Dynamic capabilities in sustainability-oriented business models

According to Bocken et al (2014) business model innovation for sustainability are innovations that create significant positive and/or significantly reduced negative impacts for the environment and/or society, through changes in the way the organization and its value network create, deliver value and capture value or change their value propositions. In order to succeed in sustainable business model innovation, several dynamic capabilities need to be mastered. Few studies however connect corporate sustainability and dynamic capabilities (Amui, 2017), and no studies so far have tried to highlight the type of dynamic capabilities necessary to manage circular business models. Yet there is an opportunity to identify what kind of dynamic capabilities should be developed to overcome circular economy business model innovation challenges. Understanding dynamic capabilities for circularity can support firms in developing the capabilities needed at process, organisational and strategic level to adjust their routines, behaviours and strategies to meet the challenges of a circular economy. Zooming out from the circular economy literature, looking at dynamic capabilities in the context of sustainable business models can provide relevant insights. However, literature around dynamic capabilities for sustainability usually takes a specific focus, whether on clean technology (Bhupendra and Sangle, 2015), sustainable supply chains (Beske 2012, Beske et al, 2014) or environmental management (Wong et al, 2012, Wong, 2013) and does not provide a systematic and transversal approach using a business model innovation perspective. When addressing necessary capabilities used in *pollution prevention and cleaner technology* strategies, Bhupendra and Sangle (2015) highlighted on one hand process and behavioural innovativeness to implement pollution prevention strategy while cleaner technology strategies require all aspects of innovative capability (behavioural, market, product and strategic innovativeness). Rashid et al (2014) focused on four capabilities key to *eco-innovation practices*: technological collaboration, green human resources, eco-innovation culture and environmental management system strategy. Gabler et al (2015) introduced the concept of *eco-capability* in which environmental orientation and organisational innovativeness are put forward as key dimensions. Hofmann et al (2012) identified the adoption of advanced technology, experiences with inter-firm relations and capacity for product innovation as the three main DC supporting green transformation of firms. According to Beske (2012), the key categories to achieve dynamic capabilities towards *sustainable supply chains* are orientation (sustainability and learning orientation), continuity, risk management, and proactivity. Building on their previous studies, Beske et al (2014) extended their scope and highlighted eight key capabilities:

knowledge assessment, knowledge acquisition, ability development, search, selection and integration of partners, supply chain link foundation, product development, relationship management, and reflexive control. Rauer and Kaufmann (2015) addressed barriers to sustainable supply chain management and proposed a set of three dynamic capabilities to meet these challenges: sensing capabilities, alignment capabilities and resilience capabilities. Eccles et al (2011) when investigating the effect of corporate sustainability on organisational processes pointed out that high sustainability-oriented companies have implemented strong stakeholder management processes, long-term orientation, and transparency in the disclosure of non-financial information. Table 1 below summarizes the dynamic capabilities identified in the sustainability literature from a material and product perspective, organisational perspective and value chain perspective. Differences and similarities in the context of circular business models will be assessed in the framework of this article.

Table 1. Overview of Dynamic capabilities in sustainability-oriented business models in the literature

CAPABILITY LEVEL	DYNAMIC CAPABILITY (from literature)
Material and product	
- Eco-innovation - Clean technologies	-Technological collaboration, green human resources, eco-innovation culture and environmental management system strategy (Rashid et al, 2014) -Behavioural, market, product and strategic innovativeness (Bhupendra and Sangle, 2015)
Organisational	
- Values - Orientation - Culture - Knowledge	- Sustainability orientation (Beske, 2012) - Long term orientation (Eccles et al,2011) - Organisational innovativeness (Gabler et al, 2015) - Transparency in disclosure of-non financial information (Eccles et al, 2011)
Supply chain	
- Supply chain	- Knowledge assessment, knowledge acquisition, ability development, search, selection and integration of partners, supply chain link foundation, product development, relationship management, and reflexive control (Beske et al, 2014) - Sensing capabilities, alignment capabilities and resilience capabilities (Rauer and Kaufmann, 2015)

2.4 Towards dynamic capabilities in circular business models

Circular business model research is a fairly young emerging area, grounded in sustainable business model innovation. Mentink (2014) provides a simpler definition for circular business models: A circular business model can be defined as "*the rationale of how an organization creates, delivers,*

and captures value with and within closed material loops". Even if the circular business model area is being more and more analyzed in the literature there is to date no consensus on the true characteristics of a circular business model as opposed to other sustainable business models. Following a circular economy thinking approach offers businesses an avenue to resilient growth, a systemic answer to reducing dependency on finite resources and a means to reduce exposure to resource price (Aldersgate, 2012). But adopting a circular model also offers opportunities to shift the economic balance away from energy-intensive materials and primary extraction, it offers new value creation opportunities dedicated to materials innovation, design, reverse cycle activities for reuse, refurbishing, remanufacturing, and recycling. The circular approach aims to be regenerative by intention (EMF 2013): it relies on efficient material flows, radical design and adapted logistical chains to maintain resources in circulation, insisting on components recovery and re-manufacturing in the technical cycle. Bio-based materials and associated distribution /collection circuits, on the other hand, are designed to re-enter the biosphere safely (e.g. through restorative agricultural processes, like natural fertilizers) and kept contamination-free.

Circular business models can be directly connected to several sustainable business model archetypes (Bocken, 2014) that go beyond merely closing material loops: maximizing material and energy efficiency, creating value from waste, deliver functionality rather than ownership, substitute with renewables and natural processes can be seen as circular business model strategies. Each of these approaches requires developing an appropriate set of skills and capabilities. Currently, literature around circular business models has not yet systematized the skills and capabilities needed in order to implement a circular business model. In order to reach that gap, a qualitative research approach is taken looking at one sector – the furniture industry – in order to identify relevant patterns of skills and capabilities necessary to support circular business model innovation. The research design is detailed in the next section.

3. Research design

In order to answer our research question, we focus on the transformation practices taking place in companies from the furniture industry having implemented a circular business model.

The furniture industry was chosen as a relevant sector to analyze. In Europe only, ten million tons of furniture are discarded by businesses and households every year (EEB, 2017). Furniture waste across the European Union accounts for more than four per cent of total municipal solid waste. Of this amount, up to 90 per cent is incinerated or dumped in landfills, with a maximum of 10 per cent being recycled. The furniture industry is facing a variety of economic, regulatory and environmental challenges, including growth in emerging markets, consumer demand for 'keenly priced' items and volatile raw material and energy costs. A more circular supply chain can promote growth and jobs in emerging service areas such as repair, reuse, remanufacture and leasing.

The research takes a multiple case study approach (Yin, 2009), focusing on 25 companies, in order to identify capabilities that were useful to transform existing business model into a circular business model. Interviews took into account the skills and capabilities of each firm but also the strategic decisions and processes that supported the transformation to a circular business model. A system view was also taken into consideration. Semi-structured interviews were organized at the facilities of the companies or through skype meetings, completed by secondary data. The interviews opened up with broad research question, narrowed down to specific identification of skills and competences supporting the transformation. The analysis of the data collected led to developing theoretical insight and supported theory development in new phenomena (Eisenhardt, 2007).

3.1 Case study selection

The research took place in the framework of FURN360, a European Erasmus+ project involving 6 different partners from four different European countries (Finland, Belgium, Germany and Spain). The project aims to develop a new training curriculum in circular economy with a special focus on the furniture industry. When selecting companies, researchers first focused on national best of class examples in each partner's countries and completed the selection with a number of recognized European examples available in additional countries (UK, France, Sweden, Denmark, Italy). The selection led to a preliminary identification of thirty five cases. A refinement to twenty five to was done in order to have a fair distribution of cases among the distinctive categories of Circular Business models. The objective was to address cases focusing on clean loop approaches (focus on renewable materials, recycled materials), short loop approaches (focus on repair/reuse), Access loop approaches (focus on leasing solutions), long loop approaches (using recovered material from existing furniture) and cascading loop approaches (multiple value creation from different uses of product/materials). The table below presents an overview of the identified cases.

Table 2. Presentation of case studies

Code	Country	Circular business model	Informant position	interview date	brief description of CBM	Level of circularity (beginner, intermediate, advanced)
S1	Spain	clean loop /cascading loop	general manager	16-04-2018	FSC certified wooden frames for upholstered furniture, production of pellets	Beginner
S2	Spain	clean loop	Manager	19-04-2018	Certified wood	Beginner

S3	Spain	clean loop/short loop	CEO	20-04-2018	Eco designed furniture, transparency and reparability	intermediate
S4	Spain	clean loop	Product and marketing manager	23-04-2018	Eco designed furniture	intermediate
S5	Spain		Director	18-04-2018	furniture design using recycled material	intermediate
S6	Spain	long loop	manager	16-04-2018	outdoor furniture design manufacturer	intermediate
S7	Spain	clean loop	quality manager	16-04-2018	fixed seats and movable seating solutions for public spaces	intermediate
S8	Spain	clean loop	Quality manager	18-04-2018	sustainable wooden door manufacturing	beginner
S9	Spain	long loop	technical director	20-04-2018	manufacturer of leather for the furniture industry using pre-consumer waste	intermediate
S10	Spain	long loop	manager	13-04-2018	furniture manufacturer made of recycled wood	beginner
S11	Spain	clean loop	head of Administrative department	26-04-2018	manufacture of upholstered furniture	beginner
B1	Belgium	clean loop	Founders	23-03-2018	furniture design using unique reclaimed wood	intermediate
B2	Belgium	long loop	project manager	11-03-2018	sustainable furniture design using local old furniture	intermediate
B3	Belgium	long loop	coordinator	30-03-2018		intermediate
B4	Belgium	short loop	CEO	11-04-2018-	transformation of workspace	Advanced

					through redesigned sustainable furniture	
F1	France	long loop	CEO	21-03-2018 and 3-04-2018	interior design of spaces using reclaimed wood material	Advanced
F2	France	long loop	CEO	9-04-2018	high end furniture designer made of reclaimed wood	Advanced
F3	France	short and Long loop	director	20-03-2018	Social purpose through working with wood for urban furniture	Advanced
N1	Netherlands	long loop and access loop	CEO	5-04-2018	design of sustainable furniture, leasing service	Advanced.
Se1	Sweden	clean loop, long loop, access loop	Founder	11-04-2018	design of sustainable furniture for public spaces	Advanced
It1	Italy	clean loop, access loop	CEO	9-04-2018	design of modular sustainable furniture	Advanced
De1	Germany	long loop, clean loop	manager	09.05.2018	Manufacturing of seating solutions with a focus on ecofriendliness	intermediate
De2	Germany	long loop	director	19.04.2018	Manufacturer of furniture	Beginner
De3	Germany	clean loop long loop	manager	09.05.2018	kitchen manufacturer with environmental concerns	Intermediate
De4	Germany	clean loop	manager	09.05.2018	Design of modular furniture	Beginner
De5	Germany	long loop	manager	09.05.2018	furniture manufacturer	Intermediate

3.2 Data collection

The timeframe for the data collection was from February 2018 to May 2018. Semi-structured interviews took place either at the firm's facilities or through skype messenger. An interview guide was drafted to support the data collection. Questions led the informant to describe their circular business model, the transformation pathways that happened from linear to circular business. A specific set of questions focused on skills and competences that were developed or used for the company to successfully transform into a circular business model. If data collection was primarily done through interviews, secondary data (company internet webpages, reports, articles in media) was used to triangulate the results. In total, twenty five informants were interviewed in 7 different countries. Interviewees were mainly CEOs or sustainability managers. Interviews lasted about an hour, were recorded and manually transcribed for the analysis.

3.3 Data analysis

Following an inductive approach, in the analysis of interviews, we searched for excerpts talking about business model innovation. We identified mentions of resources and capabilities developed when transforming to CBM, and bridged connection between the two. The next section summarizes the result of the analysis.

4. Results

In order to facilitate the organization of skills, competences and capabilities supporting the implementation of circular business models, we first classify relevant skillsets according to the various dimension of the business model construct, using a backstage/frontstage approach. In the backstage side, we focus on the relevant skills in the Resources, Activities and Actors (network) triad. In the frontstage site, we highlight skills and competences in customer segments, relationships and channels. Second, we address second order skills influencing both the backstage and frontstage side of the business model innovation. Third, we look at how the pooling of skills and competences support the development of dynamic capabilities of the BMI process, providing first insights on circular dynamic capabilities.

