Jean Mansuy, Giulia Caterina Verga, Bonno Pel,
Maarten Messagie, Philippe Lebeau, Wouter Achten,
Ahmed Zaib Khan, Cathy Macharis (eds.)

Transitioning to a circular economy

Changing Business Models and Business Ecosystems

ASP Academic & Scientific Publishers

TRANSITIONING TO A CIRCULAR ECONOMY

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INTRODUCTION

CIRCULAR ECONOMY TRANSITIONS IN BUSINESS ECOSYSTEMS

Jean Mansuy, Bonno Pel & Giulia Caterina Verga

We are living on a finite planet that can only provide a limited flow of resources. Despite this, mankind is (increasingly) transgressing planetary boundaries, consuming more than what the planet can provide. In 2021, worldwide consumption has exceeded the yearly biocapacity of the earth (what we call the overshoot day) on the 29th of July. In 2001, this day happened on the 24th of September … Such an observation is even worse when considering industrialised countries. For example, in 2022, Belgium reached that overshoot day on the 26th of March. To overcome this resource-related challenge, a new economic system, the circular economy (CE), is increasingly being promoted. This resulted in the CE concept being introduced in policy frameworks more and more often, both at the regional (for example in the Brussels regional plan for CE), national (for example in the Belgian National Recovery and Resilience Plan) and supranational (for example in the European Green Deal) level. However, the translation of the objectives stated in those frameworks into practical actions may be challenging. Hence, this book responds to the challenges of implementing and materializing the environmental objectives defined by recent policy frameworks aiming to support the transition to a CE.

These challenges related to the transition to a CE were analysed in the context of the dedicated research chair 'FEB/VBO: Transitioning Belgian companies into circularity', held by ULB and VUB between 2018 and 2021. This edited volume presents key outcomes of this research. The chapters are all guided by the aim to provide Belgian companies with concepts, strategies, methodologies, tools, in other words practical knowledge to support the transition towards sustainable CE practices. This explains the large focus of this book on Belgium. Nonetheless, these challenges of transitioning towards a CE of course also apply beyond the Belgian context. We thus provide context-specific insights

and situated knowledge, whilst highlighting how Belgian transition processes form part of broader transformations within Europe, and even worldwide.

The title of this book speaks deliberately of transition*ing*. This marks our focus on transition processes and activities. Discussions of "the transition" easily get stuck in abstract visions, remote future goals and ideological statements about the desired world of tomorrow. By contrast, much more attention needs to be paid to concrete transformation processes that could lead towards these projected futures. *Transition how? Where to? By whom?* Focusing on transition processes, this book provides insights into the actors, activities, choices and dilemmas that give direction to such processes. In particular, it further confronts a difficulty that keeps haunting the CE transitioning process: the CE has proven to be a powerful, inspiring, and mobilising concept, yet it is notoriously difficult to operationalise. An abundance of tools, metrics, frameworks, hierarchies, mappings, procedures, et cetera is already available. However, these approaches tend to elicit only some aspects of CE transitioning. This keeps fuelling debates about what should be the real, the desirable, the appropriate understanding of circularity. All approaches struggle with the fact that CE transitioning occurs on different interconnected levels. Each taken apart, all tools promise a certain overview and structuring that makes the task appear manageable. Taken together, the various neat representations of CE trajectories add up into a blur of systems, phases, and instruments. Somewhat tragically, the gathered CE wisdom easily condemns companies to run in circles.

A first important choice that is made in this book is to limit ourselves to CE models and concepts in which companies take centre stage. This company-focused approach directs attention to the particular roles of companies in transition processes. Indeed, whatever citizens, researchers and politicians may demand, envision and recommend, companies will remain key players in shaping the transformation of the economy. The transition towards a CE is a process of societal transformation in which businesses play a particularly pivotal role. This differs from transitions in mobility, energy or water management. Possessing key resources and skills, other actors (governments, civil society, academic experts) can be expected to be the prime movers in those other kinds of transitions – yet in CE transitioning they are less centrally implicated.

We highlight that companies are key actors in CE transitioning. However, this does not mean that they can bring about such societal transformations single-handedly, or through strategies pursued in isolation. A second key choice that is guiding this book is to focus on companies as *embedded* transition agents, in other words as actors that operate as part of broader business ecosystems. This "ecosystem" metaphor is quite common in innovation and business management scholarships. It indicates not so much that companies form part of natural ecosystems (although this is the case, and it is a basic necessity for CE practices). Importantly, it mainly indicates the *societal* environment of companies, in other words innovation systems, composed of actors and institutions with an immediate influence on the operations of businesses. The focus on business ecosystems indicates that companies are key actors, but only as far as they interact with their surroundings. Their transition to CE practices needs to be understood

through their responses to a changing context: changing consumer demands, access to resources, pressure to reduce external effects, emerging technological options, or changing regulations, not to mention the sudden contextual changes, the "wild card" events as foresight experts call them. Just recovering from the global epidemic that started end 2019, business ecosystems are currently shaken by the repercussions of the Russian military invasion in Ukraine.

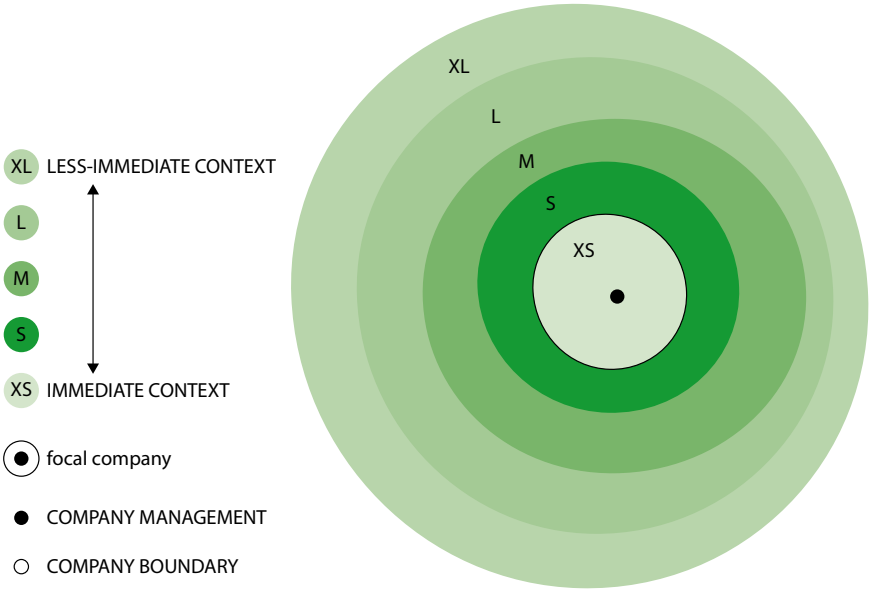


FIGURE I.I: Companies in business ecosystems

Figure 1.1 provides a basic visual representation of our focus on business ecosystems. It captures several of the key themes and insights that will be developed throughout this book:

- **Companies** are the focal actors of CE transitioning.
- Companies themselves are, of course, composites as well. The **company management** *(indicated with the black dot)* interacts with various divisions and employees. Those can thus be considered the most immediate ecosystem *(indicated by the light green circle)* around entrepreneurs and company management.
- Companies and their management evolve in wider **business ecosystems**. These ecosystems comprise the resources that companies need, the actors that they depend on (and vice versa, the stakeholders that depend on them), the institutional context that sets the rules of the game, and also the natural environment that provides certain resources. The different colours in the diagram visualise how companies can be considered through different lenses, focusing on different kinds of "ecosystems". One may focus on the institutional constraints (varieties-of-

capitalism research), regional innovation systems (economic geography), urban systems of production and consumption (urbanism), metropolitan industrial clusters (material flow analysis), et cetera.

- These different kinds of business ecosystems can be larger or smaller, indicating more or less broad system boundaries. Business ecosystems can be studied at different (micro-meso-macro) levels. The figure highlights the continuum that exists in between different levels. In this book, we analyse changes in business ecosystems across levels, as **immediate, or rather distant contexts**. Transitioning in business ecosystems involves suppliers, neighbourhood residents, but also the wider global context of scarce resources and economic competition between businesses and institutional models.
- Companies are thus shown to operate within different contexts. The "onion rings" of the ecosystem model do not form isolated layers. Instead, we consider how companies develop within ecosystems **across different levels and scales**.
- The "ecosystem" metaphor may suggest an optimistic and naïve view of the interactions a company has with its supportive environments. Yet ecosystems comprise predators and preys, competition and symbiosis. Implicit in the figure but crucial for the analysis of CE transitioning is the fact that business ecosystems involve **power relationships**. These define the ability of companies to influence their business ecosystem, and vice versa, the pressures and constraints that they experience from their surrounding contexts. Our analyses will address how some relations within business ecosystems can be rather reciprocal (for example with some business partners), while others are more unbalanced and hierarchical (for example with other partners, public authorities or the natural environment).
- Transitioning involves the **transformation of ecosystems and the interactions that constitute them**. Sketching the embedding of companies in layered, multi-level business ecosystems, **Figure I.1** indicates how transitioning towards CE practices may occur at different levels. This can be within the firm, but also at the level of institutional settings or regional innovation systems. Through this layered structure, the figure visualises why it is worthwhile to identify actors, initiatives, ambitions, innovations and instruments across scales – each of these playing a particular part in the overall transition process.

Companies within these multi-level business ecosystems evoke various questions. *What should be considered the "immediate" and the "distant" context? What are the boundaries of the business ecosystem?* These questions are important, especially if we want to quantify costs, benefits and achievements in terms of energy use and material flows. No single answer can be provided, however. The relevant business ecosystem depends on the focal company and its economic sector. Moreover, there also exist various types of "ecosystem" analysis. As indicated above, this understanding of embedded companies has been developed in innovation research, business, geography, institutional theory, urbanism, sociology and material flow analysis. Consequently, various understandings of ecosystems exist, each with different ideas about system levels, system elements,

systemic interactions, and ultimately system change. Changes in business ecosystems can be analysed as multi-level governance, as cross-scale territorial development, as an extension and contraction of supply chains, as the formation of regional or national systems of innovation, et cetera.

This book starts from the understanding that it is not a matter of finding the single right model that fits all practical issues. On the contrary, the task is to gather various models and representations of business ecosystems, to clarify the interconnections between them, and to use them to explore the strategic challenges of CE transitioning. All such schemes are mapping only particular aspects of companies' CE transitioning. The indication of levels only makes sense from a particular point of view (geographical, functional, economic or metabolic).

The key strength of this edited volume is therefore that it provides a range of perspectives on CE transitioning – by companies and across business ecosystems. The business ecosystems are explored through a range of perspectives. Multidisciplinarity is of course key to understanding a holistic concept such as CE. This diversity of perspectives is particularly useful in identifying the various aspects of CE transition processes. The book features six chapters. Each of them approaches CE transitioning at different levels, along complementary disciplinary viewpoints. The authors combine expertise in sustainable urbanism, transition governance, the redesign of systems, lifecycle analysis and business model innovation. Starting from a relatively macro focus on the CE concept **(Chapter 1)**, we continue with meso-level analyses of transition governance and "exnovation" practices **(Chapters 2 and 3)**, after which we further address micro-level aspects related to the adoption of niche innovations by companies **(Chapters 4 and 5)**, in particular business model innovations **(Chapter 6)**.

Chapter 1 presents an introduction to the concept of CE. This will help the readers to comprehend the complexity of the concept, its evolution and its current state. In addition to providing a concise overview of the academic literature on the CE, this chapter also sets the theoretical stage for further chapters. This chapter traces the history of this notion, placing it within the broader context of environmental awareness or "*pensée écologique*" as Bourg et al. (2014; 2015) put it. Providing a historical context to CE, this chapter also sketches potential trajectories for future approaches. The focus is on highlighting the ways to empower terrain actors, such as enterprises, in transitioning into circularity: moving from a predominantly top-down approach to more inclusive ones. Everyone is an actor in the transition towards more circular and resource-conscious lifestyles, all levels of interventions matter. The last section provides an overview of Belgian CE policies.

Chapter 2 invokes research on sustainability transitions. The CE can be understood as a set of metabolic material changes, but this sets targets and future limits that are notoriously difficult to attain. Various waste-resource paradoxes show the difficulty to achieve circular business ecosystems. This chapter addresses the need for theories of change and transitioning. Building on insights about socio-technical transitions, the chapter develops such a theory of change along with the concept of system innovation. It is discussed how CE transitioning entails systemic innovation on social,

technological and institutional dimensions, how it takes place along the different institutional logics of markets, states and civil society, and how it accordingly takes place through a multitude of more or less circular and sustainable practices. This transitions-theoretical perspective highlights how the transition towards a CE should not be understood in terms of major system shifts – the non-achievement of which is leading to disappointment, scepticism and resignation. By contrast, the transition theoretical perspective shows how CE transitioning is a matter of many little, and sometimes not very visible, steps. This puts companies' current transitioning attempts in a more realistic perspective; this perspective sides with those who try.

Chapter 3 continues the analysis from a transition theory perspective, introducing the angle of exnovation. It addresses the painful awareness that all of the current attempts at circular sustainable innovation may be "too little, too late". The research on socio-technical transitions provides a useful theory of change. Its concept of system innovation provides an attractive, empowering framework. As indicated in Chapter 2, it foregrounds the scope for "innovating our way out". This very belief in continued "sustainable" innovation may be part of the problem, however. It becomes more and more clear that the development of new processes, practices, technologies and business models needs to be accompanied with active management and policies towards the phasing out of the old. CE transitioning is about cradles and incubators, but also about houses of mourning. The chapter therefore addresses the new transitioning mindset that is recently emerging: Exnovation. The term indicates a certain flipside of innovation. It helps to understand the linkages between a range of vaguely connected developments in business ecosystems and business models: the phasing out of coal plants, the decline of traditional retail, the dematerialisation of economic production, the decline of industrial regions, the various policies introduced to get rid of polluting vehicles, or Marie Kondo's influential lectures on "decluttered" consumer lifestyles. Exnovation and innovation form a certain yinyang of birth and death. Exnovation may appear like just another new academic concept, lacking any practical relevance. The chapter shows, however, how various "exnovation"-related phenomena may be seen *throughout business ecosystems*: in society at large, in value chains and at the level of companies. Teasing out the main strategic implications, it is considered who the main actors are behind all this exnovating. Maybe it's especially the companies that have known how to handle decline all along, and that are now in a leading position for handling exnovation challenges?

Chapter 4 presents an overview of the factors that may influence the adoption of circular oriented innovations by companies and in particular incumbent firms. Based on a literature review, it introduces a novel classification framework for those factors, considering the origin (internal or external) and the mode of action (direct or indirect) of a factor as key variables. This classification differs from the widely used concepts of barriers, drivers and enablers by leaving out the direction of the impact (positive or negative), thereby removing variability issues experienced when using such concepts.

Based on this classification, the chapter discusses factors that affect the motivation of a company to adopt circular oriented innovations, its ability to do so, or the opportunities that are provided by its business ecosystem. Using interviews with incumbent firms, engaged in a circular transition process, it further underlines which of those factors are of particular relevance for such companies. This leads to several suggestions to support incumbent firms in further adopting circular oriented innovations, as well as policy guidance for governments to support the transition towards a CE through the adoption of circular oriented niche innovations.

Chapter 5 focuses on transitioning at the sector level, using the case of the Belgian construction industry. By focusing on an industry, it elaborates on two main themes. First a discussion of transition strategies and their hierarchy is articulated in order to explain what it could mean to embrace a circularity oriented innovation in this sector. This part is based on a review of international literature. The second part of the chapter elaborates on specific factors impacting the successful adoption of such circularity oriented innovations by companies. The factors discussed and evaluated are based on those identified in Chapter 4. This part focuses on the Belgian construction sector and the analysis is based on interviews with local stakeholders. These context-specific insights allowed us to extend the previous list of factors with novel ones (namely spatial factors). Factors are discussed in a multi-level perspective, using the classification developed in the previous chapter. The analysis is thus structured around internal factors (motivation and capacity), which each actor can modify directly (through internal actions), and external factors (opportunity), which may be modified indirectly (within their sphere of influence). The aim of this section is therefore to give concrete examples of what the transition may entail and to propose and discuss policies that could support companies in their pathway towards more circular practices.

Finally, **Chapter 6** focuses on individual initiatives participating in the transition towards a CE. In particular, it considers circular business model innovation as an organisational change process and provides support to incumbent firms for conducting such a process. Among the different business model innovation strategies available to companies, Chapter 6 focuses on business model diversification, consisting in developing a circular business model next to the (linear) core business of a firm. Such a strategy, due to the relatively low risk involved, can be seen as a first approach to organisational change processes and a first step to a broader organisational transformation. To support incumbent firms in such a circular business model diversification, the chapter introduces a methodological framework. This framework brings companies through a step-by-step and iterative approach composed of 6 stages, each with a specific objective. It is supported by a set of tools tailored to integrate the CE principles and alternates between individual and group activities with internal stakeholders or partners from the company's business ecosystem. With this methodological framework, the authors encourage readers to take the leap and start experimenting with circular business models, further refining the framework in the process.

CHAPTER 1

AN INTRODUCTION TO THE CIRCULAR ECONOMY

Giulia Caterina Verga & Ahmed Zaib Khan

The environmental, socio-political, health and economic crises of recent years are mainstreaming the need to rethink our interaction with the material world. The growing evidence of these crises and their impacts (from droughts to floods, pandemics, wars and the widening gap between the world's rich and poor) is prompting the gradual development of new paradigm shifts. Among these shifts, we can identify circular economy (CE) and circularity inspired ambitions as a systemic shift aimed at rethinking the world as we know it. CE ambitions are broad and systemic; from questioning the way the biosphere is currently inhabited, to challenging the current systems of production and consumption, and so on. While the CE notion is gaining momentum, it is unfolding excitement and enthusiasm and, at the same time, scepticism and criticism. In this context, our premise is to frame this introductory chapter based on two main questions.

> *Where do circularity inspired ambitions come from? What is the current debate on circularity?*

A series of complementary sub-questions were also developed to set the scene for the following chapters.

> *How is CE defined and delineated into strategies for implementation? What is the hierarchy of these strategies? When adopting CE strategies, which are the attention points to take into consideration to avoid rebound effects? What are the main future challenges for the development and mainstreaming of CE ambitions and practices?*

Thus, this chapter introduces the concept of the CE and reveals the potential horizons and obstacles to its implementation in the coming decades. The aim is to develop trajectories of reflection that will set the scene for the other chapters and for future debates. This introductory chapter to the CE is therefore giving an overview of the debate and strategies at a macro level. Based on multi-level socio-technical transitioning pathways (Geels 2005; Geels & Schot 2007), companies are intended as actors of broader business ecosystems (a network of stakeholders influencing directly or indirectly the creation of a common outcome). This research is based on a literature review, consisting mainly of academic articles and books, but also grey literature from CE reports, policy documents and digital platforms.

This chapter is structured into three main parts: the first part (**Section 1.1**) presents a historical perspective on CE. It underlines the ongoing evolution of this term and its significance. The second part (**Section 1.2**) gives an overview of the current debate and provides a conceptual framework (hierarchy of value retention options) on which the notion of value in CE is interpreted in this book. It also highlights points of attention for the implementation of CE strategies (rebound effects and scales of circularity), as well as discussing future challenges (sustainability, ecosystems' health, the role of people, and the need to exnovate). The third and final part (**Section 1.3**) of the chapter describes CE in the Belgian context and within the broader European debate on CE. This last section can be read by organisations operating in Belgium as a summary of policies in order to get an overview of the current landscape of initiatives. Alternatively, the description of the Belgian context (which also appears in other chapters) could be seen as a "case study", showing how the generic "international" discourse on CE is taken up in a specific context (in other words Belgium). To conclude, this chapter does not provide a definition of CE for the whole book, as the book is the result of contributions from authors from different disciplines and with different focuses. Therefore, the aim of this chapter is to set the scene for the discussion on CE by showing: (1) the historical evolution of the notion (where does CE come from?); (2) the current debate on CE (what is the state of the current debate on CE?) and a conceptual framework; (3) the Belgian context of CE policies, within the European debate on CE, as a case study.

1.1 A HISTORICAL PERSPECTIVE IN SEVEN THEMATIC PARTS

The following historical excursus on the shaping of the notion of CE, or more in general circularity, is mainly based on an extensive scholarly literature review. The sections debating the current evolution of the notions are based also on desktop research: websites and reports developed by organisations, institutions, et cetera (the so-called *grey literature*). In this first part of the chapter, we trace thematic milestones that underpin the conceptual evolution of circularity inspired ambitions from the 19th century to the present. Accordingly, we divide this section into seven thematic parts:

- Concerns about the fragility of nature: the origins of linearity.
- Analogies with "natural phenomena": the emergence of Urban Metabolism.

- Closed systems: the "whole earth" and the rise of the environmental movement.
- Economic development and the environment.
- The emergence of the CE.
- The momentum for CE: 2010-2020.
- Future perspectives: CE in practice.

I.1.1 Concerns about the fragility of nature and biophysical boundaries: the origins of linearity

The emergence of the notion of circularity could be inscribed in the wider history of the rise of environmental awareness. With environmental and ecological awareness, we mean reflections and concerns about the impact of humans' actions' on the biosphere. These concerns are intertwined with capitalism and industrial development: they appeared when economic processes accelerated, impacting on a greater scale. This was due to the ways resources were extracted and the ways landscapes were impacted. As Prieto-Sandoval et al. (2018) write, "*the linear model began with the first industrial revolution, with the exploitative scientific and technological innovations which ignored the limits of the environment and the long-term damage they were causing to society*" (Prieto-Sandoval et al. 2018).

Some environmental historians are tracing the emergence of environmentalism back to the 18th century, describing it as the raising of recurrent worries (anxieties or fears) about the fragility of nature (Matagne 1999; Ford 2016). Malthus' theory reflecting on the limits of population growth in relation to food supply (dating back to 1798) is considered the first introduction of the notion of "biophysical boundaries" of the biosphere. Already in 1887 Engels and Kelley wrote about problems arising from the linearity of the economic model based on "taking", "making" and "disposing" (Athanassiadis & Kampelmann 2019). While tracing common roots of CE concepts, Athanassiadis and Kampelmann (2019), refer to the 19th century as the first breakdown of pre-industrial recycling patterns, they bring as an example the discontinuation of nutrients cycles between farmers and city dwellers, studied in the seminal work on Paris by Barles (2018).

I.1.2 Analogies with "natural phenomena" the emergence of Urban Metabolism

Since the end of the 18th century, analogies with what had been observed in natural phenomena (such as organisms and ecosystems, metabolism, symbiosis or cycles) have influenced the way we study and describe anthropised environments (such as cities). Likening urban systems to ecosystems (Duvigneaud and Denayer-De Smet 1977), and more generally, the idea that ecosystems regenerate themselves in cycles have inspired circularity concepts and strategies to overcome the shortcomings of linear resource use and waste management (Murray et al. 2017). The ambition to rethink and redesign processes and imitate natural cycles has been outlined at several levels: at the city scale with the notion of urban metabolism (Athanassiadis et al. 2013; Barles 2008; Dijst et al. 2018; C. Kennedy et al. 2011), at the scale of industrial settlements with the notion

of industrial symbiosis and circular cycles (Frosch & Gallopoulos 1989; Gregson et al. 2015; Yu et al. 2014), and at the architectural or building scale with the notion of biomimicry (nature-inspired design, (Benyus 1998; E. Kennedy et al. 2015; Mathews 2011)) and and Cradle to Cradle (C2C) (McDonough 2002). These notions refer to "natural regenerative properties" as a source of inspiration in guiding the redesign of (industrial) production and consumption processes, aiming at maximizing the materials' efficiency. Nevertheless, one can argue that human-made processes are part of "nature" too and that entirely closed loops are impossible to realise in practical terms as they go against the second law of thermodynamics, namely entropy (Korhonen, Honkasalo and Seppälä 2018).

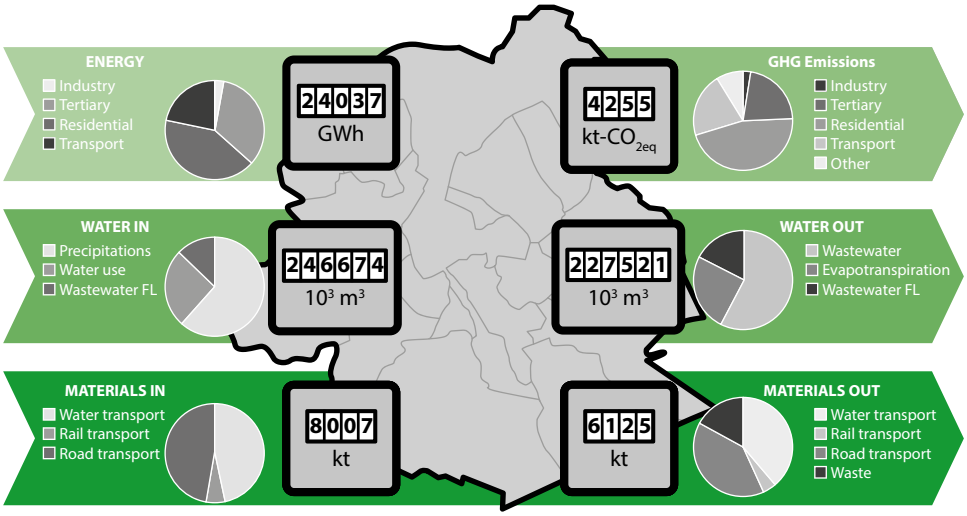


FIGURE I.I: Image of the Urban Metabolism of the Brussels Capital Region in 2016. Source: "Towards a Dynamic Approach to Urban Metabolism: Tracing the Temporal Evolution of Brussels' Urban Metabolism from 1970 to 2010". Authors: Athanassiadis, Bouillard, Crawford and Khan.

At the city scale the analogy with organisms' "metabolism" is very topical. The notion of "urban metabolism" is used to describe societal interactions with the environment, within a circumscribed territorial unit (like a nation, a region, a municipality, et cetera.). From a historical perspective, it was Marx and Engels that applied the term "metabolism" for the first time to social contexts, even if scholars argue that this notion was not used as a metaphor but as a physical description of material and energetic processes (Fischer-Kowalski 1998). In the 1930's the notion of "symbioses" was applied to industrial production (creating the term "industrial symbiosis"), but it was not until the 1960's that industrial ecologists developed the first "metabolic approaches" applied to cities, studying separated cycles such as water, carbon, nitrogen, et cetera (Frosch & Gallopoulos 1989; Murray et al. 2017; Odum 1983). In the 1960's the analogy with organisms' metabolisms has been applied to urban systems, coining the notion of

"urban metabolisms" (Wolman 1965). The Brussels-based ecologist Duvigneaud and his colleagues began to study Brussels as an ecosystem and developed in the early 1970's a series of urban metabolism studies. By describing Brussels as an ecosystem, they calculated the city exchanges with the biosphere in terms of energy flows. (Athanassiadis *et al.* 2013; Bortolotti & Ranzato 2016). If the first metabolic studies were developed in the 1960's, the tradition grew until today, as western cities are currently developing urban metabolism studies that allow the understanding and measuring of the dynamics behind the "unsustainability" of human settlements (Kennedy et al. 2011; Newman 1999). In the case of Brussels, and as well for a few more European cities, urban metabolism studies have been a first stepping stone for the definition of specific CE ambitions and policies. The research conducted and publications on Brussels' metabolisms (**Figure 1.1**) (Athanassiadis 2016), led to the deepening of these questions in further research and finally was used as a base for the shaping of the first CE regional policy PREC (2016-2020). In general, the urban metabolism community has reassembled around CE in recent years. We will not debate whether populations, communities or ecosystems have a degree of systemic integration comparable to individual organisms' metabolisms (as Fischer-Kowalski observed in 1998). What we underline here is the impact that this analogy has had (and still has) on the discourse towards more material-efficient paradigms. These analogies shaped scientific investigations, policies and narratives questioning existing linear human interactions with the physical environment.

1.1.3 Open and closed systems: the "whole earth" and the rise of the environmental movement

The birth of the "environmental movement" is generally attributed to researchers such as Rachel Carson, whose book "Silent Spring", published in 1962, was instrumental in articulating a new perspective on ecology (Carson 1962). She provided scientific evidence of how the massive use of synthetic pesticides was changing the regenerative capacity of the environment (causing disease in animals and humans). It highlighted the effects of disrupting the regenerative cycles of existing ecosystems and the interconnectedness of all actors in the biosphere. This text became a key work in ecological awareness, highlighting the effects of industrialisation on natural ecosystems (and the humans within them).

In 1966, Kenneth Boulding's seminal work "The Economics of the Coming Spaceship Earth" marked a shift in the economic paradigm, by reflecting on the biosphere as an interconnected system. He makes a distinction between open and closed economies. He calls the economic model based on openness the "cowboy economy" (where the cowboy symbolises unlimited plains and exploitative behaviour), whereas with the closed economy (the "spaceman economy") the earth becomes a single spaceship, without an unlimited supply of anything (either for extraction or pollution), in which humans must find their place in a cyclical ecological system (able to continuously reproduce material shapes and forms, even if they cannot escape the energy inputs required).

Crucial to the development of the environmental movement has also been the first visualisation of the earth as a closed system. In 1967 NASA's first colour photograph of the whole earth (western hemisphere, shot from a satellite) is released (**Figure 1.2**). This influential image contributed greatly to the spread of awareness of the biosphere as a whole, especially when contextualised within the fear of potential worldwide effects of an atomic war. An example is the work of Buckminster Fuller's "Operating Manual for Spaceship Earth" (1969) that underlines the interconnection of all terrestrial phenomena based on the awareness that the biosphere is indeed functioning as a closed system: the earth as the one (and only) spaceship humans inhabit and need to learn how to operate. Since the '60s, the earth has exponentially been described as a circle or a sphere, in which all points interconnect.

FIGURE I.2: First color photograph of the whole earth (western hemisphere), shot from the ATS-3 satellite on 10 November 1967. This is the image also used as the cover of the The Whole Earth Catalog, a US counterculture magazine published by Stewart Brand between 1968 and 1972.

Therefore, the conceptualisation of "closed systems" became another leading concept to refer to when talking about the biosphere. In thermodynamics closed systems are systems able to exchange energy (with the universe in the case of the earth) but not matter (which stays as a limited resource). Thus, as Georgescu Roegen's work shows, industrial production and consumption are destined to be confronted with scarcity as they transform matter within a closed system, by accelerating its entropy (Korhonen, Honkasalo and Seppälä 2018). The awareness of being part of an enclosed and interconnected system sparked attempts to leverage on regenerative properties of ecosystems aimed at preventing resource shortages. Closed systems are therefore studied at all scales and levels, often represented with arrows, circles, and loops while

describing the cycles of the elements that compose a certain system. In conclusion, the notion of circularity can be seen as historically connected with ambitions to re-inscribe societal processes into regenerative natural ecosystems, while redesigning the cycles of matter in loops.

1.1.4 Economic development and the environment

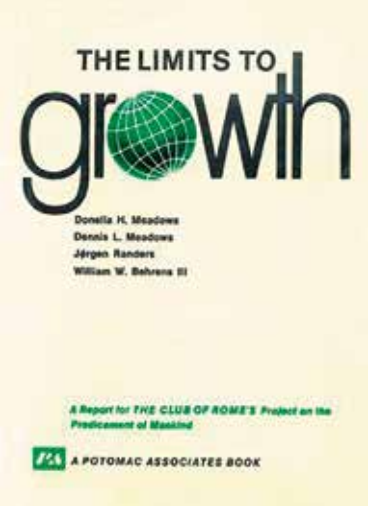


FIGURE 1.3: Covers of "The Limits to Growth" (1972).

While Boulding (1966) described the linear economy as "open cowboy economy", in 1972 Meadows, Ronders and Behrens, elaborated the "Limits to Growth" in a scientific analysis. Published by the Club of Rome, this seminal work examined the economic development trends of the 1970's in the context of the biophysical limits of the biosphere. Echoing the "Essay on the Principle of Population" written by Malthus in 1798, this work created a computer-based model to simulate the interaction of five global economic factors: population, food production, industrial production, pollution and consumption of non-renewable natural resources (Meadows et al. 1972) (**Figure 1.3**).

The awareness of the impossibility to continue with western world standards of biophysical resource consumption and waste production grew all along the 1960's and 1970's which led in 1987 to the shaping of the notion of "sustainable development" by the UN-founded Brundtland commission. In 1983 the UN asked to define "*shared perceptions of long-term environmental issues*" in order to arrive at common ambitions for the future. In the text the commission published in 1987 "Our Common Future" this notion was crafted. By definition, sustainable development matched environmental ambitions with development needs (described in the Brundtland commission's text as "inseparable"). The notion of sustainable development, aimed at synthesising environment-development dialectics: almost four decades of debate on ecological transitioning, while implying that economies can grow sustainably. The "limitation" or "condition" of such development was established by the introduction of the concept of present and future generations' "needs". With "needs" the fulfilment of the essential needs of the world's poor was taken into consideration, while the introduction of the idea of generational "limits" to the use of resources addressed the issue of biophysical boundaries. Despite the will to address world inequity, a definition of sustainable development based on the notion of "needs" allowed a large spectrum of interpretation of what such "needs" are and could be, and whose needs are being addressed first (Rotor 2014). The concept of sustainable development is rooted in systems thinking, it helps to understand ourselves and our world: a system that connects space and

a system that connects time. For example, in a systemic way of thinking, we can understand the world as a system over time and realise that the decisions grandparents made about how to farm the land continue to affect agricultural practice today, and the economic policies endorsed today will have an impact on urban poverty when todays' children grow up (Khan & Allacker 2015). The Brundtland Commission (1983-87) formulated the most diffused definition of "sustainable development" in an era when the exponential global growth lead to crucial questions on long-term feasibility, while the world's consumption was rising and never stopped until now. As Murray et al. clearly sum-up:

> *The awareness that industry and business were driving the shift towards increasingly materials-intensive lifestyles, has gradually translated in the concern that time to make changes is running out. It became more evident that governments seemed unable to instigate change against the will of the corporate world and therefore the introduction of business-oriented notion to transition towards less-materials-consuming paradigm started to be elaborated.*
> *(Murray et al. 2017).*

Therefore CE ambitions can be inscribed within this trend: circularity oriented ambitions are emerging from the awareness that businesses should play a role in the transition towards more material-conscious (and less impactful) paradigms.

1.1.5 The emergence of the CE

The previous four sections provided an overview of the emergence of notions that have been integrated within the CE discourse. Concerns about the fragility of nature, and the need to rethink the world as an interconnected system, raised awareness on the importance of natural cycles. Studies and projections on the impossibility to continue in the future within the linear (highly exploitative and polluting regime) paved the way for the development of new concepts (deeply rooted in economy and ecology).

Since the 1990's, the notion of the CE has emerged as a new conceptual asset for reconciling economic development with environmental concerns related to long-term resource scarcity and ever increasing waste. CE has so far mainly been discussed and progressively promoted by private and public institutions and businesses-oriented bodies. The origin of the notion of CE can be traced to ecological and environmental economics and industrial ecology (Bocken et al. 2017; Ghisellini et al. 2016; Merli et al. 2018). Reike et al. (2018), from an extensive literature review on CE, summarised the historical development of this notion in three main phases: (i) dealing with waste; (ii) connecting input and output in strategies for eco-efficiency; (iii) maximizing value retention in the age of resource depletion (schematised in **Figure 1.4**).

At first, this notion was predominantly dealing with waste management (Merli et al. 2018) and it appeared in Germany's and Japan's waste policies in the early 1990's

(Reike, Vermeulen and Witjes 2018; Athanassiadis and Kampelmann 2019). Nevertheless Reike et al. (2018) underline that "*in practice, input and output measures remain(ed) insufficiently connected*". In the early 2000's, China has been a forerunner in CE development, as it was already adopting CE in 2002 as the new sustainable development model, while in 2009 the "'CE Promotion Law" was implemented (Ghisellini et al., 2016). Another stream of thought promoting the loops of materials, was McDonough with the 2002 publication "Cradle to Cradle" (McDonough 2002). It sparked a reflection on how to redesign the "unsustainable linearity" (or the model called "Cradle to Grave") to erase waste from production processes, from a capitalist perspective. There has been much criticism on this concept, and especially "the unscientific basis of the cradle-to-cradle framework" (Prendeville, Cherim and Bocken 2018). In 2011 the European Union (EU) created a "Roadmap to a resource-efficient Europe", focusing on recycling and recovery of resources (Gregson *et al.* 2015).

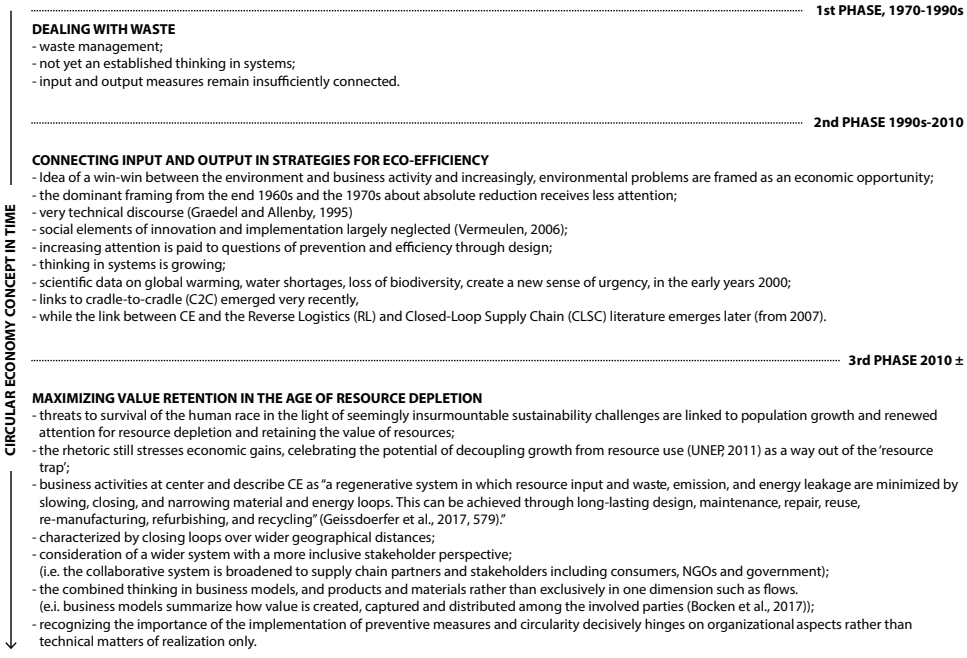


FIGURE I.4: Graphic sum-up of the evolution of the CE concept into three distinct historic phases as described by Reike et al. (2018). CE is described as an evolving concept that went from waste, to industrial efficiency, now advocated as a world paradigmatic shift, with human survival at stake. Scheme by the authors (2022).

Between 2000-2010 we can see the affirmation of the notion of CE among scholars, as well as international, national, and local administrations (policymakers), businesses and business-advocacy bodies (lobbyists) (Athanassiadis & Kampelmann 2019). The

rhetoric turned towards new ways of envisioning the development and competitiveness of western countries' economies in the future. CE was described as an adequate concept, able to match economic ambitions of renewing business, creating and keeping local employment, while paying attention to ecological concerns. It would allow to grow economically while reducing environmental impacts. On the other hand, a degrowth-oriented branch of the CE debate sees in this notion the possibility to radically reshape society. Circularity can also therefore be understood as a powerful framework capable of constraining production and consumption behaviour through regulatory policies (Athanassiadis and Kampelmann 2019). Thus, the CE also inspires discussions on degrowth (Ghisellini, Cialani and Ulgiati 2016; Kirchherr, Reike and Hekkert 2017), opening debates on the "steady-state" and "ecological economics". These analyses of the CE notion are also supported by the study of the impacts of rebound effects. Such rebound effects are debated further in this chapter (see **Section 1.2.1**).

1.1.6 The momentum for the CE: 2010-2020

In most systematic literature reviews on CE, we see a pivotal moment around the year 2010, when the number of scientific articles on this topic boomed, and in parallel, the notion started infiltrating lobbies and policies (Blomsma & Brennan 2017; Bocken et al. 2016a; Merli et al. 2018; Prieto-Sandoval et al. 2018; Reike et al. 2018). This phenomenon can be associated with the creation of advocacy bodies, such as the Ellen MacArthur Foundation (Homrich et al. 2018), a charity organisation working on the promotion of CE, in association with multinational corporations, established consultancy firms and high-level policy makers (such as the World Economic Forum) (EMAF 2013, 2020). The Ellen MacArthur Foundation's publications paved the way to the widespread dissemination of CE and, until today, they instituted the most used framework to illustrate its concepts and strategies. It is recurrent, when discussing CE to use the ReSOLVE framework (EMAF 2015) or the butterfly diagram, describing the cycle of organic and inorganic matter.

CE is in this phase more often described as a "win-win" strategy, able to design out waste while sustaining a growth-oriented society of mass production and consumption, while at the same time decoupling economic growth from the consequent environmental impacts. Most of the focus is on businesses and their engagement in changing their value chain towards more "circular" models. The lack of clarity of this concept in these early stages and its narrow interpretation attracted many criticisms from scholars (Beaulieu, Durme and Marie-Luc Arpin 2015; Gregson *et al.* 2015; Arnsperger and Bourg 2016; Geissdoerfer *et al.* 2017; Korhonen, Honkasalo and Seppälä 2018; Horvath, Bahna and Fogarassy 2019; Corvellec, Stowell and Johansson 2021). The lack of focus on eco-effectiveness measures, rather than resource efficiency ones, was also criticised by scholars. In their 2016 seminal work on "authentic circularity", Arnsperger and Bourg

elaborate on the need to reinterpret the notion of CE. It should strive for "more frugal" (*sober*) behaviours, aiming at reducing the net consumption of raw materials, rather than at optimizing loops that do not take into consideration the "bigger picture".

A general agreement is reached on the means and the objective of the CE (in other words, ladders of R-imperatives, schemes of principle applications, value hills, et cetera.) (Bocken et al. 2016a; Kirchherr et al. 2017; Reike et al. 2018), but no consensus is to be found when it comes to the actual definition of the concept itself. As Korhonen et al. (2018) write: this mismatch allows CE to be intended as an "*essentially contested concept*" (as from the classical Gallie definition in 1956), or as an "*umbrella concept*" as Blomsma and Brennan (2017) elaborate. Prieto-Sandoval et al. (2018) propose this consensus definition:

> *We defined CE as an economic system that represents a change of paradigm in the way that human society is interrelated with nature and aims to prevent the depletion of resources, close energy and materials loops, and facilitate sustainable development through its implementation at the micro (enterprises and consumers), meso (economic agents integrated in symbiosis) and macro (city, regions and governments) levels. Attaining this circular model requires cyclical and regenerative environmental innovations in the way society legislates, produces and consumes.*

Yet, until now, there is no consensus definition on the CE concept and every actor involved in the transition towards more circular paradigms must first state which of the existing definitions is embraced. This contributes to the constant rising of the number of interpretations and therefore definitions.

In 2015 the European Commission adopted the "circular Economy Package", bringing forward potential growth for opportunities that such a notion allowed. The accent was placed on the potential for the creation of local employment, allowing more independence from geopolitical instability, threatening the provision of key resources (European Commission 2015). In 2020 the Commission renewed the ambition to further develop the CE action plan, by publishing a new text in which sectors ("*key product value chains*") to be readdressed were identified (in other words, electronics and information and communication technologies, batteries and vehicles, packaging, plastics, textiles, construction and buildings, food, water and nutrients) (European Commission 2020). Since 2015 many national and local organisations targeting CE were constituted all around Europe (for example in France, the UK, The Nederlands, Belgium, et cetera.) and they played a key role in fostering CE on European political agendas (Athanassiadis & Kampelmann 2019). Engineering and natural science-oriented studies, policies and businesses-oriented publications represent, so far, the largest contributions to the debate on circularity. Such contributions focus predominantly on production and consumption patterns: enhancing high-value material cycles. Many notions arise

such as "sharing & pooling", "regenerating", "reducing", "re-using" and "recycling" of resources, materials and waste and promoting changes in consumer behaviour. On the website of Eurostat we can read the following definition of CE:

> *The CE aims to maintain the value of products, materials and resources for as long as possible by reintroducing them into the product cycle at the end of their use, while minimising the production of waste. The less products we throw away, the less materials we extract, the better for our environment. This process starts at the very beginning of a product's life cycle: intelligent design and production processes can help save resources, avoid inefficient waste management and create new business opportunities.*

1.1.7 Future perspectives: CE in practice

The current momentum for CE is predominantly embraced by governmental and business-oriented bodies advocating the development of more circular strategies and practices (EMAF 2013; European Commission 2015, 2020b). We could define these key players as top-down actors, while we also notice the rise of more bottom-up ones. Smaller initiatives are inscribed within the CE shift, an example could be the multiplication of repair cafes, food banks, material banks, upcycling workshops, et cetera. Also, some CE practices are historical ones, that have existed since way before the notion of CE was shaped. These practices often developed within the social economy (as it is the case of charities reselling second-hand clothing, books, furniture, appliances et cetera) (Verga and Khan 2022). Thus, the landscape of practices is multifaceted and ranges from technocratic solutions to low-tech ones, some focusing on the optimisation of resources and others on their democratisation (Marin & Meulder 2018). Many are the drivers and the actors, many the definitions of what circularity inspired ambitions can entail. Multi-level approaches to the transitioning pathway have been elaborated (Geels 2005, 2019) and will be further discussed in **Chapter 2** and **Chapter 3**.

Since 2020 ambitions to implement a CE have been established more broadly across society. Despite its conceptual unclarity for the most, this notion started infiltrating public debates and is increasingly used. If we take the latest European projects and calls, the "New CE Action Plan" and the "Green Deal", they provide a future-oriented agenda for achieving a cleaner and more competitive Europe in co-creation with economic actors, consumers, citizens and civil society organisations (European Commission 2020b, 2020a). They aim at accelerating the transformational change required. We can thus notice that efforts are now concentrated in the implementation phase of circular and sustainable ambitions. A collective struggle in moving from "theory" to "practice" can be perceived. Difficulties emerge in bridging the "gap" between the advancement of theoretical debate (on circularity and sustainability) and large-scale implementations of strategies emerging from such debate.

Therefore, we see a plea for an "acceleration" of the transition (an example is VBO FEB's publication of 2020): the time is now to focus on the implementation and mainstreaming of circular and sustainable strategies, rather than on developing new theories and strategies. A densely populated landscape of niche innovations is emerging, if we follow Geels' dynamic multi-level perspective on sustainable transitioning (2005, 2019). Yet, the main challenge ahead is finding ways to "upscale" such niche innovations in order to link them together and stabilise them ("mainstreaming" them). In the following chapters transitioning theories are developed in more depth and the dynamic multi-level perspective on sustainable transitioning is further explained.

The mainstreaming of CE ambitions and practices in business culture is the challenge we embrace with this book. We question how to reshape business models and business ecosystems. Businesses not only will have to deal with resource scarcity while facing a higher regulatory pressure on waste production (greenhouse gas emissions and solid and liquid waste), but geopolitical uncertainties and climate deregulation suggest the relocalisation of value chains will be crucial in order to enhance resilience. By strengthening relationships between local value chains and by making use of locally available resources and waste, logistics costs (both economic and environmental) will also decrease. The disruption experienced in the supply of goods during the Covid-19 pandemic and the war in Ukraine had heavy consequences persisting until now. Will this be the right occasion to finally redevelop local, sustainable and circular value chains?

1.2 TOWARDS A CONCEPTUAL FRAMEWORK OF CIRCULAR ECONOMY BASED ON CURRENT DEBATES

CE can be considered an "*umbrella concept*" (Blomsma & Brennan 2017; Homrich et al. 2018). Multi-level approaches to the transitioning pathways have been elaborated (Geels 2005, 2019; Geels & Schot 2007). The terminology around CE can be seen as "diverging" rather than "converging", the same is applicable to the frameworks used to develop CE strategies. This section, therefore, sets the basis of the framework this book uses (**Section 1.2.1**): we do not focus on a definition of CE but rather on value retention options and their hierarchisation. In **Section 1.2.2**, we discuss the issues to be addressed when working on circularity oriented implementations: (a) rebound effects and (b) the need to frame strategies in a multi/inter-scale approach. The last three sections (**Sections 1.2.3, 1.2.4** and **1.2.5**) provide readers with reflections on: (c) the notion of circularity in relation to sustainability, (d) the importance of adopting broad environmental approaches (addressing ecosystem health), and e) the role that behavioural changes play in the transition. Section 1.2.6 briefly presents the notion of "exnovation", which is further explained and discussed in **Chapter 3**.

Strategies from most virtuous to the least (Bocken et al. 2016b)	**9 R's Imperatives** (Kirchherr et al. 2017; Reike et al. 2018)	**Examples of practices of Value Retention Options** according to R-imperatives ladder based on the article of Reike et al. (2018)
Narrow the Loop	**#0 Refuse**	In the consumer case, scholars stress the choice to **buy less, or use less**, which may apply to any consumption article aimed at the **prevention of waste creation**. It refers to a critical position of consumers, shifting towards a **post-material lifestyle**. Refuse is also often used in the context of the **rejection of packaging waste and shopping bags**. Applied to producers, refuse refers rather to the Concept and Design Life Cycle where **product designers can refuse the use of specific hazardous materials**, **design production processes to avoid waste or** more broadly speaking, **any virgin material**, and replace polluting/non "circular" materials.
	#1 Reduce	Using purchased products less frequently, using them with more care and longer throughout, **maintenance** (service economy), or making repairs for **life extension**, for example with consumer-to-consumer support (**repair shops**). Participation in the "**sharing economy**" through **pooling** (simultaneous use) and **sharing products** (sequential use) in this category, as they expect more effective product use over time. Producers in their role in the pre-market stages of the Concept and Design Life Cycle, by **using less material per unit of production**, or referring to **"dematerialisation"** as explicit steps in the product design.
Slow the Loop	**#2 Resell/Reuse**	**Bringing products back into the economy after initial use,** from different positions: consumers, collectors, retailers and producers. Linking the concept to the "use"-phase of the Product Produce and Use Life Cycle. It applies to **a second consumption of a product that hardly needs any adaptions** and "without rework" or "without repair". Quality inspections, cleaning and small repairs are common here. From the consumer perspective, this implies **buying second-hand** after some cleaning or minor adaptations. **Online consumer-to-consumer** auctions for used products are increasingly important, but such "direct re-use" can also take place as an **economic activity via collectors and retailers**. Direct reuse of unsold returns or products with damaged packaging can be included**.**
	#3 Repair/ Restore	Its common purpose is to **extend the lifetime of the product, as "bringing back to working order"**, "recreating its original function after minor defects", "replacing broken parts". Repairing **can be done by different actors and with or without change of ownership**, by the customer or people in their vicinity, at the customer's location, and through a repair company. More recently, **peer-to-peer non-commercial repair workshops** have become a trend. Businesses may **send recollected products to their own repair centres**, to manufacturer-controlled or to third-party repair centres. We can distinguish "**planned repair"** as part of a longer-lasting maintenance plan or **"ad-hoc" repairs**.

Slow the Loop	**#4 Refurbish**	In cases where the **overall structure of a large multi-component product remains intact**, while many components are replaced or repaired, resulting in an **overall "upgrade" of the product**. Applied in this way, the concept refurbish is also known from common language in the context of an **overhaul of buildings**, while in literature airplanes, trains, mining shovels or engines and machinery are among the examples. The result should be a specified quality, **bringing the product up to "the state-of-art"** due to the use of newer more advanced components.
	#5 Remanufacture	"Remanufacture" applies where the **full structure of a multi-component product is disassembled, checked, cleaned and when necessary, replaced or repaired** in an industrial process. Compared to refurbishing, **the retained quality is as "in original condition, like new"**.
	#6 Repurpose	Repurposing is popular in industrial design and communities. By **reusing discarded goods or components adapted for another function, the material gets a distinct new life cycle**. This seems to denote **both low and high-value end products**. An example is the one of unemployed workers becoming entrepreneurs by transforming defective microchips into jewellery, glass bottles into mugs, textile waste into quilts or plastic sheeting into handbags.
Close the Loop	**# 7 Recycle**	**"Recycling" is at the bottom of the value hill but at the top when it comes to frequency of use.** It means processing mixed streams of post-consumer products or post-producer waste streams, using expensive technological equipment, including shredding, melting and others. A clear difference with the higher R's is that **recycled materials do not maintain any of the original product structure and can be reapplied anywhere, and are** also called "secondary" materials. Only for **few materials (among them metals) recycling shows as little quality loss as to enable competition with virgin material**. Finally, recycling typically **requires high energy inputs for collection and reprocessing which may supersede the retained value.** Recycling takes place also in business-to-business (described as **"primary recycling"**). Materials are not yet mixed, as opposed to **"secondary recycling"**, where used end-of-life products get collected by municipal waste collectors.
	# 8 Recover (energy)	**Recovery means capturing energy embodied in waste, linking it to incineration in combination with producing energy** or **use of biomass**. It may also mean **the extraction of elements or materials from end-of-life composites**.
	# 9 Re-mine	"Re-mine" is the retrieval of materials after the landfill phase. Both in the North and the South, **taking valuable parts from disposed products forms an informal sector which emerged under different conditions**. In developed countries, with a long history of controlled landfilling, entrepreneurs recently started to "mine" the valuable resources stored in old landfills and other waste plants, which is called **landfill mining or urban mining.** It has been argued that the concentration of various minerals is nowadays higher in landfills than in original mines. In strongly urbanised regions, the price of new land is as high as to justify investments in a **full clean-up of old landfills and the restoration of the area for urban development** (constituting an "area re-mine").

TABLE I.I: graphic interpretation of the ladder of value retention options, based on the ten R's imperatives from the literature review of Reike et al. (2018) and on the categorisation (narrow, slow and close loops) of Bocken et al. (2016), by the authors (2022).

1.2.1 Value retention options and hierarchy

In this section, we outline elements that constitute a conceptual CE framework this book embraces. Central to the framework is the notion of "value retention", which is delineated according to the ladder of value retention —based on the ten R's imperatives from Reike et al. (2018) and on the categorisation of Bocken at al. (2016)— and the visualisation of the value hill (from Achterberg et al. 2016). This framework aims at communicating that not all circularity inspired actions have the same impact, and that some are more *virtuous* than others. The CE discourse, despite its conceptual unclarity, is often described through lists of strategies. These strategies are illustrated as loops, pyramids, ladders, hills, et cetera, showing the ways in which value can be retained and suggesting steps to undertake in order to transition towards more circular practices. In the 1970's the Lansink Ladder (known also as waste hierarchy) was proposed for the first time as a tool for the Dutch government to evaluate waste treatment strategies. Ever since then, many have been the attempts to establish a comprehensive list of strategies and to organise them into a hierarchy, able to underline which of those are the most virtuous and which are the least effective, as not all circularity inspired actions have the same environmental impact. **Figure 1.5** lists a comprehensive set of value retention strategies, based on a literature review of the article from Kirchherr et al. (2017) and Reike et al. (2018), also using the categorisation from Bocken et al. (2016) underlining that the most *virtuous* strategies should aim at narrowing the loops, followed by slowing them down and only lastly to actually close them. Reduction should be the first keyword, extension of use the second one, while end-of-life strategies should be put in the backdrop (in policies for example) in favour of the previous two kinds.

> *The term "value retention" as a newly introduced term, it must be clear that it shall refer to the idea of resources carrying an intrinsic value – as applied in the sustainability discourse – as opposed to economic notions of value. Hence the retention of resource value means conservation of resources closest to their original state, and in the case of finished goods retaining their state or reusing them with a minimum of entropy as to be able to give them consecutive lives.*
> *(Reike et al. 2018).*

The most virtuous operationalisation principles (in **Table 1.1**) are characterised by the extension of the lifespan of artefacts in their integrity in their original state, thus minimising environmental impacts of rework and logistics. The least virtuous strategies do the opposite: the artefacts are disassembled and reduced to smaller parts, the outcome is an overall reduction of the value of the parts that then need to undergo industrial processes in order to be recirculated and given a new purpose. These industrial processes are work intensive and often entail high energy consumption, heavy logistics and require specific infrastructures. In literature we can find frameworks ranking actions in a hierarchical way to guide the selection of priority actions, according to their impact on resource consumption at a greater scale (Blomsma & Brennan 2017; Bocken et al. 2016a; Geissdoerfer et al. 2017, 2020; Kirchherr et al. 2017; Merli et al. 2018; Prieto-

Sandoval et al. 2018; Reike et al. 2018). The visualisation of the "Value Hill" (Achterberg et al., 2016) is complementary to the value retention ladder and helps businesses navigate the CE strategies and hierarchy in an operational way, as **Figure 1.5** shows.

> *Circular businesses aim to retain a product's added value for as long as possible, if not forever. In the context of the Value Hill, value is added while the product moves "uphill" and circular strategies keep the product at its highest value (top of the hill) for as long as possible.* (Achterberg et al. 2016)

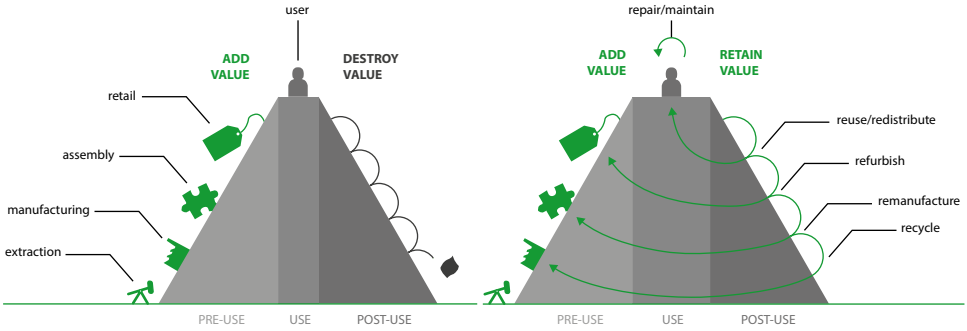


FIGURE 1.5: Value hills: on the left, the linear economy model (destroying value); on the right, the circular model (retaining value), image from Achterberg et al. 2016.

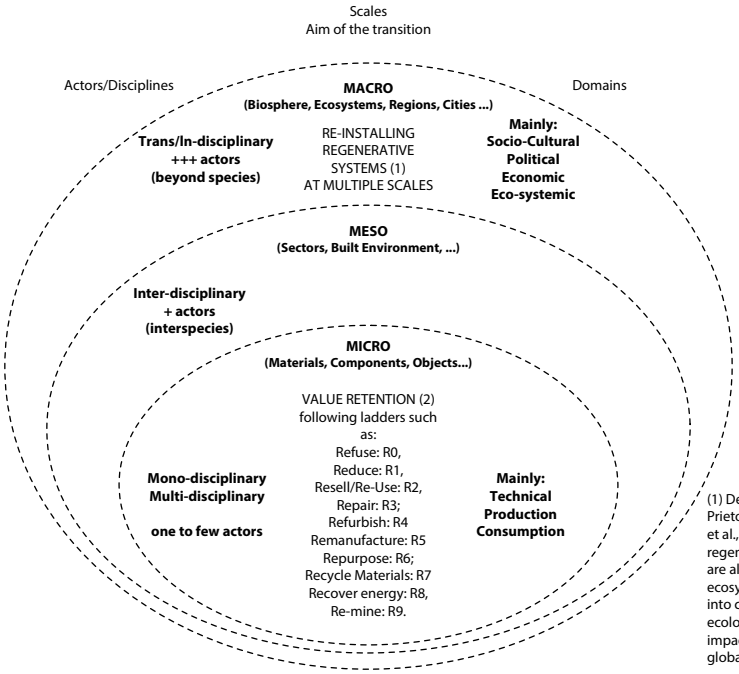
1.2.2 Attention points: scales of circularity and rebound effects

> *A singular efficiency measure could induce the rising of the overall consumption of resources and waste, and therefore have a negative impact in the global material balance* (Arnsperger & Bourg 2016, translation from French by the authors).

If we take into consideration the value retention strategies (described in the previous section) as the main guideline for the implementation of the CE, it is important to pay attention to a few elements, namely the notion of scale and the risk of rebound effects.

In the CE literature, the notion of scale is prominent, and each author develops slightly different categorisations of what they intend by *micro-meso-macro*-scale, according to the discipline, field of intervention and the focus of each article. In the consensus definition of the CE by Prieto-Sandoval et al. (2018) the *micro*-level is defined as enterprises and consumers, the *meso*-level as economic agents integrated into symbiosis and the *macro*-level as cities, regions and governments. The CE value retention strategies have mostly been developed focusing on smaller scales, on production and consumption processes, focusing on single businesses, business ecosystems and industries, yet it is important to have an assessment of the impacts of single implementations at a wider scale. Considering transitioning designs and actions in relation to different scales allows the widening of the scope of action and questions, for example, the eventual risks of rebound effects.

A fascinating analysis of what an *authentic* CE should be is formulated by Arnsperger and Bourg (2016,). They explicit the danger of focusing mainly on the implementation of microeconomics (closing specific technical loops), risking to overlook significant rebound effects and, therefore, missing the overall circularity performance (at a larger scale) in terms of net flows of material. The example given is that of steel, the most recycled material in the world, with a global recycling rate of up to 62 %. In any case, as the overall demand for steel keeps on rising yearly by approximately 3.5 %, recycling techniques only slow the pace at which raw materials (iron in this case) are consumed insignificantly. They underline that the real effectiveness of recycling in a high-growth (and even relatively moderate-growth) economy is therefore minimal. They conclude by underlining the most important R-imperative of all: *reducing*, as "*recovering even 100 % of the end-of-life flows of a raw material whose consumption is growing by several percent per year has only a derisory effect on the scale of several decades*" (Arnsperger & Bourg 2016). Therefore, it becomes crucial to consider the effect that each action, driven by circularity inspired ambitions, has on different scales simultaneously. In **Figure 1.6** a scheme is exemplifying a potential way of defying different "scales of circularity".



(1) Definition from Prieto-Sandoval et al., 2018, where regenerative systems are also intended in an ecosystemic view, taking into consideration urban ecologies and the physical impacts of choices at the global (the biosphere) scale.

(2) The term 'value retention' is taken from Reike et al. definition (2018); it shall refer to the idea of resources carrying an intrinsic value as opposedto economic notions of value.

FIGURE 1.6: Visualisation of different "scales of circularity", by the authors (2022).

The question of the "scales of circularity" opens the debate on how to actually evaluate and foresee the risks of rebound effects at a global level, keeping in mind that the aim of circularity driven ambitions is to reduce first the direct and indirect footprints of societies (limiting extraction, logistics and disposal of resources). Nowadays the main focus is based on CE operationalisation principles that are most often derived from the analysis of smaller scales of the CE (*micro*- and *meso*-scales), therefore assessments of the effects that they might engage on larger (*meso-macro*) scales are to be carried out.

> *When complex socioeconomic factors are included, the environmental outcome of the CE becomes ambiguous. It turns out that simply closing material loops is not enough to guarantee environmental improvement. (…) We argue that CE activities can increase overall production, which can partially or fully offset their benefits. (…) CE rebound occurs when CE activities, which have lower per-unit-production impacts, also cause increased levels of production, reducing their benefit. (…) so we caution that simply encouraging private firms to find profitable opportunities in the CE is likely to cause rebound and lower or eliminate the potential environmental benefits*
> *(Zink & Geyer 2017).*

Zink and Geyer's (2017) article on CE rebound effects, outlines three necessary conditions to avoid them:

> *It is necessary that CE activities produce products and materials that truly are substitutes for primary production alternatives (…).This may include educating the public to overcome stigmas or convincing buyers of the value proposition of higher-quality, longer-lasting goods relative to lower-quality throwaway goods.*
>
> *It is necessary that CE activities either have no effect on or decrease aggregate demand for goods: that they either must target areas with fairly satiable demand (in other words markets where buyers' price sensitivity is low), or they must ensure that increased secondary production does not significantly affect overall prices. Companies that focus their CE activities in these low-price-response areas are less likely to create rebound.*
>
> *If the first two conditions are met, it is also necessary that the CE activity actually draws consumers away from primary production. In other words, substitution from primary to secondary goods must actually occur.*

The lack of studies on complex socio-technical systems can be seen as a limitation to current ways of estimating rebound effects. Rebound effects are estimated through calculations, such as Life Cycle Assessments (LCA), that quantify processes at a great level of detail but that integrate with difficulty socio-cultural, context-specific behaviours and values (Niero et al., 2021). Therefore, complementary tools to LCA are being proposed to tackle socio-technical dynamics and analyse unintended rebound

effects. The aim is to study more realistic and contextual scenarios to then be assessed by LCA. An example of methodology is given by Niero et al. (2021). They propose the integration of other approaches, such as Practice Theory and Actor-Network Theory. If the risk of rebound effects is great and can undermine the sense of transitioning towards the CE, it is nevertheless important to develop more accurate socio-technical studies, focusing on socio-cultural and behavioural shifts, to overcome cultural and behavioural barriers.

It is important to reflect on the role of people –both as consumers and as citizens (Hobson 2016)- in the transition towards an *authentic* CE. Horvath et al. (2019) outline how misleading, in terms of actual environmental benefits, the focus on closing loops could be. They recommend to focus more on prolonging the utility of materials and more conscious consumer attitudes to prevent the creation of unnecessary flows. They show how misleading the focus on recycling can be in international indicators of CE development (Horvath et al. 2019). In order to promote and mainstream ambitions for an *authentic* circularity, we first have to rethink the interaction humans have with the material world, with the aim of reducing overall environmental impacts. Thus, embracing a new philosophy where "less" should also mean "better" (for example going for "less" but "better" production and consumption). Arnsperger & Bourg (2016) propose the notion of "frugality" (*sobriety*) as a way of preventing rebound effects and focusing on the reduction of the net quantities of resources consumed, and waste produced. They advocate for an economy of "*voluntary moderation and frugality*", not only at the *micro*-level of individuals but also at the *macro*-level. They argue CE thinking should be embedded within the so-called "permacultural" approach, as permaculture offers a well-founded framework for designing a genuine CE (of voluntary moderation and frugality), to this end the term "perma-circularity" was coined (Arnsperger 2016).

I.2.3 Circularity in/and sustainability

> *We define the CE as a regenerative system in which resource input and waste, emission, and energy leakage are minimised by slowing, closing, and narrowing material and energy loops (…). We define sustainability as the balanced integration of economic performance, social inclusiveness, and environmental resilience, to the benefit of current and future generations.*
> *(Geissdoerfer et al. 2017)*

In the previous historical excursus, we have argued that the notion of sustainability left a great space to negotiate what could be defined as "generations' needs" (Rotor 2014, p. 12), while circularity based reflections and urban metabolisms studies leave less room for that. Circularity and urban metabolism approaches relate the interaction of humans with their material impacts on the environment by estimating physical quantities (in other words, tons of materials, kilowatts of energy, grams of CO_2, footprints, et cetera.). Therefore, we can consider them as more material-oriented ("tangible") approaches, able to question whether a certain "need" is to be considered "too wasteful"

or "acceptable". Nevertheless, the practices to fulfil a certain "need" are carried out by humans, therefore they deeply relate to *immaterial* aspects such as cultural beliefs, lifestyles, and dealing with social, economic and political backgrounds.

Geissdoerfer's et al. (2017) article, based on an extensive literature review, analysed the intersections between the "CE" and "sustainability" concepts. Three main limitations appeared: (1) the lack of a holistic view in the CE debate compared to the one around sustainability (notably shaped by three pillars, the social, environmental and economic); (2) the lack of consideration for people's wellbeing beyond job creation and (3) a simplistic and utilitarian framing of environmental aspects in the CE debate. They observed that:

> *Most CE contributions focus on the environmental performance improvements rather than on a holistic view on all three dimensions of sustainability (as most authors) conceptually simplify the CE to resource input, waste and emission output. (…) The CE refers mostly to individual economic benefits through input reduction, efficiency gains, and waste avoidance with relatively immediate results compared to sustainability. Differently from sustainability, long-term viability seems to be excluded from most discussions.*

They also add that if in the CE debate behavioural shifts are to be encouraged with incentives, many sustainability approaches favour behavioural change through engagement and education (Geissdoerfer et al. 2017).

The notion of CE could nourish debates on the implementation of sustainability ambitions by allowing a focus on material impacts and their quantifications. At the same time sustainability goals and frameworks could help expand CE ambitions and methods beyond resource and waste efficiency strategies, by taking into consideration social and environmental aspects as foundational "pillars". Kirchherr et al. (2017), in fact, describe the CE as aiming at achieving sustainability goals. If the concept of CE is now seen on the one hand as "narrower" than sustainability, as too business-focused and lacking conceptual clarity, on the other hand, sustainability is often described as "too wide". Could then the collision (or constructive dialogue) of both these debates finally allow the shaping of pertinent socio-ecological transitioning processes?

I.2.4 Ecosystem's Health and Resilience

In the era of the *Great Acceleration* (Steffen et al. 2015), where resource consumption (and waste disposal) keep on rising, ecosystems have become new hybrid environments where fast unpredictable changes in the biosphere offer little resilience to humans. Currently, the notion of "hybridation" between natural and urban is explored from many different angles in many disciplines, claiming that the differentiation between the two does not subsist anymore. A decade has passed since the beginning of the wide spread of the notion of CE in Europe and a few ambitions have been laid out, while in the next decade more will come. The pandemic crisis the world underwent made

evident not only that the current exploitation of "nature" is creating unmanageable changes, but also that reorienting economies towards more local contexts is crucial to guarantee basic needs such as food provision. Therefore, by enhancing socio-ecological transitions towards more resilient models could provide long-run benefits (Williams 2021), while also tackling challenges the Covid-19 pandemics posed (Williams 2020; Wuyts et al. 2020).

The notion of circularity can be an entry point to think of ecosystems as more-than-human environments, where the healthiness of one part influences all others. This important aspect is debated within the notion of "One Health" (as a concept defined also by the World Health Organisation), intended as the health of ecosystems, where humans are one among many actors interplaying. A holistic approach based on circularity inspired ambitions is advocated, promoting a debate on how to preserve, salvage and remediate the healthiness of soils, water systems, air quality, vegetation, living beings (including humans, but not only), mineral elements, et cetera (Verga & Khan 2022; Williams 2019). It is also important to recall the need for the adaptation of ecosystems to be able to strengthen resilience in the face of climate deregulation (causing urban *heath island effects*, draughts, and floods), the loss of biodiversity and the impoverishment of soils. Circularity inspired ambitions shall therefore also take into consideration more-than-human worlds, beyond culture-nature oppositions, and promote a wider understanding of urban ecologies, their hybrid processes and actors (Alberti 2008; Gandy 2018; Haraway 2014; Puig de la Bellacasa 2017; Tsing et al. 2020) and materialities (Tolia-Kelly, 2013). Thus, within circularity inspired ambitions it is essential to pay attention to regenerative properties of ecosystems, while caring for the healthiness of soils, water systems, air quality, vegetation, living beings and mineral elements.

I.2.5 The role of people: opening to more inclusive narrations and practices

> *Concrete proposals for a different approach are widely available for the technological dimension and, to a lesser extent, for governmental and policy frameworks and environmental assessment metrics. The greatest challenges that lie ahead will deal with the role of people, both as individuals and as society as a whole, and that of new economic models to promote and implement circularity.*
> *(Pomponi & Moncaster 2017, p. 717, reflecting on the implementation of the CE in the built environment).*

We can observe that the debate on the CE is still predominantly shaped by top-down actors and often based on technocratic approaches (Athanassiadis & Kampelmann 2019; Marin & Meulder 2018; Pomponi & Moncaster 2017). In literature, a great challenge for the years to come is identified in promoting a shift in people's behaviours, rather than implementing innovative technologies (Corvellec et al. 2021; Hobson 2016; Korhonen et al. 2018b; Merli et al. 2018; Pomponi & Moncaster 2017). The mainstreaming (or embedding) of emancipatory reflections and actions (behaviours) could carry out a deep

transitioning process, that allows humans to lower their direct and indirect footprints on the environment. Thus, circularity inspired approaches should focus on ways of involving everyone, beyond the easy reach of green businesses and the wealthier and environmentally-aware public. Nowadays, the CE debate is focusing more and more on consumer behaviour and Camacho-Otero et al. (2018) give a good synthesis of the challenge: "*How to trigger a change both at the individual and collective levels to help the diffusion of circular solutions and the transition towards a CE*?" (Camacho-Otero et al. 2018).

It is also important to underline that some CE practices existed way before recent policies were adopted, in charitable initiatives or social economy businesses (Verga and Khan 2022). In the global south many are the embedded activities aimed at extending the lifespan of goods and reducing waste (see for example the case of the Ethiopian town Ranzato, Ahmed Z. and Moretto 2018). These practices could often target less wealthy (or marginalised) people and be shared across a multifaceted public. By including a larger public, the impacts of such practices widen and intensify, opening promising future scenarios, where the CE is embraced by as many people as possible, and tackles copious quantities of resources and waste. Therefore, the shaping of new inclusive and empowering narrations is a crucial aspect in the mainstreaming of circularity inspired ambitions. If CE ambitions and practices could be shared and made accessible to a larger part of the population, this could also help tackle structural societal inequities. Thus, the notion of affordability needs to be integrated within the CE debate. Opening the debate and widening the spectrum of the people involved could broaden the impact of the advocated transition. Framing reflections on circularity within "the doughnut compass" of Raworth could be an entry point (Raworth 2017), where planetary boundaries (Rockström et al. 2009) are important to be taken into consideration within also socially just foundations, thus paying attention to respecting the wellbeing of all humans. This notion of planetary boundaries within just foundations has already been embraced by governments, as is the case for Amsterdam (Circle Economy 2019) and Brussels (Brussels Donut 2021).

In conclusion, for a shift towards more circular paradigms, systemic changes are needed. Long-run visions and strategies should aim at opening the debate to a broader public. It would imply engaging a behavioural, cultural, societal, political and economic shift. In this panorama, companies are key players if CE ambitions are to be mainstreamed. The time to accelerate and drive the change is ripe (VBO FEB 2020), and all efforts shall now go into embedding and mainstreaming circularity inspired ambitions and practices in society at large. The coming chapters of this book discuss how the paradigmatic shift can occur in businesses and business ecosystems.

I.2.6 Exnovation

Exnovation —or the ecology of "dismantlement" (Bonnet, Landivar and Monnin 2021)— is a key concept in transitioning towards new (more circular) paradigms. Transitioning implies the implementation of exnovation processes that can range from a deliberate phaseout of products, practices and technologies to unplanned processes

of decline and destabilisation. It can be seen as the "hidden" side of the CE transition, yet it is a crucial one, especially for businesses and their ecosystems. The integration of exnovation strategies would allow to plan the phaseout of practices that do not match the transitioning ambitions. **Chapters 3** develops this key notion further and unfolds the role businesses play in regards to it.

1.3 THE BELGIAN CONTEXT

This section gives an overview of the Belgian CE policies. As the focus of this book is the Belgian context, the three regional approaches to the CE are presented (the approach of the Brussels Capital Region, Flanders and Wallonia). This section can be used by stakeholders operating in Belgium as an introduction to the panorama of CE initiatives, while it can be seen from a non-Belgian perspective as a caste study showing how international CE ambitions are adapted to a specific context. This context cannot be understood without referring to European policies. In the historical excursus European policies[1] are discussed more in depth (see **Section 1.1.6** and **Section 1.1.7** of this chapter).

The opposition of linear systems versus circular systems has gained ground in the last four decades as more and more studies on urban metabolism were carried out. The urban metabolism of cities (as the quantification of material inputs and outputs) helped identify the greater flows of resources in terms of intensity, thus it helped pinpoint specific industries (the ones producing the largest amount of waste) that needed to be tackled ("circularised") at first. Therefore, urban metabolism helped define specific sectors to be targeted by CE policies. If we take the example of the **Brussels Capital Region**, we can relate the publishing of a study on Brussels' urban metabolism analysis in 2016 (Athanassiadis 2016) as the first step towards the definition of CE ambitions. In fact, the urban metabolism study has made an important contribution to the shaping of the CE Regional Program (PREC) (Athanassiadis & Kampelmann 2019; Bortolotti & Ranzato 2016). The PREC was launched in 2016 (for a duration of four years) and about thirteen million euros were dedicated to the testing and implementation of CE, divided over four strategic axes: transversal actions, sectoral actions, territorial actions and governance actions. The objectives listed in PREC were the following: (i) turning environmental goals into economic opportunities; (ii) anchoring the economy in Brussels to produce locally where possible, reducing transportation, optimising land use, and creating added value for the people of Brussels; (iii) contributing to job creation (Bruxelles Environnement 2016). **Figure 1.7** shows how the CE is framed by the Brussels Capital Region. Supply and demand should evolve while suggesting three main strategies for value retention. Manufacturing, transformation and the sale of local products should consume little resources, and should aim at having a long

1 In 2015, the European Commission adopted the 'CE Package' (European Commission 2015), while in 2020, the European Commission adopted the 'New CE Action Plan' and the 'Green Deal' (European Commission 2020, 2020b, 2020a).

lifespan and minor impact on the environment (eco-design). Novel offers of services should promote the optimisation of the use of goods by consumers, rather than their acquisition, either by a service company (functional economy) or by services provided between consumers (sharing economy). The optimisation of resource recovery shall be developed further through economic activities based on repair, reuse and recycling. The exchange of resources and waste between economic activities in each territory shall be developed with the objective of enhancing and optimising local resources and by-products (industrial ecology). If more local value chains (or short circuits) are developed, there could be a benefit in terms of local employment and in terms of reliability of local resources and goods in the face of geopolitical instability.

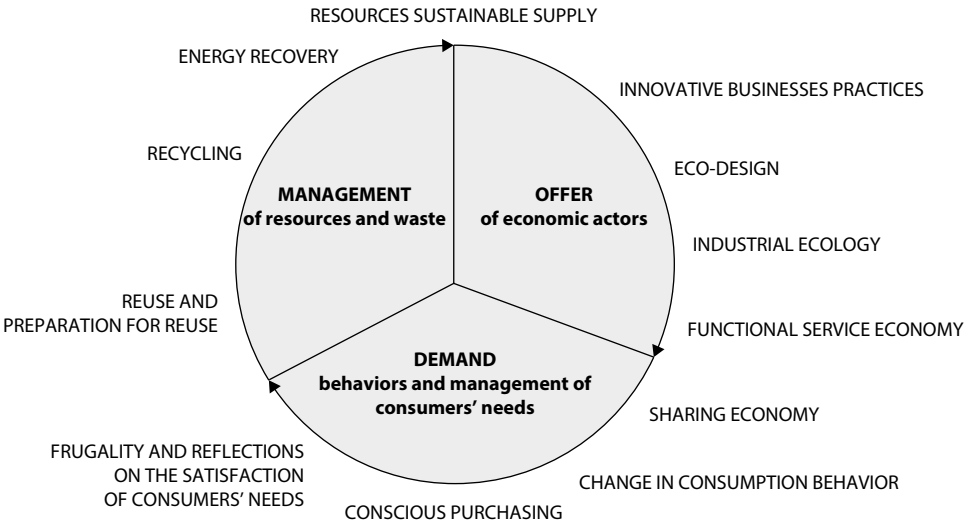


FIGURE I.7: Extract from the Brussels Capital Regional CE support platform (the Be Circular website) inspired by ADEME's 2017 scheme. Redrawn by the authors (2022).

The Brussels Capital Region became a European forerunning region where CE policies have been fostered. The regional environmental agency (*Bruxelles Environnement – Leefmilieu Brussel)* leads the first steps towards the CE implementation and monitors (with many reports) its evolutions. For example, in 2018 the United Nation Environmental Programme study – developed for *Bruxelles Environnement* – provided recommendations on how to monitor CE strategy by means of a framework to measure flows and effects while reflecting on job measurement (UN Environment Programme & Gil, S., Miller, K., Muñoz. 2018), or with more dissemination-oriented publications to showcase the projects supported during the PREC (Belin & Hananel 2019). In the PREC the selected key sectors in which to foster a CE were: construction, resources and waste, logistics, commerce and food. For a sector such as construction, many documents were published and accompanied the exploration of what a CE could imply for public administrations,

architects, suppliers, clients, contractors, et cetera (Bruxelles Environnement 2018, 2020; Galle et al. 2019b, 2019a) and similarly many publications accompanied the other sectors during the four years of PREC (Bruxelles Environnement 2019).

In the **Flemish Region**, the OVAM (the Public Waste Agency of Flanders) is the agency that initiated "Circular Flanders" (*Vlaanderen Circulair*), as since 2017 the Government of Flanders has set the CE as one of the seven transition priorities. "Circular Flanders" is the hub, the inspirer and matchmaker for CE in Flanders, as a partnership of governments, businesses, non-profits and research institutions. Initially, Flanders Circular had focused on three transversal themes: the circular city, circular business strategies and circular procurement. The organisation supports (on demand) CE projects working with materials, water, energy, space and food. In 2017, "Circular Flanders" (in cooperation with *The Shift*, the Flemish Association for Cities and Municipalities and *Bond Beter Leefmilieu)* launched the Green Deal Circular Purchasing (GDCA), as in a CE, it is not only the supply of circular innovations, products and services that is important. Circular purchasing is considered a key lever to develop the market for circular products and services. Two years of experimentation (2017-18) on these themes became the fertile ground for the promotion of exemplary cases of circular practices. A set of publications, tools and information per product group is available on their platform. Since 2020, the focus is also on establishing product group-specific communities of practice (CoP). A lot of attention went to circular strategies to embrace resilience strategies for companies in times of world pandemics. A survey conducted by "Circular Flanders" and *VITO* in May 2020 (with 500 respondents) showed that companies that applied circular business models, or business operations, suffered significantly less from the consequences of the lockdown (as 66 % of these companies said they had not experienced any shortfalls because of the crisis, compared to only 2 % of "non-circular" companies) (Vlaanderen Circulair 2021).

Since 2021 the **Walloon Region** has also embraced the CE, with the programme "Circular Wallonia" (Service Public Wallonie 2021). After consulting sector federations, associations, administrations and citizens, the Walloon Government adopted its CE deployment strategy. "Circular Wallonia" is seen as a way to promote and revive industry in a sustainable manner, by reducing the waste of resources. The main principles listed are based on eco-design, industrial symbiosis, the economy of functionality, reuse, reconditioning and recycling. The aim is to use material flows that are currently not valorised in the production cycle. Sustainable management of natural resources is also mentioned: water, ores and metals, soil, air, biomass, biodiversity and ecosystem services are all to be considered to avoid negative environmental impacts. "Circular Wallonia" aims to respond to the following challenges: (i) promoting a sustainable recovery of the economy, (ii) reducing the impact of economic activities on the environment, (iii) creating local jobs that cannot be relocated, (iv) reducing the Region's dependence on raw materials and energy supplies and (v) increasing the attractiveness of Wallonia. Throughout 60 measures, a set of challenges should be met. They directly concern Walloon companies, but also civil society, public stakeholders, and citizens. Six key sectors are identified: (1) construction and buildings, (2) plastics, (3) metallurgy, (4)

water, (5) textiles, (6) food industry and food systems. As an example, they plan to set up a recycling platform to create jobs in the construction sector, improve the separability of plastics, support research and innovation in the field of "reverse metallurgy", reuse water from wastewater treatment and develop local food processing industries.

1.4 CONCLUSIONS

This introductory chapter sets the scene for the following chapters. The approach taken is at the macro-level: companies are seen as part of broader business ecosystems. Thus, the aim of the chapter is to provide readers with a large perspective on CE ambitions, metrics and strategies. The questions "*where do circularity inspired ambitions come from?*" and "*what is the current debate on circularity?*" are addressed in the first part, where a historical overview is presented to trace the origins and evolution of the concept. This historical context helps to define future challenges and to suggest potential reflections and actions. The second part of the chapter addresses the following questions: *how is CE defined and delineated into strategies for implementation? What is the hierarchy of these strategies? When adopting CE strategies, which are the attention points to take into consideration to avoid rebound effects? What are the main future challenges for the development and mainstreaming of CE ambitions and practices?"* In this part the conceptual framework embraced by this book is outlined. We do not provide readers with a definition but rather with a set of reflections and a framework. We frame CE ambitions within the "ladder of value retention", underlining hierarchies of operational strategies. This ladder is based on the ten R imperatives from Reike et al. (2018) and on the categorisation (narrow, slow and close loops) of Bocken at al. (2016). In this section also the "value hill" (from Achterberg et al. 2016) is presented as a way to visualise and prioritise strategies. With this framework we wish to build a shared understanding that not all circularity inspired actions have the same impact, and that some are preferable to others. The aim is to help guide businesses and policymakers that wish to implement circularity oriented innovations. Later on, we warn readers about the shortfalls of naive implementations of CE by dedicating a subsection to CE rebound effects. In this subsection, the notion of "scales of circularity" help visualise the complex interaction between single efficiency measures and the boarder panorama. The last subsections of the second part discuss: (1) the relationship between *circularity and sustainability* discourses, (2) the importance of the health of the ecosystems in order to embrace holistic circularity ambitions, (3) the need to shape new and empowering discourses in order to allow the mainstreaming of circularity ambitions and practices widely across society and (4) the need to integrate exnovation as a notion able to explicitly question which activities should be part of the transitioning process and which should be phased out. We conclude this chapter with a brief zoom on the Belgian context (within the European one), and on policies currently structuring the national debate. Recent CE policies are advocating a shift from "theory" to "practice" and an acceleration in the implementation of CE is promoted and supported.

The limitations of this research lie in the non-systematic literature review. This is due to the vastness of the subject and the exponential growth of the written contributions by its community. In addition, this book being an edited volume by contributors from different fields and disciplines, does not provide only one definition of what CE is. We gathered (based on a critical understanding of this multifaceted and dense debate) elements that appeared important in future CE implementations. The selection presents only a few key aspects, but certainly many more could have been included. Future research could focus more in depth on future challenges and trends, with an emphasis on potential pathways for accelerating CE (or example on how to develop further empowering and inclusive strategies to mainstream circularity inspired practices).

In conclusion, this introductory chapter presents the concept of CE and reveals the potential horizons and obstacles to its implementation in the coming decades. The CE emerges as a promising notion, getting increasingly more attention and sparking quite opposite reactions. The CE concept can arouse enthusiasm and at the same time scepticism, therefore, this chapter questions this concept thoroughly and reveals its importance in contemporary sustainability debates, while highlighting the points of attention to take into consideration in its implementation. In order to empower readers, future perspectives are proposed to encourage people to engage with transitioning practices. Such future perspectives are multifaceted: there are many avenues of debate, each indicating where one could find room for action. We suggest that one of the main challenges ahead is finding ways to "mainstream" circularity inspired innovations in order to link them together and upscale their effects. It is important to pay attention to the necessity to move beyond environmental awareness and wealthy publics, embracing more inclusive and accessible narrations and targets. We claim that, in the end, CE is nothing new, but that wealthier societies have recently forgotten how to extend the value and the useful life of materials (limiting waste). Nonetheless, the emergence of this notion in national and international debates could become the opportunity to rethink the way humans interact with the material world, suggesting more environmentally conscious paradigms. The next chapters discuss how businesses and business ecosystems can engage with this CE transitioning, making use of the multi-level perspective starting from *macro-* (systems innovations and exnovations), to *meso-* (economic sectors), to *micro*levels (single companies).

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CHAPTER 2

TRANSITIONING INTO CIRCULAR ECONOMY: APPRECIATING THE LITTLE STEPS OF SYSTEM INNOVATION

Bonno Pel & Wouter Achten

> *The System allows for, and favours, 'loose talk'. There's nothing that keeps the politician – we read about it in the papers – to demand, to project or to promise an ecological adaptation of the economy. After all, he is not bound to economic thinking and acting, and does not operate within that system – the system that will eventually lead his demands to turn out futile.*
> *(Luhmann 1990). Our translation.*

2.1 INTRODUCTION: FROM DISTANT FUTURE VISIONS TO CE TRANSITIONING

CE initiatives and action plans are often guided by future visions. Examples are the future vision as formulated by the Belgian federation of businesses VBO FEB (2021), or the governmental CE action plans formulated on a national level and the level of the European Union. These visions help to mobilise actors and they create political support. Indicating targets and horizons for development, they coordinate actions – of business and of other actors in society – towards circularity. A striking feature of these CE visions is the widespread striving towards CE "transitions" (Ghisellini et al. 2016): Initiators of CE strategies are projecting encompassing societal changes. Envisioning system-wide innovations that cut across economic sectors, they seek for changes that extend along value chains and throughout business ecosystems.

These high ambitions and distant future visions have evoked enthusiasm, but also some doubts and suspicions. When established actors like federations of enterprises or

governmental bodies argue for fundamental transformations, critical questions[2] tend to arise about the gap between transformative ambitions on the one hand, and the vested interests of these established actors in continuity, in gradual change and in not too heavily disruptive innovation on the other hand. The visions of a CE transition have thus evoked questions such as the following:

> *Is the CE, and the associated 'transitions' language, yet another green-wash concept? Isn't the CE not just a fancy concept for recycling and similar already existing concepts like industrial symbiosis, i.e. a concept that serves us old wine in new bottles?*
> *(Fressoz 2018)*

> *Is this win-win concept (combining ecological and economic efficiency) not downplaying the political hard choices that are implied with the professed circularity principles?*
> *(Hobson & Lynch 2016)*

> *Isn't this language of circular systems sidestepping questions about the actors, responsibilities and institutional frameworks that allow economic practices to be more or less circular?*
> *(Moreau et al. 2017)*

> *Is the CE concept indeed a fiction, a 'policy legend', as far as it translates inconvenient truths about planetary boundaries and thermodynamics into webs of visions, objectives and indicators that make us lose touch with reality?*
> *(Giampietro & Funtowicz 2020)*

These critiques elicit that there is still rather a wide gap between the proclaimed visions and the achievement of targets. Pointing out the gaps between circularity dreams and realities of persistent waste production, these critical points help us towards a more sobering view on the CE.

Critical analysis is important, yet sometimes it turns into "circularity-bashing". This is neither reasonable nor useful. From a practical point of view, rhetorical, dismissive questions should be avoided. Indeed, full circularity may be unattainable. But doesn't this apply as well to ideals of justice, democracy or sustainability? And don't we consider these to be very meaningful concepts, providing relevant guidelines for action? Aren't these ideals, however difficult it is to fully realise them, more than just illusions? The CE concept should therefore be taken seriously. It is a policy concept (Kovacic et al. 2019) or a business concept with a strong strategic significance: It guides companies towards more sustainable production. We may thus criticise the CE concept as a commercialised translation of sustainable development – but isn't that relevance

2 The official opening of the VBO FEB research chair was met by protests from students. The protests challenged the credibility of the research sponsors and their CE ambitions, and questioned the authenticity/independence of this private sector funded research.

for businesses not precisely what is lacking in many sustainable visions of politicians and activists? As indicated in the introductory quote from the German sociologist Niklas Luhmann, one can turn many of the critiques around: A key quality of the CE concept is that it is not some "loose talk" about sustainable development, or some sustainability slogans that outsiders casually fired at companies. A crucial quality of the CE concept is that this approach to sustainable development has been developed by business actors *themselves,* as strategies and business models towards more resource-efficient production and consumption (Blomsma & Brennan 2017).

This issue of practical relevance is often neglected in current discussions on CE transition: The aforementioned critiques are primarily challenging CE *ideology*, and not so much the merits of particular CE strategies and business models. More generally, CE tends to be discussed in very general, wholesale fashion. Whether it is through sweeping optimistic statements about circular futures or in the form of heavy critiques, what keeps returning is the preoccupation with transformations of astronomic proportions: CE as "lever towards degrowth", or towards a "sustainable economy". Disregarding issues of manageable scales and relevant timeframes, discussions of "the CE transition" become polarised along well-known extreme positions: From naïve optimism and misleading promises of win-win solutions, we land into paralysing critiques of widespread "greenwashing" in a "system that remains the same". We should get out of these unproductive discussions. A key move in this regard is to talk less about transitions as if they were end states or goals. Rather than getting lost in discussions about transitions as distant, projected futures, we should focus more on transition processes and on activities of *transitioning*.

The question is how limited, local steps towards circularity can lead to bigger steps that, over time, *do* make a difference. Transitions research is useful precisely in that respect of change-over-time. It provides a theory of change. It usefully highlights how innovations in enterprises and business ecosystems have already set a transition process in motion. Such a transitions perspective is not naïvely believing in sustainable development through simple win-win solutions, but it does not fall for cynical critiques either. Using contemporary insights into the governance of sustainability transitions, this chapter develops a realistic and fair view on the practical limitations of any CE practice. The chapter highlights that CE transitioning is a matter of many small steps, some of which are more visible than others. The central research question is the following:

> *How to come to grips with the gap between ambitious transition visions on the one hand, and the limitations of CE transitioning on the other hand? What can we learn from transitions research about the processes of transitioning towards circularity?*

This chapter develops insights into CE strategy. The starting point for the argument is a critical discussion of the "metabolic" systems thinking that pervades current visions of CE transitioning. This metabolic view usefully unfolds how companies can "mount the circularity ladder", through adaptations in their production processes. Yet this

materials-focused perspective can also turn out disempowering, as far as it highlights the persistent gaps that exist between CE visions and the sometimes limited results of efforts towards change **(Section 2.2)**. Next, we discuss how we can come to grips with these limitations of CE transitioning. Instead of focusing on shifts in material flows, transitions theory rather focuses on the underlying processes of societal change and innovation **(Section 2.3)**. The analysis discusses three key insights on transitions governance. These pertain to the multiple dimensions of innovation that are relevant in CE transitioning **(Section 2.4)**, the multiple institutional logics that somehow need to be bridged in business ecosystems **(Section 2.5)**, and the variety of directions that such complex processes of CE transitioning may take **(Section 2.6)**. This leads to a critical, systemic understanding of CE transitioning – but this mode of systems thinking is very appreciative of the small steps towards systemic change **(Section 2.7)**.

2.2 METABOLIC SYSTEMS THINKING (AND THE DIFFICULTY TO MOUNT THE CIRCULARITY LADDER)

The CE concept has introduced a very appealing and practically useful form of systems thinking (Blomsma & Brennan 2017; Ghisellini et al. 2016). Bundling insights from industrial ecology and ecological economics, it brings the general ecological facts of finite resources and limited carrying capacity back into the economic equation **(Chapter 1)**. Its key diagnostic tool is the "metabolic" view on society. These analyses of material and energy flows provide "X-ray" pictures of economic processes, focussing on the materials and flows involved. They can specify, for example, how the Brussels region's metabolism has shifted over time (Athanassiadis et al. 2017). These metabolic analyses are also particularly powerful tools for the "evidence-based activism" and the awareness-raising actions that have developed around the CE. The analysis in terms of metabolism informs, for example, the Circularity Gap report by Haigh et al. (2021), which quantifies and specifies how the global economy continues to exceed thresholds of material use and embodied emissions. This also contains the inconvenient truth of an overall slight *decrease* in circularity in recent years (the current 8,6 % follows a 9,1 % recorded two years earlier) – despite ongoing CE efforts.

Apart from setting the scene and providing a diagnosis, these metabolic analyses also lead the way towards solution strategies. **Figure 2.1**, on CE targets and recycling rates in industrial packaging in Belgium, shows how the analysis of material flows (the various kinds of packaging used across different industries) supports coordinated CE efforts. It immediately raises further questions about the companies, economic activities, sectors, supply chains and business ecosystems that are making the recycling or reuse of particular packaging possible.

The metabolic analyses of material and energy flows support the key strength of the CE concept: the strategic principles of reuse, re-manufacturing and recycling (cf. **Chapter 1**) are a set of related strategies towards a more efficient metabolism. These CE principles have become widely known as tools of systemic intervention: Economic

practices are represented as a set of loops and product life cycles that can be cut short, redirected or slowed down **(Figure 2.2)**. The practical usefulness of these principles speaks from their application in business models across a wide range of economic sectors.

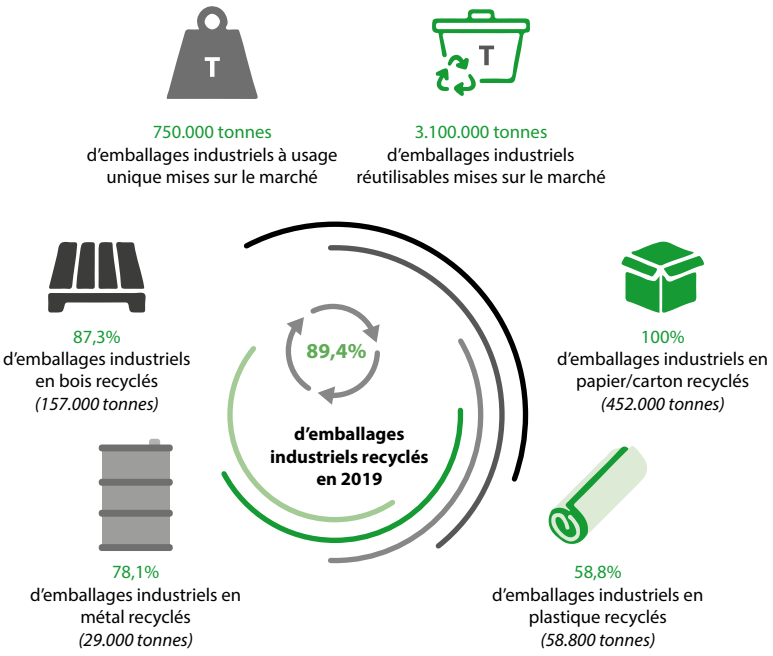

FIGURE 2.1: CE targets for the industrial packaging transition (VBO FEB 2019)

Importantly, these CE principles imply a growth model. Taken together, they form a waste hierarchy. They indicate stepwise increases towards ever more ambitious circularity set-ups. Implicit in the CE concept is this ambition of "going the extra mile", or "shifting into next gear". As Reike et al. (2018) indicate, the very concept of a CE has gone through stages of waste management, eco-efficiency and resource efficiency, in other words it has evolved from narrow to broader and more ambitious interpretations. The CE concept thus provides a useful "ladder" to climb, indicating how businesses and business ecosystems can steadily step up their efforts towards systemic change. This is an important quality, as transitions are long processes that require a certain endurance.

On the other hand, this idea of "mounting the circularity ladder" is somewhat misleading, as the underlying "metabolic" systems thinking is deceptively simple: One is easily carried away by the apparent manageability of the various material loops. One easily neglects the many discrepancies between "the model and the muddle", in other words the barriers that companies encounter in their attempts to reach more circular, sustainable business models **(Chapters 4 and 5)**. Recent CE scholarship has questioned whether the metabolic system diagnoses can actually inform strategies of

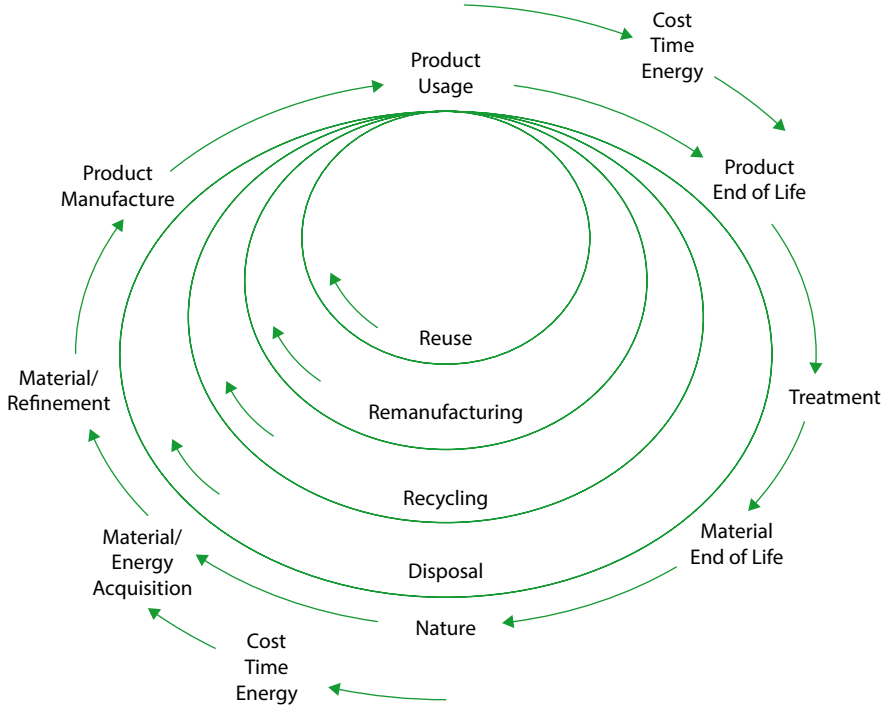

FIGURE 2.2: Circular economy principles (Source: Korhonen et al. 2018)

system *change*, in other words whether they help to envision CE transition processes. One difficulty resides in the heavy reliance on (quantitative) circularity indicators. Kovacic et al. (2020) clarify how indicators and data gathering are not uniform across countries and sectors, how detrimental side effects are insufficiently accounted for, and how the availability of data tends to prevail over the relevance of information. The preoccupation with the measurement of metabolic shifts meets ideals of evidence-based policy, yet it hides the more messy processes of negotiated truth, incomplete data and inconclusive evidence. Furthermore, there are the notorious second-order effects, rebounds and problem-shifting. These challenges of systemic change typically surface as one progresses towards more ambitious CE strategies. Geissdoerfer et al. (2017) point out for example that the sustainability assessments of CE practices tend to be limited to environmental impacts, and that the various trade-offs between impacts are poorly articulated. Various rebound effects and problem shifting remain difficult to grasp as CE practices tend to take place as bounded initiatives and projects (Korhonen et al. 2018). Individual companies may thus believe and claim to mount the ladder, whilst overlooking systemic effects such as the "waste-resource paradox" (Greer et al. 2021), or in other words the continuation of careless waste generation through the very introduction of certain circularity initiatives. These perverse incentives and negative system feedbacks are typically absent in metabolic modes of systems thinking.

Meanwhile, there is also the problem of metabolic thinking introducing a CE ladder that is too high to climb. The alarming "circularity gap" reports (Haigh et al. 2021) may thus be meant to increase the sense of urgency and to raise awareness, yet these alarming figures and visualisations also underline how remote we are, despite all CE visions and CE practices, from a de facto CE. Considering the huge gap between concept and practice, Kovacic et al. (2019) provocatively highlight the "fictitious" nature of the CE concept – which is fiction as far as it promises metabolic shifts that do not really materialise. Also telling is the analysis in the Dutch newspaper NRC (2020): As more and more becomes known about the side-effects and the limitations to CE practices, the very pursuit of a CE transition becomes discredited *as such*.

2.3 FROM METABOLIC SHIFTS TO PROCESSES OF CE TRANSITIONING

The CE transition can be taken as a set of biophysical, "metabolic" processes and as a matter of "mounting the circularity ladder". However, this metabolic thinking does not help us to handle the limitations of CE practice. As it keeps showing us the disappointing environmental bottom line, it even feeds scepticism and resignation. The limitations of CE practice may be disappointing, and from the metabolic point of view they may even appear irrational. After all, "we" know what "we" need to do and "what is needed". Yet beyond the abstract circularity principles and the envisioned circularity solutions, we need some understanding of the change processes that make them possible.

It is important to consider the underlying choices and strategies of businesses, the dynamics of business ecosystems, and the broader processes of transitioning that take place in society. The reorganisation of material flows is known to be impeded by a broad range of barriers **(Chapters 4 and 5)**. These barriers form the starting point for sustainability transitions research. This research field has emerged precisely to formulate answers to "persistent" sustainability problems (Rotmans 2005). The efforts to get to a more CE are compared with similarly ambitious initiatives to get beyond the car-dependent society, to transcend fossil fuel dependency, to transform into sustainable modes of food production, or to rethink our doctrines of control-oriented water management. The key idea is that a CE transition is not a matter of piling up circular products, processes and projects, it implies more encompassing *system innovation*. Such system innovation typically seeks to reorganise the dominant technologies, routines and cultures that we have inherited from the past. It somehow transforms the dominant system, in this case the linear economy.

Transitions theory complements the metabolic thinking. It provides a theory of change. Taking a long-term, evolutionary perspective, it helps us to put the limitations of CE practices into perspective. Circular business models and products are considered as parts of broader, more structural transformations in society, in other words as parts of system transitions:

> *Sustainability transitions are long-term, multi-dimensional, and fundamental transformation processes through which established socio-technical systems shift to more sustainable modes of production and consumption.*
> *(Markard et al. 2012).*

Figure 2.3 shows the most influential theoretical model, the Multi-Level Perspective. It visualises the following key points:

- Transitions are **slow shifts** from one dominant societal system ("socio-technical regime") to another (CE). Importantly, system transitions (for example from the routines and technologies of the linear economy towards the CE as dominant organising principle) normally take some 30 to 40 years. The "circularity gap" reports **(Section 2.2)** may thus consider the recent relapses in the CE to be alarming, however, these last two years are only passing moments in longer-term transitions.
- **Socio-technical change.** Transitions are shifts in socio-technical systems, in other words they involve innovations in technologies, policies, cultures, infrastructures and institutions. The focus on socio-technical systems introduces a completely different systems view from the metabolic, biophysical view on the CE.
- **Micro, meso and macro changes.** The multiple arrows visualise how transitions result from a multitude of innovations. This involves radical "niche" innovations by outsiders (the degrowth-inspired CE practices, or the radical forms of sharing economy and functional economy), but it also involves relatively incremental innovations (the ongoing adaptations and optimisations along the dominant modes of production and consumption, the innovation that is largely in line with the linear economy "regime"). Thirdly, this also involves broader societal trends (for example digitisation; geopolitics, climate change) and sudden crises (for example the Covid-19 pandemic). Next to purposive innovations, transitions also involve changes largely beyond the control of businesses and governments.

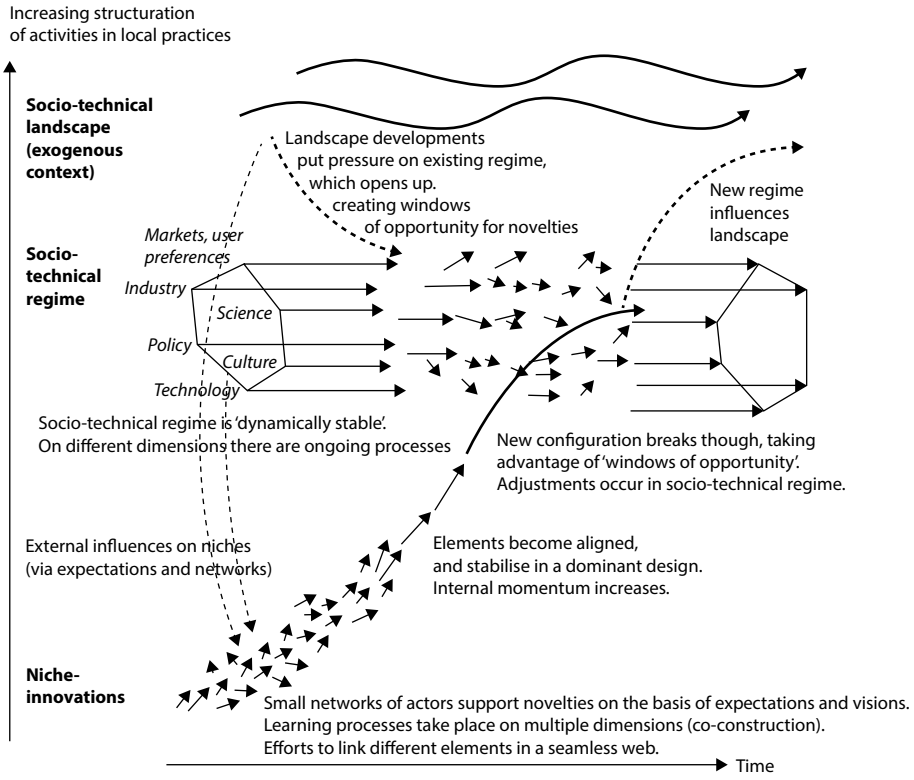

FIGURE 2.3: The multi-level perspective on transitions (Geels 2005)

In other words, transitions result from innovations inside businesses, from innovations across business ecosystems, and from changes in the broader societal context. The next sections discuss three key insights in more detail. These pertain to the multiple dimensions of innovation that CE transitioning comprises **(Section 4)**, the multiple institutional logics that somehow need to be bridged in business ecosystems **(Section 5)**, and the variety of directions that such complex transitioning processes may take **(Section 6)**.

2.4 CE TRANSITIONING: MULTIPLE DIMENSIONS OF INNOVATION

Transitions research underlines that any metabolic shift result from changes in the way society is organised (Fischer-Kowalski 2011). It directs our attention to the institutions and infrastructures that make society stable and difficult to change. Transitions research emphasises thus that any mounting of the circularity ladder is an uphill struggle. It is a fight against the societal routines of the linear economy that have become firmly anchored in society.

Transitioning to a CE amounts to a shift away from the current linear economy "regime", in other words the prevailing rules of the game: the technological standards set in industries and sectors, the prevailing organisational routines and business models, the regulations and waste management policies of governments, the economic incentives and accounting procedures, the infrastructures on which industries rely, but also the prevailing expectations, cultures and expenditure patterns of consumers. Such "regime" structures have developed over decades, and sometimes they have become heavily locked-in. Deviation from the dominant rules therefore becomes very costly. Transitions research acknowledges therefore that innovation easily becomes too disruptive, and that incremental innovation strategies are therefore attractive. However, if all innovation is incremental, it is effectively mainly reinforcing the dominant "regime" through end-of-pipe measures, marginal improvements and local solutions that have hidden side-effects elsewhere (cf. Section 2.2 on the limitations of CE practices). Transitions research emphasises therefore that radical innovation is particularly needed and particularly difficult too (Rotmans 2005). It has clarified in this regard how radical innovations tend to be fragile "niches" that have difficulty to survive under the selection pressures of regimes. They are maladapted to prevailing standards and regulations *("is it even allowed to transport and trade this flow of waste?")*, they are unfamiliar to consumers *("very nice, a service contract, but which products will it get me?")*, and initially they lack the scale to become competitive. A big part of transition management and transition governance consists therefore in the cultivation and support of radical "niche" innovations. This involves the organisation of experiments and social learning, the creation of networks of actors and institutions around innovations and also considerable activities of awareness-raising. It is crucial to change the expectations of potential users, and to create trust regarding these fragile innovations (Kemp et al. 1998).

Eventually, dominant "regimes" may transform through a combination of multiple changes and innovations that somehow reinforce each other: It is this multitude of mutually reinforcing and simultaneously evolving changes that form the essence of transitions thinking. Importantly, such shifts occur through changes on several dimensions of the dominant system. Transitioning out of a make-take-dispose linear economy involves transformation of a socio-technical "regime". This comprises technology, science, culture, industry, policy and markets and user preferences **(Figure 2.3)**. Accordingly, CE transitioning calls for innovation on various different dimensions:

- **Product innovation:** A key dimension of CE transitioning is the development of more sustainable products. Eco-design, the substitution of inefficient technologies and the creative recombination of smart solutions are at the heart of transitions thinking. After all, product innovation is the most tangible form of innovation, the innovation that is most directly connected to metabolic changes in material and energy flows. This potential for sustainable innovation and CE-based products requires creativity, knowledge of markets and cost curves.

Product innovation serves the immediate commercial interest in staying ahead of the competition. In view of their particular capacities for product innovation, transitions researchers are inclined to consider companies as the motors of CE transitioning.

- **Process innovation:** The launching of new products – guided by eco-design principles, or by the introduction of new technologies – remains the most conspicuous form of innovation. It is a crucial dimension of a transformation process that revolves around materials. Nevertheless, this innovation in products is only the superficial manifestation of broader shifts in socio-technical systems. They are crucially dependent on and drivers for innovations in production processes: shifts in organisational routines, efficient management of inputs and outputs and adaptive modes of product development. It is interesting to see how the Belgian Business Awards for the Environment (BBAE), organised by VBO FEB, are not only endorsing new products: In line with transitions thinking, this innovation contest also praises a broader range of innovations, including process innovations (VBO FEB 2019).
- **Business model innovation:** The emphasis on changes in organisational routines already indicates it: The crucial step beyond isolated product and process innovations is the innovation of business models **(Chapter 6)**. This connects firm-internal innovations with changes in supply chains, and it takes innovation to a new level: the very position in the business ecosystem is reconsidered. Transitions research tends to emphasise the importance of radical innovation, yet overly fundamental business model innovation is risky, especially for the first movers in a sector. The widely celebrated examples of radical "niche" innovation in business models are the moves towards product-service systems. Well-known are the functional economy initiatives of Decathlon, or the developments towards "Mobility as a Service". Especially the developments in the mobility sector show how the interaction between new entrants and established market players can reinforce more structural shifts beyond the isolated experiment, the niche market or the technological gimmick.
- **Social innovation:** The examples of business model innovation and the rise of functional economy principles already indicate it: the various steps on the "circularity ladder" are all involving certain changes and innovations in *social relations*. In other words, a big part of the metabolic shifts relies on social innovations (Pel et al. 2020). This comprises the aforementioned process innovations, organisational innovations and business model innovations. Yet the innovation in social relations occurs throughout CE business ecosystems. Just as companies explore novel business models, consumers developed similar modes of consumption and organisation as well. This speaks from initiatives towards a sharing economy, Slow Food, "circuits courts" and relocalised production circles, cooperatives, Timebanks and various forms of makerspaces. These social innovations generate new ideas about organisation, new lifestyles and modes of consumption, but also new ways of satisfying needs. The analysis in terms

of socio-technical "regime" shifts underlines their importance, but these social innovations are not always so prominent in CE analyses: The common indicators of CE transitioning reveal a strong preoccupation with *technological* innovation (Kovacic et al. 2019).

- **Innovation in knowledge, skills and expertise:** Socio-technical "regimes" indicate the dominant rules in society and the institutional structures. Importantly, this is not just a matter of regulation and governmental policies, in other words of formal institutions. A key dimension of transitions (and innovations more generally) are the changes in knowledge: increasing insights about the environmental impacts of processes and products, changing assessments of risks, changing ways of accounting for second- and third-order effects, or adaptations in professional training and guidelines for engineers. This is not only a matter of R&D and the development of specialised, cutting-edge expertise: Transitions thinking underlines the importance of broad, society-wide shifts in knowledge, in skills, and in know-how and beliefs. Getting out of a linear economy "regime" also entails changing the basic ways of knowing our goods: *How to instruct consumers to handle their waste better? How to develop suitable training curricula and stable jobs in the electronic waste transition? How to develop a more fundamental, society-wide understanding of resource scarcity?*
- **Infrastructural innovation:** Transition processes in mobility, energy or water management show it particularly clearly: All the aforementioned kinds of innovations are crucially shaped by, and in their turn shaping, the infrastructures of society. Historical studies show how much of the current linear economy has been structured through earlier infrastructure development (Geels 2005): the development of centralised energy systems, the development of sewer systems and waste management, and the development of transportation infrastructure as crucial enablers for a globalised economy and internationally dispersed supply chains. The very idea of system innovation indicates the need for innovation on a scale that is wide enough to overcome the inertia that comes from our infrastructures. Transitions research takes a very historical perspective on future CE transitioning, underlining the importance of innovations in infrastructures. Schot & Kanger (2018) consider, for example, how the CE transition could take place as an ICT-based wave of industrial development. Transitions research is thus inclined to agree with the idea of CE as a *digital* CE transition.[3]

This is how transitioning involves *multi-dimensional* innovation. From a practical point of view, this point holds both encouraging and discouraging messages. To start with the latter, discouraging message: This transitions perspective underlines the limitations of many CE practices. It shows how many CE innovations amount to

3 The concept of the digital CE indicates how infrastructural innovations in ICT make resources more knowable, findable, and manageable. This also reasserts the importance of various social and organisational innovations. See for example https://www.vbo-feb.be/globalassets/events/emily/20201113-webinar-ec-13-novembre-circular-call-to-action-share.pdf,)

rather one-dimensional innovations. Far from being system innovations and major impulses to shifts in socio-technical regimes, many celebrated innovations in products, technologies or business models may even seem rather futile. However creative, ambitious and different from past practices, and however great their performance on indicators of metabolic change, they tend to leave most of the linear economy logic in place. The notion of the socio-technical "regime" thus introduces a very stringent perspective on the CE, one that in certain respects is even more demanding than the metabolic perspective. Transitions-thinking shares many of the criticisms of one-dimensional solutions, and it shares the suspicions against incremental innovations that turn out to be system-confirming **(cf. Section 2.1)**.

However, transitions thinking does not simply reject incremental or one-dimensional innovation. Importantly, it gives them a place in a wider systemic perspective of multi-dimensional innovation. This brings the very reassuring message that CE transitioning can be pursued in different ways. None of the indicated dimensions may in itself be decisive, yet none of them is irrelevant. Technological innovations (in processes and in products) are crucial ways to achieve metabolic changes, and they do matter. Many of the organisational, social and institutional innovations may be less visible, and more difficult to showcase and benchmark, yet they matter. The notion of the socio-technical "regime" reminds us that they are of no lesser importance, and it highlights how the various forms of innovation incite each other. This shows how the idea of system innovation is actually not as over-demanding as it may seem. It appreciates the many little steps. It is true that incremental innovation and mere optimisation, the "within the box" approaches, so to say, are deeply mistrusted by transition advocates (for example Rotmans 2005). But the point is that this ongoing "regime renewal" does generate novelties that in turn can combine with other innovations. Ultimately, over longer periods of time, they can contribute to broader, more encompassing systemic change.

2.5 CE TRANSITIONING: INSTITUTIONAL LOGIC, INTERESTS AND TRANSLATIONS

The concept of the socio-technical "regime" highlights how various kinds of little steps can contribute to CE transitioning. Multitudes of innovations, whether incremental or radical, can reinforce each other into broader "cascades" of system innovations: Circular processes allow for circular products, CE business models help to create growing markets for CE products, and various social innovations contribute to CE-minded consumer expectations and organisational cultures. Meanwhile, developments towards intelligent infrastructures can equally form the starting point of CE transitioning; they open up opportunities for new modes of organisation, collaboration and business models. In other words, innovations on separate dimensions can provide positive feedback to each other. This is the hopeful, empowering message of transitions theory and the underlying complex systems thinking. Similar to the butterflies that can unleash tornados of change, there is the possibility for rather marginal innovations, single businesses and

small groups of consumers to start changes in CE business ecosystems. The eventual metabolic shifts and material innovations depend on reinforcements between various less tangible and visible innovations.

This reinforcement between innovations often fails to occur, however. Transitions theory provides a hopeful perspective, but it is not naïve about the scope for change. **Figure 2.3** shows them somewhat less prominently, but transition processes are also shaped through multitudes of *negative* feedbacks: many innovations stay marginal and fade out. Importantly, socio-technical regimes are path-dependent, inert structures, as they are the routines, infrastructures and institutional rules of the game that are hard to escape for any initiative of innovation. Much CE innovation is therefore absorbed, neutralised and channelled back into the normal course of the linear economy. Pioneering firms easily "get punished by the market", as established relations with suppliers and customers are difficult to unwind, and specialised personnel may be difficult to find.

The inertia of the linear economy "regime" helps to understand why it is so difficult to achieve major shifts in material flows. The dysfunctional loops in the linear economy reflect indeed biophysical limitations and technical challenges. Yet they also reflect the difficulty for the associated actors and organisations to develop cooperative interactions (Simoens & Leipold 2020). The linear economy can be seen as a curse that keeps businesses locked into isolated operations. Persistent bottlenecks like the displacement of waste problems or the waste-resource-paradox are not metabolic problems, transitions research underlines. Instead, they are primarily problems of perverse incentives towards unsustainable behaviours (Greer et al. 2021). Or more precisely, they are problems of outdated institutional structures that keep providing these incentives to enterprises and consumers.

Transitioning is first and foremost a challenge of innovation on the *institutional* level (Rotmans 2005; Geels 2005). Companies are key actors regarding the innovation in products, processes and business models **(cf. Section 2.4)**. Still, these innovations only gain force through the support and the initiative of actors from different societal quarters. Importantly, various actors have an influence in business ecosystems, without being guided by an entrepreneurial spirit. This comprises companies taking up societal responsibilities, enterprising governments, social enterprises, intermediary and hybrid organisations. Business ecosystems are thus effectively guided by mixed motives of profit and not-for-profit.

The transitioning from a linear to a more circular "regime" revolves around a certain bridging between the three basic institutional logics that are guiding socio-economic development.

Figure 2.4 visualises this typical *institutionalist* outlook of transitions research. It clarifies how companies may be considered central actors in CE transitioning. Yet this central role is largely tied to the broader business ecosystems that they operate in, and to their relations with consumers, clients, supply chains and sector organisations. Companies are operating in business ecosystems of which a significant part is guided by an institutionalist logic of markets, characterised by for-profit operations and

formalised interactions. The diagram highlights furthermore how market logic, market actors and market interactions form only one side of CE business ecosystems. CE transitioning is equally a matter of politicians, voting citizens, residents, neighbours and social networks of friends. These actors form part of broader ecosystems of social innovation (Pel et al. 2019). Other than the business ecosystems, these ecosystems are guided primarily through state and community logic. They are driven by different interests, stakes and views on what a CE should deliver: sustainability, authenticity, social inclusion, employment or social cohesion. Importantly, this institutional logic of states and communities is not necessarily inclined towards indicators of "metabolic" changes, which underlines the importance of socio-economic indicators and impact assessments (Sureau et al. 2018).

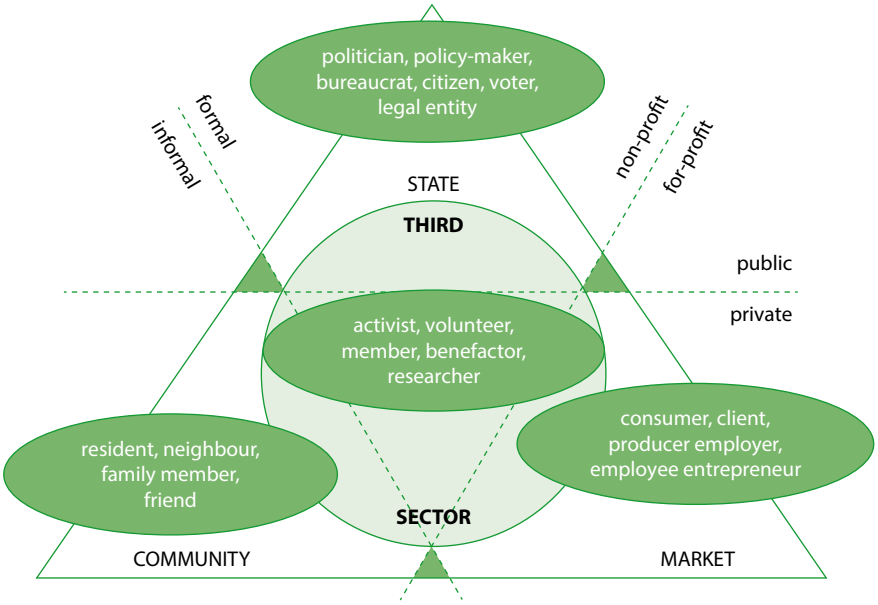

FIGURE 2.4: Multi-Actor Perspective on Transitions (Avelino & Wittmayer 2016)

Sketching the different institutional logics in some more detail, it becomes clear why transition scholars consider the CE as an *institutional* puzzle:

- **Market logic.** A shift away from linear economy "regimes" calls for a big wave of circular product and process innovations, across economic sectors. The introductory quote by Luhmann underlines this: the invisible hand of the market is crucial here to gather the know-how, to finance experimentation, and to ensure that efficient production methods will prevail in the end. The VBO FEB vision (2021) gives reason to believe in this: as the scarcity of crucial materials is becoming an increasingly acute problem, CE principles are becoming a practical

imperative. It can similarly be observed that ongoing and future CE transitioning comes with significant implications for job creation and destruction (Willeghems & Bachus 2018). The challenges of CE transitioning clearly incite the development of innovative systems and a move towards collaboration: Sector organisations and federations are becoming important actors as brokers of good practices (VBO FEB 2021) and as developers of supportive business ecosystems. Meanwhile, strong concerns remain regarding the persistence of market failures. As indicated in the introduction **(Section 2.1),** market-driven CE tends to remain limited to shallow sustainability improvements and no-regret recycling schemes. Good results for easy choices do not always stimulate the transition to higher steps on the circularity ladder. Most importantly, the earlier-discussed limitations of CE practices (rebound effects, displacement of problems, waste-resource paradoxes) can often be retraced back to economic hyper-rationality, in other words to a market logic that is too narrowly focused on immediate costs and benefits at the expense of various social and ecological side-effects. Given the fact that the invisible hand tends to come with an invisible elbow as well, CE transitioning arguably cannot be driven by market logic alone. Hobson & Lynch (2016) insist therefore that CE policies should not address the public as mere *consumers*. On the other hand, market logic is crucial to get the innovation in products, processes and business models going. Despite all the doubts about the incisiveness of the CE concept, at least it provides companies and economic actors with a sustainable development concept that makes economic sense. Kovacic et al. (2019) insightfully describe the CE as a "Trojan Horse" concept: It looks sufficiently innocuous and acceptable to be hauled in by business actors, yet eventually it guides towards more disruptive innovations and system transitions.

– **State logic.** The aforementioned issues of market failure give reasons to believe that it is actually governmental actors and regulatory reforms that form the driving force behind CE transitioning. Moreau et al. (2017) argue convincingly that all transitioning revolves around institutional and regulatory fine-tuning: *What counts as waste? Which kinds of waste can be transported and traded under which conditions? And which kinds of circularity are accordingly, given the institutional arrangements and the transaction costs, economically feasible?* Following this logic, CE transitioning crucially revolves around experiments of deregulation and removal of administrative barriers. The CIrcular REgulation DEal project (CIREDE 2019) in Brussels is one of the many "niches" in institutional CE innovation that have been launched in advanced economies. The state is not in charge of CE transitioning, transition governance scholars insist, but it continues to matter. Even if much of the CE innovation may appear to come from "outsiders" like innovative businesses and non-state actors, it remains crucial to organise sustained institutional support and room for experimentation (Ampe et al. 2021). The importance of innovation in governance and institutional capacity also speaks from industrial symbiotic arrangements. They may appear to be shining examples of market-led CE transitioning, yet governmental actors

play crucial roles as brokers. They allow the symbiosis to grow, through efforts to develop trust and stable conditions for investments (Boons & Spekkink 2012). Meanwhile, all CE transition efforts in Europe develop somewhat in the shadow of the ambitious CE programmes set up in China. These examples have incited a certain enthusiasm about state-led CE transitioning, especially in the context of geopolitical turbulence and concerns about the security of supply. Yet irrespective of their achievements in terms of "metabolic" improvements, the Chinese examples follow an institutional logic of state capitalism that cannot be easily transplanted into the Belgian or European context.

– **Community logic.** Entrepreneurs, manufacturers, politicians and public servants tend to take other roles in society as well, as residents, parents, community leaders, association members or volunteers, for example. This indicates the relevance of the community logic, and of various informal institutions and customs. As indicated, the transformation of the linear socio-technical "regime" also involves a broad range of *social* innovations. Many forms of sharing economy, functional economy and solidarity-based economy have developed as informal, trust-based alternatives. They have emerged as niche innovations, alongside and sometimes in opposition to the formal-rational CE activities according to market and state logic. Initiatives like the repair shops, the FABLABs and the Hackerspaces take a certain distance from state and business-dominated innovation ecosystems. They seek to democratise the innovation process, opening up the innovation process to non-experts, disadvantaged groups and alternative ideas about what a CE future should look like. Especially the innovation in the CE transition shows the particular pioneering roles of grassroot innovations to open up new directions for transitions (Seyfang & Smith 2007). Well-known in the Belgian context are the social enterprises that have developed activities of recycling and reuse as part of broader social innovation programmes towards social insertion (Pel & Bauler 2017). This example also shows how CE innovations driven through community logic need not stay marginal: through further institutional innovation, a social economy sector has been created that acts as an incubator for social innovations with CE elements.

CE transitioning rests thus on diverse kinds of actors, operating along different institutional logics. This does not imply some kind of institutional division of labour along different kinds of innovation. The empirical examples already reveal how business ecosystems tend to *overlap* with the civil society and state-oriented innovation ecosystems. The Brussels Regional Plan (PREC) on CE deliberately seeks to connect actors across institutional logics. Also the grassroot innovation initiatives and social enterprises are typically combining institutional logics. One can also consider how the archetypical CE example of industrial symbiosis is combining innovations in business models, institutional arrangements and production processes. CE transitioning, in other words, is to a high degree a matter of developing *institutionally hybrid* innovation ecosystems. This may involve the creation of new institutions, such as the Producer

Responsibility Organization (PRO) (Simoens & Leipold 2020). Importantly, this institution-building takes time: One can thus get discouraged by the difficulty to get the CE on electronic waste developed beyond economic cherry-picking, careless publics and fragmented layers of governmental policies. Transitions thinking elicits however that these schemes require sustained institution-building, for which short-term solutions are not available.

This development of institutionally hybrid constructions forms the essence of CE transitioning, and more generally of transitions governance. As Rotmans (2005) coined the concept of system innovation, he urged public and private sector organisations to move beyond the endless discussions of market failures and state failures. Instead, they should join forces in the resolution of broader *system* failures.

2.6 CE TRANSITIONING: NAVIGATING THE DIRECTIONS OF AN UNCONTROLLABLE TRANSITION

A third insight from transitions theory is the fundamental lack of control that we have over the course of the transition process. The metabolic modes of systems thinking usefully highlight the dramatic "circularity gaps", and the limitations of local attempts towards CE transitioning. The obvious response to these diagnoses is then that the circularity gap should be closed (Haigh et al. 2021), that the CE transition should be accelerated (Ghisellini et al. 2016), and that the phase of experimentation pilots should be followed by the scaling-up of CE practices (VBO FEB 2021). The various CE visions, road maps and implementation charts explain how "we" can get to the next stage on the circularity ladder, and how the limitations of CE practices can be overcome. But this "we" is an abstraction. It neglects the issue of what individual businesses can do, within the context of business ecosystems and complex institutional settings.

Transitions theory challenges the above assumptions of manageability. However strong the needs may be for forceful action in the face of "Peak stuff", it is necessary to take the described dynamics of transitioning seriously. As indicated earlier, CE transitioning implies innovation on different dimensions. Accordingly, there are several parallel innovation processes going on, and several circularity ladders on which to take steps. Furthermore, the crucial steps in circularity depend on the synergy between the different kinds of innovation. Transitions research provides the hopeful perspective of cascades of innovation, but such comprehensive transformation of socio-technical regimes does not come about by itself. Quite on the contrary, the transitioning depends on diverse actors, acting along different institutional logics. Big challenges reside in the development of diverse innovation ecosystems and hybrid institutions that somehow combine innovation capacities.

Zooming out further and considering the overall societal context, it actually appears odd to speak of a singular, clear-cut CE transition. *Various* transition processes are ongoing simultaneously, focused on particular dimensions of system innovation and guided by particular institutional logic, indicators and priorities. How this all adds up

in biophysical terms may be measured in the "circularity gap" reports. Yet in terms of political steering or innovation strategy, we are dealing with complex dynamics and basically open-ended processes. Transitions research distinguishes between relatively purposive and highly emergent transition processes (Rotmans 2005). The CE transition can be considered purposive, as far as it is guided by plans, visions and ideals of achieving metabolic shifts. Still it is also emergent, if we consider solely how the digital CE has developed as a side-effect of a broader revolution in ICT and artificial intelligence. Separate innovation trajectories and projects can surely be planned and managed, see for example Chapter 6 on business model innovation. Yet the *overall* CE transitioning process is rather a dispersed set of somehow CE-related practices, initiated by different actors out of different rationales and in different institutional settings. This unclear "directionality" (Stirling 2011) of transitions – the diverse range of possible outcomes – is notoriously difficult to come to grips with. CE transitioning leads to a junction, a maze of possible futures. Longing for solutions and instruments, one tends to imagine transitions however as "racetracks": *How can we accelerate the transition? How can we surmount the barriers to innovation?* This illusion of manageable trajectories becomes all the more attractive as it remains difficult to deal with the unintended systemic effects of improvements in singular products or processes. Life Cycle Analysis can provide accurate assessments of separate steps in a transition, but less so for the wider transitioning (Niero et al. 2021). Transitions thinking sensitises us to the many partial processes of CE transitioning that are going on simultaneously, and to the different directions that the overall transition may be taking. One can think of the following basic distinctions:

- **High tech vs low-tech.** System innovation can be guided by different kinds of actors and innovation ecosystems. Accordingly, one can think of different circular futures. Bauwens et al. (2020) propose a typology of four CE futures: they can be high or low tech in technological orientation, and centralised or decentralised in terms of governance and organisational forms.
- **Shallow and deep CE.** Transitions are strongly driven by radical "niche" innovations. Still, it also relies on continuous optimisation and on incremental innovation that stays largely in line with linear economy practices. Depending on which of the two takes precedence, one can thus imagine different futures: radically new kinds of production and consumption as envisioned in degrowth ideas, but also CE futures that appear rather "business-as-usual". CE principles are continuously interpreted, adapted and "translated" along different institutional logics. It is therefore to be expected that CE innovations will go through phases of radicalisation and domestication (Pel 2016). CE futures will display mixtures of shallow and deep innovation.
- **Sector transitions.** Transitions research tends to distinguish between "regime" shifts in systems of mobility, energy, agriculture or water management. Transitions are considered to be sector-specific. By contrast, CE transitioning takes place across multiple economic sectors and activities. The VBO FEB

(2021) vision sets a horizon for CE innovation across sectors, for example. CE transitioning amounts in that regard to what transition scholars describe as "deep" transitions (Schot & Kanger 2018). It amounts to an internationally circulating set of principles and know-how (Kern et al 2020) that emerges transversally, across socio-technical systems and sectors. Practically speaking it still makes sense however to focus on sector-level circularity: CE principles work differently in transportation, agriculture or construction.

– **Metabolic or organisational transitions.** As indicated earlier, CE transitioning consists of innovation activities on various dimensions. These social, technological, infrastructural innovations are intertwined with other transformation processes in society. Metabolic analyses usefully clarify CE transition scenarios along different technological and energy-related scenarios. By contrast, transitions research focuses on the underlying socio-technical systems. Accordingly, there are various organisational-institutional transitions that the CE transition can be guided by: it is intertwined with processes of digital transition, labour transition, "Just" transition, or sharing economy transition. And considering the crucial aspect of institutional hybridisation, one can also consider CE transitioning as a next phase in the longer transitioning process from "government to governance".

2.7 CONCLUSION: AN INTEGRATIVE VIEW ON THE LITTLE STEPS

The CE transition can be understood as a matter of increasingly ambitious recycling, reuse and re-manufacturing. Attempts to mount this "circularity ladder" often remain limited to the first steps. Many CE transitioning practices run into limitations. Unfortunately, this gap between CE dreams and CE practices tends to lead to repetitive, polarised debates. On the one hand, there is the "greenwashing" of big words about small steps, and the naïve optimism about CE futures that seeks to look away from the practical limitations. On the other hand, there are the paralysing critiques, in which all CE practices are ultimately only seen to reinforce an unsustainable and unfair economic system – which effectively remains the same. Yet without denying that much CE practice is limited, and without looking away from the various rebounds and the waste-resource paradoxes that haunt CE transitioning: it is important that critical analysis does not end in resignation. Or worse, it should not lead us to blame those who try. We need more refined frameworks and evaluations. Somehow we need to make sense of companies' little steps towards more sustainable, circular operations. Hence our research questions:

How to come to grips with the gap between ambitious transition visions on the one hand, and the limitations of CE transitioning on the other hand? What can we learn from transitions research about the processes of transitioning towards circularity?

A first basic answer is that the limitations of businesses' attempts at CE transitioning are easily neglected through the idealistic thinking that pervades CE thinking. The analyses of metabolic flows and circularity ladders are useful diagnostic tools, but strategically they can work against us. To be sure, the metabolic system analyses have been revolutionary in unpacking and quantifying the biophysical processes and the possible solutions in terms of process engineering. They have identified circularity principles that have been applied through a range of innovations in products, processes and business models. The metabolic modes of systems thinking set rather high targets, however, and this invites disappointment and disbelief. More importantly, the focus on material and energy flows does not clarify much about the innovation processes, actors and institutions that make the metabolic shifts possible. Transitions research provides a useful complement: any advance towards greater circularity can be understood within the bigger picture of transitions in socio-technical "regimes". **Figure 2.5** below visualises this perspective on businesses' innovation activities. It summarises the three key insights described in previous sections, highlighting how these have gradually zoomed out from micro (innovations and actors; **Section 2.4**) to meso (institutions; **Section 2.5**) and eventually the macro level of CE business ecosystems (the possible directions that the emergent CE transition may take; **Section 2.6**).

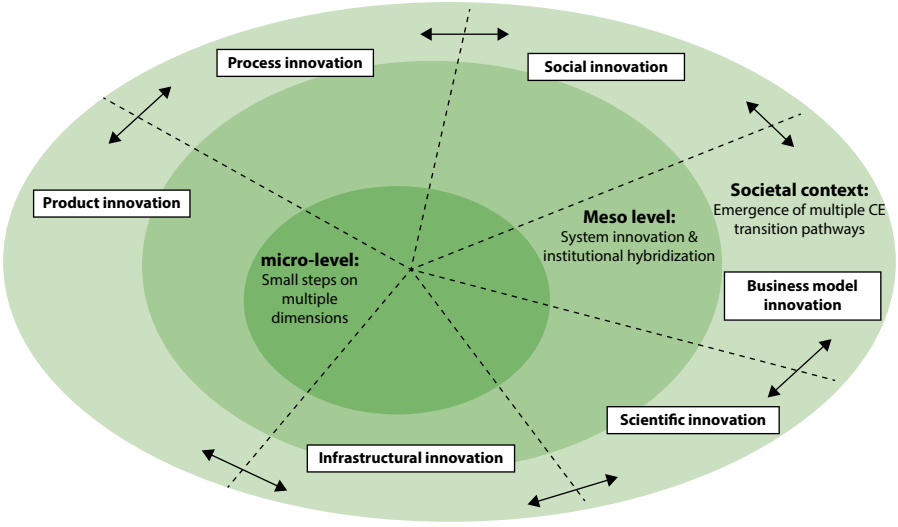

FIGURE 2.5: CE transitioning: little steps in complex innovation cascades

1) **Multiple dimensions of innovation.** This shows the limitations of one-dimensional innovation, yet it also provides an encouraging perspective: transition processes can be kickstarted through various kinds of innovations and through various kinds of actors. Companies are well-positioned for innovations in products and processes. Furthermore, transitions thinking also helps to appreciate the less tangible dimensions

of transitioning: the social, organisational innovations and the innovations in knowledge and skills. Transitions thinking is forgiving regarding the little steps. Taking an evolutionary, long-term perspective, it encourages experimentation and just trying, despite little results initially. Especially infrastructures and institutions develop only very slowly. The impact of certain little steps may thus turn out to be far greater than one can appreciate through time-bound assessments of metabolic shifts. Certain efforts of pioneering companies, and of pioneers within companies, will at first look irrelevant before gaining recognition as "innovative" advances only in hindsight.

2) **System innovation as development of institutionally hybrid ecosystems.** This point indicates how CE transitioning revolves around institutional-level innovation and institution building. The difficulty of CE transitioning becomes clear when considering how it forms a crossroads between the institutional logics of markets, states and communities. Enterprises and entrepreneurship are important, but they rely in turn on broader innovative ecosystems. A great deal of CE innovation is being supported and initiated along state or community logic, and many forms of CE are actually relying on hybrid institutions such as industrial symbiosis and social enterprises. Institutional hybridisation is a way to bundle diverse actors and their specific capacities for CE innovation – yet such institutional innovation tends to be a lengthy process of fine-tuning, coordination and development of trust.
3) **Multiple CE transition pathways.** The last point further underlines that there's no need for despair regarding the marginal steps on the road to CE transition. There is no singular, clear-cut end goal for this ongoing transition process. Neither can one really gain control over its direction or pace. Recalling the multiple, parallel transition activities that are ongoing, the transition perspective raises attention to the range of possible CE futures that may emerge. This understanding of multiple, emergent transitions may be inconvenient. On the other hand, it also moderates the expectations of what can be achieved. The instructive, empowering insight to individual companies is that local experimentation can be connected with, and supported by, a broad range of other innovations and developments that are ongoing in society.

On a last note, it is important to realise that the "metabolic" analyses cannot be replaced through the institutionalist, systems-evolutionary perspective of transitions theory. They are mutually complementary forms of systems thinking: one focusing on the material aspects, the other on the societal aspects. The point of this chapter is therefore not that impact assessment, lifecycle assessment, input-output models and environmental engineering would not be important. The point is simply that transitions research highlights how shifts in material and energy flows could be brought about, through which innovations and actors. Engaging more with the inertia of socio-technical "regimes", transitions thinking provides a rather forgiving perspective on the rather discouraging and cold figures of metabolic analyses. Against sometimes heavy

critiques of the CE "fiction" **(Section 2.1)**, it sensitises us to the little moves forward. It tells us to be patient regarding the institutional changes underway. On the other hand, analyses of the hard metabolic facts suggest that the results of all these little innovative steps may come too late. The next chapter describes how the beliefs in "innovating our way out" are eroding.

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CHAPTER 3

THE SECRET LIFE OF EXNOVATION: EXPLORING WEAK SIGNALS OF A NEW SUSTAINABILITY TRANSITIONS MINDSET

Bonno Pel, Ela Callorda Fossati & Tom Bauler

3.1 INTRODUCTION: CE TRANSITIONING AND THE RISE OF THE "EXNOVATION" MINDSET

The pursuit of a CE transition calls for a better understanding of CE transition*ing*. The work on socio-technical transitions provides a useful theory of change **(Chapter 2)**. It is an attractive, empowering framework: it foregrounds the scope for "innovating our way out".

But this all may be "too little, too late". The metabolic analyses of circularity remind us that we are, and will remain, far from circularity. Indeed, we appear to be facing a "circularity chasm" rather than just a "circularity gap" (Martinez-Alier 2021). Resource use continues at high quantities, despite the various CE innovations that have been introduced over the years. It becomes more and more evident that the development of new processes, practices, technologies and business models needs to be accompanied with active management and policies towards the phasing out of the old (Kivimaa & Kern 2016; Hoffmann et al. 2017). The transition is about cradles and innovation incubators, but also about houses of mourning and palliative care units.

Research on transitions and sustainable innovation has therefore shifted attention to processes and strategies of "exnovation" (Arnold et al. 2015; David & Gross 2019; Callorda Fossati & Fransolet 2021). This term, and associated notions like "decline", "destabilisation" and "phaseout" (Rosenbloom & Rinscheid 2020), indicates a certain flipside of innovation: the processes of saying goodbye to earlier innovations. The "exnovation" concept helps to understand the linkages between a range of developments in business ecosystems and business models that at first sight seem unconnected: the phasing out of coal plants, the decline of traditional retail, the de-materialisation of

economic production, the decline of industrial regions, the various policies introduced to get rid of polluting vehicles, or Marie Kondo's influential advice on "decluttered" consumer lifestyles.

Exnovation and innovation form a certain yin-yang of birth and death. Exnovation is a new concept, but it refers to relatively everyday phenomena. The mental shift to this "dark side" of transitions is not limited to the alternative views of counter-cultural movements. If not already circulating in society, this mindset has certainly gained ground during the societal upheaval of the Covid-19 crisis. Politicians, citizens and entrepreneurs started to consider it: *What could and should be relaunched after the crisis? To what do we have to say goodbye* (Latour 2020)*?* On the other hand, "exnovation" has not become as common a term as "transition". It is as yet only an undercurrent in society, and not a mainstream concept. Furthermore, it is more a general "mindset" and it is yet to be elaborated into strategies, policies, consumer practices or business models. Public authorities are struggling to put exnovation policies in motion: The case of the Low Emission Zones shows a relatively rare example of overtly exnovative public policies (Callorda Fossati et al. *forthcoming*).

Exnovation is even to a certain extent a taboo. Leaving the comfort zone of enthusing, constructive and innovation-stimulating governance, it easily evokes resistance. It organises its own resistance in the form of anti-termination coalitions (Heyen et al. 2017). Exnovation seems to go against the particular attractiveness of CE strategies: it drops the promises of sustainability solutions through action, productivity, and innovation (Kovacic et al. 2019). Given this deliberate positioning amidst political taboos it is not surprising that we rarely encounter "exnovation" in its literal form. Nobody uses it as a slogan. We are only catching the traces of this emerging transitions mindset. Capturing, ordering and seeking to make sense of these weak signals, this chapter considers how these dispersed developments in business ecosystems can inform more pronounced strategies towards CE transitioning. We address the following research questions:

> *Which weak signals of an emerging exnovation mindset can we distinguish? What elements of CE transitioning and which changes in the business ecosystem does it indicate? How can businesses use the concept to inform CE transition strategies?*

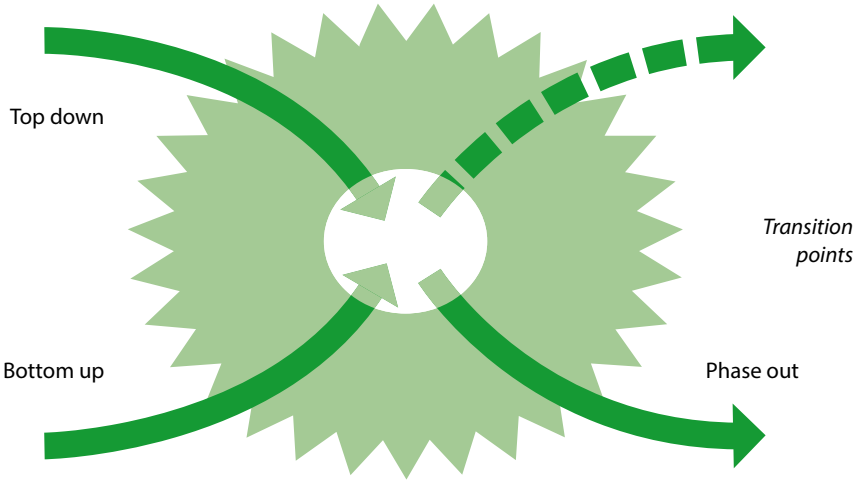
The chapter proceeds with a short theoretical discussion of exnovation and its relevance to CE transitioning **(Section 3.2)**. Next it is shown how exnovation manifests concretely on the levels of society **(Section 3.3)**, value chains **(Section 3.4)**, and companies **(Section 3.5)**. The concluding section **(Section 3.6)** teases out the main strategic implications. *Maybe it is especially the companies who have known how to handle exnovation all along?*

3.2 EXNOVATION: ATTRACTIONS AND TABOOS OF A NEW TRANSITION MINDSET

"Exnovation" marks a new wave in transitions thinking **(Section 3.2.1)**. Its uptake in government, business and society at large is still hesitant, however. It is important to consider these taboos and practical objections **(Section 3.2.2)**.

3.2.1 Exnovation: expanding transitions thinking

The most powerful element of transitions thinking is arguably the idea of system innovation. Major societal transformations can be initiated through many kinds of social and technological innovations. If targeted and timed well, the various innovations can start to reinforce each other, and form "cascades" of innovations **(cf. Section 2.4)**. Alternative, circular approaches to electronic waste can eventually become mainstream, once innovations in consumer habits, technological standards, subsidy schemes, manufacturing routines, value chains and professional training start to reinforce each other. Despite the different pace and directions of innovation trajectories, innovations can mutually reinforce. After a hesitant take-off and accelerating diffusion, innovations may eventually stabilise into a new standard.



Three governance mechanisms that need to come together to seize transition points.

FIGURE 3.1: Transition X-curve (Loorbach 2014)

Transitions research has highlighted how one can drive the trajectories of sustainable "niche" innovations into such S-curves (from experimentation by pioneers towards widespread adoption). Yet in recent years there is a growing consensus that the management and governance of transitions is not just a matter of cultivating innovations. Broader "policy mixes" of multiple transition instruments are needed: some instruments remain

needed to stimulate sustainable innovations, yet others should have the complementary job of minding the phaseout and exnovation of the unsustainable structures (Kivimaa & Kern 2016). A new transition mindset is coming up that is oriented towards the flipside of innovation: The *destructive* side of Schumpeter's "creative destruction" is rediscovered and redefined. This shift in mindset has been expressed through an X-curve figure (Loorbach 2014, see **Figure 3.1**). The transition S-curves of emerging innovations (for example from products to services; eco-design; electric vehicles) should be pursued in conjunction with its mirror-view counterpart: The active phaseout orexnovation of the unsustainable products and practices that the sustainable innovations are supposed to replace.

The awareness of this flipside of innovation is perhaps just a matter of common sense. *After all, is it not the very point of recycled projects, digitally integrated supply chains and functional economic business models that they would substitute for their linear economy equivalents?* There are reasons to believe however that the former statement is far from being true and that the exnovation mindset is particularly relevant in the current societal context. Arguably, society is moving towards an advanced phase of sustainability transitions, beyond the initial stages of experimentation. Exnovation is gaining relevance in several respects:

- **Non-substitution.** For a long time there have been strong beliefs that sustainable "niches" would eventually replace their polluting, inefficient and basically outdated predecessors. Yet as transition processes go into their next phases, it becomes apparent how certain outdated technologies and practices persist. Producers of incandescent light bulbs had foreseen for example that this product would be outcompeted by LED lighting. This technology substitution eventually took place only after the development of active phase out policies (Stegmaier et al. 2021). One can also think of the long-awaited breakthrough of electric and highly automated vehicles. In May 2022, only 1.5 % of cars on the road in Brussels are electric, while a restrictive policy on the use of old cars (LEZ) started in 2018. The ideas of a smooth and silent takeover are similarly contradicted by the continued reliance on the internal combustion engine (Gross & Sonnberger 2020). Technology substitution has also been slowed down by sustained advertising of traditional driving experiences, customers sticking to familiar brands, and continued reliance on dominant designs and established technologies.
- **Acceleration pressures: climate targets and peak stuff.** Through a multitude of innovations in the last decades, sustainability transitions in energy and mobility may have advanced considerably. Still this has not managed to close the gap between factual emissions and projected climate policy targets (Zaccaï 2019). The CE transition similarly displays a disappointing bottom line of de facto circularity achievements (Haigh et al. 2021). As society approaches "peak stuff", and the historical outweighing of biomass by the accumulated production of goods (Elhacham et al. 2021), it becomes more and more apparent that fundamental dematerialisation of the economy may be needed. Kovacic et al.

(2019) thus express very sharply how the CE remains caught in the optimistic mindset of innovation, action and productivity – happily sidestepping the inconvenient "metabolic" truths (cf. Chapter 2) about planetary boundaries. The exnovation mindset marks the growing awareness that the time for non-committal experimentation has passed, and that the CE transition needs to be accelerated. The VBO FEB (2021) adds that there are also acceleration pressures that are quite immediately linked to economic production. As the Belgian economy has to cope with high labour costs and a fragile base of fundamental resources, it is accordingly becoming a practical necessity to part with linear modes of production and consumption.

- **Covid-19: disruption and vulnerability.** The aforementioned sense of economic vulnerability and fragility has been unexpectedly reinforced through the Covid-19 pandemic. This pandemic has acted as the typical "landscape" shock, as theorised in transitions research **(Figure 2.3)**. The associated constraints on social interaction have reminded us that all the elements of supportive business ecosystems can come to a standstill. Likewise, all the innovation "cascading" can turn into reverse: the happy system feedbacks of sustainability transitions can turn into nightmares and "chains of collapse". Revealing the dependence on complex supply chains and volatile markets, the crisis made "exnovation" into a more everyday phenomenon: Politicians, citizens and entrepreneurs had to consider what could and should be relaunched after the crisis, and to which economic activities, products, services and jobs we might have to say goodbye (Latour 2020).
- **Just transitions.** As transition processes move beyond their experimentation phases, their societal effects make themselves felt more and more widely. In recent years it has become more evident that transition processes come with winners and losers. The sudden rise of the "yellow vest" movement is but one indication of this. Transition processes involve socio-economic inequalities within countries, between countries, within world regions and within companies. Telling developments are therefore the European introduction of the "leaving no one behind" principle and the Carbon Border Adjustment Mechanism. Irrespective of their concrete implications for particular exnovation processes, these initiatives towards fair and level playing fields express a growing sense of vulnerability. They show the renewed awareness that transitions are indeed processes of creative destruction. Reminding us of that destructive part, the "exnovation" concept also reminds us that creation and destruction are not always organised in a fair way.

3.2.2 Exnovation: taboos of an unactionable concept

Despite its appeal to researchers of innovation and social change, the "exnovation" mindset remains a bit of an undercurrent in society. It only seldom appears beyond the academic sphere, in policy-making and enterprise. *So what could it mean concretely for the CE transition and for companies? How does the exnovation mindset manifest concretely in business ecosystems, and how does it make a practical difference?*

Importantly, new concepts like "exnovation" are not just alternative descriptions of the world – they are interventions in it (Fischer & Forrester 1993). The CE concept is a clear example: This reframing has helped enterprises to gain recognition as leaders in sustainable development, rather than as irresponsible creators of environmental problems. The promises of system innovation along waste hierarchy schemes and business model innovations are appealing. They fit perfectly well with widespread beliefs in ecological modernisation[4], and in the capacity of society to innovate its way out (Kovacic et al. 2019). Such visions and innovation imaginaries are important ways to mobilise actors and to orchestrate somehow coordinated action. The VBO FEB (2021) vision for 2030 illustrates this very well. These beliefs in societal change through innovation are very influential. They are deeply rooted in our modes of doing business, governing and consumption (Godin & Vinck 2017).

In the context of this so strongly innovation-minded society, exnovation runs into several taboos. It is a rather awkward, unactionable, mindset (see also Bonnet et al. 2021). There is, first of all, the difficulty in Western culture to face death and decay, and to accept these as regular facts of life. But there are also more specific factors that make exnovation an uncomfortable mindset. Psychologists have indicated for example how individuals tend to systematically overlook solution strategies that are based on *subtraction* rather than on addition (Adams et al. 2021). Exnovation is indeed a subtractive, negative concept, just as the related concepts of decline and destabilisation[5]. As the apparent inverse of innovation, it therefore also attacks the associated promise of continued economic growth. Exnovation goes in the direction of degrowth. Sidestepping the negative, aggressive connotations of this term, it provides a somewhat softened concept, similar to the intriguing notion of "responsible stagnation" (de Saille & Medvecky 2016). Still, exnovation does not have the mobilising force of innovation discourse. It indicates the somewhat "latent", forgotten sides of innovation (Pel & Kemp 2020), in other words those that do not materialise as spectacular pilots, authoritative benchmarks, best practices and awarded innovations[6]. Exnovation does not easily generate funds for upscaling or political support for the initiators.

The negative element of "exnovation" creates particular difficulties in the *public* sector: Apart from the general taboos on stagnation, economic downfall and dismantling, policies of exnovation and phaseout appear to violate the "do no direct harm" principle, in other words the idea that governments should not take repressive measures (or side against) particular social groups. Exnovation does not sit well with principles of neutrality. Whether involving nuclear energy, internal combustion engines or smoking, policies of phase out tend to evoke discussions of fairness, proportional compensation, reasonable time frames, demands for technological neutrality and

4 Ecological modernisation indicates the belief that sustainable development can be achieved through reform of the current institutions, in other words through a next wave of modernisation.

5 Regarding the taboos on subtractive solutions one could also consider the "elephant in the room" in environmental debates: population control.

6 Of course there are exceptions, such as the campaigns against unsolicited commercial advertising or against smoking. But even the apparent counter-examples miss some of the appeal of innovation projects, they stay out of the league of so-called "moonshot" projects.

contestations of societal impacts (Heyen et al. 2017). Furthermore, policies towards dismantling tend to evoke discourses of defence. They evoke organised resistance and counter-narratives by different actors that have come to depend on the technologies and structures targeted for phaseout (Trencher et al. 2019). Hence politicians' attempts to avoid explicit exnovative policy discourse. The mobility minister of the Brussels region provided a telling example: *"I am not against the car, I am pro-people!"* (Le Soir 2021). This exemplifies how policy proposals need to be stated in positive formulations.

Exnovation is thus circulating as a new transition mindset– but still it is a bit of a distant rumour. Possibly this mood will just pass, along with the Covid-19 pandemic that allowed it to gain relevance? Insights from innovation sociology, Science & Technology Studies and interpretive policy analysis help to clarify, however, how exnovation is becoming ever more real: it is gaining currency in both science and practice (Voß 2014). It is not very recognizable yet in the form of concrete policy instruments and programmes on CE, yet it is clearly gaining ground in strategizing on energy transitions, mobility transitions and in various others sectors of society. It forms a backdrop to concrete decision-making and policy-formation. It is what has been called a "knowing of governance" (Voß & Freeman 2016) – a general frame, a horizon of meaning, within which decisions are made. In this sense it also seems to have entered the ways in which people and organisations are approaching the CE transition.

The next sections map out more systematically how the exnovation mindset manifests throughout business ecosystems. **Figure 3.2** visualises how it manifests on micro, meso and macro levels: This also helps to connect the examples of exnovation with the other analyses of business ecosystems in this book.

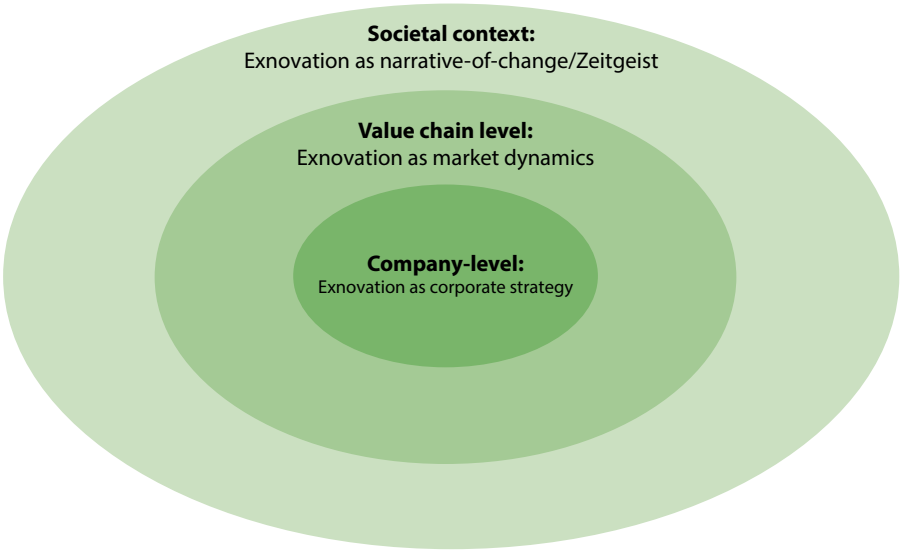


FIGURE 3.2: Exnovation on different levels of business ecosystems

The diagram will be considered from the outside inwards. Moving from the general narratives of change in society **(Section 3.3)** towards the more immediate contexts of value chains **(Section 3.4)**, we show eventually how exnovation is in fact already an integral dimension of corporate strategy **(Section 3.5)**.

3.3 SOCIETAL CONTEXT: EXNOVATION AS NARRATIVE-OF-CHANGE/ZEITGEIST

Even if seldom used explicitly, exnovation does come across as a familiar concept. Even if it is not a household term in corporate strategies, innovation management and economic development, it has developed a certain currency in the broader societal context. The exnovation mindset can be considered part of the Zeitgeist, in other words it forms part of the societal mood of the high-industrialised world. Analysed on the level of the overall societal context, we can see a wide exnovation discourse. It is carried by a diverse range of more or less utopian narratives of change, by emergent lifestyles and by hesitant shifts in public policies.

- **Delegitimisation.** The post-WWII economic boom has evoked critique and resistance throughout. Next to the Marxist critiques of alienation and exploitation, a new line of environmentalist critique came up as well. The "Limits to Growth" report by the Club of Rome stands out for its explicitly exnovative framing of economic development. Ever since that report was published, there have been activist movements and political discourses that have demanded the abolishment and phasing out of particular products and services. Prominent examples are the campaigns against CFK-based products, against products produced under the Apartheid regime or in the colonised Westbank areas, against DDT, against production heavily relying on child labour, against sex as a commodity, against products deemed unhealthy, addictive and psychologically detrimental, and against products based on animal exploitation. These examples show a long tradition of exnovation by means of de-legitimisation. Importantly, this delegitimisation is not exclusively the political terrain of activist slogans and critique: In the current internet age, delegitimisation takes place through much wider and faster communication circuits – in which a much greater range of political actors participate. Professionalised political lobbying and activist scientific research are significantly boosting these processes. A telling example of professionalised delegitimisation is the campaign to end the "cage age" for farm animals (Rodenburg et al. 2020). Also relevant is the delegitimisation undertaken, by contrast, to *defend* products and practices against being exnovated. Notorious examples of this are the smokescreen tactics used by the tobacco industry (Normann 2019). Meanwhile, the rise of the notion of "cancel culture" is significant. Whatever one thinks of it, and leaving aside to which extent it is a correct description of the changes in society, this very notion of

cancel culture indicates that the legitimacy of products is fragile – and that the licence-to-operate of producers can expire very suddenly.

- **Degrowth.** The above delegitimisation discourses are targeting specific products, producers and processes. Notwithstanding many mutual connections, these need to be distinguished from the degrowth discourse that has gained influence in recent years. Degrowth indicates a range of discourses that argue for exnovative principles of economic development. The concept of degrowth is the most explicit exnovative term for a range of alternative, heterodox economic concepts that challenge received ideas about green growth. Some of these exnovation discourses explicitly negate the growth ideology, such as the "keep it in the ground" movement. Others elaborate degrowth thinking through positively formulated concepts, such as "responsible stagnation" (de Saille & Medvecky 2016), "sufficiency" (Schulz & Affolderbach 2015) and "alternative welfare" indicators (Cassiers 2011).
- **Decentralisation & resilience.** The aforementioned narratives on alternative economic models are linked up with exnovative discourses about the phasing out of the power relations and decision-making procedures that have been inherited from the past. The most pronounced expression of these exnovative considerations is the notion of decentralisation: Considering how the centralised decision-making structures have become dysfunctional, they arguably need to be phased out in favour of more flexible, resilient, accountable and *democratised* arrangements (Ferreras et al. 2022). Examples of this are the society-wide impulses towards energy prosumerism and energy citizenship, the quests for resilient communities as pursued by Ecovillages and Transition Towns, and the renewed interest in participative, horizontal organisational forms like participatory budgeting, Timebanks, cooperatives and ethical banks. The latter initiatives can be considered as important social innovations in CE transitioning (cf. Chapter 2) – yet they also share this distinct exnovative element of de-centralisation.
- **Deceleration.** The above exnovation discourses on products, economic models and decision-making structures tend to be informed by strong political commitments. They follow from political considerations of sustainable development, inclusion, equal opportunity and democracy. Next to these political considerations one can also perceive unmistakable trends towards exnovative *lifestyles*. A very prominent group of exnovative lifestyles are the moves towards deceleration. As described by Rosa (2012), many of the pains of society are related to the acceleration of it. Individuals struggle with the pressures to keep up, to stay synchronised and to adapt to threats and opportunities presenting themselves. This critical analysis of societal acceleration explains the popularity of a wide range of deceleration movements. This ranges from Slow Food, Slow Urbanism and Slow Science movements to the widespread invocation of mindfulness, yoga and life-hacking techniques that regulate the tempo of working life (Kemp et al. 2022). These deceleration practices share a certain exnovation mindset. Whether in the form of collective social

movements or through individual lifestyle choices, they try to *rewind* society's acceleration mechanisms.

- **Decluttered lifestyles.** Particularly relevant for the circular transition are the exnovative lifestyles that have developed with regard to possessions. These dematerialised, ascetic lifestyles may for a certain time have been limited to the affluent "jet-set". In possession of abundant amounts of matter, the "mind of matter" attitude came naturally. After the accumulation of wealth, spirituality and dematerialised lifestyles came as a next form of social distinction. Meanwhile, this trend has become much broader. This speaks most clearly from the influence of Marie Kondo's philosophy of decluttered lifestyles, and the controversies that flare up around "Black Friday" sales. Also telling is the demand for "authentic" modes of production and "vintage" products. This may just form part of the hunger for new things, yet there is an exnovative element too: These products do challenge certain pressures to upgrade, renew and replace. The "planned obsolescence" of products is thus decreasingly reliable as a strategy to maintain demand: Rather than buying the new television, consumers may disconnect entirely and free their living room from this "clutter".
- **Just transition.** The exnovation mindset is thus circulating quite widely. It is significant that also the undesirable implications of exnovation are gaining attention. Particularly telling is the rise (or the re-emergence) of the "just transitions" concept. This indicates the growing awareness – in political debates but also more broadly in society – that all the above impulses towards exnovation come with losses that are not necessarily evenly distributed. This side of the exnovation mindset has become particularly prominent in Belgium and France, through the "gilets jaunes" movement. Yet it also speaks clearly from the EU-level political discourse on transitions that "should leave nobody behind". The rise of the exnovation mindset also speaks from the tendency to discuss transitions governance in terms of vulnerable workers, vulnerable sectors and vulnerable regions.

3.4 VALUE CHAIN LEVEL: EXNOVATION AS MARKET DYNAMICS

The exnovation mindset proves to be widespread, well beyond the realms of counter-culture and environmental activism. Still these developments in the general societal context do not necessarily unleash heavy dynamics towards CE transitioning. It is important to consider therefore how the exnovation mindset also manifests – more acutely – on the level of value chains. In fact, exnovation is becoming quite a relevant angle on market development: This has become particularly clear through the worldwide Covid-19 pandemic.

- **Vulnerability-of-supply.** The Covid-19 crisis has shaken up the economy throughout. Every element of companies' business models has proven vulnerable

to decline. The vulnerability of stocks and supplies has become particularly evident. The blockage of the Suez Canal by the Ever Given container vessel has indicated the extent and depth of the vulnerability of globalised supply chains. Beyond this incident, companies relying on rare earth minerals have already drawn the conclusion: CE transitioning is more than ever a practical necessity, resulting from pressures of resource scarcity (VBO FEB 2021). Governments have simultaneously been forced to reflect on their current and future access to vaccines, and on the resilience of their economic development programmes. The re-localisation of supply chains has therefore become a prominent vision well beyond the "circuits courts" (short chains) that flourished under the pandemic. The case of post-Brexit UK is particularly telling: Boons et al. (2021) observe that the pandemic may have induced a serious policy shift to reduce the UK's dependency on food imports, especially after Brexit. Meanwhile, the daunting sights of empty shelves are not uncommon in Belgium either – supply is vulnerable due to internal (strikes) as well as external developments (Covid-19; the military conflict in Ukraine). Exnovation can thus be suddenly becoming a reality.

- **Environmental standards.** The exnovation mindset has been around for quite some time already. It follows quite directly from the anticipation of tightening environmental standards. The concerns about a level playing field have recently flared up again: *Will Belgian companies stay competitive, given the geopolitical risks towards regulatory competition? Are we exnovating our national industry?* The VBO FEB future vision (2021) underlines therefore that a CE transition for Belgian companies will require "free, fair and a rules-based global trade". This emphasis on properly regulated global trade expresses concerns about exnovation: Unfolding at different speeds in different places, Belgian society could fall victim to "unbalanced exnovation". A relevant fact is that about a quarter of imported products do not entirely comply with the European norms set for product norms. This persistence of the non-compliant modes of production disturbs a process of slow but steady exnovation, in which the unsustainable modes of production fade away. Hence the strong attention to this issue in the VBO FEB vision. It is argued that also the exported materials should be made to comply with European standards of recycling, whichever the location at which they are being treated (VBO FEB 2021). Meanwhile there are of course already regulations in place, such as the Basel convention on "dangerous waste". The regulatory landscape is evolving, as evidenced by the recent waste import bans imposed by China, Malaysia, Thailand, and Vietnam. In other words, concerns about unequal, too fast or unevenly distributed exnovation have already been around for a long time. The attempts to harmonise environmental standards are essentially moves towards planned exnovation.
- **Age of access.** Cornerstones of the linear economy are the trading of products and the exclusive consumption of those. Driving consumers away from reuse, these dominant principles of value creation keep companies stuck on the lower steps of the circularity ladder **(cf. Chapter 2)**. Principles of sharing

economy and functional economy are therefore proposed as more ambitious CE transitioning strategies. They are essentially ways of exnovating ownership, and individualised, exclusive consumption. The mainstreaming of functional economy practices has started to take off slowly. Much attention goes out in this regard to the digitalisation of the economy, and the associated functional economy applications. But this shift to product-service business models is not only a matter of technological innovation. The transition to Rifkin's "age of access" arguably revolves around the exnovation of outdated business models, superfluous links in supply chains and traditional desires towards ownership. This exnovation of ownership-based value chains is already ongoing, incited by various exnovation-oriented lifestyles (cf. Section 3.4).

– **Breaking through the silos.** Finally it is worthwhile considering the exnovation of corporate identities and organisational models. The classical view of companies, as isolated agents, is challenged by the discourse on business ecosystems[7] and innovation networks. The exnovation mindset is also manifesting through various attempts to reconsider outdated organisational principles. It manifests through attempts to do away with numbing routines, ineffective modes of working and modes of organizing that suppress creativity. One of the drivers for this organisational exnovation is the changing information landscape, sometimes actively pursued as a "digital transition". The efforts to disclose data and to increase the transparency of production processes are crucial ways of making the material and energy flows visible and manageable (cf. Chapter 2 on the "metabolic" perspective on CE transitioning). Yet this digitalisation is also worth considering for its exnovative effects – it entails a certain dismantling of the closed firm model. The VBO FEB (2021) vision appears to acknowledge this: CE transitioning is described as a system innovation towards transparency, connection and collaborative strategies.

3.5 FIRM-LEVEL: EXNOVATION AS CORPORATE STRATEGY

Arguably, exnovation was already an integral part of entrepreneurship. Yet it became a particularly prominent theme due (or thanks) to the Covid-19 crisis. The various "Relance" plans revolve around concerns over recovery and continuity. They express a certain fear towards overly exnovative developments. Yet underneath the quests for continuity, there is a more chequered picture. This also includes various forms of active exnovation, by and within companies. The following six examples stand out:

– **Quests for continuity.** The Covid crisis has been a "landscape" shock, as transitions theory calls it. It is a shift in the general societal context with as

7 Structuring this book along the connections between companies and business ecosystems, we also take part in the exnovation of the firm-centred view on economic development.

yet unknown middle- and long-term effects on firm behaviours and economic development. It is this uncertainty that appears to have induced fear of too fast exnovation. The VBO FEB (2020) vision on economic recovery was tellingly called "4x4 turbo", emphasizing the need to kick-start the economy immediately. Notable elements in this regard are the pleas in favour of nuclear prolongation (ensuring energy security) and in favour of unmitigated company car arrangements – maintaining these as an "essential element" of salaries. These two examples show how phase out and exnovation appear on the agenda of employers – and how the associated political taboos exist in the world of business as well.

- **Labour and redundancy.** Exnovation on the level of the company becomes very concrete in the form of human resource management. For companies it is quite obvious, more so than in the public debate, that the shift towards a CE is not only a fairy tale of new green jobs: CE transitioning also implies a certain dismantling of the "linear economy". The VBO FEB vision indicates explicitly that CE transitioning will entail job losses, and that these losses need to be anticipated through programmes of reskilling (VBO FEB 2021). This reskilling can be appreciated as the anticipation of redundancy of resources, which are the exnovation processes that firms are particularly experienced in. Still these issues of labour and redundancy cannot all be handled within the firm. Exnovation processes extend beyond the firm, towards business ecosystems but also towards economic regions. Exnovated activities tend to be spatially concentrated, and "green" jobs are not necessarily emerging at the same sites. Firm level reskilling plans are thus being complemented by broader reconversion plans on the regional-economic level. The plans anticipating the closure of the Tihange nuclear plants are a particularly visible example in this regard, but the deindustrialisation may hit more suddenly and less well anticipated in other regions. The fate of cities such as Charleroi or Detroit shows the risks of insufficiently anticipated exnovation.
- **"Ladensterben".** This evocative German term for the passing away of shops has come up only quite recently. It appears to have become a particularly common term in the context of the Covid-19-related restrictions on public activities. *With anxious customers reluctant to spend and curtailed shopping activities, which shops will survive the Covid-19 crisis? How many shops will recover?* The already strong rise of E-commerce has made this question particularly urgent for many traditional retail companies. Further combined with other restrictions and impacts following decarbonisation policies, this has evoked debates about "the future of the classical enterprise in Brussels". The "Ladensterben" neologism speaks volumes about the relevance of the exnovation mindset. This dramatic term expresses the important repercussions for spatial quality and convivial urban life: The exnovation of shops has implications for the vitality of streets, quarters, and urban areas.

- **Deregulation and administrative rollback.** From the perspective of individual firms, the CE transition appears as a vast potential for sustainable business innovations – waiting to be unlocked by a removal of various barriers **(cf. Chapters 4 and 5)**. The VBO FEB CE vision (2021) underlines the need to overcome "paralysis". This coincides with the insight of Heyen et al. (2017): Exnovation often amounts to what political scientists call "policy termination", in other words to getting rid of administrative arrangements, policy programmes and regulations that have become dysfunctional. For firms, such policy termination has always featured high on the agenda. Entrepreneurs in institutionally high-developed countries tend to yearn for deregulation and rollback of "red tape". Particularly prominent examples in Belgium are the arrangements of workers' protection and social security, which put certain constraints on entrepreneurship. The VBO FEB (2020) post-COVID19 "relaunch" vision is therefore targeting the overall rigidity of the labour market and the limitations on flexible labour – marking these as institutional arrangements in need of exnovative changes. Similar examples of this regulatory exnovation are the removal of administrative barriers as explored by the CIREDE policy programme (cf. Chapter 2), and the proposed regulatory simplification regarding the free circulation of secondary materials in Europe (VBO FEB 2021).
- **Divestment.** A perhaps mundane example of exnovation is the divestment and reallocation of capital by firms. The writing off of investments, the phasing out of production lines, the selling or downscaling of earlier innovations – all these are common examples of exnovation. Guided primarily by motives of efficiency and profit, this is not the same exnovation as it came up in the context of sustainability transitions thinking. Still it is important that this strategic outlook on the removal of technologies and practices has a particularly long tradition in business administration. One of the earliest sources on "exnovation" is in fact Kimberly (1981), who discussed it in the context of organisational innovation.
- **Substitution and modernisation.** Finally, there is also another form of exnovation that is very familiar to entrepreneurs and firms. As indicated already under "divestment", exnovation involves anticipation of what may become obsolete or less in demand. In other words, exnovation just forms part of technological substitution processes – highlighting the less prominent part of phaseouts. The typical entrepreneurial sense for such exnovation speaks clearly from the case of the incandescent light bulb (ILB) (Koretsky 2021). Exnovation in this case appeared clearly as a complementary strategy to accelerate technological substitution: Producers had long been planning for the introduction of LED lamps, but the governmental bans on the ILB arguably facilitated the somewhat stagnant substitution process. The same example also shows how companies are quite well-positioned to handle exnovation conflicts: When embedded in a broader process of technological substitution and modernisation, exnovation loses its destructive character.

3.6 CONCLUSION: TOWARDS BUSINESS-LED EXNOVATION?

Transitions research has started to shift focus from innovation management towards broader governance approaches. The strategic focus has shifted towards the "flipsides" of innovation: destabilisation, decline, phaseout and exnovation. The latter term is appealing, yet we rarely encounter it in non-academic settings. Its relevance for companies and their transition strategies is not immediately clear. Hence the research questions:

> *Which weak signals of an emerging exnovation mindset can we distinguish? What elements of CE transitioning and which changes in the business ecosystem does it indicate?*

The answers to the first question have been elaborated in the Sections 3.3-3.5. They are summarised in **Figure 3.3**:

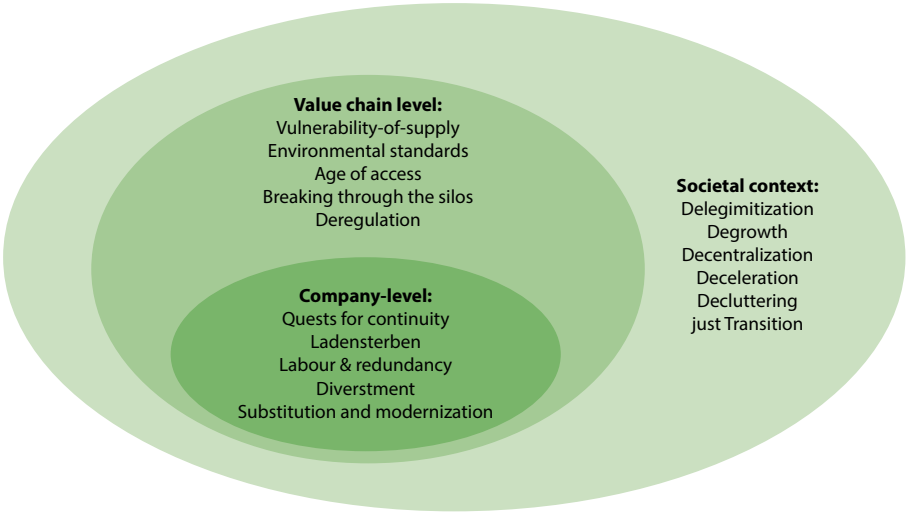


FIGURE 3.3: Exnovation in business ecosystems

The overview conveys a few basic observations:

- The exnovation mindset is more than just a rumour or a marginal undercurrent in society. The sixteen distinguished manifestations of it are recognizable developments, occurring across business ecosystems and countries. They also indicate developments with potentially deep impacts on the socio-technical order of the linear economy.

– The developments occur on different levels. The analysis on the levels of value chains and companies indicate how businesses are not only confronted with distant, general exnovation trends in the societal context. Importantly, businesses themselves are actively involved in various exnovation practices.
– This new transition mindset is psychologically more complex than the "yes, we can" attitude that pervades much transition management, innovation management and experimentation with circular business models. Various actors and organisations have started to embrace exnovative approaches to sustainability transitions – yet they also display feelings of vulnerability, anxiety and even resentment in the face of it. This ambiguity sets the (complicated) scene for the second question:

How can businesses use the exnovation concept to inform CE transition strategies?

This question is significantly more difficult to answer than the previous one. The overview of exnovation developments does provide certain indications, however:

– A lot of these exnovation developments are indeed developments than are "just happening". Most of them are not strategies that one can adopt, discard or develop. This recalls the general strategic point that transitions are largely emergent processes – they are not roadmaps that one can draw, plan, and control **(cf. Chapter 2)**. A first practical advice is therefore to consider the many autonomous developments through which "exnovation" imposes itself on business ecosystems. Only in the next instance one can consider purposive interventions: *How can these developments be influenced, deflected, slowed down, softened or anticipated?*
– Various exnovation developments are initiated by consumers and citizens. This recalls the importance to stay in tune with the societal mood. Developments of delegitimisation, decluttering, and deceleration taken together can add up to formidable forces. Yet it is also important to take a second look: *How strong is this "bottom-up" exnovation, really, and how does it weigh up against the counter-tendencies of sticking to what one has, giving oneself a break, indulging in guilty pleasures, or resigning in the face of overwhelming pressure to change one's lifestyle?* Citizen-consumers may put exnovation issues on the political agenda – yet they do not necessarily implement that agenda.
– The latter point recalls the political taboos that active phaseout policies tend to be surrounded with. Even the phase out of clearly "doomed" technologies (cf. Bonnet et al. 2021), like coal-fired energy, proves very difficult when push comes to shove: Coalitions of politicians, experts, industrial actors and workers can develop broad "discursive resistance" to defend against a phaseout (Trencher et al. 2019). Explicit exnovation policies come with severe political hazards – especially when they go beyond general exnovation visions and apply concrete instruments (for example

the Low Emission Zones or sugar taxes). Public authorities may initiate exnovation processes, but they are just as much involved with the softening of them.

– Given the political taboos and the mixed emotions of citizen-consumers, it can thus be concluded that businesses better not stick to passive, reactive strategies. Various exnovation practices are already deeply ingrained in business management as we have seen: Companies have developed strong strategic skills on issues of divestment, deregulation, and technological substitution (Section 3.5). The recent Covid-19 shock has arguably made for further lessons, learned the hard way.

Highlighting the linkages between diverse exnovation phenomena and showing the skills and initiatives that exist in society, this chapter provides outlines for more encompassing exnovation strategies. Businesses seem to be well prepared for this exnovative dimension of CE transitioning. This anticipation-of-decay is maybe easier to handle for entrepreneurs than it is for politicians, consumers or activists. Exnovation is in a way just another angle on the rational use of resources – accepting one's losses before it is too late, anticipating the inevitable end of life of products and technologies, and continuously re-evaluating the performance and productivity of the organisational structures in place. It is this relative open-mindedness towards exnovation issues that underlines the point made in **Chapter 2**: Companies are, for better or for worse, the key actors in CE transitioning.

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CHAPTER 4

TRANSITIONING INCUMBENT FIRMS TO CIRCULARITY: AN ANALYSIS OF FACTORS AFFECTING THE ADOPTION OF CIRCULAR ORIENTED INNOVATION

Jean Mansuy, Philippe Lebeau & Cathy Macharis

4.1 INTRODUCTION

As underlined in **Chapter 2**, transitioning to a CE requires the development and adoption of a multitude of niche innovations, occurring across different dimensions (Geels, 2002). Those innovations aiming for more circularity (what we will further refer to as "circular oriented innovations" (Brown, Bocken& Balkenende 2019)) can concern business models, networks, organisational structures, processes, products, services, markets or customer engagement (Prieto-Sandoval, Jaca& Ormazabal 2018). Most of such types of innovations primarily concern companies, which, therefore, have a key role to play in the transition to a CE. Among those companies, it is often suggested that niche innovations are to be implemented by new entrants. Nonetheless, incumbent firms may also engage in developing niche innovations (van Mossel, van Rijnsoever& Hekkert 2018), and not necessarily less than new entrants (Palmié et al. 2021).

As with any other type of innovation, introducing circular oriented innovations in a company can be complex. The adoption of circular oriented innovations by companies can be influenced by many factors, which can either prevent (barriers), incentivise (drivers) or allow (enablers) organisations to adopt such innovations. Many such factors have been investigated in the literature. Yet, reviews of such factors are still scarce. In addition, several papers have underlined the context-specific nature of those factors. Many investigations focused on how the size of a company influences the relative importance of such factors (Rizos et al. 2016; Ormazabal et al. 2018), to the point that this topic was classified by Kirchherr as a "boring question

scholarship" (Kirchherr 2022). However, very few papers focused on incumbency, and those that did rather focused on specific factors (for example dynamic capabilities (Santa-Maria, Vermeulen& Baumgartner 2021)) or types of innovation (for example products (Franco 2017)). Hence, the present chapter aims to *identify the factors affecting the adoption of circular oriented innovations by companies and in particular by incumbent firms*. To achieve this, the present chapter combines two different methods. First, a literature review is used to identify factors often mentioned in the (international) academic literature and to develop a classification for such factors. Second, this classification is applied to the case study of incumbent firms active in Belgium, using interviews with executives to identify factors frequently affecting the adoption of circular oriented innovations by incumbent firms in a given geographical and institutional context.

4.2 TOWARDS A NOVEL CLASSIFICATION OF FACTORS AFFECTING THE ADOPTION OF CIRCULAR ORIENTED INNOVATIONS

Following a review of existing literature on the factors affecting the adoption of circular oriented innovations, we inductively developed an alternative classification to the widely used concepts of barriers, enablers or drivers.

Methodology: literature review

Data collection

Much has been written about the different factors affecting the adoption of circular oriented innovations in companies. Given this profusion of data, we conducted a systematic literature review to identify frequently mentioned factors in the scientific literature. To do so, we searched for papers discussing both "CE" or "circular business" and barriers ("barrier$"), drivers ("driv*") or enablers ("enabl*") on the two largest databases for scientific publications: Web of Science and Scopus. The decision to use two databases was made to maximise the retrieval of the most relevant sources and to increase the resilience of the approach.

The interest in the CE has exploded in the past few years, leading to a huge number of publications addressing the topic. To limit our review to a manageable number of publications, we only searched for the selected keywords in the titles of the publications. While this approach is likely to leave some relevant publications aside, it increases the relevance of papers in the sample. Given the large availability of academic publications, we also limited the scope of the review to peer-reviewed work, focusing on academic articles and systematic literature reviews published in English. Moreover, conference papers and grey literature were rejected from the sample. In addition, we only selected papers considering

factors relevant at the scale of a company (barriers, drivers and enablers happening at different scales). Furthermore, we rejected studies focusing on only one specific factor.

The literature review was performed in early January 2021. The search strategy returned a total of 79 articles and includes papers published between 2011 and 2020. The absence of papers published before 2011 is likely due to the recent framing of "CE" as a concept. All retrieved articles were included in Scopus (71 in Web of Science). Of these articles, 40 were rejected based on their titles, 10 after reading the abstract and 4 after a full read. This led to a sample of 25 articles, listed in **Table 4.1**.

ID	Title	Authors	Year	Journal/Source
R1	Implementation of CE business models by small and medium-sized enterprises (SMEs): Barriers and enablers	Rizos, Vasileios; Behrens, Arno; van der Gaast, Wytze; Hofman, Erwin; Ioannou, Anastasia; Kafyeke, Terri; Flamos, Alexandros; Rinaldi, Roberto; Papadelis, Sotiris; Hirschnitz-Garbers, Martin; Topi, Corrado	2016	Sustainability (Switzerland)
R2	Lost in Transition? Drivers and Barriers in the Eco-innovation Road to the CE	de Jesus, Ana; Mendonça, Sandro	2018	Ecological Economics
R3	Enabling Factors and Strategies for the Transition Toward a CE	de Mattos, Claudia Aparecida; Meira de Albuquerque, Thiago Lourenco	2018	Sustainability (Switzerland)
R4	A systematic review on drivers, barriers, and practices towards CE: a supply chain perspective	Govindan, Kannan; Hasanagic, Mia	2018	International Journal of Production Research
R5	Barriers to the CE: Evidence from the European Union (EU)	Kirchherr, Julian; Piscicelli, Laura; Bour, Ruben; Kostense-Smit, Erica; Muller, Jennifer; Huibrechtse-Truijens, Anne; Hekkert, Marko	2018	Ecological Economics
R6	Prioritizing barriers to adopt CE in construction and demolition waste management	Mahpour, Amirreza	2018	Resources, Conservation and Recycling
R7	Towards a more CE: exploring the awareness, practices, and barriers from a focal firm perspective	Masi, Donato; Kumar, Vikas; Garza-Reyes, Jose Arturo; Godsell, Janet	2018	Production Planning and Control
R8	Drivers to sustainable manufacturing practices and CE: A perspective of leather industries in Bangladesh	Moktadir, Md Abdul; Rahman, Towfique; Rahman, Md Hafizur; Ali, Syed Mithun; Paul, Sanjoy Kumar	2018	Journal of Cleaner Production

ID	Title	Authors	Year	Journal/Source
R9	Exploring institutional drivers and barriers of the CE: A cross-regional comparison of China, the US, and Europe	Ranta, Valtteri; Aarikka-Stenroos, Leena; Ritala, Paavo; Makinen, Saku J.	2018	Resources, Conservation and Recycling
R10	Drivers and barriers to CE implementation: An explorative study in Pakistan's automobile industry	Agyemang, Martin; Kusi-Sarpong, Simonov; Khan, Sharfuddin Ahmed; Mani, Venkatesh; Rehman, Syed Tahaur; Kusi-Sarpong, Horsten	2019	Management Decision
R11	Is it possible to change from a linear to a CE? An overview of opportunities and barriers for European small and medium-sized enterprise companies	Garces-Ayerbe, Concepcion; Rivera-Torres, Pilar; Suarez-Perales, Ines; Leyva-de la Hiz, Dante I.	2019	International Journal of Environmental Research and Public Health
R12	Drivers and approaches to the CE in manufacturing firms	Gusmerotti, Natalia Marzia; Testa, Francesco; Corsini, Filippo; Pretner, Gaia; Iraldo, Fabio	2019	Journal of Cleaner Production
R13	CE in the manufacturing sector: benefits, opportunities and barriers	Kumar, Vikas; Sezersan, Ihsan; Garza-Reyes, Jose Arturo; Gonzalez, Ernesto D. R. S.; AL-Shboul, Moh'd Anwer	2019	Management Decision
R14	Unlocking circular business: A framework of barriers and drivers	Tura, N; Hanski, J; Ahola, T; Stahle, M; Piiparinen, S; Valkokari, P	2019	Journal of Cleaner Production
R15	Exploring barriers to implementing different circular business models	Vermunt, D. A.; Negro, S. O.; Verweij, P. A.; Kuppens, D. V.; Hekkert, M. P.	2019	Journal of Cleaner Production
R16	Driving the transition to a circular economic model: A systematic review on drivers and critical success factors in CE	Aloini, Davide; Dulmin, Riccardo; Mininno, Valeria; Stefanini, Alessandro; Zerbino, Pierluigi	2020	Sustainability (Switzerland)
R17	Barriers to circular business model innovation: A multiple-case study	Guldmann, Eva; Huulgaard, Rikke Dorothea	2020	Journal of Cleaner Production
R18	Sector perception of CE driver interrelationships	Gue, Ivan Henderson V.; Promentilla, Michael Angelo B.; Tan, Raymond R.; Ubando, Aristotle T.	2020	Journal of Cleaner Production
R19	Barriers to the CE in European small and medium-sized firms	Garcia-Quevedo, Jose; Jove-Llopis, Elisenda; Martinez-Ros, Ester	2020	Business Strategy and the Environment

ID	Title	Authors	Year	Journal/Source
R20	Organizational enablers for CE in the context of sustainable supply chain management	Hussain, Matloub; Malik, Mohsin	2020	Journal of Cleaner Production
R21	Understanding barriers to CE: cases from the manufacturing industry	Jaeger, Bjoern; Upadhyay, Arvind	2020	Journal of Enterprise Information Management
R22	Getting the ball rolling: an exploration of the drivers and barriers towards the implementation of bottom-up CE initiatives in Amsterdam and Rotterdam	Russell, Max; Gianoli, Alberto; Grafakos, Stelios	2020	Journal of Environmental Planning and Management
R23	Managing operations for CE in the mining sector: An analysis of barriers intensity	Singh, Rajesh Kumar; Kumar, Anil; Garza-Reyes, Jose Arturo; de Sa, Marcelo M.	2020	Resources Policy
R24	Transition to CE on firm level: Barrier identification and prioritization along the value chain	Werning, Jan Philipp; Spinler, Stefan	2020	Journal of Cleaner Production
R25	Analyzing barriers for developing a sustainable CE in agriculture in China Using Grey-DEMATEL approach	Xia, Xiqiang; Ruan, Junhu	2020	Sustainability (Switzerland)

TABLE 4.I: List of papers included in the literature review

Data analysis

Following the identification of relevant publications, we listed all factors mentioned in an Excel spreadsheet, regardless of their nature (in other words barrier, enabler or driver), and characterised them with a unique identifier. We also reported the original categories in which factors were classified in the publication they came from. This led us to a list of 568 (potentially overlapping) factors.

We then removed duplicates and applied an inductive approach to cluster identified factors and develop a classification. Such an approach required several iterations (Locke, Feldman& Golden-Biddle 2022), in which we looked for commonalities between factors. During the process, we noticed that several authors used the internal/external dichotomy to distinguish between factors. In addition, Santa-Maria, Vermeulen& Baumgartner (2020) further distinguished between antecedents and moderators. When looking at factors from those two angles, we noticed a similarity with the MOA (Motivation-Opportunity-Ability) model (Ölander & Thøgersen 1995), a widely used framework to explain pro-environmental behaviour. We, therefore, decided to classify factors based on that MOA model, considering the motivation, opportunity and ability concepts as classes or "taxons".

Factors can be characterised by three different (but complementary) variables: (1) the direction in which a factor affects circular oriented innovation (in other words positively or negatively), (2) the origin of the factor (in other words endogenous or exogenous), and (3) the way it impacts the adoption of a circular oriented innovation (in other words directly (antecedent) or indirectly (moderator)). When considering the first aspect (direction), which can be represented by a continuous variable, factors can either be considered as obstructers, catalysts or have an ambivalent nature (Sarja, Onkila& Mäkelä 2021). This ambivalence makes this characteristic highly contextual, depending on the innovation considered or on the characteristics of the company implementing it. Hence, using this aspect can lead to a certain overlap between categories, which is not suitable for classification (Bailey 1994). We rather suggest using a classification made of categorical (or nominal) variables (Collier, LaPorte& Seawright 2012) and focused on the two other aspects, in other words where the factor comes from and how it impacts the innovation process. Analysing those two aspects, we identified similarities with the MOA model (Ölander & Thøgersen 1995), which explains pro-environmental behaviour as a combination of motivational, opportunity-related and ability-related factors. An overview of that classification, as well as its relationship with the barrier, driver and enabler concepts, is provided in **Figure 4.1**.

The motivation, opportunity and ability concepts used to characterise the groups of the novel classification were originally used to explain the behaviour of individuals, not organisations. Using them might suggest considering a company as a homogenous entity, which it is not (Crozier & Friedberg 1977). In fact, our approach does not deny the diverging positions of actors within a company but rather takes a holistic approach in considering organisations as systems interacting with their environment. Another singularity of using such concepts in our classification is the further division of the motivation concept between intrinsic and extrinsic motivation. While this distinction of motives is not included in the original MOA model, it has been extensively discussed (Ryan & Deci 2000), and fits the groups of our classification related to antecedents well.

The adoption of a circular oriented innovation is seen as the behaviour of an organisation. This adoption follows a process that is initiated by the **intention** of the focal firm (more precisely of its management) to innovate (**Figure 4.2**). This intention is driven by motivational factors. A key determinant of the intention to adopt a circular oriented innovation lies in the **expected outcomes** of this innovation. Outcomes vary for each circular oriented innovation. But what is important is not so much the outcomes as the expectations for these outcomes. The capability of the company to rightly assess the future outcomes of an innovation, therefore, plays a crucial role in the decision of the company to adopt a circular oriented innovation. These assessed outcomes will influence the **attitude of the management towards circular oriented innovation**. This attitude will also be impacted by the **organisational culture** of the company. Another factor impacting the intention of a company to adopt circular oriented innovation lies in the **social norms** in place.

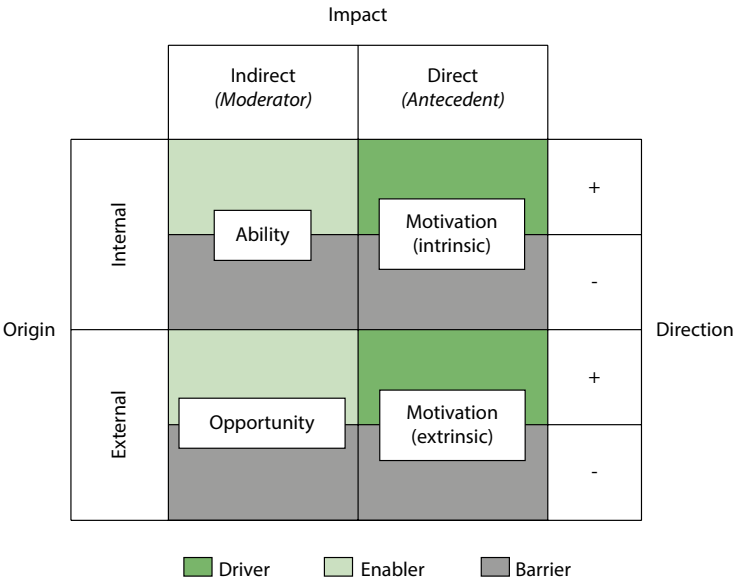

FIGURE 4.1: MOA-based classification and comparison with the barrier, enabler and driver concepts

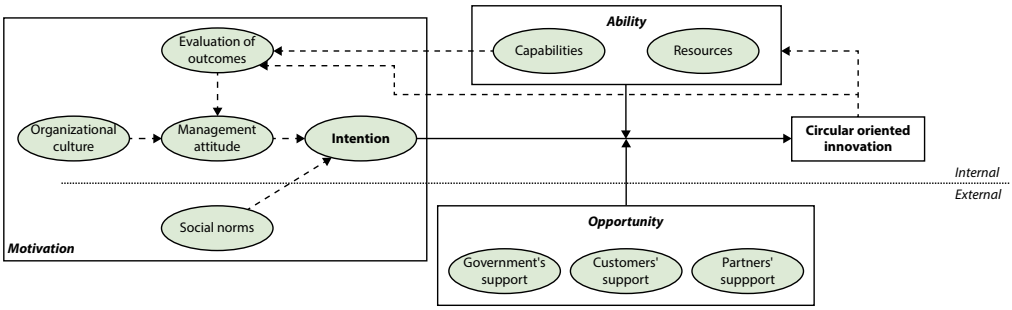

FIGURE 4.2: Adapted MOA model for circular oriented innovation

Motivation alone cannot ensure the successful implementation of a circular oriented innovation. Two additional categories of moderating factors are needed to bridge the "intention-behaviour gap": (1) **ability** and (2) **opportunity**. Ability refers to the ability of a company to adopt a circular oriented innovation. Factors in such a category are related to the **resources** and **capabilities** of a company. Such factors can vary greatly based on the characteristics of a company, such as its organisational structure or its size. Ability is required in all stages of the innovation process. It can, in return, be affected by the successful implementation of a circular oriented innovation and benefit from additional resources and capabilities induced by learning effects. Opportunity refers to the opportunities provided to the company by its business ecosystem. It is strongly related to the **support of stakeholders** (for example customers, value network (including supply chain) partners or governments) of the circular oriented innovation.

As for the focal companies, the assessment of outcomes will impact the decision of stakeholders to participate in, or support, a circular oriented innovation. The next section of this chapter describes in further detail the factors introduced above and summarised in **Figure 4.2**.

4.3 FACTORS AFFECTING THE ADOPTION OF CIRCULAR ORIENTED INNOVATIONS: A COMPARATIVE ANALYSIS

Using the classification introduced above as a coding framework, we compared factors identified from the literature with those identified through interviews with executives working for incumbent firms active in Belgium. An overview of the types of factors mentioned by publications retrieved from our literature review and by interviewees is provided in **Table 4.3** and **Table 4.4** respectively. The following section discusses the different factors identified and further underlines the differences between those mentioned in the literature and those mentioned by the incumbent firms we interviewed.

Methodology: interviews

Data collection

Following the development of our classification, we conducted semi-structured interviews with executives working for companies active in Belgium. The present work focuses on the transition process. We only considered incumbents, thereby rejecting companies whose business models were designed as circular from the beginning. In particular, we focused on incumbent firms having experienced circular oriented innovation processes. To identify such firms, we primarily relied on peer recognition. Hence, we listed companies that (1) participated in regional, national or international circular awards (for example the EEAward, the Belgian Business Awards or The Circulars), (2) received regional or national grants for setting up a circular project (for example by BeCircular or Vlaanderen Circulair) or (3) were used as examples in special issues on CE from several national or regional business magazines (for example Reflekt or Susanova). We then classified the identified companies according to their sector and size. To define sectors, we used the sections of the NACE codes (European Parliament& Council of the European Union 2006). For sections gathering a large variety of activities (such as manufacturing), we further distinguished companies by their divisions. Regarding the size of companies, we considered as an SME any company employing less than 250 people (in a full-time equivalent). This information was either retrieved from the website of the company or its LinkedIn profile. To simplify the classification, we did not consider financial data, in spite of the European Commission's recommendation to consider as an SME only companies with an annual turnover lower than 50 million euros and/or an annual balance sheet not exceeding 43 million euros (European Commission 2003).

This led us to a list of 196 companies, of which 110 were incumbents. Most of these incumbents (68 %) were large companies, as most SMEs in the list (71 %) have adopted a circular business model from their start. In addition, several sectors (such as mining, banking or culture for example) were underrepresented (or even not represented) in the list, limiting the diversity of the sample. Hence, we extended the scope of our research in these "missing" sectors by identifying incumbent firms that are members of a professional network focused on sustainability (The Shift) and that communicate on CE-related projects. Those circularity claims were identified using online search engines. That resulted in the addition of twenty companies to the list.

To select companies from our list of 130 incumbents, we opted for a purposive sampling strategy, assuming incumbent firms have different perspectives based on their sector and size (Robinson 2014). In particular, we contacted at least one company from each NACE section from A to H, and for sections J, K and R (other sections being absent from our list of incumbents), while making sure that the share of SMEs is similar to the one in our extended sample (around 30 %). We decided to contact more manufacturing companies (section C) due to their high diversity of activities (it is composed of 23 divisions) and high preponderance in our extended list. The selection of companies within each section was performed using a convenience-based approach in order to maximise the response rate. This led us to contact 21 companies by email, of which eleven answered positively and one negatively (a response rate of 57 %). An overview of interviewed companies is provided in **Table 4.2**. Missing sectors (A (agriculture) and H (logistics)) correspond either to missing or negative answers to our meeting requests.

	Mining	Manufactur.	Energy	Waste	Construct.	Retail	Telecom	Finance	Culture
SME				I2					I11
Large	I10	I1, I6, I9	I5		I3	I7	I4	I8	

TABLE 4.2: Interviewed companies, classified by sector and size

Within each selected company, we targeted executives with a good knowledge of CE activities within the company and who were involved in circular oriented innovation processes, such as CEOs, directors of strategy, CSR managers, sustainability managers, et cetera. We, however, left the companies to choose the interviewees and accepted interviews with several executives. This led to a large heterogeneity of positions among the interviewees.

Data collection was supported by an interview guide (Kallio et al. 2016) that we tested both internally and with the first three interviewees (by asking for their feedback at the end). This guide contained both guiding questions and planned prompts (Leech 2002) about (1) the current circularity of their company, (2) the factors that hinder(ed) their adoption of circular oriented innovations, (3) examples of circular oriented innovations they implemented and (4) the impact those innovations had (for example on their operations, customers, partners, et cetera).

Interviews lasted around one hour each and were performed either in English or French, at the convenience of the interviewee(s). All were held remotely, either via a videoconferencing software or by phone, and were recorded in agreement with the interviewees. In compliance with GDPR, we provided interviewees with an information form describing our usage of the data and asked them to fill out a consent form on that usage. Additionally, we provided interviewees with the possibility to review the transcript of their interview and to remove any confidential data, which was considered particularly important in our case, executives being a specific type of "elites" (Harvey 2011).

Data analysis

Following the interviews, we transcribed the records verbatim (following the suggestions of McLellan, MacQueen& Neidig (2003). Additionally, we pseudonymised interviews using a unique identifier for each company and adapting or removing all data that could indirectly be linked to the company. We then uploaded transcripts into the NVIVO software for coding. Transcripts were coded by a single coder following the classification framework developed in the previous stage of the research (based on the literature review). In addition to the overarching factors identified in the literature review (and summarised in **Figure 4.2**), we further added subcategories when relevant (in other words when a factor included a wide heterogeneity of related aspects), which were reported in the classification obtained from the literature and recoded iteratively. Once we had arrived at a stable common coding framework, we then compared factors obtained from the interviews with those obtained from the literature.

		R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15	R16	R17	R18	R19	R20	R21	R22	R23	R24	R25
Motivation	Evaluation of outcomes	X	X		X	X	X	X	X		X	X	X	X	X	X	X	X	X		X	X	X	X	X	X
	Economic	X	X		X	X	X	X	X		X	X	X	X	X	X	X	X	X		X	X	X	X	X	X
	Incl. customer-related	X			X				X		X		X	X	X	X	X	X							X	
	Operational		X		X						X		X	X	X						X					
	Organisational culture	X	X	X		X					X			X	X			X	X			X				
	Management attitude	X			X						X			X	X		X	X					X	X		
	Social norms (civil society)		X		X				X	X	X		X	X	X		X				X					
	Environmental		X		X				X	X	X		X	X	X		X				X					
	Social				X									X			X									
Ability	Resources and capabilities	X	X	X	X	X	X	X	X		X	X		X	X	X	X	X		X	X	X	X	X		X
	Human	X	X	X	X		X		X		X	X		X	X	X	X	X		X	X	X	X	X		X
	Intellectual	X	X		X				X		X			X	X	X	X	X				X	X	X		X
	Financial	X				X	X				X	X			X	X	X	X		X			X	X		X
	Physical							X			X			X	X			X						X		X
	Organisational characteristics	X			X		X					X			X		X	X		X		X		X	X	X
	Organisational structure				X		X								X		X	X				X		X	X	X
	Company size	X										X								X						X
	Location in the value chain	X																								

		R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15	R16	R17	R18	R19	R20	R21	R22	R23	R24	R25
Opportunity	Customer's support	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	X			X		X	X	X
	Awareness of CE benefits	X			X	X	X	X	X					X	X	X	X							X		X
	Offer-related issues	X	X		X	X	X			X	X					X	X					X			X	
	Procurement procedures					X										X		X						X		
	Partners' support	X	X		X	X	X	X	X		X			X	X	X	X	X			X	X	X	X	X	
	Collaboration	X	X		X	X	X	X	X		X				X	X	X	X			X	X				
	Supply issues	X			X		X	X						X		X		X			X	X	X	X	X	
	Government's support	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X		X
	Enforced and effective legislation	X	X		X	X	X	X		X	X		X	X	X	X	X	X			X		X	X		X
	Public support	X	X	X	X		X	X	X		X			X	X	X	X		X				X			X
	Administrative burden	X						X				X				X				X						X

TABLE 4.3: References to factors affecting the adoption of circular oriented innovation in the literature review

		I1	I2	I3	I4	I5	I6	I7	I8	I9	I10	I11
Motivation	Evaluation of outcomes		X	X	X	X	X	X			X	
	Economic		X	X	X	X	X	X			X	
	Incl. customer-related			X	X	X						
	Operational			X			X	X			X	
	Organisational culture							X		X		
	Management attitude			X	X			X		X		
	Social norms (civil society)			X	X	X	X				X	X
	Environmental			X	X	X	X				X	X
	Social											
Ability	Resources and capabilities			X	X			X			X	
	Human			X	X			X				
	Intellectual			X								
	Financial			X							X	
	Physical							X				
	Organisational characteristics			X	X	X		X		X	X	X
	Organisational structure			X	X	X				X		
	Company size			X	X	X				X		
	Location in the value chain					X		X		X	X	X
Opportunity	Customer's support	X		X	X	X	X	X	X	X		
	Awareness of CE benefits	X		X	X			X	X	X		
	Offer-related issues			X	X	X	X	X	X	X		
	Procurement procedures					X				X		
	Partners' support	X	X		X	X	X	X		X	X	X
	Collaboration	X	X		X	X	X	X		X		
	Supply issues	X	X		X	X	X	X		X	X	X
	Government's support	X	X	X		X	X	X	X	X	X	
	Enforced and effective legislation	X	X			X	X	X	X	X	X	
	Public support			X		X				X		
	Administrative burden								X			

TABLE 4.4: References to factors affecting the adoption of circular oriented innovation in the literature review

4.3.1 Factors affecting the motivation to implement circular oriented innovations

Among the different expected outcomes associated with a given circular oriented innovation, economic motives are by far the most often mentioned, both in the literature and during the interviews we conducted. Most companies we interviewed started circular related projects for economic reasons, and all agreed that circular oriented innovations must be profitable to reach financial sustainability. One interviewee tempered that statement by underlining that some circular oriented innovations will lead to profits and others to losses. Hence, he suggested pooling projects in front of financial officers, to present a complete circular story.

Financial sustainability can be harder to reach with circular oriented innovations, as many require high upfront investment costs, leading to a longer return on investment. This long-term focus often goes against shareholders' preferences, which can further explain the lack of motivation for implementing circular oriented innovations. The length of the return on investment can also increase risk, particularly for circular business models such as product-service systems, which spread revenues over a product's lifetime. In use-oriented or result-oriented product-service systems (Tukker 2015) companies keep the ownership of a product but do not control how customers use this product. If the customer breaks the product before its amortisation period, the value is lost for the company. Reducing such risk requires important work on the content of the contract.

Despite a longer return on investment, many circular oriented innovations can be highly profitable, as underlined by several interviewed companies. A way for circular oriented innovations to increase the rate of return is by reducing costs, notably variable costs, which are often reduced due to a higher resource efficiency (inducing a decrease in waste management cost) and a reduced cost of materials. The variable cost is, however, not always lower, as it highly depends on the type of circular oriented innovation and the market and institutional context. For example, several interviewees mentioned the low price of primary raw materials, particularly those based on fossil fuels (at the time of the interview), as particularly harmful for the competitiveness of recycled materials.

Regarding primary raw materials, an interviewee mentioned the uncertainty of their future price as potentially limiting the investment in circular oriented innovations, the volatility of prices making it hard for companies to assess their potential economic benefits. On the opposite side of the spectrum, several companies mentioned increased resilience, induced by a reduced dependency on primary raw materials, and therefore less supply risk, as a factor motivating them to increase their circularity. Hence, the same cause (price volatility) can lead to different outcomes based on the expectations of a company.

Next to cost reduction, economic motives can also be related to an increase in revenue. Indeed, circular offers can be a way to differentiate from competitors, thereby leading to the acquisition of new customers. This customer acquisition can be related to the focus on new customer segments or even new markets. However, a fear of cannibalisation of existing offers by new ones is often mentioned in the literature.

While this concept was never mentioned in our interviews, the fear of losing market share was. Next to customer acquisition, circular oriented innovations, in particular business models such as product-service systems, can strengthen the relationship a company has with its customers and support customer retention.

Another type of a non-financial expected outcome impacting the adoption of circular oriented innovation is related to operational benefits. Indeed, one interviewee mentioned an increase in product quality, while another one reported that making circular buildings (in other words buildings that were designed to be deconstructed) could lead to significant time savings.

Adopting circular oriented innovation might conflict with certain business cultures, particularly those involving a reluctance to change or risk-aversion. Such issues were not mentioned by the companies we interviewed, except for having a shortterm mindset. On the contrary, the importance of top management support was often underlined. Indeed, the CE was brought into the corporate strategy of several incumbent firms we talked to at the initiative of their CEO or their board of directors. Some interviewees even stated that the will of the management would remove all possible barriers, including the availability of resources.

In addition to factors related to intrinsic motivation, several external factors can also drive extrinsic motivation. Indeed, many circular oriented innovations lead to a decrease in environmental impact. As noticed by several interviewees, environmental awareness is spreading in society, leading to a change of mentality (both internally and externally) and increasing the pressure on companies, notably from civil society, to increase the sustainability of their practices. The implementation of such sustainable practices can increase brand prestige and reputation, which can in the end influence consumers' choices. Nonetheless, the pressure to adopt more circular practices is only related to how a company is perceived. Indeed, one of the companies we interviewed mentioned that it was perceived more as "*a CO_2 polluter than a waste polluter*". Therefore, pressure from NGOs was more oriented towards pushing it to reduce its greenhouse gas emissions rather than its waste (which could, for some, have a non-negligible environmental impact). Next to environmentally related issues, the only other issues leading to pressure on companies were health-related (related to their local emissions), with no mention being made of any social issues.

4.3.2 Factors affecting the ability to implement circular oriented innovations

The ability of a company to conduct circular oriented innovations is strongly impacted by its own **resources** and **capabilities**, which themselves depend on the **company's characteristics** such as its structure, its size or its activities. Four types of resources are usually distinguished: physical, intellectual, human and financial (Osterwalder & Pigneur 2010).

Most resource-related issues mentioned in the literature are human-related, first and foremost associated with a lack of skills and knowledge. These can be technical skills (related to a specific technology) or knowledge of the CE concept or of specific

methodologies. Such a lack of skills and knowledge is either (or both) related to a lack of financial resources to hire appropriate profiles or to a lack of training procedures to develop required knowledge and skills internally. Next to knowledge, the commitment of employees has also been stated as an important factor. Developing such commitment may require the establishment of internal information campaigns. Nevertheless, committed employees do not suffice, and a capability to manage their engagement is needed, as one of our interviewees found out when being overwhelmed by ideas after an information session. In addition, this commitment can only translate into action if the remuneration schemes are aligned with the CE objectives.

Intellectual resources also play a role in the implementation of circular oriented innovations, particularly those requiring specific technology. In particular, intellectual property can impact the access of a company to the required technology. This lack of access can also be related to a lack of research and development capabilities, possibly strengthened by a lack of financial resources. Indeed, some of the companies we interviewed mentioned the risks associated with important technological developments they had to go through to adopt a circular oriented innovation. Finally, a lack of access to specific information and data can also play a role in the adoption of circular oriented innovation.

As mentioned, the two resources above (and a lack thereof) are strongly related to financial resources, which can be particularly impactful when large upfront investments are needed. Aside from the availability of capital, a major issue lies in the potentially complicated access to external funds. Indeed, banks may consider some circular oriented innovations a risky investment. In addition, companies may also lack access to public funds (when public funds are available), especially SMEs, due to a lack of human resources to cope with the administrative constraints.

Finally, circular oriented innovations may require specific physical resources (such as infrastructure or equipment) that a company does not own. Even more relevant from an incumbent perspective are the assets a company owns, which can hamper circular oriented innovation. Indeed, some assets may not be compatible with circular practices (for example equipment that does not accept any recycled material as input). Yet, a company is unlikely to replace such assets before the end of their amortisation period, creating a lock-in effect. Hence, the availability of an infrastructure compatible with the CE is key to implementing circular oriented innovations. In particular, one of the companies we interviewed mentioned the benefit of owning and managing all its infrastructure for the adoption of circular oriented innovation, as the company has more control over them and, therefore, more latitude to make its own choices. Nevertheless, this can also be seen as contradictory to circularity principles, which often promote usage over ownership.

While several incumbents mentioned issues associated with resources in the interviews we conducted, this remains quite anecdotic when compared to the existing literature. Overall, the lack of resources did not seem to be an important source of concern for our interviewees, which might partly be explained by the presence of many large companies in our sample. In addition to resources, incumbent firms

also mentioned a few capabilities, in particular processes. Alongside more technical processes, one interviewee discussed improper accounting processes associated with procurement, while another one mentioned the importance of good communication. In addition, a few respondents also discussed the need to develop internal collaboration processes, especially to avoid silo thinking.

The availability of the resources mentioned above is related to the size of a company, a fact underlined by the many publications focused on identifying barriers to the CE in SMEs. In addition to the access to resources, size can also prevent economies of scale, which are important to efficiently operate certain processes such as recycling. On the other hand, it can also impact the agility and flexibility of a company. Such agility is highly related to the structure of an organisation, which is another characteristic of a company that could potentially impact the adoption of circular oriented innovations. Many incumbents we interviewed were vertically organised, with a strong division of labour. Those types of structures are at risk of creating silo thinking, induced by limited collaboration between different departments. Avoiding this requires further efforts to improve internal collaboration, related to the capability discussed above.

In addition to their size and structure, a significant number of companies we interviewed (in particular non-manufacturing ones, for example in the mining, energy, retail or cultural sectors) mentioned the impact of their core business, and of where it was located in the value chain, on their ability to adopt circular oriented innovation. The importance of this aspect, almost absent from the literature, is likely related to our study design. Indeed, we purposefully interviewed companies in many different sectors, where circularity was often underdeveloped, while most existing studies focused on (often manufacturing-based) sectors with specific relevance from a CE perspective. In addition to the location of its main activity in the value chain, the scope of its activities also impacts the ability of a company to adopt a circular oriented innovation. Indeed, covering more value chain activities adds operational complexity, but reduces the complexity of the value network and the dependency of a company on other actors (an issue further discussed below). One of our interviewees adopted this vertical integration strategy to a significant extent.

4.3.3 Factors affecting the opportunity to implement circular oriented innovations

Opportunity is created by a context favourable to the development and adoption of circular oriented innovations, driven by the support of stakeholders for such innovation. This support is related to the stakeholders' evaluation of the outcome of an innovation, which, in turn, impacts their motivation to participate in the circular oriented innovation. Among the many stakeholders that can influence circular oriented innovation, customers and value network partners are likely the ones having the most impact, alongside the government, who defines the institutional context in which a company operates.

A lack of support from customers is a very often mentioned issue in the literature. This lack of support is associated with low or uncertain market demand. Among the factors affecting this support is the lack of awareness of consumers of the benefits of circular oriented innovations, which is associated with difficulties for companies to promote their circular offers. Contrary to the literature, this lack of awareness was not often mentioned by our interviewees. Instead, what was often mentioned is rather the discrepancy between what customers claim to value, or do, and what they actually do, both for purchasing and disposal behaviours. Such a discrepancy seems to be particularly important for consumers.

Reasons for the lack of customer support differ by customer segment. In B2C (business-to-consumer) markets, circular offers are often met with a reluctance on the part of consumers. Indeed, many circular offers rely on products that are not brand new (although they might be "as new", such as remanufactured ones) or on the sale of usage (e.g. rental services) rather than ownership. This conflicts with a focus on ownership and newness that is highly anchored in consumers' minds and that many consumers are unwilling (or unable) to change. In particular, circular offers can suffer from the (often flawed) consumers' perception regarding product quality or hygienic issues, as well as from fashion vulnerability. This issue is supported by a few examples, among our sample, of circular products that were cheaper, and sometimes of better quality, but that had to be discontinued due to a lack of demand. However, circular offers are not always cheaper and can also bring more inconvenience when compared to conventional offers. The lack of willingness to pay a premium for circular offers was often cited in the interviews we conducted. At the same time, one interviewee advised against selling a recycled product, with similar quality, cheaper than its new counterpart, as it can give a wrong signal about its quality to customers. Finally, circular offers are usually unfamiliar to consumers, which may frighten them. Nevertheless, novelty can also represent an incentive to adopt a circular offer for several consumer segments (in other words innovators and early adopters).

In B2B (business-to-business) and B2G (business-to-government) markets, issues are quite different from their B2C counterpart. Organisations (public or private) are less reluctant to lease or rent products (Tukker, 2015) and can accept remanufactured products more easily (Guide & Li, 2010). In such markets, the choice for circular offers rather depends on the procurement procedures in place. Currently, most tenders focus on cost, lacking sustainability or circularity criteria. This lack of integration of circular aspects in procurement does not only concern the private but also the public sector. A few interviewees mentioned the lack of circular criteria in the public tenders they participated in, and even mentioned a fear within the public sector of excluding too many companies if such criteria were to be integrated. In addition to a lack of circular related criteria, inappropriate accounting rules, for example provisioning yearly purchasing budgets without accounting for the increased lifetime (and therefore replacement time) of a circular asset, can also hamper the adoption of circular oriented innovations.

In addition to customers, value network (including supply chain) partners also play an important role in the adoption of circular oriented innovations. Indeed, circular

offers usually involve a more complex value network than their linear counterparts, notably due to the necessary addition of new suppliers and service providers. Such an increased complexity of the value network usually induces a greater dependency of a company on third parties. This increases the importance of collaboration across the value network, which has been strongly supported in our interviews. In particular, some companies mentioned the lack of communication between producers and reprocessors (in other words remanufacturers or recyclers) leading to supply issues, caused by an unsuiteable design for the latter. One interviewee even mentioned the benefits of collaborating with competitors (what is called coopetition (Bengtsson & Kock 2014; Bouncken et al. 2015)), for example, to co-use infrastructures.

Nevertheless, convincing partners to collaborate on a circular oriented innovation is not always easy. For example, some of the interviewees struggled for months or years to convince a supplier to adapt its operations (if they managed to at all). Hence, several interviewees mentioned the need for a circular oriented innovation to bring value to all involved stakeholders, not just to their company. Such a broader value creation process can lead to governance issues, associated with how value and responsibilities are shared across the value network, which can engender many contractual issues. Agreeing on governance aspects can be particularly complex, as a partner that does not see any interest in a circular offer is unlikely to support, or even oppose, it. Such opposition can threaten the adoption of a circular oriented innovation, even more so in cases where the power share across the value network is unbalanced and in favour of the reluctant partner.

Another issue associated with collaboration across the value network is related to a lack of trust or to confidentiality issues that result in a reluctance to share information. This can lead to large information asymmetry, which is particularly problematic when that concerns a lack of information on product design or material content. Indeed, this lack of knowledge on the characteristics of secondary supply was mentioned as an obstacle to the adoption of circular oriented innovations depending on this supply. For example, one interviewee mentioned supply issues related to the REACH certification, that producers were reluctant to pay for it due to a lack of insight into the potential value for their by-products. Those information-related issues led several interviewees to call for more traceability and transparency.

Nonetheless, the lack of support from value network partners is not always related to a lack of motivation but can also be due to a lack of ability, potentially caused by a lack of key resources on their side. Two strategies can be adopted to cope with that issue: either supporting existing partners or looking for new ones. Many of our interviewees opted for the first option, a few even invested financially in their partners. The second optionthe substitution of an existing partner, is not much discussed by our interviewees. That could potentially be related to contractual issues preventing a change in partnership in the short run, thereby creating a lock-in effect.

The lack of substitution for circular partners might also be related to the absence of such potential partners. Indeed, many incumbent firms we interviewed mentioned issues related to a lack of potential partners, sought-after circular offers or circular supply being non-existent. Due to the niche nature of the CE, the choice of potential

partners is quite limited, if not absent. That can lead to monopolistic abuse, which was reported by one interviewee who called for the development of more circular offers to compete with existing players. This same interviewee also mentioned his company had to wait for three years before finding a partner that could provide what it needed. A strategy to cope with this absence of circular partners or suitable supply, mentioned by some interviewees, could be to perform the needed activities internally. That, however, can be quite complex and risky. For example, a company might want to implement its own take-back system (what some of our interviewees have done). However, this requires much investment, with the establishment of complex reverse logistical operations and a strong cooperation with customers.

Aside from customers and value network partners, other key stakeholders from the business ecosystem of a company, that were mentioned to greatly influence the adoption of circular oriented innovations, are governments, which set the institutional context in which the company evolves. A government can use two types of approaches when willing to support circular oriented innovations: either prompting certain interventions or implementing coercive legislation.

A first approach government can adopt to support circular oriented innovation is by orienting the operations of actors in a non-coercive way. This can take the form of direct incentives, such as grants, or indirect incentives, making linear practices less appealing. An example given by an interviewee is the carbon tax, which might indirectly support the adoption of circular oriented innovations (as it often leads to a lower environmental impact). Nevertheless, such public support is not that often mentioned by our interviewee as compared to the literature. This could be linked with the less frequent mention of resource-related issues, since the incumbent already developed a set of key resources they can allocate to new projects. While those incentives can greatly support circular oriented innovations, they might also lead to unforeseen adverse effects. For example, support for recycling might hamper reuse. In addition, there might also be unaligned incentives, for example, a higher VAT on services than on goods. Hence, supporting schemes must be carefully designed.

On the other hand, governments can take measures to impose or forbid specific operations. The literature particularly underlines both a lack of effective legislation and its enforcement. Hence, it further suggests the development of coherent policy packages. Our interviewees underlined two policy issues in particular, that are related to the institutional context we focused on (Belgium) but can also be relevant to other contexts. The first issue is related to the complexity of the legislation, and the many administrative burdens associated with it. These administrative burdens were mentioned by companies of all sizes but were said to have a stronger impact on smaller companies, which were subject to the same legislation but could not afford to dedicate a full team on compliance issues. The second issue mentioned was related to the lack of harmonisation of policies between different regions. While in many countries this only concerns multinational corporations, this was considered particularly problematic in a country like Belgium, where seven different legislations (French, Luxembourgish, German, Walloon, Brussels, Flemish and Dutch) can be encountered in less than a 400 km drive.

4.4 DISCUSSION

4.4.1 Specific challenges for incumbent firms to adopt circular oriented innovations

Incumbent firms are, by definition, involved in socio-technical regimes and can, therefore, have a vested interest in maintaining the status quo (Johnstone, Stirling& Sovacool 2017). This often led researchers to assume incumbent firms oppose sustainability transitions, an assumption that has only recently been questioned (Turnheim & Sovacool 2020). Indeed, some incumbent firms, such as the ones we interviewed, can see the interest in transitioning to circularity. Nonetheless, those firms may face challenges that are specific to their incumbency, which can further explain the tendency to focus on the status quo. Those specific challenges are mostly related to the embeddedness of incumbent firms in a business ecosystem (Moore 1993; Jacobides, Cennamo& Gawer 2018), which is a set of actors that contribute to a collective outcome (Konietzko, Bocken& Hultink 2020), and in particular to a common value proposition in the case of value creation (Kapoor 2018). Such an ecosystem includes a broad set of stakeholders (such as suppliers, service providers, end-users, regulators or civil society organisations), with potentially conflicting interests, but that agreed to collaborate on the common value proposition. Hence, any change in this original value proposition may impact other actors, and therefore lead to a reaction.

Among the different types of relationships between actors in a business ecosystem, contractual ones are likely the most binding for a company. Such relationships are often found in supply chains, which may explain the importance of supply chain-related issues in our findings. In particular, contractual relationships may be time-bound, and therefore create lock-in effects slowing down the transition process of an incumbent. Other lock-ins might also be found in the resources of the company, particularly in its infrastructure. Such lock-ins can partly explain the strategy, which is often adopted by incumbent firms, to delay the transition (van Mossel, van Rijnsoever& Hekkert 2018).

Aside from contractual relationships, other relationships might also affect incumbent firms and orient their strategy towards a transition to circularity. Among those are the relationships that a company has with its customers. Indeed, incumbent firms already have a customer base, that they try to keep and grow (Blank & Dorf 2012). When implementing circular oriented innovations, incumbent firms can be afraid of losing customers, and thereby market share. A notable change in many circular offers, based on circular business models promoting the sale of usage (e.g. rental services) or results (e.g. "as a service" offers) instead of ownership, is the transformation of rather informal customer relationships, based on short-term contracts, to formal relationships based on long-term contracts. While this secures the firm's revenues, this can also lead to a loss of customers interested in the flexibility provided by the absence of long-term contracts.

Another distinctive aspect of incumbent firms is related to the existence of key resources and capabilities. While these resources and capabilities likely allowed them to get a competitive advantage (as supported by the resource-based view of the

firm (Wernerfelt 1984; Barney 1991)), they can also limit the possibilities for further reconfiguration of the firm. Indeed, several key resources of a company might not be aligned with the requirements of a circular oriented innovation. In addition, several organisational processes might not be aligned with circular principles, as shown by the example of procurement policies and accounting rules. Hence, the organisational transition of incumbent firms to circularity further requires dynamic capabilities to adapt their resource base (Teece 2007; Santa-Maria, Vermeulen& Baumgartner 2021).

4.4.2 How can incumbent firms adopt circular oriented innovations?

The interviews we had with incumbent firms led to the identification of several pieces of advice that could support incumbent firms in the adoption of circular oriented innovations. Those are summarised in **Table 4.5**.

	Advice	MOA dimension
1	Engage top management	Motivation
2	Integrate circular principles in your corporate strategy	Motivation
3	Integrate circular oriented innovations into a circular story	Motivation
4	Engage employees	Ability
5	Invest in circular oriented R&D	Ability
6	Develop dedicated circular oriented business units	Ability
7	Adopt circular oriented innovations adapted to your company	Ability
8	Use circular offers to access new markets	Opportunity
9	Align your circular offer with customers' needs	Opportunity
10	Do not undersell circular products	Opportunity
11	Integrate circularity criteria in your procurement policy	Opportunity
12	Consider the total cost of ownership (or usage) of a product	Opportunity
13	Engage partners (with particular suppliers)	Opportunity
14	Increase the traceability of your supply chain	Opportunity
15	Consider coopetition to reduce infrastructure cost	Opportunity

TABLE 4.5: Advice for incumbent firms to adopt circular oriented innovations

The first pieces of advice (*1-2-3*) are related to the creation of a circular story, driven by the top management and embedded in the corporate strategy. Such a circular story can as such be presented to financers, enabling less profitable circular oriented innovations to be adopted (on the condition that the whole story remains profitable). It can also be given a catchy name for people to remember, therefore easing communication. In addition, such a story must be embraced by employees (*4*).

Our results also suggest, supplementing the literature (Atasu, Dumas& Van Wassenhove 2021), that a company must adopt circular oriented innovations that are aligned with its resources and capabilities, as well as with its structure (*7*). Indeed, not all circular

oriented innovations are well suited for incumbent firms with well-defined organisational processes. In such a case, an incumbent firm may prefer to use structural separation (Kuhlmann, Bening& Hoffmann 2022), developing its innovation in a spin-off, or even a joint venture, that will be much more flexible. This strategy can also be interesting to support the company in targeting a new market (8), keeping risks out of the core business. If the circular oriented innovation is aligned with the resources and capabilities of an incumbent firm, the firm can also choose to develop it internally. In such a case, it is advisable to develop it in a dedicated business unit (6). However, it is important that this business unit is not considered less important than others and does not serve as an adjustment variable. Indeed, research has underlined the need for a protected and autonomous experimental space in the intra-organisational development of circular oriented innovation (Smith & Raven 2012; Hofmann & Jaeger-Erben 2020).

A particularly important factor, when developing a new circular offer, is to develop a price strategy that is aligned with the customers' willingness to pay. Indeed, most customers are not ready to pay a premium for circular offers. Hence, the offer should reflect that, either being cheaper or providing a new type of value (for example convenience, flexibility, et cetera), aligned with the customers' needs (*9*). Nonetheless, a circular offer should also not be too cheap (*10*), as this might give a wrong signal about its quality to customers. Hence, pricing a circular offer well is a real balancing act.

On the other side of the spectrum, companies should also take great care about the upstream of their value network. A first aspect to consider is related to the procurement policy of the company. Indeed, a company can have a great influence on the circularity of its value network by integrating circularity criteria in its tenders (*11*). In addition, many companies tend to focus on the capital expenditure (CAPEX) of an asset. However, it may well be that some products requiring a large upfront investment cost will last longer, are cheaper in the long run. