Politecnico di Milano

Faculty of Industrial and Information Engineering

Master of Science in Management Engineering

Design Management, Innovation and entrepreneurship – Digital Business and Market Innovation

Circular Economy and Business Model Innovation:

A framework towards business transition from linear to circular

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Academic Year 2019-2020

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For a mother and father who have always been my main source of support and inspiration, and to whom I owe not only this degree, but my whole life with all the accomplishments that may come with it.

For all the people, places, and experiences that I was blessed to have as part of my journey so far.

And last but not least, for the Politecnico di Milano, my colleagues, and my teachers from whom I learned and changed, and to whom I will always be grateful.

Astratto

L'economia circolare è un paradigma globale che sfida il modo tradizionale in cui i prodotti e i servizi vengono creati e scambiati nei mercati moderni e mira a preservare e rigenerare le risorse naturali appartenenti alla biosfera terrestre. La transizione verso un'economia circolare coinvolge molti attori diverse, uno di questi attori principali sono le imprese. Il quadro proposto offre una serie di attività che possono essere implementate a livello di modello di business delle imprese che desiderano effettuare la transizione verso l'economia circolare. Precedenti ricerche sull'economia circolare dal punto di vista del modello di business offrono molte strategie e approcci all'argomento, che sono stati attentamente studiati e illustrati durante la progettazione del quadro proposto. Il quadro contribuisce a coprire il divario di ricerca all'interno della letteratura in merito alle linee guida pratiche che le imprese devono adottare durante il loro passaggio da lineare a circolare. Molti diversi casi studio sono stati analizzati nell'ambito della ricerca; tuttavia, al fine di collegare meglio la portata del quadro per colmare le lacune esistenti nella ricerca, il caso di un'impresa storica italiana è stato studiato e analizzato in dettaglio.

Abstract

Circular economy is a global paradigm that challenges the traditional way products and services are created and exchanged within modern-day markets, and aims at preserving and regenerating natural resources belonging to earth’s biosphere. The transition towards a circular economy involves many different actors and stakeholders, one of these main actors are businesses. The proposed framework offers a set of activities that can be implemented on the business model level of businesses looking to make the transition towards the circular economy. Previous research on circular economy from a business model point of view offers many strategies and approaches to the topic, which have been carefully studied and illustrated while designing the proposed framework. The framework contributes in covering the research gap within the literature concerning practical guidelines for firms to adopt during their transition from linear to circular. Many diverse case studies have been analyzed as part of the research; however, in order to better relate the scope of the framework to address the existing research gaps, the case of an Italian incumbent firm has been studied and analyzed in detail.

"If we could build an economy that would use things rather than use them up, we could build a future."

- Ellen MacArthur -

Opening Remarks

Ever since the beginning of the industrial revolution in the 18th century and the dominance of the capitalistic economic system, constant economic growth has been considered the norm for the majority of nations. For decades, the notion of value creation, delivery, and capture has been guiding entrepreneurs and their businesses in navigating their markets. The word "value" on its own can be viewed through many lenses relative to a number of disciplines including economy, sociology, anthropology, physiology, marketing, design, and more. Despite the popularity of the word, it is still found elusive and difficult to grasp a solid definition for the word value.

An abundance of intriguing views on the notion of value exist in literature, such as the one most adopted in the UX design world, which assumes that value is the sum of six factors responsible for successful user experience design and resulting in successful performance of new products in markets: usefulness – usability – findability – credibility – desirability – accessibility. Looking at this conception of value – which belongs to a relatively new and developing field – evokes attention to a factor that has been commonly lacking from classical conceptualizations of value in economic domains, and which is only recently beginning to be taken in consideration: Sustainability.

Sustainability here refers to the capacity for the biosphere and human civilization to coexist. Since the cognitive revolution of humans[1], we have been consciously and actively seeking to increase our utility as a species. The agricultural revolution allowed the human population to explode. Constant technological advancement has allowed the continuation of the exponential trajectory of population growth, reaching a projected 10 billion people by 2030.

This continuous growth in terms of both population and economy, coupled with the somewhat incomplete conceptualization of value taken up by business strategists, has positioned businesses in the top rankings in the lists of causes for most of the environmental and social issues the world suffers today. Global issues such as climate change, ocean contamination, child labor, and poverty can be traced back to unethical and non-inclusive business practices. As a result of increased

[1] Sapiens: A Brief History of Humankind, a book by Yuval Noah Harari.

awareness on such issues, attention of scholars and practitioners in related fields began to shift towards sustainability studies. An emerging body of research spanning different literatures advocates the argument that sustainability, broadly defined as the management of balanced and responsible production to ensure enduring and long-lasting corporate relationships, living conditions, and social conditions, will change the landscape by placing new demands on skills and abilities of a company's resource base (Parida & Wincent, 2019).

Fundamentally speaking, sustainability from a business viewpoint envisions a balanced integration of economic performance, social inclusiveness, and environmental resilience (Geissdoerfer et al., 2016). This integration can be measured and communicated in modern day business reports using the so called 'triple bottom line'. This thesis is based on the study of the circular economy, which is a concept that is often framed within the wider concept of Sustainability. The circular economy is defined as a global economic model minimizing the negative effects of finite resource consumption, by focusing on intelligent design of materials, products, and systems. Inspired by the concept of closed-loop economy, the circular economy paradigm was introduced at the end of the '80s (W. Stahel & Reday-Mulvey, 1981) to minimize emissions, resource use, pollution and waste, and maximize the resource efficiency of material assets. According to a systematic literature review on approaches for circular and sustainable business model innovation (Marina P.P. Pieroni, Tim C. McAloone, Daniela C.A. Pigosso), we can distinguish more accurately circular economy as an umbrella concept that was introduced as part of the wider scope of sustainability that is more focused on a more resource-effective and efficient economic system by internationally narrowing, slowing, and closing material and energy flows (Blomsma & Brennan, 2017) and decoupling economic growth from virgin material consumption.

This thesis represents one of the manifestations for the author's personal passion towards the notion of sustainability and his belief in the role of business in achieving social and environmental gains. As the final assignment in his academic journey as master's student at the Faculty of Industrial and Information Engineering of Politecnico di Milano, he dedicates this research to fellow environmental and social enthusiasts.

1. Executive Summary

1.1 Introduction

The circular economy is a term that has recently been gaining popularity between both academics and practitioners in the areas of management and economics, among others. The concept can be defined as a global economic model minimizing the negative effects of finite resource consumption, by focusing on intelligent design of materials, products, and systems (Rosa et al., 2019). Since the early 18th century and the beginning of the industrial revolution, the economy had been founded on the basis of a linear system that relies on extracting natural resources from nature "taking", transforming them into usable consumer goods or using them to provide services "making", selling these goods and services to consumers who benefit from their value for a period of time "using", and then disposing the end of life cycle reminders "wasting" (Sariatli, 2017), and thus, the term 'linear economy' is also known as the take, make, waste system. This system has been successful in an era when which it was possible to depend on cheap energy, cheap materials, and cheap credit to reach the required throughput (Webster, 2018). Logically, this approach has been taking a toll on earth's biosphere[2], which is the main source of all what is produced and consumed. Demographic and natural phenomena emerging in recent decades, such as the exponential growth of the world population and drastic climate change, are applying even more pressure on the biosphere, making it difficult to continue meeting the increasing consumers' needs for products and services while operating on the outdated system set by the linear economy. Evidence of the relationship between business practice and socioenvironmental wellbeing can be noticed in drastic situations that cause a temporary suspension or slowdown of business activities such as the 2008 recession, which was accompanied by a temporary dip in global carbon emissions, and the 2020 Covid-19 outbreak, which according to a study illustrated in the ScientificAmerican.com[3], has led to a 25% drop in carbon emissions in China within only one month of the epidemic.

[2] https://www.nationalgeographic.org/encyclopedia/biosphere/

[3] https://www.scientificamerican.com/article/how-the-coronavirus-pandemic-is-affecting-co2-emissions/

As the practical applications of the circular economy to modern economic systems and industrial processes have been gaining momentum since the late 1970s - led by a number of academics, thought-leaders, and businesses (EMF, 2013) - the transition from a linear to a circular system is perceived by many specialists as one of the few avenues available for maintaining economic growth to meet future demands and at the same time counterbalance the negative environmental effects caused by centuries of relying on the linear economy. Further evidence to the importance and potential of a circular economy can be remarked in the UN's 2030 agenda for sustainable development[4] (Transforming our world: the 2030 Agenda for Sustainable Development .:. Sustainable Development Knowledge Platform, n.d.), with at least 12 out of its 17 objectives that can be either directly supported, or positively influenced by adopting circular systems.

Consequentially, the thorough study performed by the author of this thesis on the existing literature concerning the circular economy and all its original schools of thought has led to the conclusion that in order to realize the transition from a linear to a circular economy, a profound investigation regarding business models – being, among others one of the crucial pillars of the concept – is required. Considered as the main value architecture of a business (Foss & Saebi, 2018), business models play a key role in the transition, due to their capability of making circular practices lucrative for their adopting firms; contrast to other sustainability-based economic concepts that focus merely on the creation of socioenvironmental results (e.g. social entrepreneurship and sustainable business models). There is evidence, as per Dr. Martin R. Stuchty, founder of SYSTEMIQ and ex-consultant at McKinsey & Co, that *"The fastest growing companies, that we are aware of as McKinsey, are in fact those that are working along the principles of the Circular Economy"*.

Based on the above premises, the author has dedicated this thesis to furtherly explore the relationship between business models and the emerging concept of the circular economy, proposing the following research question:

[4] https://sustainabledevelopment.un.org/post2015/transformingourworld

How can incumbent firms operating on the basis of a linear business model shift towards adopting a more circular business model?

By answering this question, this research aims at contributing to the academic body of literature combining the two topics, tending to research gaps such as 1) consolidated business practices guiding companies in improving the circularity of their products and services (Rosa et al., 2019), 2) frameworks to support researchers and practitioners in conceptualization, design, and implementation of circular or sustainable business models as means to solve or avoid environmental or social issues, while aiming for economic benefits (Pieroni et al., 2019), and 3) the company level implementation of circular economy, including the challenges associated with the transition to CBMs (Guldmann & Huulgaard, 2020). Another aim for this research is providing practitioners with a set of guidelines that can be adopted by incumbent firms while redesigning their business models in a way that allows them to contribute in the transition to a circular economy and benefit from the potential value it offers.

The proposed RQ was addressed according to a qualitative research best suited to the explorative and inductive nature of the required outcome. A single case study involving one of Italy's biggest players in the Pulp & Paper industry was adopted as the main strategy for exploring the phenomena in question. The research was initially planned to draw first hand data through interviews, however, due to the unfortunate events taking course across the world, the author was forced to carry on the research depending on secondary data drawn from different cases, scientific articles, books, and other second hand sources.

1.2 Theoretical background

1.2.1 Circular economy

Multiple definitions exist in the literature for describing the circular economy. For the purpose of this thesis, the author has adopted the following definition: the circular economy is a global economic model minimizing the negative effects of finite resource consumption, by focusing on intelligent design of materials, products, and systems (Rosa et al., 2019).

The circular economy is derived from a wide range of theories belonging mainly to the disciplines of ecological economics, environmental economics, and industrial ecology (Wautelet, 2018). According to the literature, the most recent theories contributing to the formulation of what is modernly known as the circular economy are as flows: performance economy – industrial ecology – cradle to cradle – permaculture – biomimicry – collaborative consumption (sharing economy) – regenerative design (Geissdoerfer et al., 2017). Among others, these theories represent the backbone from which the paradigm can grow and evolve. The outcome of this thesis was built upon the following circular economy concepts, origins, and practices.

1.2.1.1 The three founding principles of the circular economy (EMF, 2013)

1) **Designing out waste and pollution.** Here, we view waste as a design flaw that can be avoided by harnessing new materials and technologies.
2) **Keeping products and materials in use.** Achieved By designing products and materials so they can be reused, repaired, and remanufactured, and finally, returned safely to the biosphere.
3) **Regenerating natural systems.** Aiming not only to protect, but actively improve the environment.

1.2.1.2 Closing, slowing, and narrowing resource loops (Bocken et al., 2016)

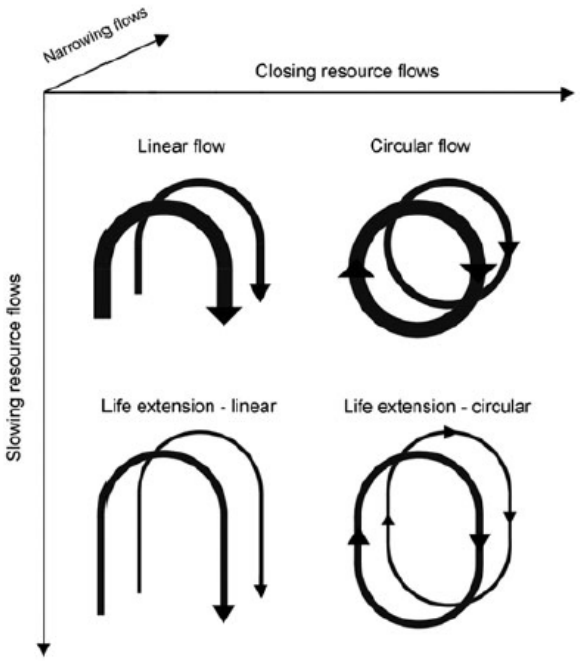


Figure 1. Closing, slowing, and narrowing resource flows (Bocken et al., 2016).

The following two fundamental strategies toward the cycling of resources (illustrated in **Error! Not a valid bookmark self-reference.**)
: **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. These two approaches are distinct from a third approach toward reducing resource flows: **3- Resource efficiency or narrowing resource flows**, aimed at using fewer resources per product.

1.2.1.3 Performance Economy (W. R. Stahel, 2010)

As the cost of acquiring resources such as materials and energy increase, there is an opportunity to be captured by managing existing physical stocks that can provide resource security for enterprises and nations, under the conditions that we consider the goods of today as the resources of tomorrow at the resource prices of yesterday. By definition, circular economy business models focus more on labor and less on material and energy consumption. Stahel argues that 75% of the energy required in manufacturing products is utilized in the early phases of extracting and curating raw materials; on the contrast, only 25% of labor is utilized in this phase. Moving downstream towards the phases of manufacturing and assembly, only 25% of the total energy is utilized while 75% labor is utilized. **The Inertia Principle** proposed by Dr. Stahel serves as a rule of thumb when considering to follow circular economy philosophy:

- Do not repair what is not broken.
- Do not remanufacture something that can be repaired.
- Do not recycle a product that can be remanufactured.
- Replace or treat only the smallest possible part in order to maintain the existing economic value.

1.2.1.4 Circular Economy System Diagram

Building on the cradle to cradle theory of Braungart and McDonough (Braungart et al., 2007), the Ellen McArthur Foundation has designed and introduced the circular economy system diagram, better known as the 'butterfly diagram' (see Figure 2) in an attempt to capture the essence of the circular economy, reflecting the flow of materials, nutrients, components, and products, whilst adding an element of financial value. The loops in the butterfly diagram represent different ways in which waste can be eliminated by reintroducing it to the system as input for a process belonging to a previous stage within the value chain. By designing products for disassembly, repair, reuse, remanufacturing, and recycling, and by adopting business models that reward firms by enabling them to capture additional value by exploiting these loops, businesses can pave the way for a global transition towards a circular economy.

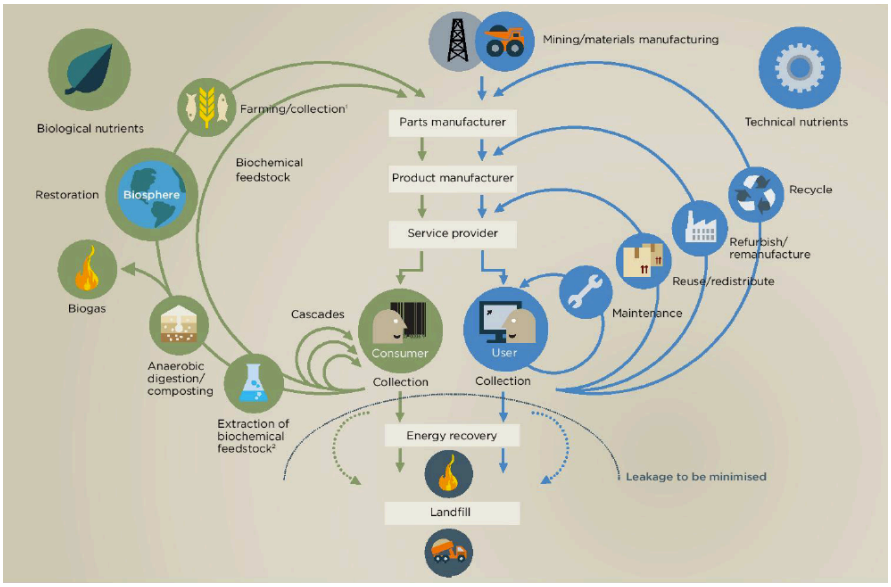


Figure 2. The butterfly diagram, Ellen McArthur Foundation circular economy system design. Drawing based on Braungart & McDonough, cradle to cradle (C2C).

1.2.2 Circular strategies and business models

1.2.2.1 Value architecture

As the main value architecture of a business (Foss & Saebi, 2018), business models play a leading role in the transition from a linear to a circular economy. This thesis takes into account **the Business Model Canvas** (Osterwalder, 2004) as a reference framework, among other business notions such as the **360 Business Model Innovation framework** (Rayna & Striukova, 2016) and the **Extended Value Proposition** (Guldmann & Huulgaard, 2020).

1.2.2.2 The business value in a circular economy

The business value in a circular economy (*Four types of value creation (1/3) | 2.3 Value Creation in a Circular Economy | CircularX Courseware | edX*, n.d.) can be classified as follows:

- **Sourcing value**: All types of direct cost reductions and savings that can arise from closed loop business practices.
- **Environmental value**: Benefits that result from improved ecological footprints, such as ease of compliance and improved green image.
- **Customer value**: Increased customer loyalty, better customer satisfaction, and superior brand protection.
- **Informational value**: Closing the loop generates valuable data on production and supply problems, failure rates, useful lifetime of the product and usage patterns.

1.2.2.3 The level of circularity of a business model

(Urbinati et al., 2017b) (see Figure 3) can be classified as

- **Downstream circular**, concerns firms that adopt a price scheme or a marketing campaign that is based on the "use" and "re-use" of products, but where internal practices and design procedures for products do not seem to reflect the characteristics of a circular "adopter".
- **Upstream circular**, concerns firms that adopt circular principles in their product design activities and eventually establish effective relationship with new suppliers, but that do not make visible to their final customers, neither on the price or in the marketing campaigns their adoption of circular economy.
- **Full circular**, concerns firms that are circular both internally and externally.

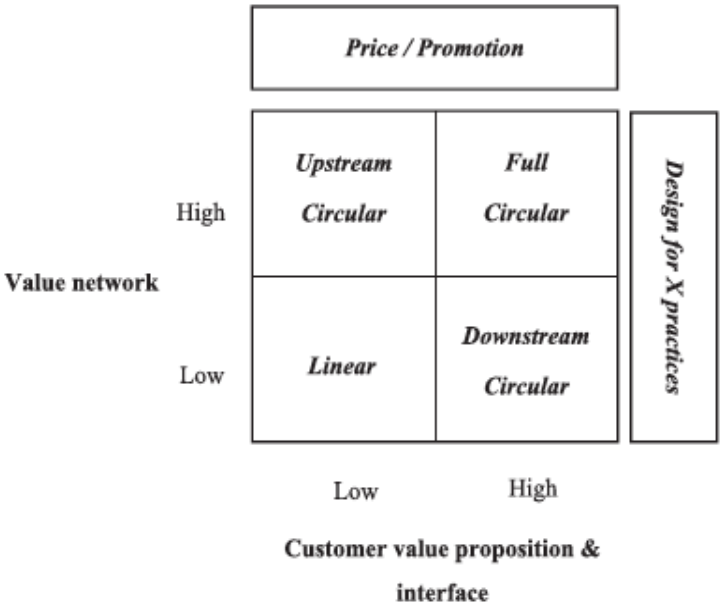


Figure 3. The four available modes to adopt circular economy principles, (Urbinati et al., 2017b).