4.1 Backstage

4.1.1 Key resources

Key resources are the main inputs that a company uses to develop its value proposition, service its customer segment and deliver the product to the customer. They are usually based on a combination

of tangible and intangible resources. These assets support the creation of the end product and deal with the operational end of the business spectrum. They highlight the type of materials needed, the equipment required and the type of knowledge held by the staff employed. In the business models analyzed focusing on companies applying circular economy principles in the furniture sector, the following intangible resources were identified*: 1) Knowledge and skills in sourcing the right material and the right suppliers of ecological products, 2) Skills in acquiring new knowledge to process reclaimed material.*

Accessing the raw material (either reclaimed material collected locally or wood coming from sustainably managed forests) is the most critical aspect in the new business model development. This either requires knowledge and skills in developing a chain of custody certification for FSC/PEFC wood – if the strategy is to focus on responsible sourcing, or relevant skills in identifying and securing a stable source of reclaimed wood (either through partnerships with waste handling companies or local public authorities) if the business model focuses on reusing reclaimed materials. In the case of B4, the customer is also the provider of the raw material, as the company offers integrated solutions for upcycling existing furniture. Accessing this existing resource requires the implementation of a relevant logistics routine (collection, sorting, cleaning processes) that is only possible if the company has the right p artners at hand. As they are driven by a strong ecological purpose, the circular furniture companies strive to use more ecological products in their manufacturing process. Finding substitutes to chemically processed glues, looking for alternatives to varnish by using natural oil – the use of ecological options requires to adapt existing manufacturing processes but also to search for the right eco-supplier.

Working with material which has previously been manufactured (in the furniture sector, the majority of circular business cases make use of reclaimed wood) has consequences on the way to handle and reprocess the resource: new skills need to be acquired throughout the production cycle (from design to manufacture) as the type of wood that is supplied generally comes in various batches and has different origins, different properties, and different conditions. This needs to be analyzed, case by case. N1 manager, which has an extensive experience in working with reprocessed wood highlights this competence: *"Eight years ago we were learning things and today we still learn other things because there is always another type of wood coming up."*

Despite existing studies highlighting the importance of clean technologies supporting the transformation to sustainable business models, technological novelties are often disregarded as the main resources necessary to produce circular furniture. On the contrary, working with reclaimed wood mainly requires manual work in order to put the wood back into its initial condition. As F1 manager points out: *"There is no need in technical innovation but in vision and adaptation depending on the material that you have to work with".*

However, to make the transition successful, the staff needs to be aware of its limitations and search for new knowledge. This is often done through trials and errors in a process that is more timely than working with stable supplies. As B3 manager reflects, management has to communicate the sustainability values that drive the company to work in such manner, to make sure the staff understands and embraces this approach: "*you have to make sure that your co-workers want and can work in this way*". Table 3 provides an overview of relevant skills and competences associated with the business model block "key resources".

Table 3. Overview of relevant skills in Key Resources

Skills	Business model element	Key process/routine	skills/competences	Example	Representative quote
Reconfiguring	Key Resources / key suppliers	Sourcing	Knowledge on accessing sustainably produced or reclaimed material.	B1 assesses different options of wood and resources based on its ecological impact (location, certification, etc…).	*"we need a clear understanding and knowledge of the different resources and raw materials" B1 founder.*
Reconfiguring	Key Resources/ Network	Sourcing	Knowledge on identifying the right eco-suppliers for material substitution.	B2 has identified the right eco-supplier for ecological oils.	*"We try to deal consciously with our material. We try to find raw material as close as possible to our production place to promote short-circuits"B2 founder.*
Reconfiguring	Key Resources / network	Sourcing	Skills in handling the customer as a provider.	B4 uses the old furniture from its clients as raw material for new furniture	*"our clients are important as we get the raw material from them" B4 CEO*
Reconfiguring	Key resources	staff training	Awareness of skills limitations and will to extend knowledge.	B2 manager had to train himself and work by trial and error.	*"There are different types of wood. I had to learn how to manufacture it and develop my technical*

					knowledge by trial and error" B2 manager "You have to make sure that your co-workers want and can work in this way" B3 founder.
Reconfiguring	Key resources	staff training	Ability to communicate values to staff.	B3 founder stresses the importance of communicating the values behind the company to the workers remanufacturing the furniture.	

4.1.2 Key activities

Transforming a linear business model into a circular one calls for a number of key activities in order to operate successfully. Similarly to key resources, key activities are required to create and offer a renewed value Proposition, reach markets, maintain customer relationships, and earn revenues. Like key resources, key activities also differ depending on the business model type. In the furniture manufacturing sector, the production part is the main relevant set of activities. These activities relate to designing, manufacturing, and delivering a product of superior quality. As a circular furniture products aim to deliver a superior product with a minimum impact on resource use, *adopting, mastering and implementing eco-design skills* (1) is perceived the most important distinctive key activity along with *Research and innovation along untapped material use* (2).

Eco-design strategies are multiple and encompass various interventions throughout the life cycles of a product/service. Strategies such as design for environment, design for disassembly, design for modularity, design for recycling (design for material recovery), design for reuse and remanufacturing (design for component recovery), design for reliability, design for maintainability, and design for end-of-life allow the manufacturer to increase the sustainability and circularity of their products to limit their impact on the environment in the various life-cycle phases (Go, 2015). Circular furniture companies highlight the importance of these Design for X strategies. B4 manager for instance, stresses the significance of design for remanufacture as a key aspect in eco-design process to facilitate the transformation of used products into new ones. If most of the companies prioritize the use of eco-materials (ecological glues for instance) in their manufacturing process, thinking of the next life of the manufactured product seems to be more important to achieve a closed-loop process, as F1 founder discusses:*"we design our furniture in a way that we could easily assemble and disassemble the material and reuse it after its life cycle*". Following a cradle-to-cradle approach (Braungart and McDonough, 2002), N1 founder combines Design for Environment with Design for Remanufacture: "*We are also developing a new glue that would be biodegradable on 18-20 years so that we could reuse the wood when we get the tables back*". Specific to the circular furniture sector, design skills are implemented once the resource (in this case the reclaimed wood) is acquired. B3 manager for instance stresses the need to *"readapt your design to the product and to the material*". Eco-design skills however should not hide the need to develop products whose value proposition relies first on aesthetic. As F1 director points out: "*we think the environmental approach will only be successful if we offer a beautiful product. Design is at the service of the raw material, aesthetics at the service of ethics."*

Alongside eco-design capabilities, eco-innovation culture and environmental management system strategy (Rashid et al, 2014) are also highlighted. Larger scale companies interviewed have implemented environmental management systems to reduce their environmental impact.

Innovation in using untapped material is also recognized as a recurrent pattern in circular furniture companies. Beyond product design and manufacture, circular companies in the furniture sector may also innovate to maximize the value of their waste. In the case of furniture manufacturer N1, the sawdust from the manufacturing process is sold to a local partner which uses the glucose present in the wood and mixes it up with out of date biscuits to make bio-alcohol. The pulp is used as filling for cat litter and compost, while a small part of the wood waste is also used to warm up a local farming facility. This cascading use of the various forms of wood by-products lead to close to zero-waste process, reinforcing both the environmental purpose of the company while providing additional revenues. Table 4 provides an overview of relevant skills and competences associated with the business model block “key activities”.

Table 4. Overview of skills in Activities

Skils	Business model element	Key process/routine	skills/competences	Example	Representative quote
Reconfiguring	Key Activities	Design	Skills on design for X.	B2 develops its product so that material can easily be recycled at its end of life.	*"We use steel table legs that can be completely recycled because we do not mix the alloys"B2 manager.*
Sensing	Key Activities	Research and innovation	Innovation in untapped material use.	B1 tries to innovate in using parts of trees that would otherwise be used for biomass energy	*"We are also trying to develop design techniques to reuse branch tree tops to be able to upcycle" B1 founder.*
Seizing	Key Activities	Waste management	Knowledge on recycling and cascading use.	N1 aims for zero waste processes by taking a cascading approach to its wood by products.	*"We have no waste. Waste is just waste because you call it that way, everything is raw material but you need to find the contacts that can helps you and use it"N1 CEO*

4.1.3 Key partners/value network

Alongside Key Activities and Key Resources, creating a relevant value network of suppliers and partners is essential to make the business model effective. Opting for the right partnership is instrumental in making a business success or a failure. Reasons for partnership and collaboration may involve create new resource streams, access new skills or competences, create new markets presence or pooling resources to offer an integrated solution. If not all partnerships are key to the business, *the capacity to identify key actors and generate long-lasting collaboration* (1) is an essential feature of a successful business model innovation.

In order to close the loop or reinforce the sustainability of the final product/service offered to the customer, collaboration skills and the ability to use external expertise are of high importance. Belgian company B4 for instance, when not able to produce all the furniture requested by the client, offered the customer Cradle to cradle certified products manufactured by other companies as part of an integrated solution. The results led to an increased overall sustainability of the final service provided.

Collaboration skills also provide access to new projects and resources. F1's partnership with a local authority gave the company entree to waste management facilities allowing the company to access abundant and regular wood waste flows. In this win-win partnership, the company provided the authorities with figures on the amount of diverted wood waste, thus supporting the regional recycling/reusing targets. In the Netherlands, N1 developed a long term partnership with a company recovering materials from buildings, allowing it to get access to untapped wood material.

Long term commitment and trust in partnership development is also perceived as key. B4 has been developing its network of suppliers for 25 years and can count on the strength of these relationships to deliver its services. The partnerships also extend to the clients side. Long lasting relationships with clients provide the best word of mouth advertising. F2 developed a steady set of complementary partnerships to support its development. First, with a French waste management company. The company located its offices on the waste management site in order to directly access the wood waste collected by its partner. The company also partnered with a used furniture collector. In order to increase its commercial reach at European level, the company teamed up with one of their client (a large office furniture brand) to distribute their production, giving it more credibility and an extended customer outreach. Table 5 provides an overview of relevant skills and competences associated with the business model block "Key Partners".

Table 5. Overview of relevant Key partners skills

Skills	Business model element	Key process/routine	skills/competences	Example	Representative quote
Seizing	Network/key suppliers	sourcing	Collaboration and partnerships skills.	B2 developed a strong alliance with a local waste management organization to access it bulky waste.	*"Without the collect of the bulky waste and its supply of wood, the project could not have been conducted" B2 manager.*
Seizing	Network/key suppliers	sourcing	Networking skills.	B1 has learnt to develop strategic partnerships with regional waste management authorities, to help them source relevant untapped material.	
Reconfiguring	key Resources/network	strategic	Pooling of complementarity skills.	B2 identified the right partners to fit with its existing competences.	*"I had the marketing and production skills while he had access to the material and has a good network and corporate skills" B2 manager*

4.2 Frontstage

4.2.1 Value proposition

The value proposition of a company provides a unique combination of products and services which provide value to the customer by resulting in the solution of a problem the customer is facing or providing value to the customer. In the furniture sector, if the conventional value proposition is to provide access to high-quality, functional design furniture, the emotional dimension of the product, translated in a strong responsible and sustainable ethos, is always combined to the functional and aesthetic dimensions generally promoted in the sector. In that respect, circular furniture manufacturers need to develop skills and competences associated to the *sustainable value* (1) associated with their offerings, while responding to their customer needs, through *product customization* (2) and *product uniqueness* (3) features.

Product customization is a strong feature in circular value proposition of the furniture industry. As Belgian company B3 coordinator states: "Everything is custom made". Client needs and preferences are clearly identified. A matching between existing wood in stock and client preferences is being made. Similarly Italian furniture company It1 develops its kid's furniture design with a strong focus on product personalization. Clients are invited to download tutorial on the company website to transform or upgrade the initial purchase, allowing the client to give a personal and unique feel to the product. Associated with product customization, *product uniqueness* is a common feature in circular furniture value propositions. Belgian company B1 for instance doesn't search for the perfect wood but sees value in working with imperfect and unique trees with provides a sense of uniqueness to the product and offers a story to the client on the origin of the tree used to develop the product.

Associated services are often included in the value proposition. Beyond selling furniture, circular furniture companies often use their sustainability/circularity expertise as an added value to reach customers in need for an improved sustainability impact. Swedish company Se1 for instance, active in the B2B sector, highlights in its value proposition the increased sustainability image of public clients purchasing their furniture. This results in a *Brand booster* value proposition in which the client benefits from the sustainability value of the furniture company. Similarly, French company F1 uses its communication skills combined with sustainability expertise:*"We make up a storytelling for our client so that it would also be easier for them to communicate about their sustainability actions on their social media. We provide the client with a communication strategy that is pre-established."* Table 6 provides an overview of relevant skills and competences associated with the business model block "value proposition".

Table 6. Overview of relevant Value proposition skills

Skill	Business Model element	Key process/routine	skills/competences	Example	Representative quote
Sensing	Value proposition	Communication	Building and communicating a sustainable image.	B1 founders learnt about sustainability in their education and automatically translated it in their brand identity. B2 highlights environmental, aesthetic, local and social value in their marketing	
Seizing	Value proposition	design	Product uniqueness development	Company B1 highlights imperfection from trees to create unique products	*"We work with third choice wood because it has imperfections such as knots and cracks which is what we are searching for" B1 founder.*
Seizing	Value proposition	design	Product customization	B2 involves the client in selecting the form of the end product	*"we discuss with the clients about the type of wood he wants, the dimension and the finishing work of the furniture" B2 manager*

4.2.2 Customer segment

Customer segments are the community of customers or businesses that a company is aiming to sell its product or services to. In order to remain viable, the product or service offerings must appeal to its target customer segment. In the circular furniture sector, customer segments are generally perceived as a niche market. Niche market refers to a customer segment with extremely defined characteristics and very particular needs. As a consequence, this segment expects a highly tailored product, custom made, to suit their needs. This in turn has a strong effect on the value propositions, distribution channels and customer relationships, all closely defined according to the preferences of this particular customer segment.

Companies applying circular economy principles in their business model and in their value proposition therefore directly target consumer driven by high green and sustainable values. In the B2C market, targeted segments are sensitive to the environmental and or social dimensions of the products or services offered. In that respect, furniture companies offering solutions fitting with circular economy principles do need to understand green consumption motives and behaviors and adapt their value proposition accordingly. Green certifications on one hand, or a compelling storytelling supports the customer in choosing a product close to its values. As several circular businesses in the sector include a strong social dimension (by employing staff with disabilities or facing employability challenges), the social purpose of the company leads to focus on customer segments sensitive to these issues. In the B2B market, targeted segments are often companies willing to improve their sustainability credentials by using furniture or interior design solutions that can be easily associated with a green image (through the purchase of products with a clear “recycled” look and feel). Table 7 provides an overview of relevant skills and competences associated with the business model block “customer segment”.

Table 7. Overview of relevant skills in the "customer Segment"

Skill	Business Model block	Key process/routine	skills/competences	Example	Representative quote
Sensing	Customer segment	Communication	Knowledge on green consumption motives and behaviours.	B3 develops its promotion mix to attract green-minded consumers	“we target people that have a social and ecological self-conscience” B3 coordinator

4.2.3 Customer relationships

Customer relationships define the nature of the relationships that an organization develops with its customer segments. The customer relationships that a company opts for are based on their overall business model and directly impacts the customer experience. Companies active in circular furniture tend to create and maintain a strong personal relationship with their active clients. This has direct impact on customer acquisition, customer retention and sales increase. These personal relationships development requires specific dedicated skills which focus on engaging the customer through *trust and transparency* (1), *personal assistance* (2) and *community building* (3).

Building trust and confidence requires a high level of *transparency*. *"We always meet the client before we create a product so that we can explain who we are, what we do and why we do it."* tells B3 coordinator. *"We invite people to see our workplace"*.

Personal assistance is also highlighted. As ecological furniture may need special after-care to keep its long-lasting properties, it is important to educate the client, provide resources and information on how to maintain the product. Education the client goes beyond product features: perception of reclaimed material is often perceived as a barrier to purchase from a customer perspective. A remanufactured product is often compared to a second hand or recycled product. Providing the client with the right communication is key to turn an initial negative perception into a positive, value creating message. Belgian company B4 for instance provides certificates to the clients showing the CO2 emissions reductions associated to their use of service.

Customer relationships can also be maintained through *Community-building* strategies. As an illustration, It1 created a community of users around their modular furniture products, with the goal of exchanging ideas on how to upgrade or transform their initial kid's tables and chairs. Organization of workshops with clients is also a favored strategy to reinforce community building. F2 regularly co-creation workshops where upcycling techniques are taught. Table 8 provides an overview of relevant skills and competences associated with the business model block "Customer Relationships".

Table 8. Overview of relevant skills in "customer relationships"

Skills	Business Model element	Key process/routine	skills/competences	Example	Representative quote
Seizing	Customer relationships	Manufacturing	Transparency in product manufacturing	company B1 invites clients to visit their facilities to explain their manufacturing process	*"The fact that the people can see the origin of their products begins to be important again" B1 founder.*
Sensing	Customer relationships	Communication	Personal assistance: educating the client	B1 informs their clients on the ecological impact of their product	*"We have the responsibility to communicate the best choice to our client" B1 founder*
Seizing	Customer relationships	Communication	Community-building	B3 aims to implement workshops for the clients to create a stronger sense of community	*"..organize some events when families can come, have a drink, see the workspace. We would like to bring people together". B3 coordinator.*

4.3 Second-order capabilities

Beyond the different dimensions of the business model innovation and the associated skills analyzed in the previous section, it is possible to identify recurring skillsets that help shape the circular business model of the companies interviewed. These second-order capabilities influence and bridge several dimensions of the business models of these companies. Four second-order capabilities are presented below: *sustainability capabilities (1), entrepreneurial capabilities (2), systems capabilities (3) and user-centered capabilities (4).*

4.3.1 Sustainability capabilities: Translating personal sustainable values into a new value proposition

In line with literature highlighting sustainability orientation as a key dynamic capability for sustainable business models (Beske, 2012), all informants are driven by strong personal values in relation to environmental challenges. Belgian company B1 developed its value proposition based on its knowledge about the finitude of resources and the need to apply a reuse principle in its business model. The founders all understand the need to change the existing linear model to make a positive impact. *"We want to produce something that has no or little impact on the environment"* states the founder of French company F1. These values also extend beyond the awareness of the environmental challenges. Translating a social purpose into a business model is what drives the companies who have added a social component (professional reinsertion of people with working disabilities) in their business model. These values are anchored in the companies DNA from the start due to the personal conviction of their founders. Companies with a longer business lifetime engaged in a transformation to realign their initial purpose with their current values. Belgian company B4 for instance, after calculating its carbon emissions footprint, realized it could do more by reusing used furniture/material in its process. The strong will to reduce the impact of its activities on the environment and climate is what drove the company to develop its circular services. Translating personal values into a renewed business model comes from the capability to be future oriented and embrace a long term orientation (Eccles et al, 2011):*"If you are future oriented and if what you do makes sense, you have to go for it. If not, do not start with it"* states N1 CEO. *"I'm not doing circular economy for myself but for my child and for the future generations to have a brighter future. This can only happen if we change things now*." Table 9 synthetizes the relevant skills to translate personal values into a new business model.

Table 9: Overview of sustainability capabilities

Capabilities	Business model block	Key process/routine	skills/competences	Example	Representative quote
Sensing	Value proposition, Key Resources	Strategic vision	Awareness and education on global environmental challenges and the will to act upon it.	Company B1 founders have received trainings on the principle of circular economy in their education	*"The way we are consuming for the moment is not sustainable so we try on a small scale to go towards the good direction"*
Sensing	Key Resource/Key activities	Strategic vision	Translating a social purpose into a business model.	B2 redesigned his business model by taking into account the social motivations behind it.	*"The cooperative wanted to enable professional reintegration and to work locally by using an abundant local resource." B2 manager*

4.3.2 Entrepreneurial capabilities

Engaging in the circular economy does not come without bump. As the approach defies current businesses practices in the sector, it is therefore necessary to adopt an *Entrepreneurial mindset* to overcome all the unexpected challenges coming along, from the building of new supply chains, the adoption of different manufacturing processes and the utter complexity to convince consumers to purchase a product that might be perceived as "not new".

Before even grasping the challenges ahead, the idea leading to a renewed business model comes from a strong sensing of opportunities, as B3 manager states*: "In the beginning we already used scaffolding wood. People came to us to buy this wood and then saw what we could actually do for them. The opportunity appeared at the moment."* Seizing the opportunity behind a circular business model however requires to understand the necessity of a *trial and error* approach, a feature shared by the majority of informants. This mindset is present in the young companies entering the market as completely circular, but also among the companies who went to a gradual transformation. Belgian company B4, who has been in active as a circular company for 10 years confirms: *"We still work on trial and error. We build our knowledge thanks to that and we still build knowledge".* The acquisition of new skills often take time and patience, as N1 director points out:*" I had to test a lot of methods, do by trial and error to be able to reach the circular level that I have attained now. The more we make mistakes, the better. We have to learn by trial and error. It is the best way to improve oneself"*

As part of the entrepreneurial mindset often comes a *bricolage* skillset (Baker and Nelson, 2005[2]). In this make-do approach, often constrained to low investment and limited resources, time and personal conviction are the driving force to try out new ways to work with the wood. *"You have to work a lot, develop new techniques, and acquire common sense. You continuously have to ask yourself questions. You need to take time to try new methods"* asserts N1 founder. B4 manager*: "we search for solutions and try them out before you find the optimal solution."* Table 10 synthetizes the relevant skills and competences associated to the entrepreneurship mindset.

Baker, T. Nelson, R. E. 2005. Creating Something from Nothing: Resource Construction through Entrepreneurial Bricolage.Administrative Science Quarterly 50(3),329-366.

Table 10: Overview of relevant entrepreneurial capabilities

Capabilities	Business model element	Key process/routine	skills/competences	Example	Representative quote
Sensing	Key resources	Strategic	Entrepreneurial mindset.		*"You need the power and challenge to work in such a way" B1 founder*
Sensing	Value proposition	Strategic	"Think outside the box" skills.	B4 looks at space use inefficiency as a driver to offer new value proposition to its clients	*"We try to motivate our clients to use their space differently, to find the optimal use of the workspace" B4*
Seizing	Key activities	manufacturing	"Trial and error" approach to innovation.		*"We had to do a lot of things for the first time so we were always encountering problems. in the end we learnt to deal with these problems" B1 founder*
Seizing	Key activities	manufacturing	"Bricolage" skills.	B1 used reclaimed wood to begin with because it was cheap and easily accessible	*"In the beginning the free material was useful because we didn't have the capital to invest in other wood" B1 founder.*

4.3.4 User-centered capabilities

User-centered design tries to optimize the product around how users can, want, or need to use the product, rather than forcing the users to change their behavior to accommodate the product. This skillset is translated in practice by engaging the customer in a *co-creation process*, offering an *integrated customer value creation process* and *meeting customer needs*.

Placing the customer as a co-creator of value has been recognized as a key paradigmatic shift in the recent marketing discourse (Lusch and Vargo, 2006). In many customer-supplier relationships today, customers engage in dialog with suppliers during each and every stage of product design and product delivery. In this interactive process of learning together, firms and their customers have the opportunity to create value through customized, co-produced offerings. This co-creation process can assist firms in highlighting the customer's point of view and in improving the front-end process of identifying customers' needs and wants (Lusch and Vargo, 2006). This pattern is preponderant in the circular business models from the furniture industry. Given the resource versatility of reclaimed wood, the majority of companies in the circular furniture sector are focusing on custom designs. They involve customers from the first stage of the design process, inviting them to the facilities to look at the available raw material and select the most suitable ones to meet their expectations. This logic can often be extended to a stronger involvement of the customers, when for instance, workshops are organized at the client facilities to co-build the renewed interior with recycled wood materials.

Knowledge about customers' value-creating processes should not be based solely on hard data (such as customer satisfaction measures), but should incorporate a deep understanding of customer experiences and processes (Payne et al, 2008). This requires being able to take into account the various dimensions inherent in the *customer value creation process*. Beyond the functionality associated with the furniture itself, companies active in the circular furniture business are able to engage the customer through highlighting other value dimensions: *Experiential and sensorial value,* through the creation of a unique aesthetic furniture design, but also *symbolic value,* by engaging the customer in experiencing the use of an ethical product, free of chemicals and made of reclaimed waste.

Another key aspect of user-centered capabilities is to *meet customer needs*. In the pre-purchase phase, it is important to support the client in making the right consumption choices. Firms in the circular furniture business act as sustainability expert and can advise on the right sustainable alternatives. Advice and support on taking care of the furniture in the post purchase phase is also of high importance, to maintain the lifetime of the product purchased.

Table 11: Overview of relevant skills in the user-centered capability

Capabilities	Business Model block	Key process/routine	skills/competences	Example	Representative quote
Reconfiguring	Value proposition/key activities	design	Cocreation with customers	B1 offers "build your space" workshops for its clients	*"we bring our tools, material and knowledge and we boost the participants" B1 founder*
Sensing	Value proposition	value creation	Understanding of the various dimensions of the customer value creation		
Sensing	Value proposition	value creation	Responding to customer needs	B3 starting designing upcycled furniture to meet customer demand.	*"Our clients were asking for furniture made of reclaimed material. We wanted to do what our clients like. the clients are part of the story. B3 manager*

4.3.4 Systems capabilities

Sustainability challenges are complex and interconnected in their nature. However they are often approached through single issue and technical dimensions rather than seeing it as a systemic issue. In order to understand the challenges, taking a systems approach and looking at these challenges in a holistic way, having a broad understanding of sustainability whilst also using tools such as systems thinking and mapping can facilitate the transformation of companies toward a circular economy. In that respect taking a systems perspective can also strengthen the value proposition of the business model.

B4 for instance, has managed to integrate different strategic activities internally due to its specific position in a holding group offering supporting complementary services, such as removal and logistics services. The understanding of the advantageous position of the company in its value net allowed the company to provide a holistic approach on the whole value chain of the circular solution (access to used furniture, removal, transport, sorting, storage and inventory, remanufacturing, interior design transformation services). Taking a value network approach also reinforced the quality of products/service offered by the company. "*You have to include architects, designers, and consumers in the story of the company, make it possible to think together and give advice to each other"*. Table 12 synthetizes the relevant skills and competences associated to the entrepreneurship mindset.

Table 12. Overview of relevant skills in Systems capabilities

Dynamic Capabilities	Business Model block	Key process/routine	skills/competences	Example	Representative quote
Seizing	key resources / key partners	Strategic	systems mapping and understanding	B4 has created a systemic circular solution based on its position in its value net involving different companies from the same group	*"We have a real chain operation"*

4.4 Dynamic capabilities for a circular business model innovation: a conceptual framework.

In the previous section, we first identified specific routines and processes relevant to reconfigure the most relevant aspects of business model components for furniture companies to embrace circular economy principles. Each of these routines and processes are supported by a set of skills and capabilities which have facilitated the transformation of companies to become circular. Secondly, at meta level, four sets of second-order capabilities were identified (*sustainability capabilities, systems capabilities, entrepreneurial capabilities, user-centred capabilities*). These skillsets are not only influencing specific business model components individually, they also shape and influence simultaneously the various key routines and processes identified at organisational level. In between operational capabilities at business model level, and second-order capabilities at meta level, we highlight a third layer – dynamic capabilities – which allow the firm to pool, integrate and reorganise these existing resources, to seamlessly design a successful business model. (figure 1 and 2).

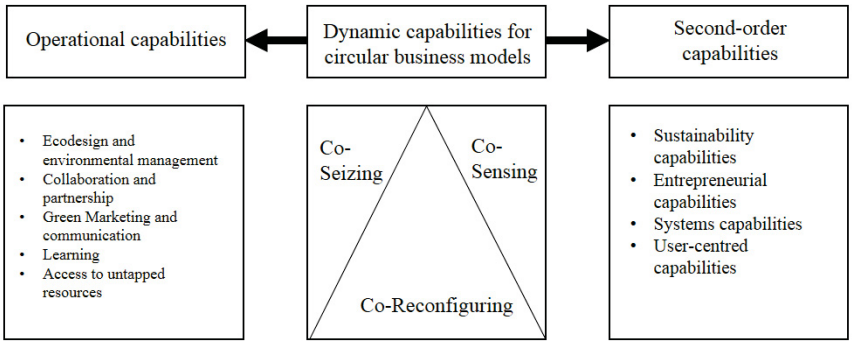

Figure 1. Bridging operational capabilities and second order capabilities through dynamic capabilities

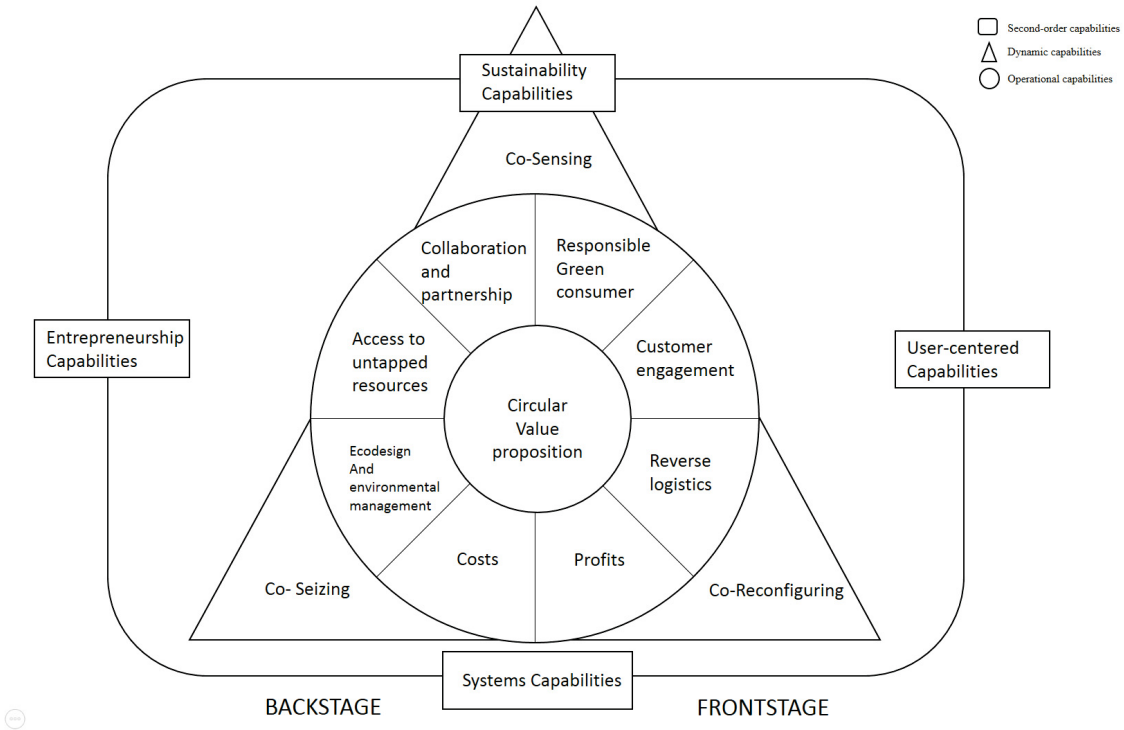

Figure 2. A conceptual framework for Dynamic capabilities in Circular business models

The three capabilities are presented below:

Co-Sensing: the integration of *sustainability capabilities* and *user-centred capabilities* into the value proposition. The business integrates the need to adapt its raison d'être to meet environmental and social challenges by co-developing a value proposition that integrate resource constraints and/or improvement of social conditions of workers in order to meet its customer needs. The business senses an increased concern from the customer to offer sustainable products and services. This in turns is reflected in the operational capabilities of the business model (access to untapped resources, collaboration skills to secure skills and resources, integration of eco-design principles and environmental management processes).

Co-Seizing: the integration of *entrepreneurial capabilities* and *user-centred capabilities* into the value proposition the business is able to engage the customer in cocreation processes while developing new sustainable products and services that meet customer demands.

Co-Reconfiguring: the integration of *entrepreneurial capabilities* and *systems capabilities* into the value proposition. The business is able to transform the sustainability challenges and resources constraints into a new business model by integrating in its value creation process the resources from other actors (suppliers, partners and customers) while adapting its own activities and resource base.

5. Discussion and conclusions

The objective of this paper was to understand how business model innovation and Dynamic Capabilities interconnect in the context of a circular economy. Our goal was to explicitly identify which capabilities are required to design and sustain over time a successful circular business model. As an outcome, our framework has conceptualized the key dimensions in managing skills and capabilities supporting circular business model innovation. Our contribution to the circular economy business model literature is both theoretical and practical.

5.1 Theoretical implications

From a theoretical perspective, we contribute to the literature on circular business model by taking a skills and capabilities lens. Dynamic capability is an established field of research in strategy and management, it is however scarce in sustainable and circular business model literature. Through an empirical analysis of 25 circular business models from one specific industry, we identified the main capabilities relevant for circular business model innovation.

Our research highlights the interconnections between organizational routines/processes and their associated skills relevant to each key aspect of the business model construct and the higher order capabilities supporting the transformation to circular business models. More specifically, our research develops a new frame that bridges higher order capabilities in sustainable business model innovation (*sustainability skills, user centered skills, systems skills and entrepreneurial skills*) with operational skills, through a dynamic capability lens. Further, we emphasize the dynamic processes taking place when co-*seizing, co-sensing and co-reconfiguring* existing internal and external resources of the firm in order to frame a successful business model.

5.2 Practical implications

From a practical perspective, our research aims at providing managers with a framework to manage the identification of existing skills and competences inside the company and in its value network and address the missing links in their business model innovation process. The illustrations from the analyzed business cases of the furniture industry also provide practical examples on how to identify and develop new skills to facilitate the transformation.

5.3 Limitations and further research directions

From a micro perspective, engaging in the transition to a circular economy is a complex process. It requires systems-level redesign and a pressing need for new skills and competences. Business models fitting the circular economy are prone to even more dynamic changes than in conventional markets Analyzing circular business model through the lens of dynamic capabilities can provide new insights on the success factors supporting the transformation. This paper attempted to provide a detailed view on the dynamic capabilities needed to support circular business model innovation. It however has limitations. The research results reported here has focused only on examples of companies operating in the European furniture industry. Although this study highlights a number of patterns that can be generalized in other circular business models cases, our learning focuses on an industry that has its own specificities (predominance of a recyclable and renewable material – wood, importance of design in the value proposition, emphasis on manual work, etc..), it is therefore questionable to see if the skillset and capabilities identified here could apply to any other industry. Further research is therefore required to test this framework in other sectors. Second, the research design did not directly focus on financial data. The results can not directly link the use of specific competences and skills with the financial successes of the companies interviewed.

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A Value Network Perspective On Circular Business Models: lessons from five case studies

1. INTRODUCTION

Circular economy has recently been highlighted as a promising avenue to address current socio-technical pressures (i.e. resource scarcity, climate change) while offering new opportunities for companies to challenge and renew their value creation strategies (Geissdoerfer et al, 2017). The transformation towards a circular economy requires however changes at all levels -micro, meso and macro levels (Lewandowski, 2016). Most recently, the circular economy discourse has started to pay more attention to circular business models as enablers to create a competitive advantage (EMF, 2013). At the most fundamental level, a circular business model can be defined as "*one which creates, delivers, and captures value in a manner that is compatible with and enables regeneration of finite natural resources, and keeps products, components and materials at their highest value and utility, within a relevant system boundary*" (Smith-Gillepsie, 2017). Simultaneously, we are currently witnessing a shift in the business model concept from a blueprint of how a single company does business (Osterwalder et al, 2004) to a blueprint that explains how network partners collaborate and create a platform in which network partners' competences and skills are combined to create a synergetic, network-level benefit (Lindgren et al, 2010). Networks have recurrently been associated with new ways of creating, delivering and capturing value (Zott et al., 2011), and the traditional linear value chain outlook has gradually been replaced by a value network perspective (Peppard and Rylander, 2006). A value network can be defined as "any set of roles and interactions in which people engage in both tangible and intangible exchanges to achieve economic or social good" (Allee, 2008). Understanding the relationships between actors is key in realizing the potential of a circular economy (Vanner et al., 2014). Discerning these relationships requires however to take a system perspective, as circular business models are rooted in complex intertwined relations at system level. It requires indeed discerning interactions between all ecosystem actors, including both the core business network and other stakeholders (Bocken et al, 2016). Therefore, managing the network of actors forming a circular business model become an important activity that should not be minimized (Sempels, 2013).

Research gap

As new business models are identified as a powerful transformative tool towards the circular economy paradigm, new knowledge on designing circular business models is needed to foster a successful implementation of the circular economy (Sempels, 2013, Lewandowski, 2016). Literature focusing on inter-organisational relationships in a circular economy context has mainly focused on remanufacturing, closed-looped and reverse supply chains, without necessarily taking a holistic systemic approach (Ghisellini et al, 2016). There is indeed only a limited understanding on how circular value networks emerge and are maintained, more specifically on the expected roles of focal companies when actively developing networked circular business models. Taking a value network perspective on circular business models can thus offer relevant insights on how value creation occurs within circular business models.

Objectives of the paper

The goal of this paper is to contribute to the ongoing discussion related to the theoretical foundations of circular business models, by adopting a value network perspective. In this paper, we posit that value creation mechanisms in circular business models need to be vested in a value network perspective. We therefore aim to answer the following research question: *which attributes of a value network perspective can support the development of circular business models?* As circular business models can be classified according to specific distinctive typologies, we also posit that the circular business model configuration influences the way the value network is emerging and organised. Through a multiple case study approach, we aim to uncover the distinctive value network configuration approaches implemented by focal companies in light of their distinctive circular business models archetypes.

Relevance of the paper

The paper sheds a new light on features and characteristics of circular value networks. From a theoretical perspective, it provides new insights on how to bridge business model innovation in a circular economy with a value network analysis. Ultimately, the study results can support managers to successfully adopt a circular business models

Structure of the paper

The remainder of the paper is structured as follows: Section 2 includes the literature review on value networks and circular business models; Section 3 (Research Method) presents the case study approach; Section 4 (Results) describes the purpose, design and governance mechanisms shaping the circular value networks studied ; Section 5 includes a discussion which describes the results in the light of extant literature as well as limitations and potential for future research.

2. Background

The literature section introduces the theoretical background of the study. More specifically, it first explains the emergence of a network perspective on value creation and second, bridges it with the current discussion around circular business model innovation. It then proposes a framework for circular value network analysis.

2.1 The network paradigm: a shift in perspective

Networks can be defined as "*a particular form of organising, governing, exchange relationships among organisations*" and are characterised by "*recurring exchange relationships among a limited number of organisations that retain residual control of their individual resources and periodically jointly decide over their use*" (Ebers, 1997). Market-as-networks theory is strongly rooted in the view that firms rely on each other's resource for their performance and survival (Aldrich, 1979). Actors are linked through resource dependency and relationships are perceived as the vehicle to access or co-create new resources. The theoretical approach explores complex questions such as how networks emerge, how networks differ from each other, what are their key drivers, how do they evolve (Möller, 2013). In his seminal paper, Thorelli (1986) highlighted the need to address networks as a third constituent within the open markets-integration continuum. In the network perspective, various flows of power, information, money and resources are circulating in long-term relationships through a dyadic or multi-actor perspective. According to Thorelli, the entire economy may be viewed as a network of organisations, with a vast hierarchy of subordinate, criss-crossing networks, a view that bears a strong similitude with the systems view favoured by circular economy proponents (EMF, 2012). In networks, which might be loose or tight depending on their quantity or quality, notions of power and influence, trust and legitimacy are shaping the positions of the involved actors. Networks are not static constructs, but rather dynamic: from the entry to the exit, a constant positioning and repositioning exercise is taking place over time with regards to existing members of the networks. This network paradigm carries along strong strategic implications and as Thorelli

points out, may serve as an engine of growth. The network paradigm also redefines the role of marketing, as marketing outcomes are increasingly decided by competition between networks of firms rather than by competition among firms (Kotler, 1999).

2.2 Managing value creation in networks

Every business relationships can be conceptualized as consisting of three layers; an actor layer, a resource layer and an activity layer (and their corresponding inter-organizational couplings). In this framework, activities are performed by actors which have access to, or are in control of various resources (Hakansson and Snehota, 1995). The juxtaposition of these three layers provides a space for value creation. Value-creating systems are set of activities creating value for customers and carried out by economic players using tangible and intangible resources (Parolini, 1999). These resources are controlled by the different actors and form a resource constellation which is then used by customers to co-create value (Vargo and Lusch, 2004). Understanding these value creating systems is key to provide a set of managerial recommendations in the way networks are governed, especially the ones with a strategic focus, also called strategic nets (Möller and Rajala, 2007). Möller and Rajala classified business nets based on their value creation logic: current business nets (vertical demand-supply nets, horizontal market nets), business renewal nets (aiming at incremental innovation) and new business nets (innovation networks, dominant design nets, application nets). The constructed value system framework shows that based on the level of determination of the network, different modes of governance solutions should be applied.

Companies operating in the network paradigm need to depart from a perspective focusing on internal resource allocation towards an approach apprehending how resources and activities relate to other actors active in the company's environment. This shift of perspective has strong strategical implications, in terms of interactive behaviour within the network. Companies need to react and adapt their behaviour in relation to other actors. The linking between activities and resources available in the network are the primary tasks of organizations, which then embrace a "*transaction function rather than a production function*" (Hakansson, 2006). Integrating resources rather than controlling resources becomes a priority in the network paradigm.

2.3 Value network: a central tenet of circular business model innovation

Circular economy as a phenomenon strongly rooted in a systems perspective can be linked to the large of body of literature related to the network paradigm. More precisely, it becomes relevant to connect it with the "value network" construct.

The notion of value networks has been rising on the agenda in the last 20 years, emerging in parallel with technological developments (digitalization, web services, dematerialization) and the increasing speed of manufacturing, which necessarily lead to redefine the notion of physical linear value chains and move towards a complex web of dynamic and simultaneous interactions. In this context, inter-firm relationships have moved from niche to mainstream. Strategic alliances, "co-opetition", shared platforms for open innovation have been booming and became the focus of and extensive body of research. Verna Allee (2002) defines a value network as "*any web of relationships that generates tangible and intangible value through complex dynamic exchanges between two or more individuals, groups, or organizations.*" The organisations making the most progress in establishing a circular economy in their fields see the potential beyond their existing organisational boundaries and create the space to think and act outside their own capabilities and skills. In order to transform to circular business models, organisations need to be open to work with others actors beyond their usual partners, and in doing so create new value networks by establishing new flows of knowledge, resources, skills and more.

2.3.1 Managing value creation in circular value networks

Circular business models are by essence networked (Antikainen et al, 2016) and in-depth collaboration between key partners of a circular venture has been identified as a key element for the success of a circular business model (Lewandowski, 2016; Bocken, 2014). In order to be successful, collaborative circular business model innovation requires re-thinking of partnerships (Lieder & Rashid, 2016). In this context, the value creation process does not only occur within the boundaries of the focal company but is co-created in the network interactions. The systemic nature of circular business models is reflected upon the various interdependencies between the different members of the value network and its complex architecture in which members actively pool complementary assets (Rohrbeck and al, 2013).

As co-creation of value with the network of the focal company has been recognized as a crucial and strategic element in maintaining competitive advantage (Porter, 2011), it also requires to rethink the roles and positions of the key actor of the network. Stakeholders relevant to new

circular business models can be organized into three distinct categories: stakeholders internal to a company, stakeholders in a value chain and stakeholders in an extended value chain (Tyl et al., 2015). To add complexity, a company in a networked business environment may be part of various value chains with changing dynamic roles, alternatively being a solution provider or a purchaser (Aminoff et al, 2017). Moreover, the successful implementation of the network-based circular business model requires that the participants commit to share valuable insights, complementary skills and assets and commit to an open-innovation paradigm. Preconditions include trust and the capacity to identify mutually benefiting business (Rohrbeck and al, 2013). Circular value networks can be defined as co-evolving, dynamic and potentially self-organizing configurations in which actors integrate resources and co-create circular value flows in interaction with each other (Aminoff et al, 2017). Understanding the nature of network roles and activities undertaken by focal companies engaging in circular business model innovation can provide insights on how value creation mechanisms are developed in circular value networks.

2.3.2 Circular business models typologies

However, circular business models cannot be classified as a homogenous group distinct from traditional business models, we therefore posit that their value creation mechanism at network level might differ. As the concept is currently being theoretically framed, several publications have intended to classify circular business models according to their similar patterns and characteristics. In this paper, we build upon Mouazan (forthcoming), who systematically reviewed circular business model typologies attempts and proposed an integrated classification of circular business models following a set of specific criteria: (1) the aim of the business model in relation to circular economy principles (regenerating loop, narrowing loop, slowing loop, intensifying loop, dematerializing loop, cascading loop and closing loop principles); (2) the business model orientation (material – product – service); (3) the focus taken by the business model on the product lifetime phases (pre-use, use, post-use), and lastly (4) its circular value dynamics (retain value, optimize value, recover value). The use of these criteria allows to distinct 5 circular business categories, detailed in table 1 below. Five generic circular business models can be delineated as a result from the classification: “Clean loop”, “Short loop”, “Access loop”, “Cascading loop and “Long loop” business models. In the remainder of this paper, we use this typology as a starting point to understand if value creation mechanisms in circular value networks are managed differently according to these distinctive circular business models.

Table 1: Circular business model typology

Circular business model	Description	CE principles	Position in the product use cycle	Business model orientation	Value dynamics
(1) Clean loop	Business model is designed around fully renewable, recyclable or biodegradable inputs	Regenerative loop	Pre-use	Material	Retain value
(2) Short loop	Business model is designed around products manufactured for extended life time and additional value is created through services supporting the maintenance of the product for the same customer (repair, upgrade), or different customer (reuse, remanufacture)	Narrowing loop, slowing loop	Use, Post-use	Product (Service)	Retain value
(3) Access loop	Business model is designed around offering access to a solution through leasing/hiring/renting products without change of ownership or through a platform allowing maximisation of utilisation.	Intensifying loop, dematerializing loop	Use	Service	Optimize value
(4) Cascading loop	Business model is designed to diversify the use of materials and products to create value from coproducts in multiple value chains within and between industries	Cascading loop	Post-use	Material (Product)	Recover value
(5) Long loop	Business model is designed based on recovering already used-resources in order to extend the value of resource through recycling	Closing loop	Post-use	Material (Product)	Recover value

2.4 Circular value networks analysis: a framework

If literature describing models to analyze circular value networks is still in its infancy, mainstream literature aiming at exploring value networks and business ecosystems has seen various descriptive approaches developed over time which we can build upon.

Several authors have focused on modeling and visual approaches to describe their understanding of value exchanges within value networks i.e. *e3-value modelling* (Gordijn et al., 2000), and it extension *c3-value model* (Weigand et al., 2007). Other have focused on specific dimensions of value, i.e. *value network model of intangibles* (Allee, 2002); while some have intended to model and capture the dynamic interactions among ecosystem business entities i.e. *BEAM: business ecosystem analysis and modelling* (Tian et al, 2008) or highlighted their foresight and strategic dimensions i.e. *Mobena methodology* (Battistella et al. 2013). Differences of analysis and wording occur as models are often based on different theoretical tenets (e.g. the Activities - Resources - Actors model, the Resource Based View model.), It is however possible to identify core elements that constitute the main components of a value network analysis. Descriptive models start with defining the scope and perimeter of the value network or business ecosystem in which *meaning and purpose* help framing other interconnected elements. Next, *actors or participants* are defined. They are independent entities - representing a company, an organization, or a customer - which are actively involved in the network. *Relationships* are another key element of a network analysis, as networks consist of several direct and indirect relationships between actors. The way in which the value is created is influenced by the nature of the *relationships* that the network actors have with each other. Close to relationships is the nature of *exchange* elements which can take several forms (product/service exchange, information exchange, financial exchange, and social exchange). At the basis of the exchange is *a value proposition (or value object)*, the promise of value to be delivered, communicated, and acknowledged to one or a set of network actors. This could be a service, a good that has an economic or societal value to at least one of the actors of the network. Emphasis is placed on what the network actor understands and feels to be the benefits. *Capabilities* are organizationally embedded resources that can create differential value for the end user when they are created and used through a chain of *activities* that are carried out by the network *actors*.

As suggested by Evans et al. 2017, sustainable business models require a value network with a new purpose, design and governance (Evans et al. 2017). Our framework of analysis follows these three key elements. First, by addressing the value network purpose, second by detailing

business model design elements (value network proposition and its associated value configuration); third by detailing enabling governance and capabilities mechanisms supporting the value network emergence). Figure 1 offers a preliminary framework to analyze circular value networks. Each analytical block is described further below.

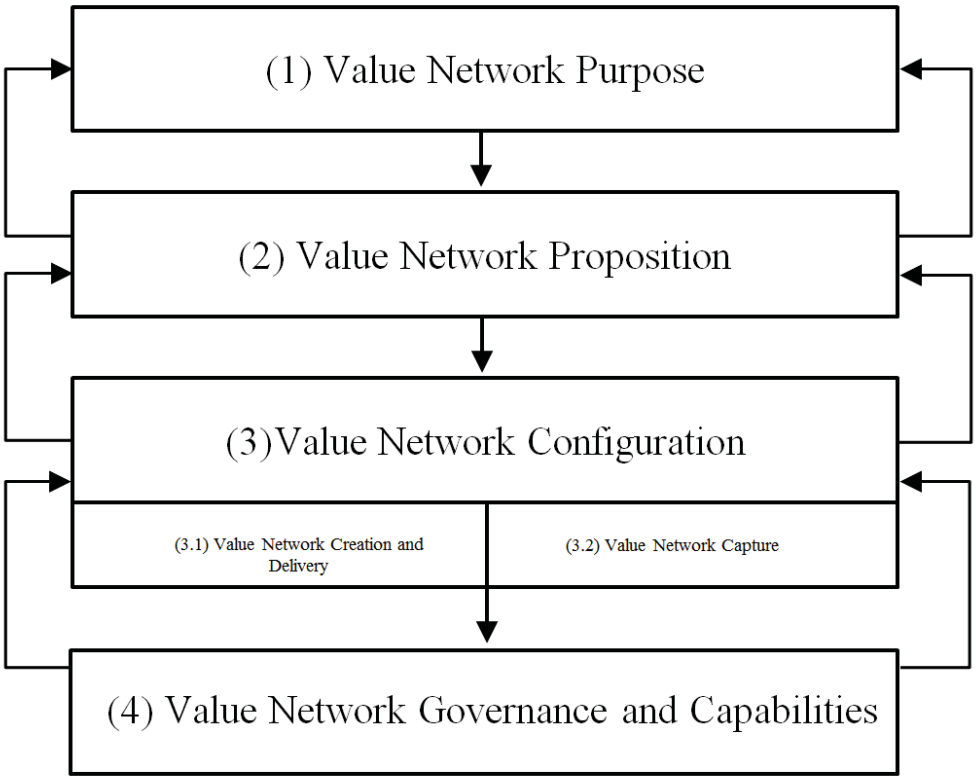

Figure 1. Value network analysis: a framework

(1) Value Network Purpose

The Value Network has a *purpose*. This purpose also implicitly sets the boundaries of the network. It describes the *drivers* and *motivations* to create the circular value network.

(2)Value Network Proposition

It clarifies the network offerings (i.e. products or services or combination of both). It describes the *benefits* associated to the circular value network for all involved stakeholders.

(3) Value Network Configuration

It describes the *interactions* between *actors* of the network leading to value creation. It includes:

- *Value Creation and Delivery Mechanisms*
  It describes the interconnected *activities* and *exchanges* of *resources* between *actors* of the value network.
- *Value Capture mechanisms*
  It describes how value is translated into *economical, social and environmental benefits*

(4) Governance and Capabilities mechanisms
It describes the formal or informal arrangements that govern resource configurations and transactions, as well as the *roles, skills* and *competences* to operate in the value network.

In the remainder of the article we use the framework to guide our analysis. Next, research method is described.

3. RESEARCH METHOD

In this research, we use an explorative, empirical research approach by selecting cases of circular business models to identify in practice how focal companies develop and manage a value network enabling the implementation of their circular business model. This approach is in line with current business model research where cases from practice are used to build ontologies and establish configurations (Wirtz et al., 2016). The study contributes to building a knowledge base rooted in practice within the field of circular business models.

3.1 Company selection

In this study we selected five companies (table 2) which are actively engaging in developing circular business models taking a strong emphasis on adopting a value network perspective. Cases were extracted from the author´s database of circular business cases. The database compiles 65+ recognized cases of circular business models taken from academic and grey literature identified from academic search directories and practitioners publications. The sources provide a description of the business models, which were later on inputted in a excel database. Each case is described according to its business model components and classified according to its value creation mechanisms. Additional secondary data was included to complete the analysis if the initial source did not provide enough information.

From that pool of existing identified cases, the following selection criteria were applied to extract the cases:

- The case companies were selected according to their circular business model typology (using the 5 loops circular business model typology). Each five selected case is representative of a specific type of CBM.
- Represents different industries.
- Include different levels of maturity in the development of the circular business model (launch phase, growth phase)
- Should represent cases active in technical and biological nutrient cycles, following the butterfly diagram (EMF, 2012).
- Business model should represent different focuses (product, material or service focus).

Table 2 describes the companies selected for the research.

Table 2: Description of five case study companies

Circular business model	Description	CE principles	Position in the product use cycle	Business model orientation	Value dynamics
(1) Clean loop	Business model is designed around fully renewable, recyclable or biodegradable inputs	Regenerative loop	Pre-use	Material	Retain value
(2) Short loop	Business model is designed around products manufactured for extended life time and additional value is created through services supporting the maintenance of the product for the same customer (repair, upgrade), or different customer (reuse, remanufacture)	Narrowing loop, slowing loop	Use, Post-use	Product (Service)	Retain value
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(5) Long loop	Business model is designed based on recovering already used-resources in order to extend the value of resource through recycling	Closing loop	Post-use	Material (Product)	Recover value

3.2 Data collection

In-depth, semi-structured interviews were chosen as a data collection method. The approach enabled data collection of individual participants' perspectives, in their own words, of the circular value network characteristics discussed. Open-ended, semi-structured interviews, in contrast to closed-questionnaire design provide enough structure and focus within a limited time frame (Savin-Baden and Major, 2013) while also being sufficiently open to allow for unusual responses to emerge and the exploration of new areas of knowledge (Bryman, 2008).

The aim of the data collection was to gather insights on specific characteristics of the value networks in place using the framework of analysis developed in the first phase. The interviews were conducted with the focal companies representatives between December 2018 and April 2019, expect for case CircPack where data was collected in a former collaborative project throughout multiple interviews between 2014 and 2016. Interviews were held either in person, via Skype or telephone, and lasted around one hour. Interviews were recorded digitally before being manually transcribed. To augment the interview data and achieve triangulation, secondary information was collected though desk research from multiple sources, including company publications, reports, web pages and other publications.

3.2 Data analysis

The transcribed interviews were coded and refined into categories associated to the analytical framework to draw out key themes. Codes were derived from the interview data based on the actual words or terms used by the interviewees or by summarizing the concepts discussed by the interviewees into themes. Coding included chunks of text at the phrase, sentence and paragraph level. Pattern-matching techniques were used to identify patterns throughout the different cases and relate them to constructs of value networks and circular business models, using a cross-case analysis. In particular, the elements of the framework were used for pattern-matching. However, we did not restrict our investigation to these elements but also looked for additional patterns.

4 RESULTS

The results are organized as follow. First, we briefly introduce the five company cases. Second, we present an integrated circular value network analysis using the framework detailed above**.** Results are discussed in section 5.

4.1 Overview of cases

The table below describes each company case detailing the company's value proposition, value creation, delivery and capture mechanisms. A larger description of the cases is available in annex 1.

Table 14. Overview of cases

Company case	Value proposition	Value creation and delivery	Value capture
CircPack	The packaging solution directly aims at tackling a global environmental issue (packaging waste), while offering advantages for both e-shops (green positioning and additional customers' acquisition) and end-users (economic incentive to shop in sustainability oriented online retailers).	The solution combines an eco-designed packaging solution that circulates between actors of the value network (online retailers selling sustainable oriented products and end users interested in acquiring sustainable products). An IT solution allows to track each and every package to monitor the circulation of the solution and reward responsible users.	The company charges on the use of the solution, not on its sales. The reusable package is going back to the company at the end of its use, to be redistributed later on to the same e-shop or to another member of the network. Another revenue stream is related to taking a 5% fee on the any additional order coming from a customer using the voucher.
CircMat	The company offers sustainable cellulose-based materials which are cost-efficient, environmentally friendly and a preferred option for brands. Associated Benefits for brands include a sustainable process that uses no chemicals while providing an inexpensive alternative to man-made cellulose	The company works with textile industry brands directly, bringing the fiber products to the markets together. CircMat only provides fiber and fabric test samples to its commercial partners. They are not selling a commodity, but the innovation and its associated technology.	The company's revenue model is explored through collaborative joint-ventures with clients.

CircWaste	CircWaste rendering plant recycles the by-products of the meat industry in a controlled manner and adjusts to the client's production quantity and speed.. The value proposition offers a diversity of customer benefits: (1) new revenue streams compared to e.g. mass burning or landfilling (electricity, biogas, landfill gas, thermal energy, fertilizers, bottom ash, metals, glass, carbon credits etc.), (2) an efficient conversion of waste into energy with combined net electricity production 30-40 % more than mass incineration, allowing the treatment of the low-calorific-value and high-moisture waste streams; (3) an eco-friendly, modular, flexible and fully scalable solution with excellent ROI and short payback time	CircWaste builds its business model on the capacity to develop modular plants with capacity varying from 12,000 to 100,000 tons of animal by products per year. The value creation is built upon the extensive know-how on building adaptive treatment plants meeting individual user needs.	CircWaste plant produces valuable commodities that are in high demand in the world market. Revenue from production side streams complements the profitability of the solution. The company uses different revenue capture strategies (from selling a tailored solution to servicizing contracts in operating the built plant) which also capture environmental benefits.
CircFood	CircFood connects sustainable restaurants, cafes, and grocery stores with consumers that appreciate eating affordable quality food. CircFood partners can drastically reduce their food waste with the help of a location-based mobile and web service with enables consumers to find and rescue surplus food in their proximity. The company's mission is to reduce food waste to zero at restaurants, cafes, and grocery stores.	The value creation is supported by the development of a matchmaking service in the shape of a mobile app that connects food surplus provider and end users.	Value is captured from extending the lifetime of a meal which can be sold to the members of the service rather than being wasted. One sold meal brings on average 4 euros to the food provider. A percentage of the sales goes to the company.

CircFash	CircFash turns other industries' surplus materials into luxury accessories with a completely transparent value chain. Their main material sources are excess leather from furniture factories, elk leather from Nordic population control hunting and salmon skins left over from food industry.	The company rescues different materials, including excess leather from Finnish furniture factories; elk hides left over from Nordic population control hunting and salmon skins, by-products of food production.. As part of value creation is a strong focus on developing a transparent narrative translated into Product DNA.	The products are sold through direct channels (online website and showroom) to avoid the use of middle men or large retailers which would otherwise take another portion of the prices

4.2 Circular Value Network analysis

The circular value network analysis follows the framework development by detailing in stages the components of the analysis.

First we explore the purpose leading to the emergence of each circular value network and its associated network value proposition. Second, we explore the configuration of each circular value network looking at the value creation, delivery and capture mechanisms operating within each value network. Third, we identify specific governance mechanisms including roles and capabilities of the focal company supporting each circular value network.

4.2.1 Circular Value Network Purpose

This section explores the drivers and motivations leading to the emergence of the five circular value networks analysed.

- Unsustainability of the operating system as a starting point

Whether operating in the food, the energy or the fashion and textile industry, focal companies developing a circular business model all recognized as a starting point the current unsustainability of their current business environment. CircFash was created as a response to the unsustainability of the fashion industry, where the increasing multiplication of seasonal collections inevitably leads to waste. CircPack designed its business model as a response to the enormous amount of single-use packaging solutions generally used in online retailing. CircMat realized that there is not enough sustainably-produced cellulose to meet the growing demand of the textile industry. While clearly understanding the unsustainability of the system where they operate, companies strategically focused on positioning themselves at a certain point in the system.

- Circular value networks as purpose-driven constellations

If the five case studies explore different pathways to develop innovative circular business models using a network perspective, every company share the same motivation, *addressing a challenge bigger than their individual market.*

CircFood doesn't only match food retailers accumulating surplus food with potential additional end users; the company contributes to a more systemic goal of creating zero food waste communities by focusing first on the end of food value chain. *CircFash* doesn't only sell sustainable fashion accessories, it aims to contribute to a new narrative surrounding fashion and textile products in which fashion products carry a story of responsibility and transparency. By communicating *an ideology through the form of a bag*, the company supports the necessary need for a system change in the fashion industry towards more environmentally friendly and socially fair conditions. Similarly, *CircPack* doesn't only sell an innovative packaging solution, it strengthen the role of end users and retailers in making the logistics of goods more sustainable. CircWaste doesn't only develop solutions for the meat processing industry; it takes a system perspective to generate wealth while protecting natural resources and the environment with snowball effects in the food and energy sector. *CircMat* does not only turn cellulose into textile fiber, it positions itself as a key disruptor in the whole textile industry while opening up collaborations with energy companies in search of sustainable use of their side streams.

In order to efficiently address these bigger challenges, the companies have understood the need to match multiple value propositions from different companies into a larger value network proposition.

4.2.2 Value network proposition

The cases analyzed illustrate how multiple aligned value propositions are nested into a value network proposition.

CircFood value proposition from the end user perspective is to provide access to surplus food at a discount. This value proposition is complemented by offering additional benefits to the food retailers' distribution the surplus food. By becoming members of the network, food retailers can generate profits from food that would otherwise be wasted. The customer acquisition and retention benefits are also perceived as additional value. Similarly, the data collected through the transactions of surplus food can also create additional value in terms of stock and order management. Only by looking at the different expectations from the different actors of the value network can the focal firm become more efficient in reaching its systemic goal. *CircPack* takes a similar approach to its business model innovation. Not only the company provides a guilt-free solution to end users ordering products online, the business model is designed to provide a large set of benefits for the online retailers part of the network: Increased brand reputation in coherence

with the green values of the retailer, a burden free solution for packaging goods, and the possibility to acquire additional customers interested in using their voucher in one of the online shops part of the system. *CircFash* through its transparency approach, communicates for each item the history of each material, production process and what is paid for the handcrafting, and allows its suppliers to become recognized partners and key actors of the whole value network.

CircWaste, starting from a modular technical solution that can be plugged in to other supporting technologies aiming at maximizing value from waste streams, creates additional individual benefits to all the actors part of the value network. The company's value proposition is modular and depends on the inputs and needs of other members of the network. Similarly, *CircMat* allows its clients to develop sustainable textile products while offering new profit avenues to wood sector actors and producers of waste side-streams.

4.2.3 Circular Value network configuration

The section details how the value network perspective taken by focal companies developing a circular business model supports their value creation, delivery and capture mechanisms

- *Value Network creation and delivery*

Traditionally, value creation has been seen as a linear process - i.e., value is created through a value chain (Vargoa, Magliob and Akakaa, 2008). However, in today's economies, managing value creation economy requires a strong appreciation of the intangible aspects of a business model and an understanding of network dynamics (Allee, 2002). Value creation in a network perspective refers to the collaborative processes and activities of creating value for end users and other stakeholders. It requires the focal company to discern the added value offered to the network while also distinguishing the perceived benefits of the collaboration.

In a circular economy perspective, value creation is built upon a systematic value leakage assessment at network level. *CircPack* value creation process is based on substituting single-use packaging with a reusable solution. The company creates value to the network by offering a packaging solution that allows the reduction of packaging waste in the online retail sector, while offering a common solution to sustainable online fashion retailers to reduce costs and increase their sustainable image. *Circfash* value creation is built upon its capacity to design new fashion accessories in a reversed manner, starting from recovered materials whose features dictate the

forms and function of the designed items. Identifying waste side streams from other industries and turning them into raw materials is at the core of the network value creation process. *Circmat* value creation is based on a disruptive technology which addresses another value leakage in the textile industry. *CircFood* similarly saw surplus food turning into waste as a major leak in the system. Recovering the food before it becomes waste through a match making app allows to create value for all the actors of the network. These value creation strategies are adaptive and locally attuned responses to an issue rising at network level. By actively aiming at dynamically build symbiotic relationships, focal companies support value creation at network level.

- *Value Network capture*

Value capture, in its conventional definition, refers to the individual firm-level actualized profit-taking; that is, how firms eventually pursue to reach their own competitive advantages and to reap related profits. Taking a circular economy network perspective, value capture at network level not only benefits the focal firm with profit making realization, it extends to the capture of societal and environmental benefits that go beyond the collaborative network of direct stakeholders. In the case of *Circpack*, value is captured by reusing the same packaging solution several times, resulting in costs reduction for the solution provider as well as the online retailers. Value is also captured at network level by offering to the end user a portfolio of online retailers sharing the same purpose – offering sustainable fashion items. *Circfash* captures value from turning waste from other members of its value network into new resources, while creating compelling narrative around the suppliers of their fashion accessories, bringing recognition to the value network members. *Circmat* captures value from the contractual agreements with its customers but allows also its suppliers to generate added value from waste side streams. Similarly CircWaste captures value from recovering valuable resources flows and allows its customers to market that resource stream as additional nutrients or energy, whith benefits for each single actor and the regions in which the projects are implemented.

4.2.4 Circular Value Network Governance

The section below first describes the role of focal companies within their associated value network. Second, we highlight skills and capabilities developed by focal companies when taking a value network perspective.

- *Role of focal companies in the circular value network*

Each value network actor generally fulfills certain functional or strategic roles. Functional roles are fulfilled by actors that contribute to the value network through their knowledge, experience, and specialties. Strategic roles are fulfilled by actors who contribute directly to a key objective or function of the value network. The section below details strategic roles of focal companies interviewed. The result of the analysis allows us to discern generic roles or "archetypes" attributed to each focal actor in their respective circular value network. Five generic roles are identified: *Enabler, optimizer, extender, recoverer and integrator*. Table 4 presents an overview of these archetypes and their main characteristics. Each role is described in the sub-sections below.

Table 4: Generic roles of focal actors in Circular value networks

	Enabler	**Optimizer**	**Extender**	**Recoverer**	**Integrator**
Role and activity in the value network	Facilitate circular value creation by developing materials and processes that can easily be cycled.	Maximize existing value creation processes by improving circulation of products through enhanced connection	Maintain value creation and capture through multiple use of product in the value network	Recover value of materials in the value network by offering new life in the post use phase	Recover value from resources through cascading use in multiple collaborations within the network
Position in the value network	Upstream / Core	Midstream / Periphery	Downstream / Periphery	Downstream / Periphery	Midstream / Core

(1) Enabler

Role and activity in the circular value network: The *Enabler* archetype describes a firm within a circular value network which facilitates another one to achieve an end. In itself, the enabler does not provide a circular solution, but develops materials or technological solutions that enable other members of the network to increase the circularity potential of their products. *CircMat*, which has developed a technological innovation to turn cellulose into textile fiber, enables fashion and textile brands to design sustainable fabrics and products coming from renewable sources with stronger

regenerative features – as materials at the end of life can be disposed of without harming the environment.

Position in the value network: Enablers can often be positioned at the intersection of two value networks from two different industries. In the case of *CircMat,* the company is positioned upstream of the sustainable textile value network by offering an innovative technological solution to be used in a sustainable manufacturing process, but it also operates downstream the forestry value network, in which it recovers by-products from the wood industry.

Relation to circular business model: Enablers fit within the *Clean loop* business model typology. Clean loop business model focus their value creation mechanisms on developing recyclable materials from renewable sources, an *enabling* condition to ultimately close the loop by allowing the materials to be used as nutrient at the end of their useful life.

(2) Optimizer

Role and activity in the circular value network: the *optimizer* archetype offers a supporting solution to an existing network by optimizing value creation during the useful life of a product. Recognizing a node in the system where value is missed or destroyed, the optimizer develops a solution to avoid value loss.

Position in the value network: The Optimizer is positioned midstream between two key nodes and acts at the periphery of the network, as its position complements previously existing relationships between other actors. In the case of CircFood, the firm, active in the sustainable food value network, doesn't produce food but extend the usability of food portions by positioning itself between the food retailer and the end user, enhancing their connection. The solution avoids value loss from the retailer associated to wasted unsold meals.

Relation to circular business model: The Optimizer archetype fits within the access loop business model typology. Through the use of a dedicated platform, the Optimizer enhances the value of the circulating product during its use phase and increases access to the product by a bigger amount of end-users leading to an intensification of usage.

(3) Extender

Role and activity in the circular value network: The *Extender* archetype creates solutions that allow the resource flow to stay longer in circulation. The outcome leads to slowing the pace of new products (and their associated resources) released on the market.

Position in the value network: The Extender is positioned midstream between two key nodes and acts at the periphery of the network, as a supporting solution. In the case of CircPack, the reusability of the packaging solution combined with the innovation of the business model allow the product to stay longer in use.

Relation to circular business model: The *Extender* archetype fits within the short loop business model typology. Through business model innovation, the value of the product is maintained for a longer period of time within the circular value network.

(4) Recoverer

Role and activity in the circular value network: The Recoverer archetype is focusing on recovering value from resources in an existing network that fail to be exploited longer. The resource is then reentered in a different value network.

Position in the value network: The Recoverer is positioned downstream from an existing value network and upstream from another value network. In the case of CircFash, waste from food systems (salmon skins, elk skins) are recovered to be reentered as raw material into a different value network – the fashion system.

Relation to circular business model: the *Recoverer* fits within the long loop business model, in which materials at the end of their useful life are recovered to be used a raw material for a different usage.

(5) Integrator

Role and activity in the circular value network: the *integrator* archetype combines multiple value propositions targeted at several customer groups originating from different sectors by developing cascading solutions using recovered resources in multiple functions.

Position in the network: The Integrator is positioned midstream and at the core of the value network. It integrates different actors and orchestrates the overall solution. In the case of CircWaste, different resources flows are used in the operating plant resulting in the development of a portfolio of by-products generating value for different industries.

Relation to circular business model: The *Integrator* archetype fits within the cascading loop business model typology, in which value from existing resources is recovered through multiple inter-organizational symbiosis.

- *Skills and capabilities to operate within a circular value network*

Common skillsets and capabilities emerge from the analysis of the five case studies. These general skillsets can be categorized into six distinctive capabilities - *Network scanning (1), network seizing (2) , network reconfiguring (3) network zooming (4) network marketing (5) and network bridging (6),* which all include a set of micro-foundations detailed below.

Network Scanning (1) includes the analytical systems to learn and to sense, filter, shape, and calibrate opportunities within the value network. Concretely, network scanning comprises all processes that help the focal firm collect and analyze network information upstream and downstream, to learn about end users, suppliers, partners. *CircFood* for instance, is actively exploring latent needs of its partners and intentionally allocates resources to identify those needs. By reflecting on one's value proposition and identifying hidden benefits, it becomes possible to maximize the value capture related to an indirect value proposition and let it transform into a new value proposition. *CircWaste*, when developing tailored solutions with their clients, has developed the capability to see one step further the offered solution to gradually improve over time the combined benefits related to multiple symbiosis. This requires to depart from a narrow silo focus to enlarge the scope of possible interventions within the network. Network scanning in essence is built upon the ability to listen to new signals in the network, things for which you were not looking. It is about having receptors and antennae open to receive unexpected information, then using it to guide action.

Network grasping (2) relates to addressing the network sensed opportunities through new products, processes, or services. Network grasping includes increased collaborative research and development activities, prototyping new solutions with members of the network. *Circmat* for instance, which has developed a technology to manufacture textile fibre out of wood-based

cellulose, is actively partnering with future clients to co-create prototypes for spinning textile fibre out cellulosic waste streams. Nurturing future emerging opportunities is key to optimize the effectiveness of the value network. *Circmat* engages in mentoring activities with sustainable fashion startups which could eventually lead to new business opportunities.

Network reshaping(3) refers to the ability to recombine and to reconfigure assets and organizational structures within the network to match the value network processes with seized opportunities. Network reshaping capability comprises agile responsiveness and adaptability skills. *Circwaste* when implementing a new case, needs to orchestrate a new set of partners configurations to respond to the client needs. This might require finding new local partners fitting the technical requirements if the solution is developed in a new geographical market, or combine an existing set of preferred actors to design a solution adapted to the client. The modularity of the configuration and its diversity is what ultimately create the most benefits to the client. When looking at future development strategies, *Circfash* sees its internationalization as the multiplication of hubs situated in different parts of the world, but adapted to the local context in which they operate. Rather than reaching high volumes production in a centralized facility, a distributed growth strategy is favored, with the objective to reproduce the set of symbiotic relationships that emerged in the first place within the first operating environment. By organically replicating new complementary partnerships with partners sharing similar features, purposes and operating processes, while based in other locations, the company recognizes that no one size network configuration fits all. Rather reconfiguring the value network in other locations necessitates to take an open pool perspective to match the required new value delivery. Finally, network reshaping capabilities also include the capacity to manage co-evolved interaction. While actively trying to scale up its activities, *CircFash* for instance also aims at supporting the growth of its network partners rather than replacing them with other suppliers with higher manufacturing capacities.

Network zooming (4) refers to the capability to dynamically change the focal length when interacting within the value network. In the analyzed cases, focal firms are able to navigate between the different sub-levels that constitute the value network. *Circfood* when developing new partnerships with food retailers and restaurants has learned that addressing both decision makers (CEO level) and staff on the ground (selling meals to end users) is necessary to make the new partners understand the benefits of using their services. Understanding micro-level motivations and drivers at individual level while in parallel responding to drivers and obstacles of partners at

organization level is key to design the most fit value proposition. When taking a value network perspective, focal firms also need to possess the necessary skills to constantly operate upstream and downstream the network. *CircFood* for instance actively works downstream with end users, equipping them with tools to become community ambassadors, while engaging upstream with larger food retailers to understand their needs in managing stocks and surplus.

Network marketing (5): Taking a value network perspective to circular business model innovation also requires to develop capabilities when marketing the products and services associated to the business model. Marketing strategies in the analyzed cases are built upon developing communities of practice. *CircPack* actively co-creates its marketing strategies with its first-level clients (online clothing retailers) who in turn promote the solution to their end users. *Circfood* takes a similar approach by positioning itself as an enabler in a zero waste community, comprising food retailers, restaurants and the community of clients. The solution is marketed by giving a more dynamic role to the end users who are actively empowered to become community ambassadors and recruit other clients. End users capacity building is also strategically favored by *Circfash* which develops instructions for its customers to keep products in use for as long as possible. A dedicated section on the company website provided hands-on instructions on how to take care of each individual items based on the source of materials. Empowering members of the value network in an inclusive way leads to an overall increased effectiveness of the value generated as a whole.

Network bridging (6): Taking a network perspective requires companies to engage efficiently in cross-sector integration. *Circpack* for instance creates bridges between the packaging sector, the logistics and distribution sector, and the online clothing retailer sector. *Circwaste* when developing multiple cascading value propositions operates at the intersection of food, agriculture, waste and energy sectors. This requires focal companies to understand the logics, processes and values of each and every sector. The capabilities are summarized in the table 5 below.

Table 5: Circular value network capabilities

Circular Value Network Governance	**Key capabilities**
Network Scanning	New signal capture, reception and treatment of unexpected information
Network Grasping	Prototyping , nurturing emergence of new opportunities
Network Reshaping	Replicability, adaptation to local context, co-evolved interaction
Network Zooming	Focal length shifting
Network Marketing	Community of practice development
Network Bridging	Cross-sectoral integration

5 DISCUSSION AND CONCLUSIONS

The paper aimed to fill a gap in the emerging research around circular business models by exploring how circular business model innovation and a value network perspective are interconnected. Through a qualitative analysis of five cases studies of circular business models embedded in value networks, we aimed at identifying the attributes of a value network perspective which are central in enabling circular business model innovation.

We validate the relevance of bridging circular business model innovation with a value network perspective. As circular business models are networked by essence, addressing the characteristics of these value networks can provide relevant insights to support circular business model innovation. In that perspective, the results of the study allow us to highlight specific characteristics defining circular value networks: first, the studied cases all display a purpose alignment from all actors involved in the network. This feature can be considered as the foundation of a circular value network. Concretely, addressing a wicked resource problem that requires complementary tangible and intangible resources pooled together in a symbiotic fashion is the main driver leading to the emergence of a circular value network. Shared mindsets from multiple actors involved in concomitant sectors consolidate the forming of circular value networks. This key characteristic of circular value networks allow us to distinguish circular value networks from the traditional understanding of value networks, which focus on creating superior value creation for the customer. Second, we highlight that circular value networks are strongly positioned at the interaction between different sectors and industries. This specific position allows to create more value for all involved stakeholders

When analyzing the business model components of focal firms embedded in circular value network, we can highlight the following characteristics. Looking at the *value proposition* component, focal companies design their own value proposition in light of other actors' needs in the network, and strive to offer multiple complementary benefits to the network. Consequently, the focal company value proposition can be described as a nested component of the whole value network proposition. Looking at *value creation and delivery* mechanisms, we highlight that value creation is built upon a systematic value leakage assessment at network level which is turned into a new value opportunity. For the focal firms, providing adaptive and locally attuned responses aiming at dynamically build symbiotic relationships support value creation at network level. Taking a circular economy network perspective, value capture at network level not only benefits

the focal firm with profit making realization, it extends to the capture of societal and environmental benefits that go beyond the collaborative network of direct stakeholders.

As reviewed by Nordin et al. (2013), value networks can be characterized by various dimensions (figure 2): degree of embeddedness (Echols and Tsai, 2005); level of interconnections (Iansiti et al, 2004), amount of actors (Battistella et al, 2012), level of dependence and control (Koenig, 2012), type of service provision (Vargo et al., 2011), level of diversity (Williamson and De Meyer, 2012). A closer look at the five circular value networks investigated in the study can allow us to position these networks against these specific dimensions and provide generic characteristics of circular value networks. Circular value networks can be characterized by a *high level of embeddedness* (i.e. the measurement of a firm's relation to its environment through an aggregate measure of the quality and quantity of firm ties), displaying *tight interconnections* between a core set of complementary actors which act in *reciprocal interdependence* (i.e. the output of one unit provides input for another and vice versa*)*. Circular value networks are built on a *heterogeneous set of actors*, often spanning through multiple sectors, which rely on *symbiotic service provision*. Often created from an *intentional* perspective strongly associated to the grand challenges they aim to tackle, circular value networks as they formalize, display some *emergence* features (i.e. the arising of novel and coherent structures, patterns and properties during the process of self-organization in complex systems (Goldstein, 1999)). Value networks are like living organisms and thus are constantly learning, evolving and adapting to changing requirements (Lusch et al., 2010).

Characteristics	Continuum	
Embeddedness	Low	High
Interconnections	Loose	Tight
Number of actors	Few	Many
Interdependence	Pooled	Reciprocal
Control	Centralised and intentional	Decentralised and emergent
Service provision	Separate	Symbiotic
Diversity	Homogeneous	Heterogenous

Figure 2. Value network characteristics continuum. Adapted from Nordin et al. (2013)

Beyond these generic features, we highlight that circular value networks, as a multifaceted and heterogeneous construct, can take different forms and characteristics depending on where one's circular business model is positioned on the life cycle of its associated product-service system. The shape or pattern of the circular business model built within a value network depends on the

overall purpose of the value network and the key strategies adopted to make the business model circular.

Nonetheless, it is possible to identify specific archetype roles for companies active in circular value networks: based on the position of the focal company in its value network, specific roles (*enablers, extender, optimisers, recoverer, integrators)* lead to associated value creation, delivery and capture mechanisms. The more integrated, the more modular and multi-functional the circular business model is. Moreover, to successfully operate within a circular value network, specific capabilities can be highlighted: *Network scanning, network grasping, network reshaping, network zooming, network marketing and network bridging* capabilities. The findings open up new research avenues on the typology of roles and activities firms may be expected to take to successfully manage *in* networks.

Beyond this attempt to characterise circular value networks, several managerial implications are inferred. The article illustrates through the five cases how adopting a value network perspective when engaging in circular business model innovation can bring new value opportunities. The circular value network framework used to analyse the cases can also provide a more systematic method to position oneself in one network depending on the business model archetype pursued. By highlighting specific roles and capabilities, the study also offers managers of circular economy-oriented companies relevant insights to support their managerial postures at network level.

The study however is not without limitations. First, the data collection for each case was limited to interviews and documents related to the focal actor of the value network. More in-depth studies including all actors involved in each value network would create a richer understanding of circular value networks. Second, we used a sample of Finnish SMEs, and though they all have multinational customers and some operations abroad, the country-specific sample may limit external validity. Third, most of the companies selected in the sample are small start-up companies with a rather young operating history. Larger traditional companies engaging in a new circular business model may develop different roles and capabilities when shifting their existing value network to a more circular one. Fourth, the study focused on the value network relationships at one point in time. Findings may be integrated with a more dynamic time- and process- oriented perspective. It is expected that the size and shape and nature of the network evolves in time; thus, roles and activities of focal companies may adapt as the value network evolves. New research should address these limitations and pursue theory-building around circular business models in a network perspective. For instance, the tension between planning and emergence of circular value networks, the balance between autonomy and interdependence of focal firms are not directly addressed in this research and should require further investigation.

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ANNEX 1: CASE DESCRIPTION

Case 1: CircPack

CircPack offers a packaging solution whereby once products are delivered, packages can be returned the company and then re-used. The service is currently being used by online retailers in several European countries. As people shop online and check out, they have an option to choose the *CircPack* solution instead of disposable packaging by paying a small extra amount. When the package is received, the end user is invited to mail the packaging back with no extra cost. The packaging solution flattens and folds nicely into letter size envelopes and can be returned via any local postal service in Europe. Once the reusable packaging is sent back, the company offers a voucher to be used among the e-shops affiliated with the system. The voucher is similar to the deposit system for recyclable bottles in place in several Scandinavian countries.

Value proposition: The packaging solution directly aims at tackling a global environmental issue (packaging waste), while offering advantages for both e-shops (green positioning and additional customers' acquisition) and end-users (economic incentive to shop in sustainability oriented online retailers).

*Value creation and delivery***:** The solution combines an eco-designed packaging solution that circulates between actors of the value network (online retailers selling sustainable oriented products and end users interested in acquiring sustainable products). An IT solution allows to track each and every package to monitor the circulation of the solution and reward responsible users.

Value capture: From a revenue stream perspective, the company charges on the use of the solution, not on its sales. The reusable package is actually going back to the company at the end of its use, to be redistributed later on to the same e-shop or to another member of the network. Another revenue stream is related to taking a 5% fee on the any additional order coming from a customer using the voucher.

A short loop business model: The circular business model can be classified as a short loop business model as it is designed to extend the useful life of the product (packaging solution) through a *reuse* strategy.

Case 2: CircMat

CircMat mission is to provide the textile industry with the most sustainable fiber in the world, produced with minimal harm to the environment, at a reasonable cost. The company has developed an ecological innovation that turns cellulose into textile fiber simply, without harmful chemicals.

Value proposition: the company offers sustainable cellulose-based materials which are cost-efficient, environmentally friendly and a preferred option for brands. Associated Benefits for brands include a Sustainable process that uses No chemicals while providing an Inexpensive alternative to man-made cellulose

*Value creation and delivery***:** the company works with textile industry brands directly, bringing the fiber products to the markets together. CircMat only provides fiber and fabric test samples to its commercial partners. They are not selling a commodity, but the innovation and its associated technology. Their main activity as scientists is to develop new materials based on their technology innovation. The new process uses FSC-certified wood pulp that is ground into a gel-like material called microfibrillated cellulose, which is made of tiny fibers. The material flows through the startup's patented machinery to create a network of fibers that are spun and dried into a fluffy, firm wool that can be knit or woven into fabric and then made into clothing, shoes, or other textiles.

Value capture: the company's revenue model is explored through collaborative joint-ventures with clients.

A Clean loop business model: The company's business model is designed around the development of fully renewable, recyclable or biodegradable inputs *for the textile industry*.

Case 3: CircWaste

In many economies, animal by-products and other by-products from the meat supply chain remain unexploited causing massive stress on nature. The guiding principle behind CircWaste's inception was to create an easy-to-buy and easy-to-deliver solution that can help protect the environment. To solve the challenge, a modular animal by-product recycling mill was developed. Animal by-product rendering is only a small part of the circular economy chain or the meat supply chain. Other operators in the fields of energy generation, biogas production, waste water treatment and similar are needed. CircWaste was thus established by two complementary companies through a joint venture delivering circular economy solutions. The first cofounder has been producing and manufacturing pure raw materials from an animal origin since the 1960s. The company carries out research and development to reach ecologically sound production processes; recycling operations and improved methods of producing natural fertilizers, animal feeds and raw materials for the bioenergy industry. The second cofounder is an EPC supplier of modular waste-to-energy power plants. The plants use different waste and biomass streams to generate steam and electricity used in rendering animal by-products. The company's power plants are the engine behind the CircWaste operations.

*Value proposition***:** CircWaste rendering plant recycles the by-products of the meat industry in a controlled manner and adjusts to the client's production quantity and speed. Meat bone meal and fat can be recycled locally, but they are also rated in the world markets, and they have buyers in many industries. The value proposition offers a diversity of customer benefits: (1) new revenue streams compared to e.g. mass burning or landfilling (electricity, biogas, landfill gas, thermal energy, fertilizers, bottom ash, metals, glass, carbon credits etc.), (2) an efficient conversion of waste into energy with combined net electricity production 30-40 % more than mass incineration, allowing the treatment of the low-calorific-value and high-moisture waste streams; (3) an eco-friendly, modular, flexible and fully scalable solution with excellent ROI and short payback time.

Value creation and delivery: CircWaste builds its business model on the capacity to develop modular plants with capacity varying from 12,000 to 100,000 tons of animal by products per year. The value creation is built upon the extensive know-how on building adaptive treatment plants meeting individual user needs.

Value capture: CircWaste plant produces valuable commodities that are in high demand in the world market. Revenue from production side streams complements the profitability of the solution. The company uses different revenue capture strategies (from selling a tailored solution to servicizing contracts in operating the built plant).

A cascading loop business model: The company's business model is designed to diversify the use of materials and products to create value from coproducts in multiple value chains within and between industries through industrial symbiosis.

Case 4: CircFood

CircFood is a start-up company connecting sustainable restaurants, cafes, and grocery stores with consumers that appreciate eating affordable quality food. CircFood partners can drastically reduce their food waste with the help of a location-based mobile and web service with enables consumers to find and rescue surplus food in their proximity. The company's mission is to reduce food waste to zero at restaurants, cafes, and grocery stores.

Environmental concerns acted as a starting point to start the business. How to tackle the fact that we consume more than 1.5 planets every month? How can food, a key ecological issue can be tackled? The business idea comes from the vision of a zero food waste community. The business aims to provide solutions to achieve this goal, starting first with tackling the end of the supply chain challenges, that is food waste generated between the moment it is produced in restaurants and the moment it is acquired by the end user. Food surplus - food prepared but not sold, then becoming food waste - is the primary concern of the company.

Value proposition: To overcome this issue, the company is offering a multiple value proposition, aimed both at food retailers/restaurants (food transformers/distributors) and end users (food consumers). On one hand, the food sellers can receive specific benefits from using the solution. Increased revenue (1): The solution turns the lost revenue from unsold meals into an extra revenue stream by bringing in customers who pay real money for the surplus food. Reduction of food waste (2): The company claims that each retailer can sell more than half of its surplus food with the solution.. Every portion sold and not thrown away reduces unnecessary emissions caused by food production. Customer acquisition (3): 70% of end users have found new restaurants to dine in while using the app. Selling surplus food doesn't cannibalize existing sales, as picking up surplus food serves different user needs than lunch and á la carte dining. Brand image (4): restaurants and stores see their brand image improved by including environmental concerns in their value proposition. On the other hand, the end user gets access to affordable quality food easily on a map and on a list. The offering consists of meals, ready-to-eat snacks, and massive grocery bags that usually have a 50% discount on regular prices. Meals are purchased easily with a payment card or PayPal. Multiple offers can be added to a single order. Food orders are ready for pickup immediately after the order, thus saving time and resources. End users get also to discover new restaurants that are part of the same community

*Value creation and delivery***:** the value creation is supported by the development of a matchmaking service in the shape of a mobile app that connects food surplus provider and end users.

Value capture: Value is captured from extending the lifetime of a meal which can be sold to the members of the service rather than being wasted. One sold meal brings on average 4 euros to the food provider. A percentage of the sales goes to the company.

An Access loop business model: The company's business model is designed around offering access to pre-waste food through a platform allowing maximization of utilization.

Case 5: CircFash

Value proposition: CircFash turns other industries' surplus materials into luxury accessories with a completely transparent value chain. Their main material sources are excess leather from furniture factories, elk leather from Nordic population control hunting and salmon skins left over from food industry.

Value creation/delivery: The company rescues different materials, including excess leather from Finnish furniture factories; elk hides left over from Nordic population control hunting and salmon skins, by-products of food production. The material gathered dictates how and what is designed. As part of value creation is a strong focus on developing a transparent narrative translated into Product DNA. Artisans put a coded label inside each bag. By using the code on the website's DNA page or scrolling down the product page, customers can find out where each part came from, who made them and where, and what was paid for it.

Caring for nature, people and purpose is also embedded in the relationship created with the customers who are advised on how to take care of the purchased products to keep them in use for as long as possible. The company website offers detailed instruction based on the materials used in the accessories for the customer to respect their purchase and take care of it.

Value capture: The products are sold through direct channels (online website and showroom) to avoid the use of middle men or large retailers which would otherwise take another portion of the prices.

A long loop business model: The company business model is designed based on recovering already used-resources (by products from the food industry – elk, salmon skin) in order to extend the value of the resources.