1.3 Methods

1.3.1 Research design

The qualitative approach adopted for this research is an explorative and inductive research approach, and applies a single case study as a main strategy.

An exploratory research is a research conducted for a problem that has not been studied more clearly, intended to establish priorities, develop operational definitions and improve the final research design (Shields & Rangarajan, 2013). Thus, this research is classified as exploratory, as it aims to gain familiarity with a phenomenon and to acquire new insight into it in order to develop

a hypothesis (Kumar & Singh, 2011). To compliment the qualitative nature of the research, the author designed it as a qualitative research . An exploratory research is a research conducted for a problem that has not been studied more clearly, intended to establish priorities, develop operational definitions and improve the final research design (Kumar & Singh, 2011).
Based on the aforementioned research parameters, a single case study was conducted, as case studies are well suited to explore the phenomenon in a comprehensive way (Yin, 2013).

1.3.2 Case & industry selection

As part of the desk researched conducted by the author, an initial set of 116 companies (Appendix A) adopting full or partial circular business models have been analyzed, varying in dimensions, status, and nationality. This sample was then shortlisted based on company status to better comply with the research gaps targeted, i.e. incumbent firms. After a third round of flirting, the list finally settled down to 67 Italian incumbent companies that contain circular elements within their business models, selecting Italy as it is considered as one the leading EU regions in circular economy[5] (Ketels & Protsiv, 2017).
The remaining companies operate in different industries. The process of selecting the industry went in parallel with the process of selecting the case, and the logic behind the selection depended on two main factors: 1) the degree of overall circular potential of the industry, 2) the level of circularity adopted by the company. A third factor taken in consideration was the availability of contacts with firms.

As a result, the Italian Pulp & Paper industry was selected due to its relatively high potential for transitioning from linear to circular, the already existing technologies rendering recyclability as a norm, and the wide spread and cross-industry application for its products, such as packaging materials. Finally, 'Fedrigoni Group' – a well-established incumbent and world leading player in the industry – was selected for the study.

[5] The European Commission Cluster Observatory report.
file:///Users/abdulla/Downloads/PSR%20Circular%20Economy%20SP%2020170707.pdf

1.3.3 Data gathering & analysis

Secondary research involves re-analyzing, interpreting, or reviewing past data. Secondary information consists of sources of data and other information collected by others and archived in some form. These sources include government reports, industry studies, archived datasets, and syndicated information services as well as the traditional books and journals found in libraries (W. Stewart & A. Kamins, n.d.). Initially, this thesis was intended to gather first hand data about the selected case. Due to critical circumstances, the sources for first hand data were no longer made available, and the author relied on secondary data instead. As resource efficiency (e.g. time and cost) might be an obvious advantage of secondary research, other advantages can be resembled in the quality of data that can be collected from reliable and professional sources. Reliable data sources were utilized for this thesis, including scientific papers and journals, firms websites, and governmental reports. More than 116 companies have been looked into in the early phases of the research before focusing on the selected case study. Their business models were screened for circularity and categorized base on industry, type, and nationality.

1.4 Findings & contribution

The main outcome of the research is a framework that converts the different circular economy aspects, theories, and ideologies found in the literature to a clear set of practices that can be encrypted in the business models of adopting firms in order to suite their circularity goals. This outcome contributes to the exiting body of literature by covering gaps concerning practical frameworks for converting linear business models into circular ones, and thus contributing to the global transition from a linear to a circular economy. This outcome also offers implications for practice, as it resembles a practical guideline for strategists within firms, giving them a clear picture of how they can increase circularity within their firms' business models.

The framework (Table 1**)**

The framework consists of six main elements, five of which categorize the first based on different criteria. The elements are as follows:

1) **Circular economy practices (CE practices).** This group represents the actual circular economy practices extracted from theory and belonging to different schools and authors, harmonized and reintroduced as actions that can be adopted by firms seeking to increase the circularity of their business models. The 25 proposed CE practices represent the basic set of data introduced by the framework. The practices are as follows:
2) **Circular economy family (CE family).** For the sake of harmony, the CE practices were grouped into three main families, which represent the three main principles of circular economy proposed by the Ellen McArthur Foundation.
3) **Product/ Service life cycle (Product/ service LC).** This element indicates the product or service lifecycle phase in which each CE practice falls.
4) **Value bracket.** The main business model reference adopted by the framework is the business model canvas. This group furtherly classifies each CE practice based on the value bracket it belongs to (i.e. value creation, value delivery, value capture). For the sake of simplicity and ease of use, it was decided not to go further and classify each practice according to specific elements within the canvas (e.g. key activities).
5) **Stream.** This group classifies each practice based on the stream (i.e. downstream or upstream) based on the circular economy taxonomy proposed by (Urbinati et al., 2017a).
6) **Business value type.** Last but not least, the 'business value type' group was introduced in order to classify the circular economy value returning to the firm thanks to each practice.

Table 1. The CE practice framework

CE practice	CE family	Product/service LC	Value bracket	Stream	Business value type
Design for attachment/ trust	Design out waste and pollution	Design	Value creation	Upstream	Informational value
Design for durability	Design out waste and pollution	Design	Value creation	Upstream	Informational value
Design for standardization/ combatability	Design out waste and pollution	Design	Value creation	Upstream	Informational value
Design for ease of maintenance and repair	Design out waste and pollution	Design	Value creation	Upstream	Informational value
Design for upgradability/ adaptability	Design out waste and pollution	Design	Value creation	Upstream	Informational value
Design for dis/reassembly	Design out waste and pollution	Design	Value creation	Upstream	Informational value
Use recycled material	Keep products and materials in use	Raw materials/components	Value creation	Upstream	Sourcing value
Use refurbished/ remanufactured parts	Keep products and materials in use	Raw materials/components	Value creation	Upstream	Sourcing value
Use maintained parts	Keep products and materials in use	Raw materials/components	Value creation	Upstream	Sourcing value
Reuse parts	Keep products and materials in use	Raw materials/components	Value creation	Upstream	Sourcing value
Use renewable energy	Design out waste and pollution	Manufacturing	Value creation	Upstream	Environmental value
Use recycled energy	Design out waste and pollution	Manufacturing	Value creation	Upstream	Environmental value
Offset energy consumed	Regenerate natural systems	Manufacturing	Value creation	Upstream	Customer value
Utilize industrial symbiosis	Design out waste and pollution	Manufacturing	Value creation	Upstream	Sourcing value
Use access & performance model	Keep products and materials in use	Use	Value delivery/capture	Downstream	Customer value
Utilize pay-per-use	Keep products and materials in use	Use	Value delivery/capture	Downstream	Customer value
Communicate circularity	Keep products and materials in use	Use	Value delivery/capture	Downstream	Customer value
Seek new customer segments (e.g LOHAS)	Keep products and materials in use	Use	Value delivery/capture	Downstream	Customer value
Utilize take back systems	Keep products and materials in use	Use	Value delivery/capture	Downstream	Informational value
Resell EOLC waste to other market segments	Keep products and materials in use	Use	Value delivery/capture	Downstream	Sourcing value
Remanufacture/refurbish EOLC and resell as if new	Keep products and materials in use	End	Value delivery/capture	Downstream	Sourcing value
Extract materials for recycling (internal or external)	Keep products and materials in use	End	Value delivery/capture	Downstream	Sourcing value
Sell/barter EOLC waste	Keep products and materials in use	End	Value delivery/capture	Downstream	Sourcing value
Produce ecofriendly waste	Regenerate natural systems	End	Value creation	Downstream	Environmental value
Minimize harmful emissions	Regenerate natural systems	End	Value creation	Downstream	Environmental value

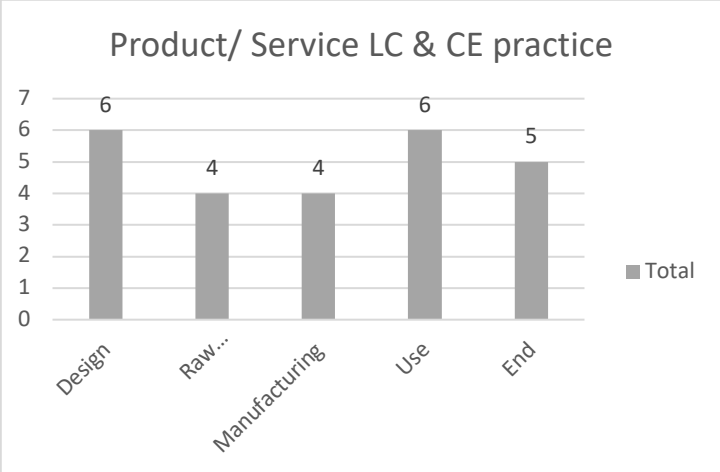


Figure 5. CE practice and product/ service LC

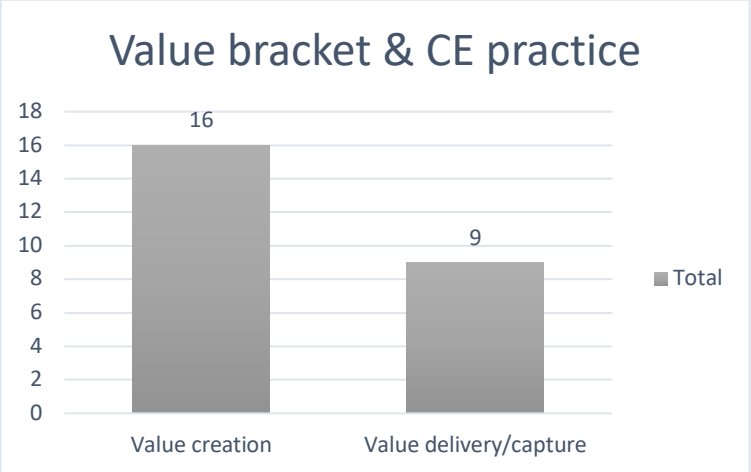


Figure 4. CE practice and value bracket

The data was furtherly analyzed to measure CE practices according to different parameters. According to the data set, 6 out of the 25 CE practices take place in the Design phase of the product/service life cycle, 4 in the Raw Materials & Components phase, 4 in the Manufacturing phase, 6 in the Use phase, and 5 in the End of life cycle phase. (Figure 5)

16 of the CE practices happen in the Value Creation phase, and the 9 remaining happen in Value Delivery and Capture phases. (Figure 4)

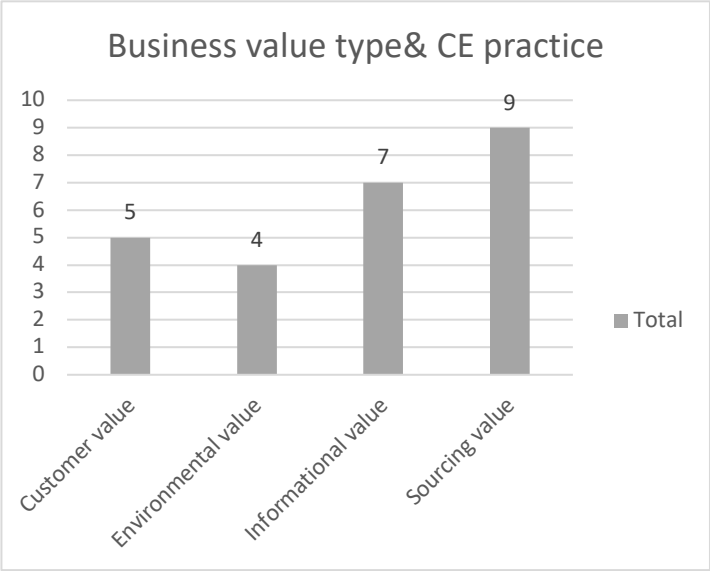


Figure 6. CE practice and business value type

As for the business value types, 5 CE practices result in Customer Value, 4 in Environmental Value, 7 in Informational Value, and 9 into Sourcing Value.
(Figure 6)

The relationships between CE practice – value bracket – business value and between CE practice – product/ service LC – business value are shown in Figure 7 and Figure 8 respectively.

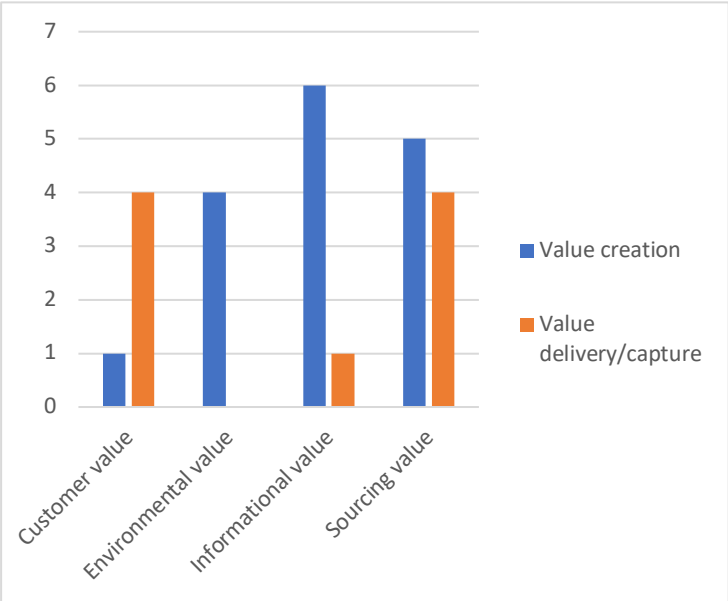


Figure 7. Value bracket and value type

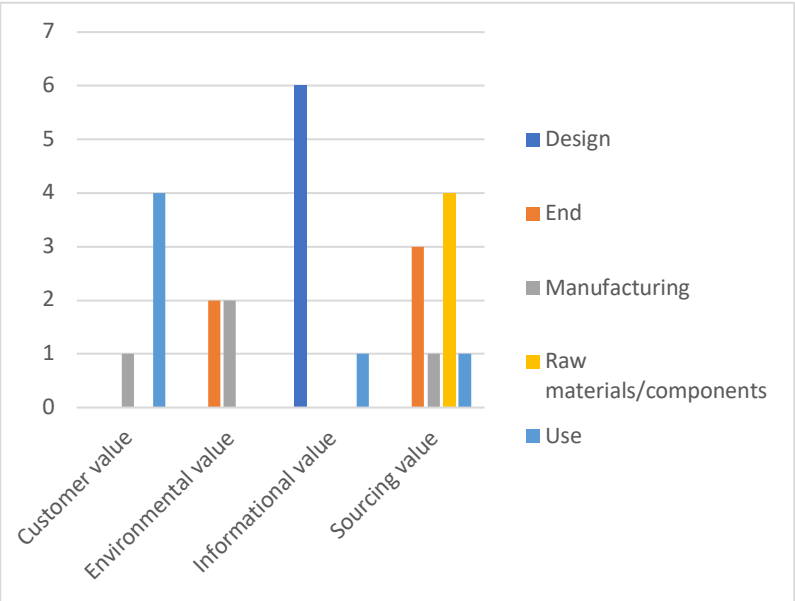


Figure 8. LC and value type

1.5 Conclusion & limitations

This thesis examines the implication of modern circular economy principles in business model. In specific, it concentrates on incumbent firms, and their contribution towards the transition from a linear to a circular global economy. Relying on the existing body of literature on circular economy and business models, and on case studies, the author proposes framework that can be adopted by incumbent firms as a guideline for transforming their business models from linear to circular.

The proposed framework consists of 25 practices that can be taken into consideration whilst reshaping and updating a business model. Each practice is classified using 5 different criteria. This classification allows better understanding of 1) the origin of the practice and its relevance to the circular economy, 2) the product/ service life cycle phase it belongs to, 3) its position within the value structure of the business model, 4) Its position within the value chain, and last but not least 5) the business value that can be expected as a result for applying the practice.

By this framework, the author wishes to contribute to the existing body of literature combining the circular economy and business model innovation, and invites incrementation and recreation on its basis. The most notable limitation to this thesis is its dependence on secondary data. As a secondary research, the author relied on well referenced and reliable sources of data, such as scientific papers and journals, corporate websites, and governmental reports. Further avenues for research can pursue testing and furtherly verifying the proposed 25- practice circular business framework, and proposing different frameworks able to educate and guide practitioners through their transition from linear to circular.

2. Literature review

The literature review was conducted with a focus on academic work; however, due to the novelty of the concept of Circular Economy (CE) other sources have been adopted as references to offer a broader, more accurate and detailed analysis. A fundamental source of data utilized was the Ellen McArthur Foundation website (https://www.ellenmacarthurfoundation.org/) thanks to its conclusiveness and richness in essential and clarifying material, such as case studies and economic reports.

An extensive research was conducted to identify key literature discussing Circular Economy, Sustainability, Business Model Innovation, Circular & Sustainable Business Models, and Innovation Catalysts. This chapter is dedicated to reviewing the concept of Circular Economy as a whole in addition to related concepts and relevant topics, and to showcase the existing literature on the areas of Business Models and Business Model Innovation from a Circular Economy viewpoint.

2.1 Circular Economy

The circular economy concept has deep-rooted origins and cannot be traced back to one single date or author. Its practical applications to modern economic systems and industrial processes have gained momentum since the late 1970s, led by a small number of academics, thought-leaders, and businesses (EMF, 2013). It is impossible, nevertheless, to discuss circular economy concepts without mentioning the wider notion of sustainability. While the concept of sustainability is increasingly discredited as a useful concept by itself, it appears to be serving some purpose when preceded by a delineating modifier like “ecological” or “agricultural” or “economic.” (Morelli, 2011). If we look at the term “ecological sustainability” for example, as per Callicot and Mumford’s definition, sustainability is about meeting human needs without compromising the health of the ecosystems (Callicott & Mumfordf, 2017). In economics on the other hand, sustainability is viewed from a “preservation of environmental assets” point of view; as Foy explains, sustainability requires that current economic activity not disproportionately burden future generations (Foy, 1990). One definition for circular economy views it as a global economic

model minimizing the negative effects of finite resource consumption, by focusing on intelligent design of materials, products, and systems (Rosa et al., 2019). We can hence, quickly notice that the paradigm of the circular economy, is indeed part of the bigger paradigm of sustainability. The circular economy concept is much heralded among policy-makers, scholars and industry professionals as an accelerated pathway towards sustainability (Henry et al., 2020). (Boulding, 1966) describes the earth as a closed and circular system with limited assimilative capacity, and inferred from this that the economy and the environment should coexist in equilibrium. This description has led authors such as Andersen (2007), Ghisellini et al. (2016), and Su et al. (2013) to discover 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, they investigate the linear and open-ended characteristics of contemporary economic systems (Geissdoerfer et al., 2017). The goal of transitioning from a linear, open ended economy, to circular and looped economy is to limit the use of nature's non-regenerative resources and decoupling economic growth from virgin material consumption, making the most of whatever material extracted from earth, and eliminating waste by reintegrating it to provide further value.

2.1.1 Schools of Thought

The circular economy is derived from a wide range of theories belonging mainly to the disciplines of ecological economics, environmental economics, and industrial ecology (Wautelet, 2018). According to the literature, the most recent theories contributing to the formulation of what is modernly known as the circular economy are as flows: performance economy – industrial ecology – cradle to cradle – permaculture – biomimicry – collaborative consumptive (sharing economy) – regenerative design (Geissdoerfer et al., 2017). Among others, these theories represent the backbone from which the paradigm can grow and evolve. In the following part of this section, the author briefly presents a number of these theories which are most relevant to the research.

2.1.2 Performance Economy

In his book "The Performance Economy" Dr. Walter R. Stahel, considered as one of the main intellectuals behind the circular economy paradigm, argues that transitioning to a circular economy can unlock a huge potential by substituting energy usage by manpower (W. R. Stahel, 2010).

According to Stahel, as the cost of acquiring resources such as materials and energy increase, there is an opportunity to be captured by managing existing physical stocks that can provide resource security for enterprises and nations, under the conditions that we consider the goods of today as the resources of tomorrow at the resource prices of yesterday. By definition, circular economy business models focus more on labor and less on material and energy consumption. Stahel argues that 75% of the energy required in manufacturing products is utilized in the early phases of extracting and curating raw materials; on the contrast, only 25% of labor is utilized in this phase. Moving downstream towards the phases of manufacturing and assembly, only 25% of the total energy is utilized while 75% labor is utilized. Figure 9.

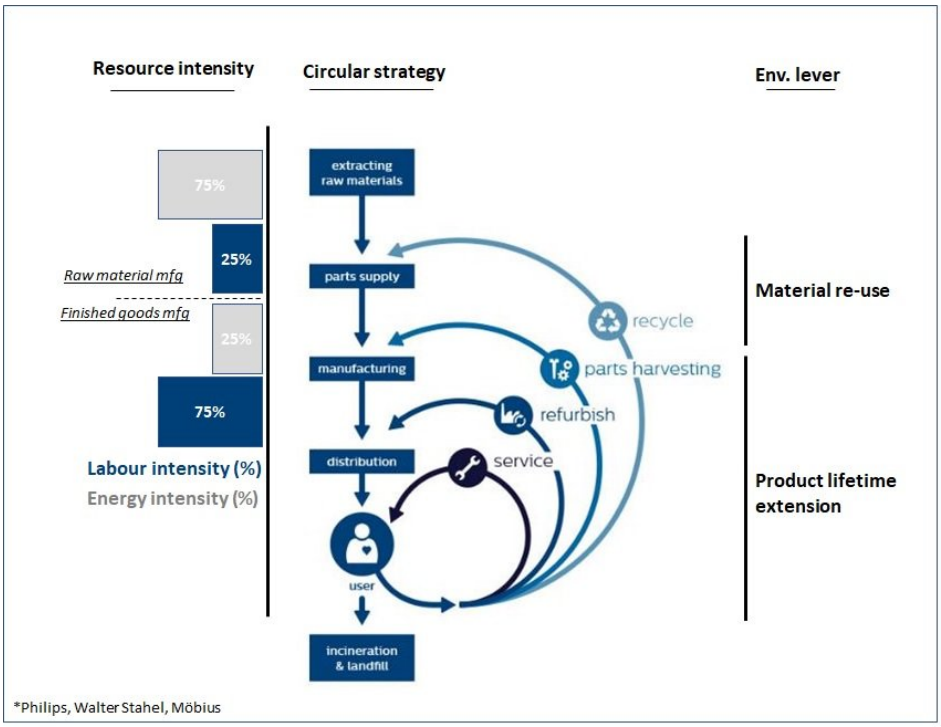


Figure 9. Stahel's 75/25 rule.

2.1.3 Cradle to Cradle

German chemist and visionary Michael Braungart went on to develop, together with American architect Bill McDonough, the cradle to cradle concept and certification process (Braungart et al., 2007). This design philosophy considers all material involved in industrial and commercial processes to be nutrients, of which there are two main categories: technical and biological. The cradle to cradle framework focuses on design for effectiveness in terms of products with positive

impact and reducing the negative impacts of commerce through efficiency. To elaborate, the three main takeaways from the cradle to cradle are: eliminating the concept of waste "waste equals food", power with renewable energy, and think in collective systems rather than individual processes.

2.1.4 Biomimicry

Is a practice that learns from and mimics the strategies found in nature to solve human design challenges (Biomimicry institute). As defined by Janine Benyus, author of "Biomimicry: Innovation Inspired by Nature", biomimicry is a new discipline that studies nature's best ideas and then imitates these designs and processes to solve human problems. An example would be studying a leaf to invent better solar cells (Pathak, 2019).

2.1.5 Industrial Ecology

"Industrial ecology is the study of material and energy flows through industrial systems". The core idea of industrial ecology is to redesign our industrial society as a specific ecosystem within the biosphere. Accordingly, the concept of industrial ecology relies on a systemic, comprehensive and integrated analysis of the industrial system and all its components within its environment, considering them as a joint ecosystem (Graedel & Allenby, 2010).

2.1.6 A closed-loop economy (Wautelet, 2018)

While most businesses in the present industrial economy have been focusing on the management of throughput flows over the last 200 years, moving towards a Performance Economy requires a change of focus, shifting from throughput flow management to stock optimization and from value added to value preservation and maintenance (Wautelet, 2018). This change of focus opens opportunities in three loops of different characteristics and with different impacts geographically, which are shown graphically in Figure 10 (Stahel and Clift (2016, p. 140)):

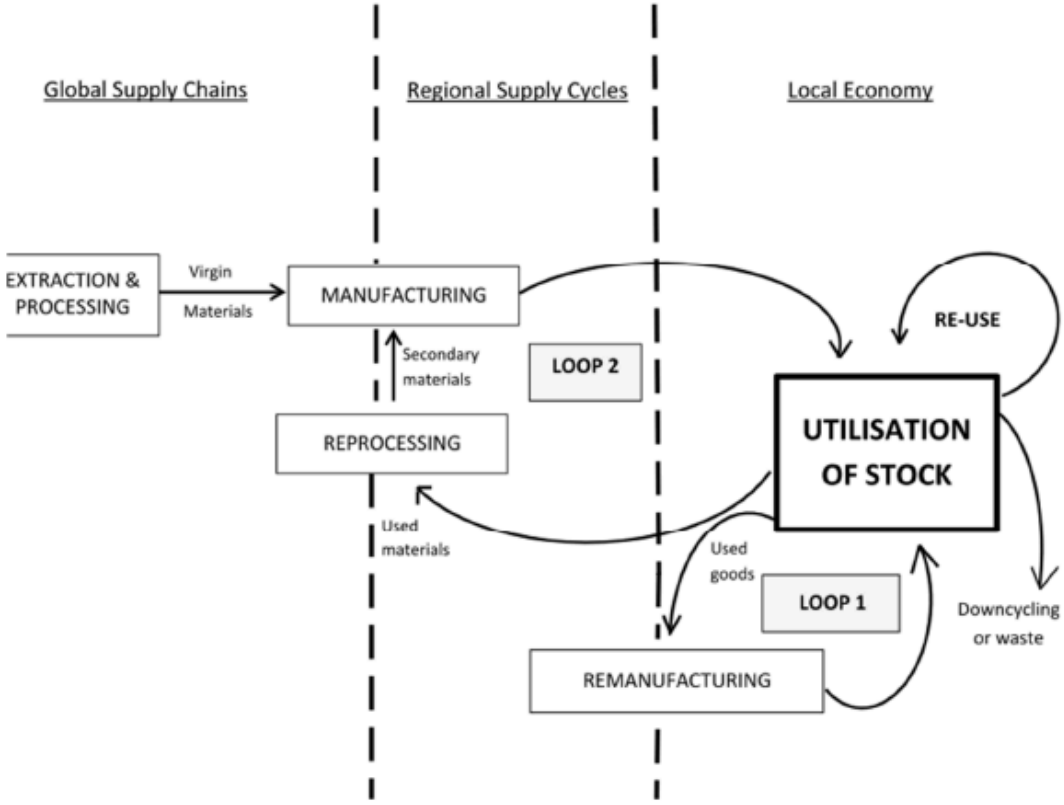


Figure 10. The main loops of a circular economy, Stahel and Clift (2016, p. 141)

- **Reuse Loop:** it includes second-hand markets (from garage sales and flea markets to eBay), commercial and private reuse of goods (e.g. refilling of beverage containers, resale of clothes). These product remarketing activities are usually done locally.

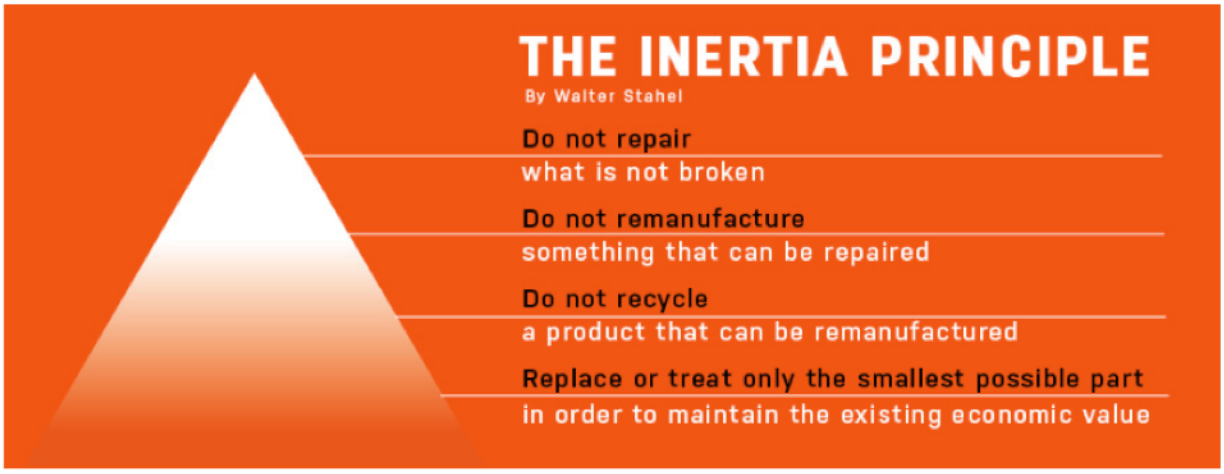
- **Loop 1- Remanufacturing:** it includes product-life extension activities such as repair, remanufacturing and upgrading which can be carried out locally or via regional service centers.

- **Loop 2 – Recycling:** it includes product reprocessing activities which recovers secondary materials to be used in the manufacturing of new products (e.g. recycling of paper and plastics). These activities may be operated at a regional level of as part of a global supply system.

As shown in Figure 3, some end-of-life products and materials may be used into lower specification applications (downcycling) in other locations including energy recovery. A Performance Economy is characterized by a number of principles which are described here below (Stahel (2013, pp. 4–6)):

1. **The smaller the loop (activity-wise and geographically) the more profitable and resource efficient it is**. Activity-wise means "don't repair what is not broken, don't remanufacture what can be repaired, don't recycle what can be remanufactured" and geographically, "the small loops (reuse, repair and remanufacture) are best done locally or regionally" (Stahel (2013, p. 4)). This theory is referred to as 'the inertia principle', see Figure 11. Two distinctively different types of resource efficiency govern the Performance Economy: resource sufficiency in the loop 1 through reuse and service-life extension activities and material efficiency in the loop 2 through recycling of materials embedded in products. As recycling is often part of a global supply chain, favoring resource sufficiency over resource efficiency enables to avoid packaging and transport costs while at the same time it creates local jobs. Furthermore, "sufficiency solutions can mean turning a problem into an opportunity or a virtuous loop, in the sense of finding solutions that do away with unwanted environmental and social effects but without renouncing or reducing needs!" (Stahel (2010, p. 50)) These solutions deliver the desired performance with fewer resources and for the same amount of revenue, which increases the profits of the solution provider. Multiple examples of sufficiency strategies are given by Stahel (2010, pp. 52–56): for instance, sheep can be used to replace herbicide and mechanical mowers while waterless urinals do away with water and water pipes.

Figure 11. The Inertia principle by Walter Stahel.



2. **Loops have no beginning and no end**. "The concept of maintaining value, quality and performance of goods through stock management replaces the concept of value added in the linear economy." (Stahel (2013, p. 5)) In a linear economy the responsibility for goods stops

at the point of sale whereas, in a Performance Economy, businesses focus on maintaining and preserving the value of goods throughout its lifetime. Therefore, the notion of "value added" up to the point of sale and "depreciation" after the point of sale are not anymore relevant in a Performance economy.

3. **The speed of the circular flows is crucial**: the efficiency of managing stocks increases with a decreasing flow speed. For example, material recycling of short-lived goods such as beverage cans leads to fast circular flows and a rapid loss of the material stock (i.e. 50% of the original material is recycled in the first cycle, 25% in the second cycle, 12.5% in the third cycle, etc.). In such case, favoring reusable glass bottles can slow down the material flow speed.
4. **Continued ownership is cost-efficient**: reuse, repair and remanufacture without a change of ownership save double transaction costs. For example, the tire manufacturer Michelin offers a pay-per-kilometer contract to truck fleets. This performance business model enables to save transaction costs by internalizing the tire retreading and maintenance activities and thus to increase their profits.
5. **A performance economy needs functioning markets**. In this aspect, the performance economy does not differ from the industrial economy: it needs efficient market places where supply and demand can meet.

2.1.7 The Blue Economy

As defined by defines the biggest advocate for the blue economy, Gunter Pauli (Belgian businessman and former CEO of Ecover), the Blue Economy is new economic model which departs from our prevailing economic model, the Red Economy, and from the emerging one, the Green Economy (Pauli, 2010). The Red Economy refers to businesses and industries which focus mainly on one core business and one niche product. Success in the red economy relies on low production cost which encourage economies of scale to achieve minimum margins, monocultures to scale-up, delocalization to reduce labor cost, and robotization of human labor more, faster, and cheaper (Wautelet, 2018). As a result of this approach, negative environmental and social impact occurs. The Green Economy, on the other hand, refers to the emerging business models which

builds on green technologies, renewable energies and biomaterials this approach is criticized by Pauli due to:

1- Its lack of systemic approach.
2- High costs.

The green economy focuses on one advantage and tends to disregard the global picture and potential harmful effects. As an example, Pauli often talk about biodegradable soaps which are produced from palm oil, leading to the destruction of primary rainforests in Indonesia ((132) Change the rules of the game: Gunter Pauli at TEDxMaastricht - YouTube, n.d.). Another example that highlights the second deficiency in the green economy is solar energy. Its high costs must be subsidized by tax payers money. Non like the red and green economies, the blue economy relies on innovative business models which restore the environment, provide many jobs, enhance skills, and produces high quality and cheap products.

2.2 Circular strategies and business models

The vision of transitioning to a global circular economy system can be carried out by following three main principles: 1- designing out waste and pollution, 2- keeping products and materials in use, and 3- regenerating natural systems (EMF, 2013). For this vision to become a reality, business models have a crucial role to play. Defined as the value architecture of a business (Foss & Saebi, 2018), effectively designing a business model that communicates all potential value in a circular business strategy is key to its realization. For realizing the aforementioned principles it is necessary to view the flow of resources as a loop, and discover ways to elongate the flow of resources within these loops.

2.2.1 Closing, Slowing, and Narrowing Recourse Loops

Demonstrated in a paper by Nancy M. P. Bocken, Ingrid de Pauw, Conny Bakker & Bram van der Grinten (Bocken et al., 2016) the following two fundamental strategies toward the cycling of resources are introduced, illustrated in Figure 12: 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. These two approaches are distinct from a third approach toward reducing resource flows: 3- Resource efficiency or narrowing resource flows, aimed at using fewer resources per product.

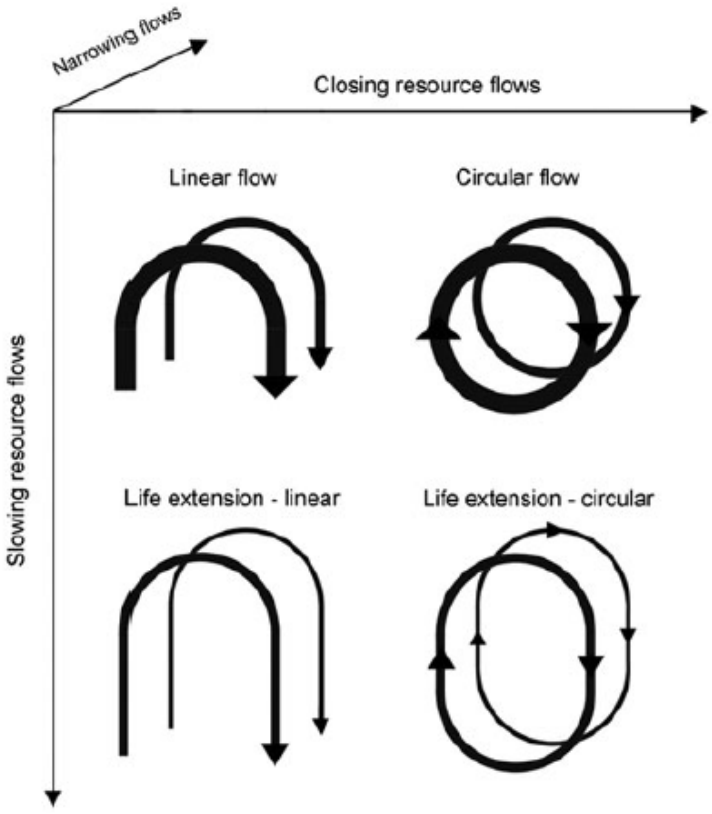


Figure 12. Closing, slowing, and narrowing resource flows (Bocken et al., 2016).

2.2.2 Extending Value Proposition

Another intriguing perspective on circular business models is demonstrated in a paper by Eva Guldmann and Rikke Dorothea Huulgaard, who propose that the integration of slowing and closing strategies in a company can be conceptualized as adding a value recreation and redelivery component and a value recapture component to the existing business model (Guldmann & Huulgaard, 2020). Figure 13 illustrates this conceptualization (right side of figure 3) in respect to the value creation, delivery, and capture of a linear business model (left side of figure 3).

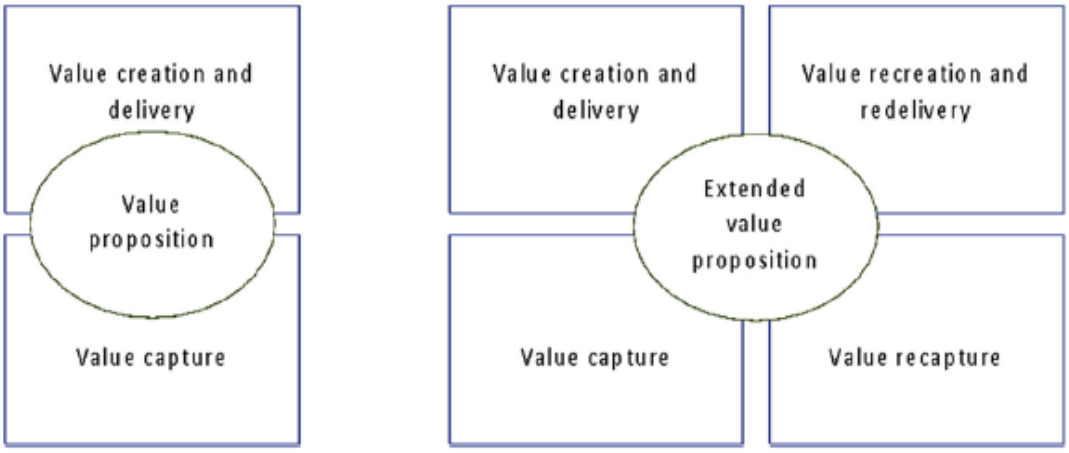


Figure 13. The extended value proposition (Guldmann & Huulgaard, 2020).

2.2.3 Value Networks and Customer Relations in a Circular Business Model

Relatedly, a theoretical framework was introduced by Andrea Urbinati, and Davide Chiaroni, Vittorio Chiesa as a new taxonomy of circular economy business models (Urbinati et al., 2017a). They suggest that for businesses seeking transition from linear business models to circular ones, or for new businesses seeking to operate based on a circular business model, it is worthy to 1- add and manage the activities of the reverse supply chain, i.e. the reverse logistics, the inspection and evaluation of products' current state, their redistribution/reuse, remanufacturing and recycling. 2- Building a value proposition that offers products-service systems (PSSs). 3- Enrichment of the relationships with customers mostly enabled by leasing and rental contracts. 4- Redirect the flow of revenues according to the use or result oriented services accompanying the pay-per-use scheme. See Figure 14.

(i)	(ii)	(iii)	(iv)
Reverse supply chain activities and higher degree of cooperation with the actors of the supply chain	Transition from a "pay-per-own" to a "pay-per-use" approach	Higher degree of cooperation between companies and customers	Payment for use-oriented or result-oriented services
Value network	**Customer value proposition & interface**		

Figure 14. Circular Economy in Business models (Urbinati et al., 2017a).

2.2.4 Circular Economy System Diagram

Building on the previously mentioned schools of thought, especially the cradle to cradle theory of Braungart and McDonough (Braungart et al., 2007), the Ellen McArthur Foundation has designed and introduced the circular economy system diagram, better known as the 'butterfly diagram' (see Figure 15) in an attempt to capture the essence of the circular economy, reflecting the flow of materials, nutrients, components, and products, whilst adding an element of financial value.

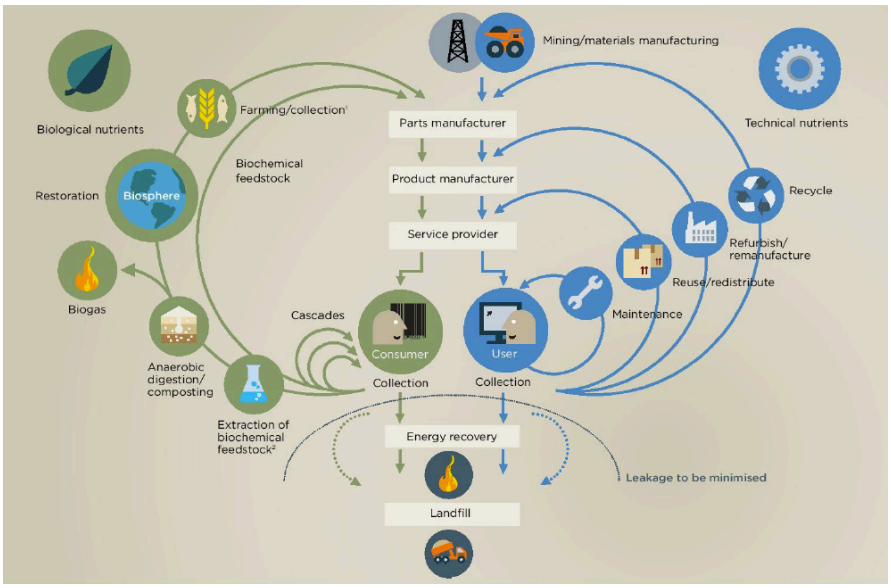


Figure 15. The butterfly diagram, Ellen McArthur Foundation circular economy system design. Drawing based on Braungart & McDonough, cradle to cradle (C2C).

The loops in the butterfly diagram represent different ways in which waste can be eliminated by reintroducing it to the system as input for a process belonging to a previous stage within the value chain. By designing products for disassembly, repair, reuse, remanufacturing, and recycling, and by adopting business models that reward firms by enabling them to capture additional value by exploiting these loops, businesses can pave the way for a global transition towards a circular economy.

2.2.5 Examples for Circular Business Models

Circular business models are a new kind of business models, where the value creation is grounded on keeping the economic value embedded into products after their use and exploit it for new types of market offerings (Rosa et al., 2019). Table 2. Generic approaches to circular business models relying on slowing and closing loops based on the work of (Bocken et al., 2016) summarizes some of the generic approaches to circular business models relying on slowing and closing loops based on the work of (Bocken et al., 2016).

Table 2. Generic approaches to circular business models relying on slowing and closing loops based on the work of (Bocken et al., 2016)

	Value proposition	Value creation/delivery	Value caputre
Slowing loops:			
1- access and performance model	delivery of the service rather than ownership	Hassle of S&M is taken over by manufacturer/ retailer	pricing is per unit of service (time, number of use..)
2- extending product value	manufacturers exploiting the residual value	Take back systems,	reduced material costs (however maybe increased labor and logistics)
3- Classic long-life model	High quality, long lasting products. high service level	Durable product design and high customer service	Charging premium
4- encourage sufficiency	similar to above, however focusing on reducing consumer's consumption	Company takes a non-consumer approach to sales (no sales commission)	High end- premium
Closing loops:			
5- extending resource value (happens at the product level)	exploiting the residual value of resources	new collaborations and take back systems	Turning "wasted resources" into a form of value
6- industrial symbiosis (happens at the process/ man. level)	Reduction of overall operating cost and risk	collaboration, exchanging by-products, sharing communal services	Joint cost reduction and potential creation of new business lines

2.2.6 Product-Service systems (PSS)

Product service systems are highly relevant to the circular economy. Defined as "a mix of tangible products and intangible services designed and combined so that they jointly are capable of fulfilling final customer needs" (Tukker & Tischner, 2006), we can immediately colligate the concept with a main circular economy principal, which is that of decoupling growth and material

consumption. By applying this principal, producers can aim at satisfying customer's needs by offering products with low physical contents (Urbinati et al., 2017b). Figure 16 presents the simple spectrum of product-service systems (*Business models for a circular economy (1/2) | 2.5 Business Models for a Circular Economy | CircularX Courseware | edX*, n.d.). We can distinguish three different categories of product-service business models:

1- **Product-oriented**: the business model is geared towards sales of products. Some extra services are added, for instance, a maintenance contract.

2- **Use-oriented**: The product still plays a central role. It is owned by a provider and is made available to a client. This is also referred to as an "access" model.

3- **Result-oriented**: The client and provider agree on a result. There is no pre-determined product involved. This is also referred to as a "performance" model.

The transition from a product-oriented model to a result-oriented model is difficult. Typical barriers are the need to pre-finance the products that are offered as part of the service contract, the need to organize maintenance, repair, and acquisition, and the need to change the "sell more, sell faster" culture of the organization. As an example, we can look at Rolls-Royce transition from a model in which they sold aircraft engines to airlines, to that of selling engine uptime instead, with a guarantee of up to 99.9% reliable uptime. This decision required significant investments and business model adjustments from Rolls-Royce, however, it held huge value to their client airlines.

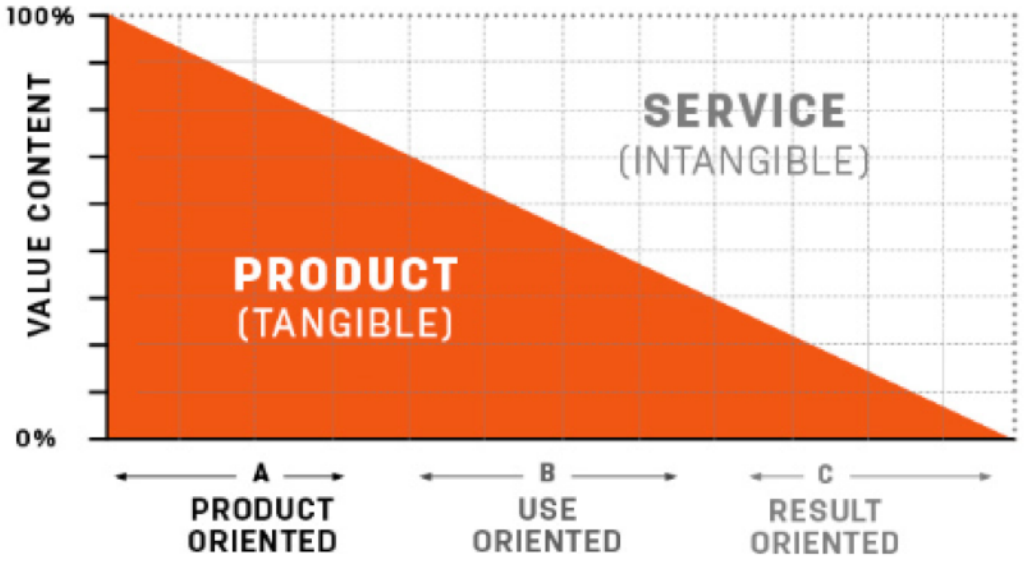


Figure 16. The product-service system spectrum, Delft University.

2.2.7 Business value in a circular economy

In a study made at the Rotterdam School of Management, Dr. Erwin Van Der Laan was asked but interviewer David Peck a series of questions regarding business value in closed loop supply chains, and in a circular economy in general (*Four types of value creation (1/3) | 2.3 Value Creation in a Circular Economy | CircularX Courseware | edX*, n.d.). The first response the topic by Dr. Erwin was highlighting the goals of companies, *"For companies it's not so much about saving the planet, right? That is not their first concern. Their first concern is to make money and to be economically successful. So, for them it is about business value I guess, right? And that also holds for the Circular Economy. If a company wants to be successful in applying Circular Economy concepts they need to have a business model. They need to create business value. So that is what I mean with creating value"*. He then continues to explain his four flavors of business value that circular business models can provide, see Figure 17.

1- **Sourcing value**: All types of direct cost reductions and savings that can arise from closed loop business practices. For instance, creating new markets that sell refurbished products and provide and direct sourcing value for a business. By this, a company gains a bigger

market and thus bigger revenues. It can also be on the cost side, by having access to cheaper resources

2- **Environmental value**: Benefits that result from improved ecological footprints, such as ease of compliance and improved green image. In order to benefit from sourcing value, communication must happen. By communicating the new business models to customers, a business gains more customer loyalty. By communicating to municipalities or governments, it becomes easier for a company to deal with legislation.
3- **Customer value**: Increased customer loyalty, better customer satisfaction, and superior brand protection. By setting up reverse supply chains, customers can gain value such as making it easier for them to return or exchange products, or even getting a new kind of product such as refurbished products.
4- **Informational value**: Closing the loop generates valuable data on production and supply problems, failure rates, useful lifetime of the product and usage patterns.

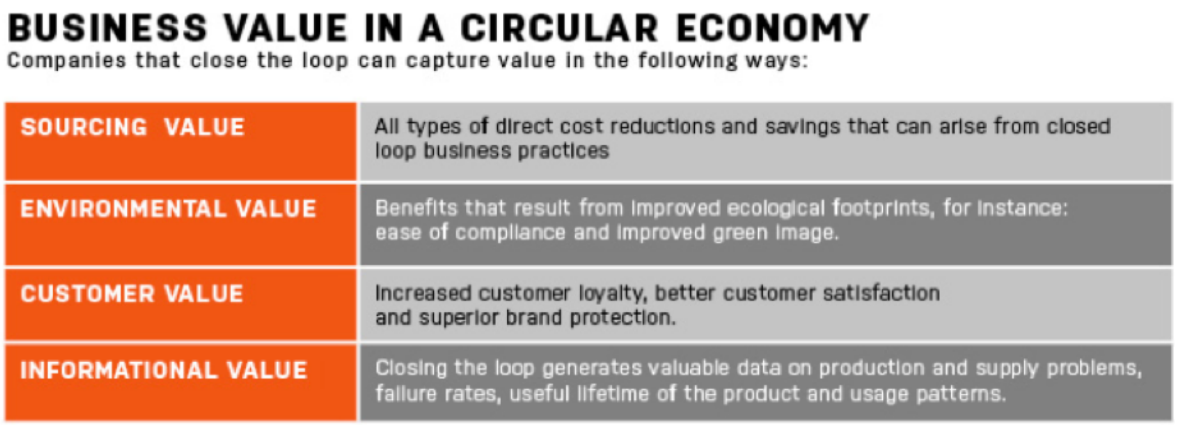


Figure 17. The four flavors of value provided by circular business models, by Dr. Erwin Van Der Laan from the Rotterdam School of Management.

2.2.8 Product design strategies for the circular economy

Design plays a key role in the transition to a circular economy. The reason behind this is that by adequately designing a product, you also design out the waste and pollution colligated with this product, which is the first of three main pillars defining the circular economy according to the Ellen McArthur Foundation (What Is The Circular Economy?, n.d.). In an interview held by

Conny Baker of TU Delft, where she explores the Six design strategies for longer lasting products with her subject Dr. Marcel Den Hollander, they go in depth in each strategy. See Figure 18.

1- **Design attachment and trust**. This is one of the most difficult to achieve, as it requires precise assumptions on how users would perceive and emotionally react to a product in the future. However, if done correctly, it will guarantee that users will hold on to the product for as long as possible.
2- **Design for durability**. In order for a product to be functional for a long period, it needs to be able to withstand wear and tear
3- **Design for standardization and compatibility**. The ability to expand the useful life of a product by replacing parts. This requires designing products consisting of parts that not only fit their specific product, rather designing these parts taking in consideration the bigger spectrum of products that can collectively achieve this objective. This creates and abundance in spare parts and thus allows products to be repaired easier and for longer.
4- **Design for ease of maintenance and repair**. This falls in perfect line with the previously discussed inertia principle. By designing for ease of maintenance and repair, loops become smaller, which result in less energy consumption.
5- **Design for upgradability and adaptability**. This allows taking into consideration the changes in customers' needs as well as changes in products contexts.
6- **Design for dis- and reassembly**. However long a product lasts, it will come to an end at some point, for that reason it is wise to consider that since the design phase. By doing so, recycling can be done in a proper and efficient manner.

Figure 18. Six design strategies for longer lasting products. TU Delft.

By looking carefully at the order of this list of strategies, we can see the logic behind it. 'Product integrity' is what Dr. Hollander uses to express the level of 'wholeness' of a product throughout its lifecycle. "If you have a product that stays whole as close as to it was produced in the first place then you can apply product attachment. But if you take it apart and operate at a parts level you actually go a long way from the state in which the product was originally produced. "*So the product integrity is lower at that point. And all the different strategies along that scale have a diminishing level of product integrity. So more things change in the product in order to make it last longer."*

2.2.9 The Urban Mine

The topic of another relevant interview held by David Peck who is an adjunct Professor at MIP, Politecnico di Milano Graduate School of Business and runs the Circular Economy program. Various EU program, interviewing Dr. Ester Van Der Voet from the Institute of Environmental Sciences, Leiden University, was the notion of urban mines (*Exploring the urban mine | 6.4 The Urban Mine | CircularX Courseware | edX*, n.d.). According to Dr. Ester, urban mines refer to the above ground stocks of metals opposed to the underground stocks that are geological mines.

The upside of using urban mines in securing resource is that it often requires less energy and more labor to extract, process, and utilize. It also differs from geological mines as there is less geopolitics involved. Similarly to geological mines, however, the concentration of urban mines must be studied and feasibility assessed. For example, it makes much more economic sense to utilize stocks of out-used cables for obtaining copper that it is to extract precious metals or rare earth metals from mobile phones. Another challenge is the lack of information available regarding urban mines. Initial studies have been conducted and initial estimates have been proposed, however it is still difficult to identify the quantity and quality of urban mines located on earth today.

In order to make circular sense out of urban mines, some questions need to be asked, such as:

- How much urban mines are out there?
- What is their concentration?
- When will the materials become available?
- How can we collect the materials when the time comes?
- What are the potential new technologies that can help in the process of recycling?

Planning ahead is crucial for taking advantage of urban mines, including designing new products in such a way that we keep in mind that they will become future sources for materials. At the end of the interview Dr. Esters concludes that *"the gains of a circular economy are basically in the potential for the reduction of environmental impacts due to a reduction of energy use. And we should make sure that that actually happens, because if it doesn't then the whole reason behind the circular economy disappears"*.

2.2.10 A model of economic entity adapted to circular economy

The international market characterized by competitiveness and always undergoing changes forces the economic entities to anticipate the availability of the energetic and material resources and to predict the effects of the climatic changes which may influence the economic activity of the entity (IONESCU et al., 2017). Therefore, the economic

entities of the future, which will activate in a circular economy, have to develop research and development departments that will contribute to the technical and technological evolution, by which the entity minimizes pollution, extends a system of rational usage of non-renewable resources and enforces the usage of renewable resources, implements a selective recycling system leading to collection, re-usage, renovation or transformation of wastes into raw materials required in the technological process of the entity. Collaboration, cooperation, and teamwork relation developed between the economic entity and external partners especially the customer is important to highlight. Since the development and manufacturing of new products with longer lifecycle, reusability, and recyclability happens inside the new circular economic model, the economic entity no longer plays the role of a mere producer and supplier, it becomes and entity mainly focusing on after-sale services which contribute to product lifecycle extension as well as pushing collection and recycling. The following model of the economic entity adapted to circular economy may be configured and customized to the need of different entities based on their field of work. Figure 19.

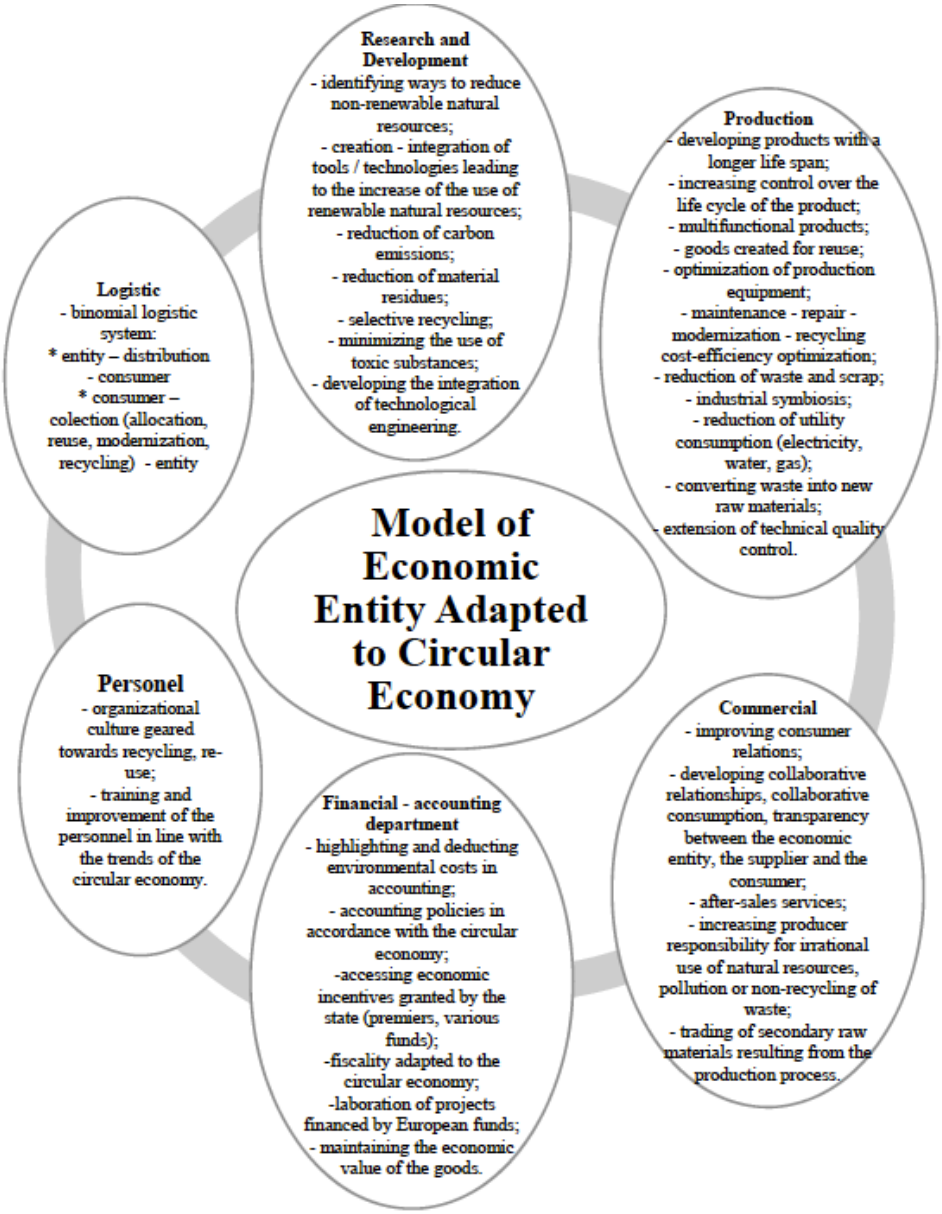


Figure 19. Model of economic entity adapted to circular economy, (IONESCU et al., 2017).

2.2.11 Business model innovation

A business model consists of two essential elements – the value proposition and the operating models – each of which has three sub-elements (Lindgardt et al., 2009). Figure 20.

The value proposition answers questions about what a business is offering and to whom is it offering to. It reflects choices along the following three directions:

- Target strength. Which customers do we choose to serve? Which of their needs do we seek to address?
- Product or service offering. What are we offering the customers to satisfy their needs?
- Revenue model. How are we compensated for our offerings?

The operating model, on the other, answers questions about how to profitably deliver the offering? It captures a business choices in three critical areas:

- Value chain. How are we configured to deliver on customer demand? What do we do in-house and what do we outsource?
- Cost model. How do we configure our assets and costs to deliver on our value proposition profitably?
- Organization. How do we deploy and develop our people to sustain and enhance our competitive advantage?

In this research conducted by BCG, it is highlighted that value of business model innovation is amplified in times of instability. The author of this thesis finds this approach relevant to the topic in hand, as one of the main drivers of the circular economy and its concepts is the instability our planet is experiencing because of the way traditional business models have operated in the past.

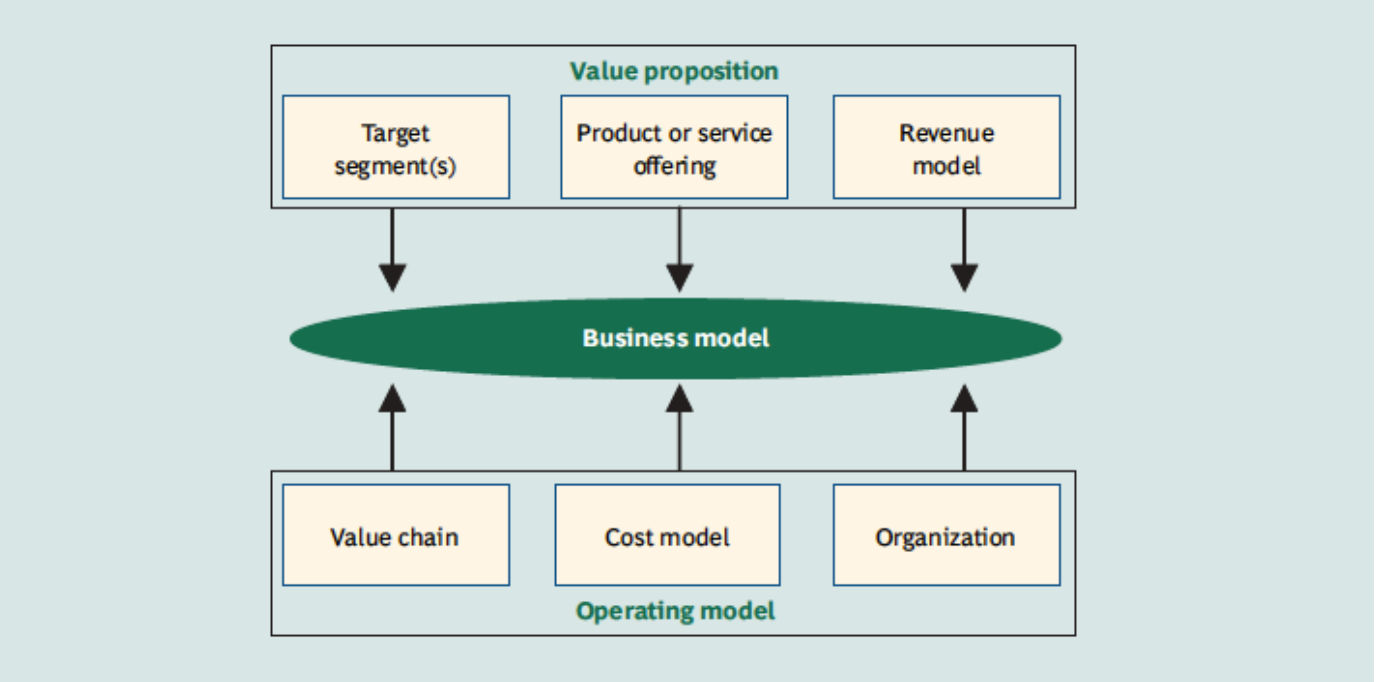


Figure 20. A business model typically consists of six components, source: BCG research ((Lindgardt et al., 2009).

Business model innovation may be considered more challenging than product or process innovation, but it also delivers superior returns. (Andrew et al., 2008) see Figure 21.

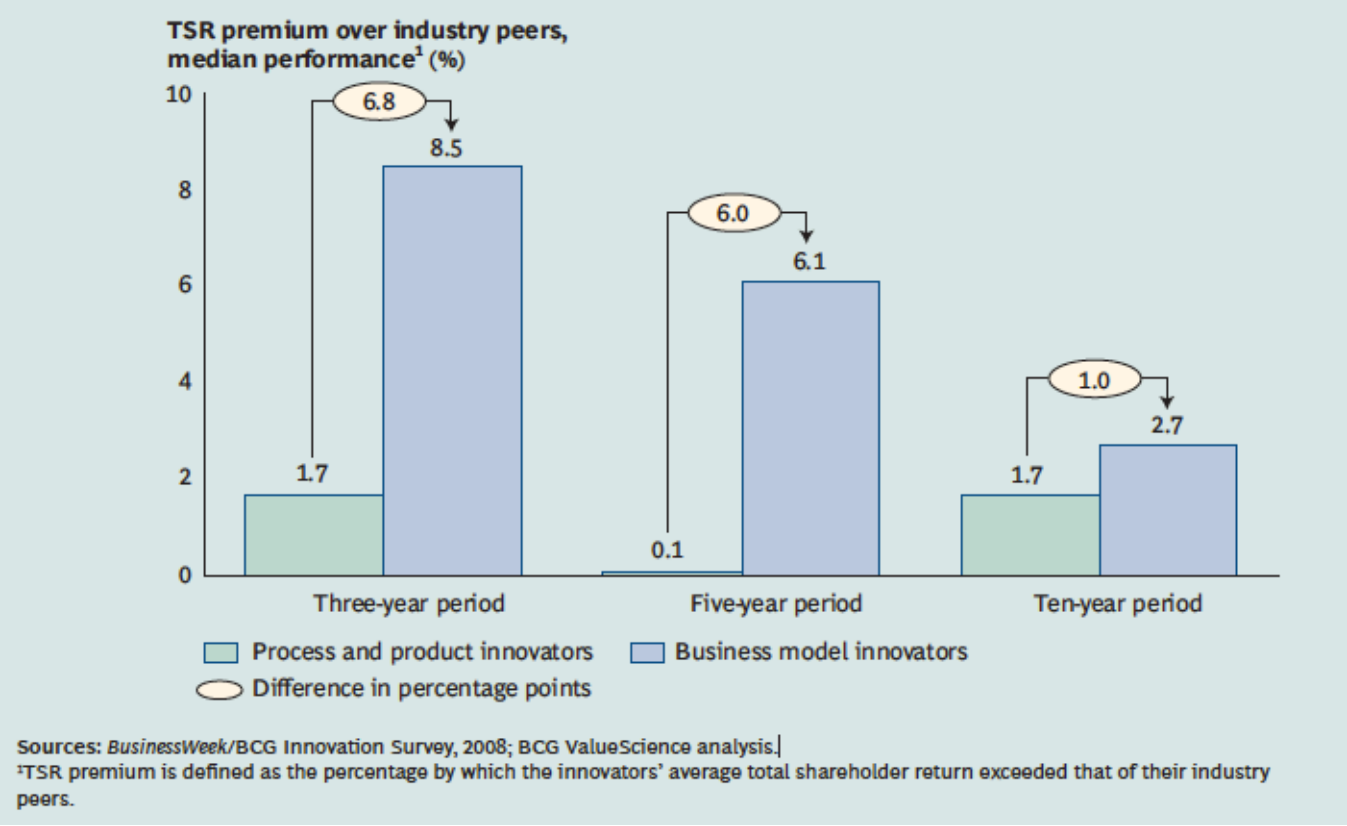
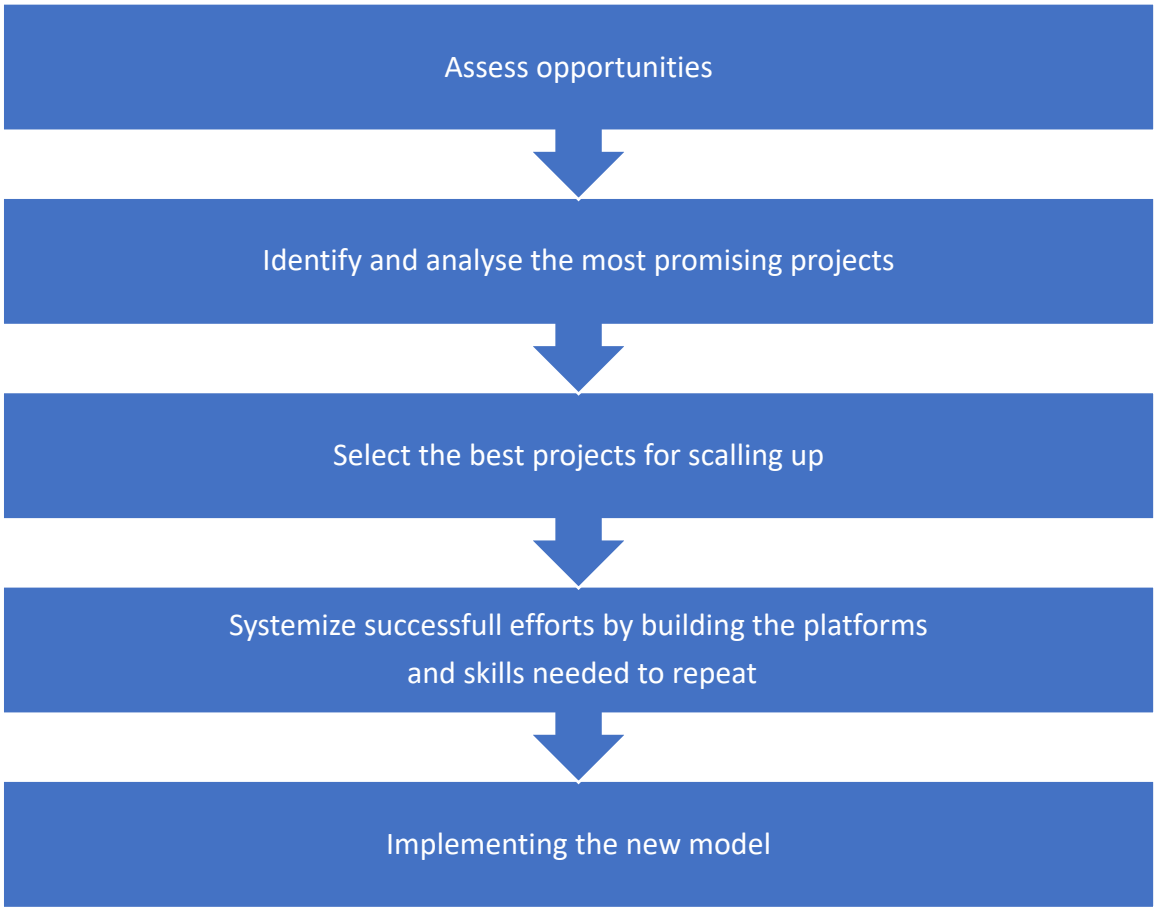


Figure 21. Business model innovators outperform traditional innovators over time (Andrew et al., 2008).

The study highlights some different contexts in which business model innovation had played a decisive role in a company's success, such as beating back intense competition, extending a business model with current customers, and extracting brand value by extending the business model. It also features a generic step-by-step approach for establishing a capability for business model innovation by companies. This approach is considered by the author of this thesis when exploring novel approaches to circular business model innovation. The approach is as follows:



3. Methodology

3.1 Research Aim

This research aims at exploring the relationship between business models and the emerging concept of the circular economy. More specifically, the author is on a mission to contribute to the literature of circular economy by covering gaps considering 1) consolidated business practices guiding companies in improving the circularity of their products and services (Rosa et al., 2019), 2) frameworks to support researchers and practitioners in conceptualization, design, and implementation of circular or sustainable business models as means to solve or avoid environmental or social issues, while aiming for economic benefits (Pieroni et al., 2019),and 3) the company level implementation of circular economy, including the challenges associated with the transition to CBMs (Guldmann & Huulgaard, 2020).

The research also aims at providing practitioners with a set of guidelines that can be adopted by incumbent firms while redesigning their business models in a way that allows them to contribute in the transition to a circular economy and benefit from the potential value it offers.

3.2 Research relevance and importance

The importance of such research stems from the current global suffering from phenomena such as climate change, ocean contamination, child labor, and poverty. Issues that can be traced back to unethical and non-inclusive business practices. As a result of increased awareness on such issues, attention of scholars and practitioners in related fields began to shift towards sustainability studies. An emerging body of research spanning different literatures advocates the argument that sustainability, broadly defined as the management of balanced and responsible production to ensure enduring and long-lasting corporate relationships, living conditions, and social conditions, will change the landscape by placing new demands on skills and abilities of a company's resource base (Parida & Wincent, 2019).

Fundamentally speaking, sustainability from a business viewpoint envisions a balanced integration of economic performance, social inclusiveness, and environmental resilience (Geissdoerfer et al., 2016). This integration can be measured and communicated in modern day business reports using

the so called 'triple bottom line'. This thesis is based on the study of the circular economy, which is a concept that is often framed within the wider concept of Sustainability. CE is defined as a global economic model minimizing the negative effects of finite resource consumption, by focusing on intelligent design of materials, products, and systems. Inspired by the concept of closed-loop economy, the CE paradigm was introduced at the end of the '80s (W. Stahel & Reday-Mulvey, 1981) to minimize emissions, resource use, pollution and waste, and maximize the resource efficiency of material assets. According to a systematic literature review on approaches for circular and sustainable business model innovation (Marina P.P. Pieroni, Tim C. McAloone, Daniela C.A. Pigosso), we can distinguish more accurately CE as an umbrella concept that was introduced as the part of the wider scope of sustainability that is more focused on a more resource-effective and efficient economic system by internationally narrowing, slowing, and closing materials and energy flows (Blomsma & Brennan, 2017) and decoupling economic growth from virgin material consumption. The concept of the circular economy is described in more detail in the 'Literature Review' section of this document.

In this thesis, the author investigates the role of business model innovation in realizing circular business models that will accelerate the transition from a traditional linear economy to a circular one. The cruciality of considering BMs in this transition stems from the power of a BM to influence all aspects of a business and its entire supply chain, from creating new profit opportunities, reducing volatility and increasing security of supply, to improving customer interaction and loyalty (Circular Economy Learning Hub, n.d.).

A transition from a linear to a circular system is perceived by many specialists as one of the few avenues available for maintaining economic growth to meet future demands and at the same time counterbalance the negative environmental effects caused by centuries of take-make-use-waste linear systems. The urgent need for this transition is reflected in the UN's 2030 agenda for sustainable development (Transforming our world: the 2030 Agenda for Sustainable Development .:. Sustainable Development Knowledge Platform, n.d.), with at least 12 out of its 17 objectives that can be either directly supported, or positively influenced by adopting circular systems. Despite the apparent and desirable environmental and societal consequences of adopting circular systems, it is also becoming increasingly lucrative for firms to incorporate circular practices within their

upstream and downstream processes (Urbinati et al., 2017a). Seemingly, confirmed evidence on the increasing demand from consumers for sustainable and eco-friendly products and services may justify investments in adopting circularity on the downstream, on the other hand, the upstream is also being highly rewarded for sustainability: According to big four consulting firm E&Y (What investors want to know about ESG metrics | EY - Global, n.d.), "investing using environmental, social and governance (ESG) criteria is no longer a niche activity. It is an increasingly important theme in the asset management world, with many predicting that it will soon become a default approach for most funds, not just those that badge themselves as specialist ESG products".

3.3 Research question formulation

Staring from the above premises, the following research question was thus developed:

"How can incumbent firms operating on the basis of a linear business model shift towards adopting a more circular business model?"

Leveraging on case study analysis, this thesis investigates in depth the key practices that can help propel the current linear economy model towards a circular one through Business Model Innovation and Transformation within incumbent firms. Accordingly, a fundamental literature review on Sustainability, Circular Economy, Business Model Innovation, Circular Business Model Innovation, and Social Innovation, confirms the presence of a common gap in the literature concerning practical methods and practices that can support firms in their transition process from linear BMs to circular BMs.

It was decided to focus the scope of research on Business Models – being the main value architecture for firms – in order to grant flexibility in exploring and innovating all aspects of value creation, delivery, and capture according to the CE concepts, and furtherly contribute to the missing links within the literature. The heterogeneity of data sources permitted by multiple case study analysis as the main methodology used to enrich the research results, making them applicable for a wide array of industries and sectors.

3.4 Research nature

An exploratory research is a research conducted for a problem that has not been studied more clearly, intended to establish priorities, develop operational definitions and improve the final research design (Shields & Rangarajan, 2013). When a research aims to gain familiarity with a phenomenon or to acquire new insight into it in order to formulate a more precise problem or to develop a hypothesis, exploratory studies come in handy. If the theory happens to be too general or too specific, a hypothesis cannot be formulated (Kumar & Singh, 2011). Therefore, a need for an exploratory research may be realized and instituted to gain experience that may help in formulating a relevant hypothesis for more definite investigation (Kumar & Singh, 2011). Consequently, since the research aims to explore a somewhat under-researched phenomena (i.e evolving linear business models into circular ones), this research is classified as exploratory. Since the research addresses a real life debate and aims to solve an existing problem, it is classified as applied research.

3.5 Approach and design

Qualitative approaches facilitate the understanding of complex phenomena (Yin, 2009), such as business models and circular economy. A qualitative approach is an appropriate and effective strategy for early-stage research on a specific topic to gain understanding in situations where there is limited knowledge (Gartner & Birley, 2002). In addition, qualitative methodologies work well capturing multidimensional phenomena and non-linear, sometimes fuzzy, patterns of the reality offering a clear and holistic view of the context of study (Sinkovics et al., 2008). The literature offers a wide range of methods for qualitative research as case studies, ethnography and participant observation, grounded theory, biographical and participative inquiries, and these methods appear particularly suitable for research where multiple actors and environments are involved. The expected research outcome would be a novel framework/methodology for better managing the transition from linear to circular business models, thus approach used is inductive.

The qualitative approach adopted for this research is an explorative and inductive research approach.

An exploratory research is a research conducted for a problem that has not been studied more clearly, intended to establish priorities, develop operational definitions and improve the final research design. When a research aims to gain familiarity with a phenomenon or to acquire new insight into it in order to formulate a more precise problem or to develop a hypothesis, exploratory studies come in handy. If the theory happens to be too general or too specific, a hypothesis cannot be formulated (Kumar & Singh, 2011). Therefore, a need for an exploratory research may be realized and instituted to gain experience that may help in formulating a relevant hypothesis for more definite investigation (Kumar & Singh, 2011). Consequently, given the complexity of impact investing, the exploratory approach represents a good fit to this research.

While, **the inductive approach** consists in drawing new hypotheses or theories by gathering and analyzing data. It works from the more general to the more specific. Sometimes this is informally called a "bottom-up" approach. We might begin with studying topic of interest. We then start to form more specific hypotheses that we can generalize.

3.6 Research strategy

This study adopts a single case study methodology (Yin, 2013) to explore the phenomenon in a comprehensive way. The case study methodology is preferable when there is a new phenomenon to be explored and also for allowing serendipity of findings in idiosyncratic situations (Ünal et al., 2019). In this case, since the transition toward the circular economy just started and the impacts of it in organizations have yet to be explored, the author employs an in-depth case study approach to have a comprehensive understanding of the phenomenon. A case study is a method for learning about a complex instance, based on a comprehensive understanding of that instance obtained by extensive description and analysis of that instance taken as a whole and in its context (Monique Hennink, Inge Hutter, 2011)

3.7 Data gathering & analysis

Secondary research involves re-analyzing, interpreting, or reviewing past data. Secondary information consists of sources of data and other information collected by others and archived in some form. These sources include government reports, industry studies, archived datasets, and

syndicated information services as well as the traditional books and journals found in libraries (W. Stewart & A. Kamins, n.d.). Initially, this thesis was intended to gather first hand data about the selected case. Due to critical circumstances, the sources for first hand data were no longer made available, and the author relied on secondary data instead. As resource efficiency (e.g. time and cost) might be an obvious advantage of secondary research, other advantages can be resembled in the quality of data that can be collected from reliable and professional sources. Reliable data sources were utilized for this thesis, including scientific papers and journals, firms websites, and governmental reports. More than 116 companies have been looked into in the early phases of the research before focusing on the selected case study. Their business models were screened for circularity and categorized base on industry, type, and nationality.

4. The industry

The European pulp, paper, and packaging industry is responsible for satisfying one quarter of the world's demand for paper (*Key Statistics 2016 | CEPI - CONFEDERATION OF EUROPEAN PAPER INDUSTRIES*, n.d.). With a total annual turnover of EUR 180 bn, the industry employs around 647,000 workers in 21,000 companies, making it a powerful social benefactor (*Pulp and paper industry | Internal Market, Industry, Entrepreneurship and SMEs*, n.d.). In 2018, 92.2 million tons of paper and board have been produced in Europe, of which 20.6 million tons were exported overseas. Another 5.8 million tons were imported, and a total of 77.4 million tons were consumed within Europe. As shown in Figure 22, Germany leads the continent producing 24.6% of the total production, followed by Finland and Sweden. Italy falls in 4th place with 9.9% of Europe's production.

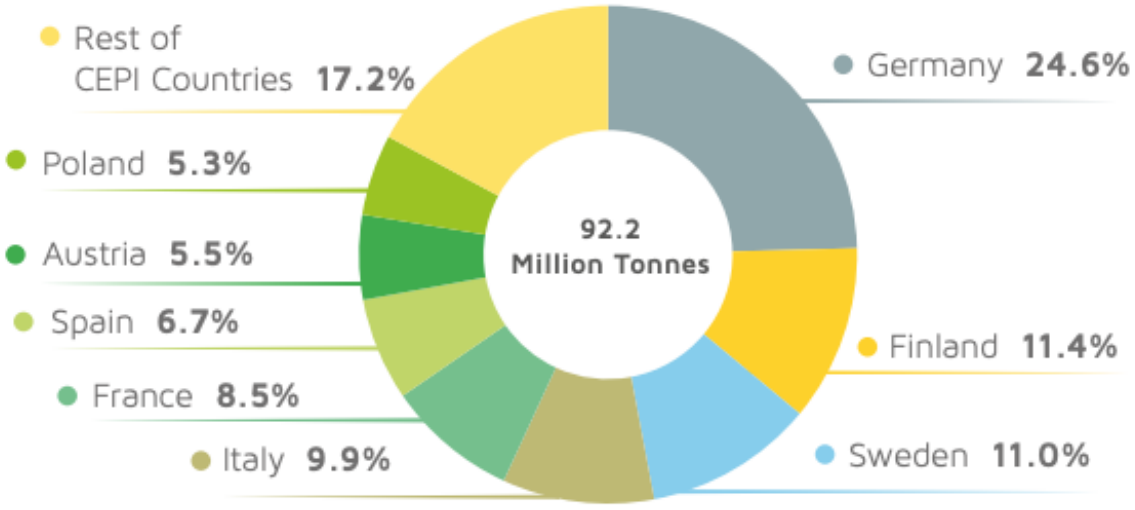


Figure 22. CEPI paper and board production by country in 2018, (*Key statistics 2018*, 2018)

Investments in the industry had seen a notable growth of 7.5% by the end of 2017, to reach EUR 5.5 bn (*Strong performance for European paper industry in 2017 | Printweek*, n.d.). An interesting phenomena to investigate is the relationship between production and production facilities. As shown in Figure 23, as the production rate is increasing, the number of facilities required is decreasing, which is evidence to the increasing efficiency of the industry.

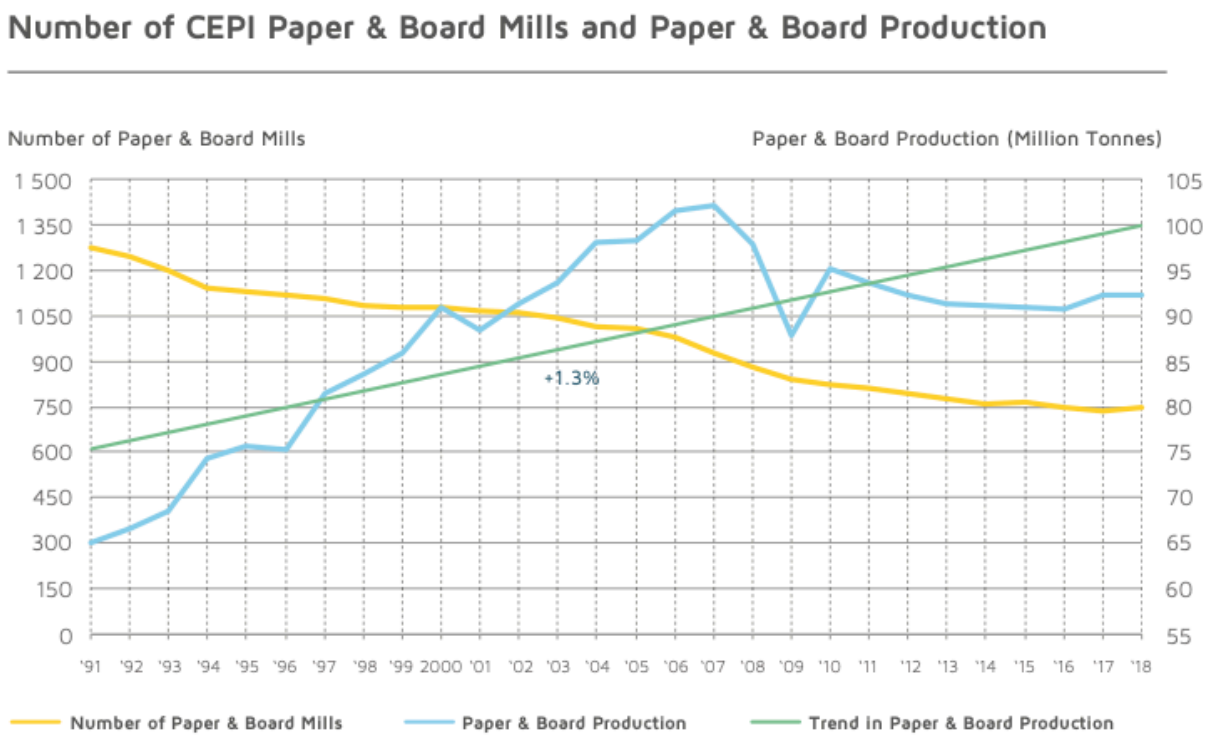


Figure 23. CEPI paper and board mills vs. production, (*Key statistics 2018*, 2018)

4.1 Relevance to the circular economy

The circular economy is of high relevance to the paper industry given the high recyclability of the materials produced. Companies operating within the industry are mostly early adopters for the concepts of the circular economy, thanks to the apparent economic and environmental benefits it can provide. Figure 24 shows the utilization of paper for recycling by country in Europe, with a total 48.8 tons of utilized used paper for production purposes, and a 71.6% European RFP recycling rate.

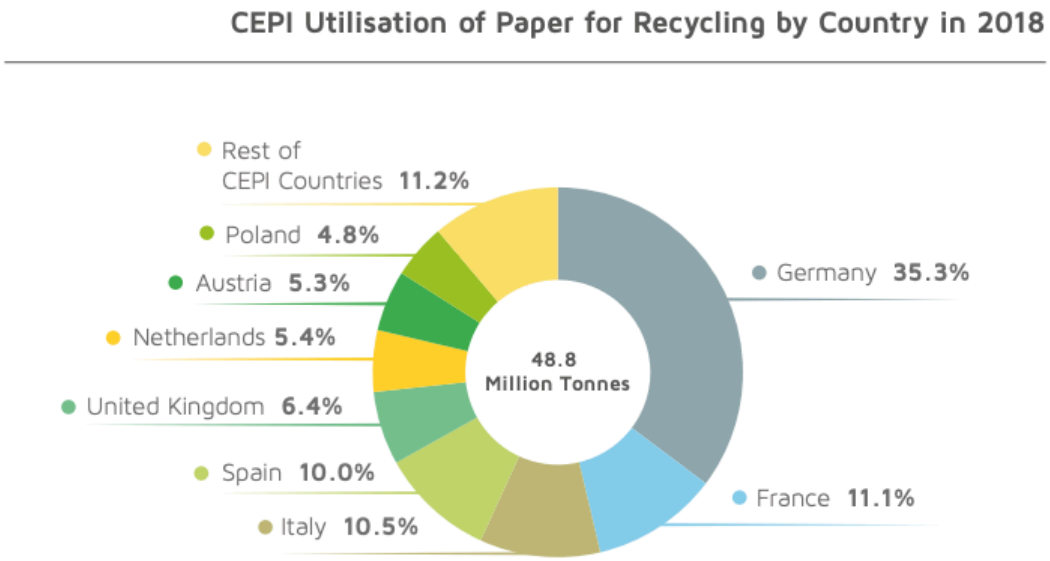


Figure 24 .CEPI utilization of paper for recycling by country in 2018, (*Key statistics 2018*, 2018).

Another point of relevance to the circular economy is the constantly reducing resource consumption and waste generation. Figure 25 shows the constant decline of CO2, COD, NOX, SO2 emissions, electricity and water consumption as production steadily increases. Regeneration of the biosphere is also achieved thanks to the European industry players' efforts in offsetting their consumption. It is estimated that over the past two decades, the area of European forest representing the main source of raw materials for the paper industry has been growing with a rate equivalent to 1,500 football fields/ day (Medugno & Assocarta, 2017).

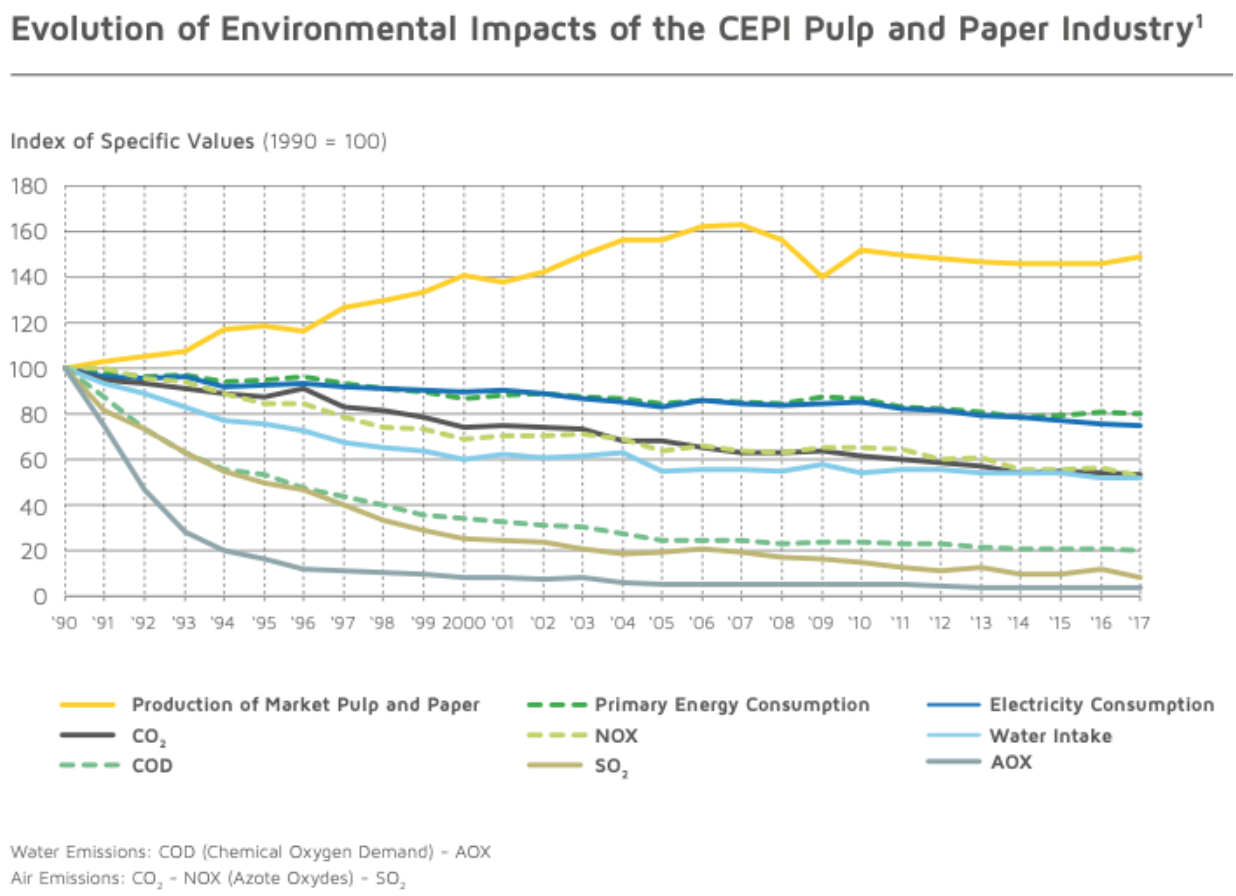


Figure 25. Evolution of Environmental impacts of the CEPI pulp and paper industry, (*Key statistics 2018*, 2018).

4.2 Italy

In Italy – a country considered poor in natural resources – striving to make material use more efficient, innovative, and intelligent, has always been essential. As a result, Italy is now one of the most advanced countries in both green and circular economies. In respect to Europe, Italy is the nation with highest level of circulated materials used in manufacturing, with almost a fifth of all materials used in manufacturing. As a direct effect, energy savings equivalent to more than 17 million tons of crude oil per year and thus 60 million tons of CO2 emissions are spared (*I 00 I Tal I a N C I R C U La R Econo M Y Sto R I E S*, n.d.). Circularity is adopted by many companies within the country, operating in numerous industries. The author had analyzed over 100 cases of Italian companies adopting circularity before selecting the case of Fedrigoni group, an Italian incumbent and one of the world leaders operating in the Pulp & Paper industry. The list of companies initially analyzed include startups, SMEs, and incumbents who were either early

adopters of the circular economy, or currently exploring the concept by pilot projects or by business model innovation. The list of companies analyzed can be found in Appendix A.

5. The case (Fedrigoni Group)

5.1 Introduction

Founded in 1888 with the slogan of "Excellence in the production of special papers", The Fedrigoni Group is one of the main players in the world and the European leader for production and sales of special papers for graphic use and self-adhesive products for labels (*About us - Fedrigoni Group*, n.d.). In particular, it is the global leader in the production of self-adhesive labels for the wine sector. The Group, among others, owns the historic Fedrigoni and Fabriano brands, renowned throughout the world for high quality and excellence. This tradition is equally combined with technological research and innovation as regards materials and production processes developed internally by Group companies.

With over 130 years of history, the Group boasts a strong identity and positioning in market niches ensuring high added value, high recognition of its brands, excellence and innovative product range, backed up by an effective and efficient global distribution network.

Fabriano paper boasts more than 750 years of history and is part of Italy's cultural heritage; it is preferred by millions of students and artists in Italy and worldwide every year. The Fedrigoni Group also develops stationery products sold through 10 single-brand Fabriano Boutiques.

In 2018, Bain Capital Private Equity, a global investment company, became the main shareholder in the Fedrigoni Group with a 90% stake in company equity, alongside a branch of the Fedrigoni family retaining 10% of shares.

In 2018, the Group achieved 1,181.5 million euros in revenues (pro forma balance sheet), with 3.000 employees in 16 production centers in Italy, Spain, Brazil and United States, with more than 25.000 references in the catalogue distributed and sold in almost 130 countries around the world.

The main revenue streams are illustrated in Figure 27. Fedrigoni Group revenue streams and main products, Fedrigoni.com and broken-down in Table 3.

5.2 Group Companies

See Figure 26. Fabriano Group companies.

Figure 26. Fabriano Group companies

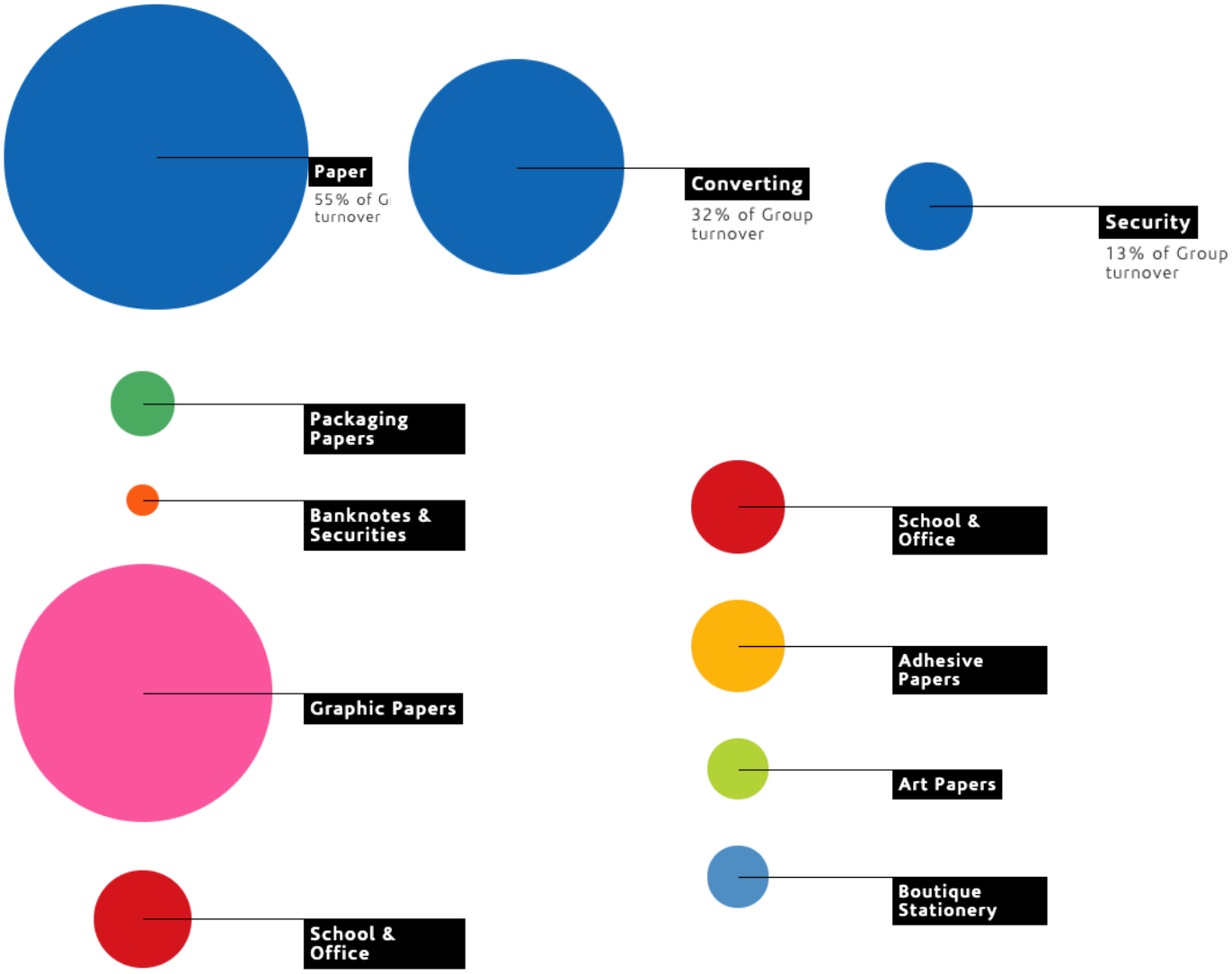


Figure 27. Fedrigoni Group revenue streams and main products, Fedrigoni.com

Table 3. Fedrigoni Group activity breakdown, Fedrigoni.com

Product Group Product Sub-group (% of total turnover)	**Description**	**Produced by**
Paper (55%)		
Packaging papers	Special papers for luxury packaging, shoppers and lining of boxes and publications.	- **Fedrigoni** - **Fabriano**
Graphic papers	Production developed for offset and digital printing presses. Coated and natural papers for publishing, brochures, headed paper, posters and mailing.	- **Fedrigoni** - **Fabriano**
School & office papers	Production of special media and sizes for the office world, printers and fax, with excellent whiteness and ideal runability requisites.	- **Fabriano**
Adhesive/ label paper	Adhesive papers and films. Production designed for offset and digital printing of labels for industrial applications and in the wine and food sector. Casting-Release. Papers used in the regeneration of leather and the production of imitation leather, used in clothing, leatherwear and furnishing.	- **Arconvert** - **Arconvert Brasil** - **Manter**
Art papers	Kits and papers for the world of schools, art, hobbies and delightful gift articles in paper.	- **Fabriano**
Boutique & Stationary	Fabriano Boutique creates a range of delightful and useful articles based on paper for the non-professional community as well. Everything available in the boutiques is designed by Fabriano and made in Italy by highly skilled craftsmen using only the best materials.	- **Fabriano** - **boutique**
Pressure sensitive labels (Converting) (32%)	The Pressure Sensitive Labels line is dedicated to the production and marketing of self-adhesive papers and films used to produce self-adhesive labels in the wine and agro-food sectors and for many others, including pharmaceuticals and publishing. The production process is based on converting paper and/or plastic films into self-adhesive products using specific chemical-physical treatments.	- **Arconvert**
Banknotes & security (13%)	The Security line is dedicated to the production of paper used to print banknotes, securities and security features for banknotes that Fedrigoni makes for numerous central banks and state printing offices worldwide. Fedrigoni has acquired proprietary know-how in this sector, protected by patents, for the production of highly technological, highly sophisticated products manufactured in high-precision production centers.	- **Fabriano Securities** - **Fabriano**

5.3 Circularity

In this section, the author explores Fedrigoni Group's activities, goals, and practices that are in line with the circular economy concept. As the group is committed to balance the impact of its production processes with the ecosystem, and faithful to a growth strategy that is responsible and that entails genuine concern for the impact of every action it takes and meeting the needs of the present without compromising the ability of future generations to meet their own needs, this strategy can be witnessed throughout its entire value chain. Following is a description of the sustainability practices adopted by the group associated to their correspondent concepts related to the circular economy. Figure 28. Circular economy adoption by Fedrigoni Group.

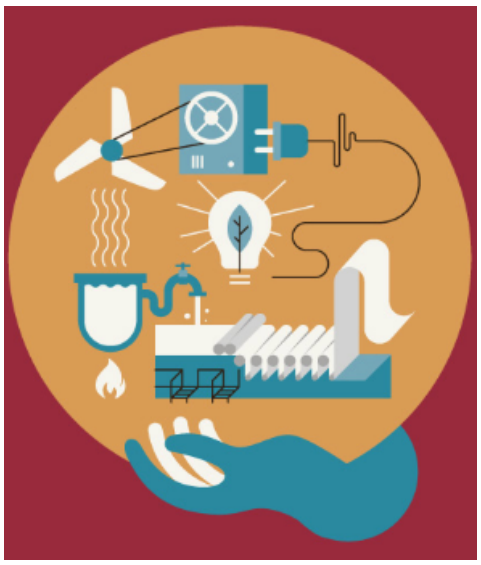
elaborates the practices.

5.3.1 Raw materials

Raw materials used in Fedrigoni Group's production are environmental friendly. By using annual plants[6]. This choice of raw material means that the Group's production has little to no negative impact on forests. It also means that the end of life waste resulting from the products will be biodegradable. In circular economy words, this can be related to levering the biological cycle of the butterfly diagram which is the most efficient in terms of conserving the biosphere and for designing out waste. As a key player in the paper industry, the Group is also intentionally contributing in regenerating the natural system they rely upon for sourcing their raw materials. According to the (Food and Agriculture Organsiation of the United Nations, 2015), making paper does not destroy forests. Over the past 10 years (2005-2015), in fact, the forest area of Europe has grown by more than 4 million hectares.

[6] An annual plant is a plant that completes its life cycle, from germination to the production of seeds, within one growing season, and then dies (Rees & Long, 1992)

5.3.2 Energy consumption



Thanks to major investments and constant attention to technological innovation, Fedrigoni was able to exploit the process of co-generation of energy. By using the heat energy generated in a plant and transforming it into electric energy, the plant becomes semi-self-sufficient in terms of energy. This process of tranforming waste energy into useful energy is a clear example for recycling, narrowing resource flows, thinking in systems, cradle to cradle, industrial symbiosis, and renewable energy utilization. This tactic has allowed the Group to cut its virgin energy consumption by 44% between 2002 and 2015.

5.3.3 Water consumption

The group has payed special attention to the rate of water consumed by its processes. In 2015, on average they used 29 liters of fresh water for each kg of paper produced, whereas in 2002 the usage was 52 liters. And this significant reduction in the consumption of natural resources continues to improve year after year. This 45% saving has been achieved mainly by constantly redesigning and improving the processes and equipment used in production. This provides a strong example of narrowing resource flows, designing for the environment, and industrial ecology.

5.3.4 Emissions

Production of paper, as many industrial processes, emits a certain amount of greenhouse gases that contribute to global warming and might have other toxic effects. One of the most known of these gases is CO2, which Fedrigoni was able to cut by 30% from its processes between 2002 and 2015. Nitrogen oxides (NOx) are also considered toxic gases, that the group was able to cut by almost a half (47%) within the same period. It's important to mention that this reduction was happening during a period in which the group was able to increase its productivity by over 29%, which is clear evidence of their success in decoupling growth and waste generation.

5.3.5 Waste

Turning waste into food is another way of describing the cradle to cradle concept, which is main objective of the group. Between 2002 and 2015, the company was able to increase the amount of paper produced by 69%, all while:

- Using 44% less energy
- Consuming 45% less fresh water
- Cutting CO2 emissions by 30% and NOx by 47%
- Producing 29% overall waste

The 29% waste reduction was achieved thanks to re-use and recycling. One of the most iconic products by Fedrigoni is its CENTO paper. "Cento", meaning one-hundred, refers to the products original materials, which are 100% recycled paper. The product is considered and sold as high quality paper as it has an excellent degree of smoothness and assures improved printing performance and extra-ordinary whiteness. The group also believes in the "Zero Km" philosophy, and they achieve it by recycling and re-using its own in-house production waste, and is fully recognized and certified by FSC[7]

[7] The FSC certification is considered the "gold standard" designation for wood harvested from forests that are responsibly managed, socially beneficial, environmentally conscious, and economically viable.

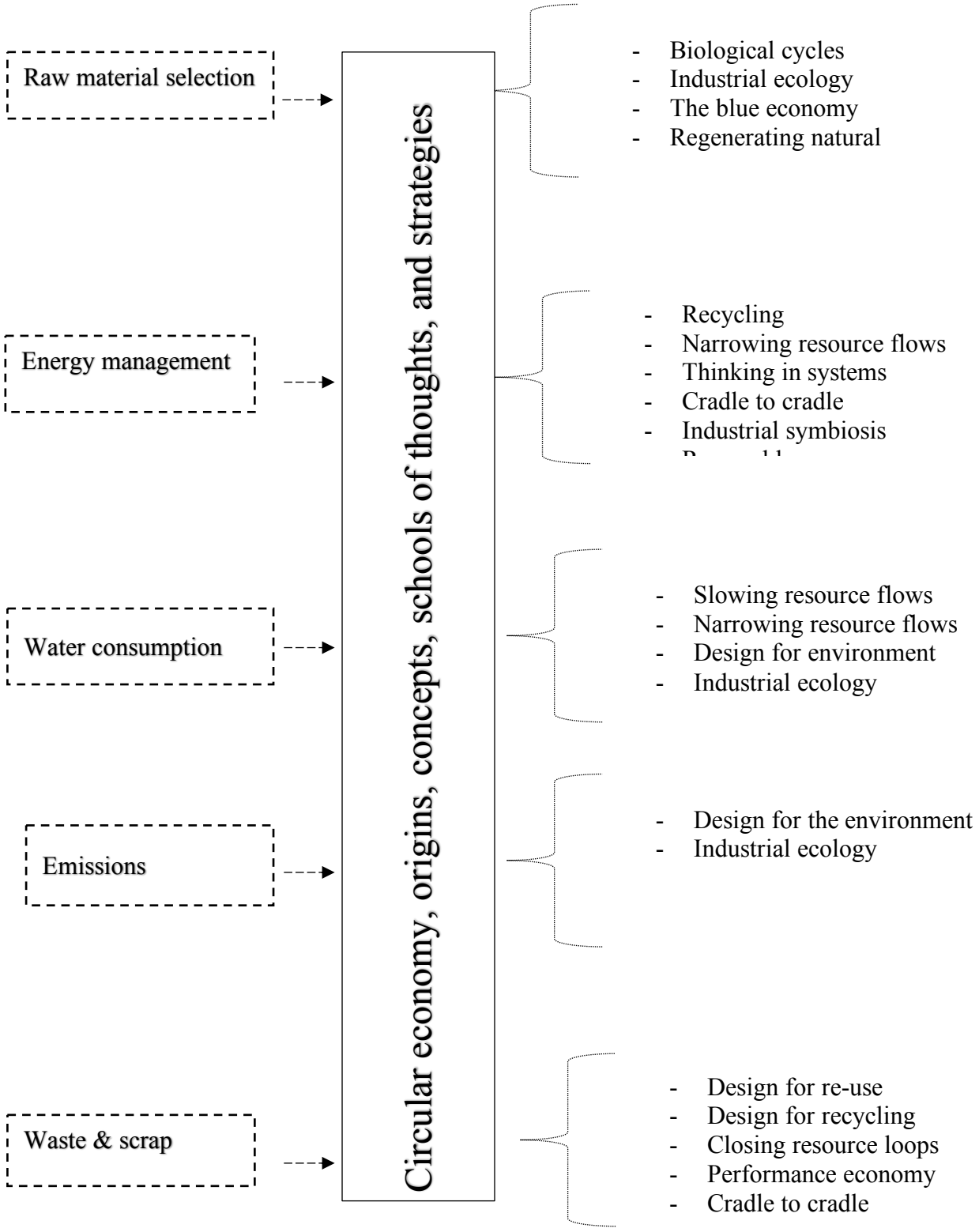


Figure 28. Circular economy adoption by Fedrigoni Group.

6. Findings and Contribution

The main outcome of the research is a framework that converts the different circular economy aspects, theories, and ideologies found in the literature to a clear set of practices that can be encrypted in the business models of adopting firms in order to suite their circularity goals. This outcome contributes to the exiting body of literature by covering gaps concerning practical frameworks for converting linear business models into circular ones, and thus contributing to the global transition from a linear to a circular economy. This outcome also offers implications for practice, as it resembles a practical guideline for strategists within firms, giving them a clear picture of how they can increase circularity within their firms' business models.

The framework (Figure 29. The CE practice framework**)**

The framework consists of six main elements, five of which categorize the first based on different criteria. The elements are as follows:

1) **Circular economy practices (CE practices).** This group represents the actual circular economy practices extracted from theory and belonging to different schools and authors, harmonized and reintroduced as actions that can be adopted by firms seeking to increase the circularity of their business models. The 25 proposed CE practices represent the basic set of data introduced by the framework. The practices are as follows:

- Design for attachment/ trust
- Design for durability
- Design for standardization/ compatibility
- Design for ease of maintenance and repair
- Design for upgradability/ adaptability
- Design for dis/reassembly
- Use recycled material
- Use refurbished/ remanufactured parts
- Use maintained parts
- Reuse parts

- Use renewable energy
- Use recycled energy
- Offset energy consumed
- Utilize industrial symbiosis
- Use access & performance model
- Utilize pay-per-use
- Communicate circularity
- Seek new customer segments (e.g LOHAS[8])
- Utilize take back systems
- Resell EOLC waste to other market segments
- Remanufacture/refurbish EOLC and resell as if new
- Extract materials for recycling (internal or external)
- Sell/barter EOLC waste
- Produce ecofriendly waste
- Minimize harmful emissions

2) **Circular economy family (CE family).** For the sake of harmony, the CE practices were grouped into three main families, which represent the three main principles of circular economy proposed by the Ellen McArthur Foundation. The three families and their underlying assumptions are as follows:

- Designing out waste and pollution. Waste and pollution are not accidents, but the consequences of decisions made at the design stage, where around 80% of environmental impacts are determined. By changing our mindsets to view waste as a design flaw and harnessing new materials and technologies, we can insure that waste and pollution are not created in the first place.
- Keeping products and materials in use. Products and materials must be kept in the economy. We can design some products and components so they can be reused, repaired, and remanufactured. But making things last forever is not the only solution. When it comes

[8] LOHAS: Lifestyle Of Health And Sustainability.

to products such as food and packaging, we should be able to get the materials back so they don't end up in landfill.

- Regenerating natural systems. In nature, there is no concept of waste. Everything is food for something else. Instead of simply trying to do less harm, we should aim to do good. By returning valuable nutrients to the soil and other ecosystems, we can enhance our natural resources.

3) **Product/ Service life cycle (Product/ service LC).** This element indicates the product or service lifecycle phase in which each CE practice falls.

- Design phase
- Raw materials or component sourcing phase
- Manufacturing phase
- Use of product or service phase
- End of life cycle

4) **Value bracket.** The main business model reference adopted by the framework is the business model canvas. This group furtherly classifies each CE practice based on the value bracket it belongs to (i.e. value creation, value delivery, value capture). For the sake of simplicity and ease of use, it was decided not to go further and classify each practice according to specific elements within the canvas (e.g. key activities).

- Value creation
- Value delivery
- Value capture

5) **Stream.** This group classifies each practice based on the stream (i.e. downstream or upstream) based on the circular economy taxonomy proposed by (Urbinati et al., 2017a).
6) **Business value type.** Last but not least, the 'business value type' group was introduced in order to classify the circular economy value returning to the firm thanks to each practice.

- Sourcing value
- Environmental value
- Customer value
- Informational value

CE practice	CE family	Product/service LC	Value bracket	Stream	Business value type
Design for attachment/ trust	Design out waste and pollution	Design	Value creation	Upstream	Informational value
Design for durability	Design out waste and pollution	Design	Value creation	Upstream	Informational value
Design for standardization/ combatability	Design out waste and pollution	Design	Value creation	Upstream	Informational value
Design for ease of maintenance and repair	Design out waste and pollution	Design	Value creation	Upstream	Informational value
Design for upgradability/ adaptability	Design out waste and pollution	Design	Value creation	Upstream	Informational value
Design for dis/reassembly	Design out waste and pollution	Design	Value creation	Upstream	Informational value
Use recycled material	Keep products and materials in use	Raw materials/components	Value creation	Upstream	Sourcing value
Use refurbished/ remanufactured parts	Keep products and materials in use	Raw materials/components	Value creation	Upstream	Sourcing value
Use maintained parts	Keep products and materials in use	Raw materials/components	Value creation	Upstream	Sourcing value
Reuse parts	Keep products and materials in use	Raw materials/components	Value creation	Upstream	Sourcing value
Use renewable energy	Design out waste and pollution	Manufacturing	Value creation	Upstream	Environmental value
Use recycled energy	Design out waste and pollution	Manufacturing	Value creation	Upstream	Environmental value
Offset energy consumed	Regenerate natural systems	Manufacturing	Value creation	Upstream	Customer value
Utilize industrial symbiosis	Design out waste and pollution	Manufacturing	Value creation	Upstream	Sourcing value
Use access & performance model	Keep products and materials in use	Use	Value delivery/capture	Downstream	Customer value
Utilize pay-per-use	Keep products and materials in use	Use	Value delivery/capture	Downstream	Customer value
Communicate circularity	Keep products and materials in use	Use	Value delivery/capture	Downstream	Customer value
Seek new customer segments (e.g LOHAS)	Keep products and materials in use	Use	Value delivery/capture	Downstream	Customer value
Utilize take back systems	Keep products and materials in use	Use	Value delivery/capture	Downstream	Informational value
Resell EOLC waste to other market segments	Keep products and materials in use	Use	Value delivery/capture	Downstream	Sourcing value
Remanufacture/refurbish EOLC and resell as if new	Keep products and materials in use	End	Value delivery/capture	Downstream	Sourcing value
Extract materials for recycling (internal or external)	Keep products and materials in use	End	Value delivery/capture	Downstream	Sourcing value
Sell/barter EOLC waste	Keep products and materials in use	End	Value delivery/capture	Downstream	Sourcing value
Produce ecofriendly waste	Regenerate natural systems	End	Value creation	Downstream	Environmental value
Minimize harmful emissions	Regenerate natural systems	End	Value creation	Downstream	Environmental value

Figure 29. The CE practice framework

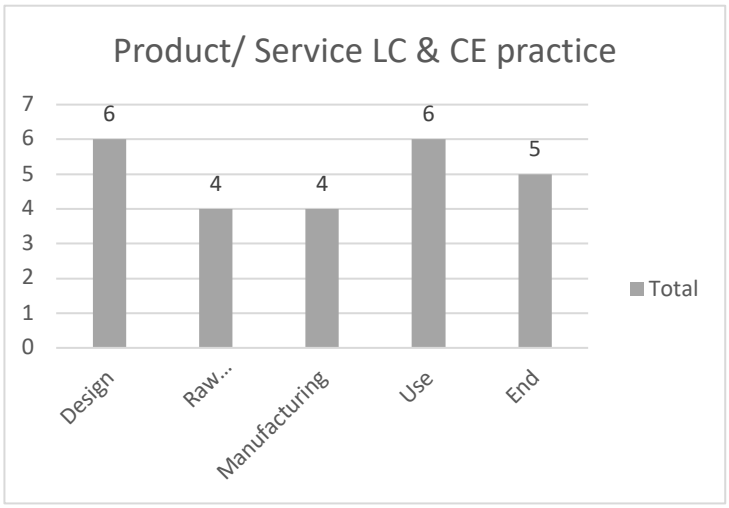


Figure 31. CE practice and product/ service LC

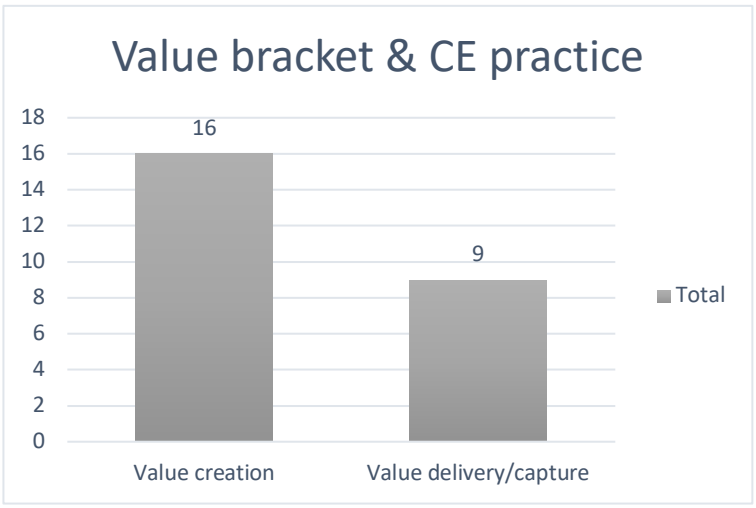


Figure 30. CE practice and value bracket

The data was furtherly analyzed to measure CE practices according to different parameters. According to the data set, 6 out of the 25 CE practices take place in the Design phase of the product/service life cycle, 4 in the Raw Materials & Components phase, 4 in the Manufacturing phase, 6 in the Use phase, and 5 in the End of life cycle phase. (Figure 31. CE practice and product/ service LC)

16 of the CE practices happen in the Value Creation phase, and the 9 remaining happen in Value Delivery and Capture phases. (Figure 30. CE practice and value bracket)

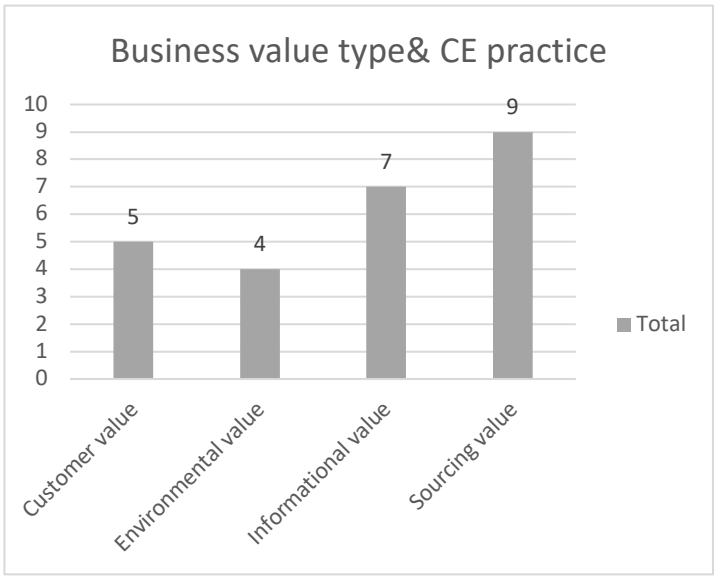


Figure 32. CE practice and business value

As for the business value types, 5 CE practices result in Customer Value, 4 in Environmental Value, 7 in Informational Value, and 9 into Sourcing Value.
(Figure 32. CE practice and business value)

The relationships between CE practice – value bracket – business value and between CE practice – product/ service LC – business value are shown in Figure 33. Value bracket and business value and Figure 34. Product/ service LC and business value respectively.

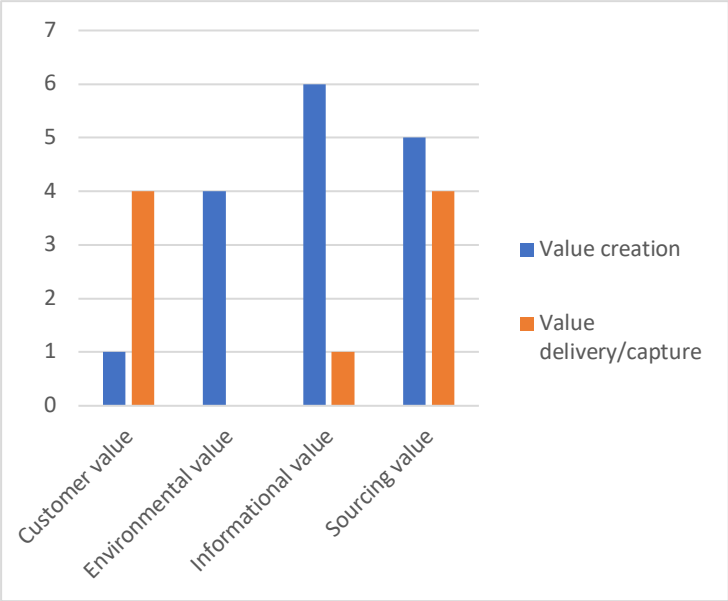


Figure 33. Value bracket and business value

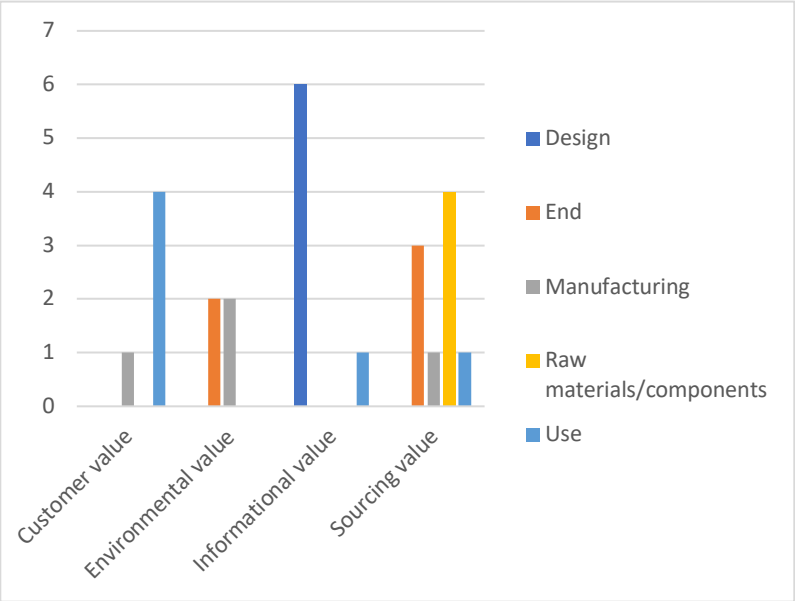


Figure 34. Product/ service LC and business value

7. Conclusion and Limitations

This thesis examines the implication of modern circular economy principles in business models. In specific, it concentrates on incumbent firms and their contribution towards the transition from a linear to a circular global economy. Relying on the existing body of literature on circular economy and business models, and on case studies, the author proposes a framework that can be adopted by incumbent firms as a guideline for transforming their business models from linear to circular.

The proposed framework consists of 25 practices that can be taken into consideration whilst reshaping and updating a business model. Each practice is classified using 5 different criteria. This classification allows better understanding of 1) the origin of the practice and its relevance to the circular economy, 2) the product/ service life cycle phase it belongs to, 3) its position within the value structure of the business model, 4) Its position within the value chain, and last but not least 5) the business value that can be expected as a result for applying the practice.

By this framework, the author wishes to contribute to the existing body of literature combining the circular economy and business model innovation, and invites incrementation and recreation on its basis. The most notable limitation to this thesis is its dependence on secondary data. As a secondary research, the author relied on well referenced and reliable sources of data, such as scientific papers and journals, corporate websites, and governmental reports. Further avenues for research can pursue testing and furtherly verifying the proposed 25- practice circular business framework, and proposing different frameworks able to educate and guide practitioners through their transition from linear to circular.

8. Appendix A

company/ project	type	Nationality	sector	notes
Aboca	incumbent	Italy	chemical / pharmaseutical	using 100% natural resources that are safely returned to nature
Alisea	incumbent	Italy	design / research	turning waste to useful products
Amethyst	SME	Italy	new materials / resources	patent technology in purifying wastewater using natural rocks and plants
Aquafil	incumbent	Italy	clothing / accessories	transforming used materials into nylon
Armadio Verde	SME	Italy	enablers / platforms	a platform to collect and exchange babys' clothes
Astelav	incumbent	Italy	enablers / platforms	project RIGENERATION aims at refurbishing and reselling end of use appliances
Bionap	SME	Italy	chemical / pharmaseutical	using process waste as resource
Bio-on	incumbent	Italy	chemical / pharmaseutical	producing bio-plastic
Caimi Brevetti	incumbent	Italy	furniture / construction	designing for longlivety, disassembly, and recycling
Caldara Plast	incumbent	Italy	new materials / resources	turning waste plastic from production into new products
Carmina Campus	SME	Italy	clothing / accessories	turning industrial waste into accessories and furinture
Cartina	SME	Italy	clothing / accessories	making shoes out of paper based material that is both recycled and recyclable, using renewable energy and water based colors
Catalyst Group	startup	Italy	furniture / construction	construction. Making bricks from demolished bricks on site, saving energy, transport, and emissions
CDA di Cattelan	incumbent	Italy	agri-food	coffee grounds to bio-fule
Cuki Group	incumbent	Italy	industrial / automation/ manufacturing	exploiting recycling
Dalma Mangimi	incumbent	Italy	agri-food	processed food waste into animal feed

Dell'orco & Villani	incumbent	Italy	industrial / automation/ manufacturing	building equipment and mechanical systems that treat leftovers from the textile industry to new fabrics and more
Eataly	incumbent	Italy	agri-food	waste reduction
Ecodesign lab	startup	Italy	design / research	environmental consulting and product development
Ecomat	startup	Italy	furniture / construction	flooring out of recycled material
Edilatte	startup	Italy	furniture / construction	construction materials out of food waste
Eggplant	startup	Italy	chemical / pharmaseutical	bioplastic
Enerpaper	startup	Italy	furniture / construction	paper refuse is turned into coils of recycled paper
Erreplast	incumbent	Italy	new materials / resources	recycling PET bottles
Esosport	incumbent	Italy	new materials / resources	recycling sports shoes and bike tubes
Fater	incumbent	Italy	chemical / pharmaseutical	recycling nappies and absorbent roducts and creating super-absorbent polymers
Fattelo	startup	Italy	design / research	creation from waste
Favini	incumbent	Italy	paper / packaging	paper out of reused leather waste
FECS	incumbent	Italy	new materials / resources	reusing aluminum
Florim	incumbent	Italy	furniture / construction	flooring out of waste flooring, energy generation, and using waste water for operations
Freyrie Flores	incumbent	Italy	design / research	architechtural studio that designs the evolution of built-up areas that are no longer inhabited or used and returning them to fit the needs of life
Garbagelab	startup	Italy	clothing / accessories	creating accessories out of pvc and other waste
Giunko	startup	Italy	enablers / platforms	app that helps individuals with recycling
Green idea technologies	incumbent	Italy	consultancy	consulting firms for sustainability
Greenrail	startup	Italy	industrial / automation/ manufacturing	making reliable railway slippers out of end of life rubber
Group Fantoni	incumbent	Italy	furniture / construction	MDF panels and other boards, a leader in recycling
Gruppo Hera	incumbent	Italy	enablers / platforms	

Intesa San Paolo	incumbent	Italy	enablers / platforms	financially backing circular projects
I Provenzali	incumbent	Italy	chemical / pharmaseutical	using waste from the agri-food industry and using it for cosmetics
Irritec	incumbent	Italy	industrial / automation/ manufacturing	eco-sustainable micro-irrigation systems that reduce water consuption
Kube design	SME	Italy	furniture / construction	making firniture out of cardboard
Last minute market	incumbent	Italy	enablers / platforms	selling food and other products before they go to waste
Manifatture Maiano	incumbent	Italy	furniture / construction	zero kilometer, 100% recycling, energy saving, reverse supply chains
Mapei Group	incumbent	Italy	furniture / construction	a product the can recover unused concrete
Matrec	SME	Italy	design / research	archive for materials with information environmental and technical charachteristics
Nolpal	startup	Italy	enablers / platforms	sharing wooden pallets, therefor lengthening life cycles and sharing the pallets
Nova Mont	incumbent	Italy	chemical / pharmaseutical	biodegradable products
Nuova Fratelli Boretti	incumbent	Italy	clothing / accessories	saving energy, water and CO2 by using used clothes as raw materials for their fabrics
Orange fiber	SME	Italy	clothing / accessories	creating fabric out of citrus by-products
Osteria Francescana	incumbent	Italy	agri-food	resturants the rely on surplus
OVS	incumbent	Italy	clothing / accessories	reverse supply chain, gathering used garments, reselling them or downcycling
Palm	incumbent	Italy	industrial / automation/ manufacturing	making wooden pallets using less material, thus saving transport fule. Also recovering, repairing, and reselling pallets
Passoninature	incumbent	Italy	furniture / construction	using apple production waste in producing furniture
Poliphenolia	incumbent	Italy	chemical / pharmaseutical	using grape waste from the wine industry to produce anti-aging creams and other
Radici group	incumbent	Italy	clothing / accessories	saving material, energy, and CO2 by recycling PET plastic to polyester
Redo upcycling	incumbent	Italy	clothing / accessories	creating accessories and other products using as input objects desitned to be thrown away

Regenesi	incumbent	Italy	clothing / accessories	creating accessories and other products using as input objects desitned to be thrown away
Renovo	startup	Italy	enablers / platforms	a circular economy hub for innovation
Reware	SME	Italy	electronics	recovering computer components
Riva	incumbent	Italy	furniture / construction	using old (unuseful) trees to create premium firnuture
Rotoprint sovrastampa	incumbent	Italy	paper / packaging	allowing re-writing on packaging, so you can change the design of packagin in case it needs to be changed for any reason, saving material, energy, landfill space
Salvatore Ferragamo	incumbent	Italy	clothing / accessories	using 100% renewable energy
Saviola Holding	incumbent	Italy	furniture / construction	the most important wood waste transformer in the world
Selena Spa	incumbent	Italy	new materials / resources	industrial symbiosis, collaboration between companies to create something new out of their individual waste
Subito	incumbent	Italy	enablers / platforms	website for exchanging used products
Thermore	incumbent	Italy	clothing / accessories	creating thermal padding for clothes using recycled polyester
Tonello	incumbent	Italy	industrial / automation/ manufacturing	producing machinery for garment treatment, extendign the circular economy back through the supply chaing and all the way to design phase
Torcitura Padana	incumbent	Italy	clothing / accessories	designing a fire-proof fiber that does not need chemicals to produce
Valcucine	incumbent	Italy	furniture / construction	world's first 100% disassemblable and and recyclable kitchen, laso lightweight, less material, less energy, clean energy
Vegea	SME	Italy	clothing / accessories	using grape waste from the wine industry to produce materials for the fashion industry
A&C ecotech	SME	Italy	electronics	recovering computer components
Acea	incumbent	Italy	chemical / pharmaseutical	urban biowaste to bio methane
Bioman	SME	Italy	industrial / automation/ manufacturing	producing electricity and bio methane from urban waste
Calcestruzzi Ericina Libera	SME	Italy	furniture / construction	selling recycled building material
Aureli	incumbent	Italy	agri-food	a family farm using bio gas from their own waste

Cartiere di Trevi	incumbent	Italy	paper / packaging	paper and cardboard
CF plast	incumbent	Italy	new materials / resources	recycling industrial production waste
Cascina Pulita	incumbent	Italy	new materials / resources	racycling waste from farm work
corgom	incumbent	Italy	new materials / resources	recycling and refurbishing tiers
corvasce	incumbent	Italy	furniture / construction	firnuture from used cardboard
Ecoface	startup	Italy	new materials / resources	recycling paper, plastic, cardboard, glass, metals
Ecoplan	incumbent	Italy	furniture / construction	producing building panels from waste oil
Gica design	incumbent	Italy	design / research	producing certified packaging and design firniture from their waste
Intec slr	incumbent	Italy	new materials / resources	raw materials through recycling
ICO srl	SME	Italy	paper / packaging	producing corrugated board packaging using secondary raw materials from other businesses
Mani Tese Sicilia	incumbent	Italy	new materials / resources	utilizing second hand markets
Mobile dishwasher	incumbent	Italy	enablers / platforms	avoiding the use of plastic cups, plates, and cutlery in events
Mercatino srl	SME	Italy	enablers / platforms	secondhand objects broker
Mica slr (Kanesis)	incumbent	Italy	new materials / resources	developing industrial products using 3D tech from Hemp agri waste
Montello spa	incumbent	Italy	new materials / resources	recycling to get high quality bio fertilizer
Naturalmente colore	startup	Italy	new materials / resources	paints from local plants
Morgan's srl	SME	Italy	enablers / platforms	platform managing urban waste
Nau spa	SME	Italy	clothing / accessories	eyeweare made up of 96% recycled plastic from regular eyewear production
MrPack by Volscambiente	incumbent	Italy	new materials / resources	gives shopping cupons in exchange for plastic wasate
Non scado by Legambiente	incumbent	Italy	agri-food	fighting food waste by redistribution
Papa slr	startup	Italy	agri-food	recollecting and reuse of vegy oil
Recrea slr	startup	Italy	clothing / accessories	fashion accessories made of recycled raw materials
Sesa spa	SME	Italy	new materials / resources	electricity through methane from natural fermentation

San gregorio	incumbent	Italy	agri-food	producing dairy products using renewable energy, local distribution, and waste to biogas
Tecnomatic spa	incumbent	Italy	industrial / automation/ manufacturing	design and produce automatic machines for car disassembly to recover noble raw materials
Vesti Solidale	SME	Italy	new materials / resources	repairing and reuse of objects
Airtile	startup	Italy	furniture / construction	closing loops and using renewable energy
Cynomis	startup	Italy	enablers / platforms	the company's products create efficiency by narrowing resource flow
Enerbrain	startup	Italy	enablers / platforms	the company's products create efficiency by narrowing resource flow
Nito- nuova industria	startup	Italy	industrial / automation/ manufacturing	producing electric vehicles
Pcup	startup	Italy	enablers / platforms	sustainable and circular cups for events and multipuropus
SolarFertigation	startup	Italy	enablers / platforms	creating efficient arrigation systems
Fedrigoni Group	Incumbent	Italy	new materials / resources	narrowing and closing loops, energy sufficiency and innovation
Ecovative Design	Incumbent	USA	new materials / resources	ecofriendly plastics and materials
British Sugar	Incumbent	UK	agri-food	regenerating natural resources and industrial symbiosis through production of sugar
Gerrard Street	SME	Netherlands	electronics	sound systems using leasing and use oriented business models, take back systems
Bundles	SME	Netherlands	enablers / platforms	leasing and reparing washing machines
Braiform	Incumbent	UK	enablers / platforms	creating a closed loop system for providing a hanger system for retailers
Mazuma	Incumbent	UK	enablers / platforms	mobile phone recycling service
Teemill	startup	USA	clothing / accessories	a creative platform that produces customized garments for small brands, utilizing circular economy methods and practices such as renewable energies, take back, recycle
Petit Pli	SME	UK	clothing / accessories	using technology to creat durable garments, such as kids wear that grows with them

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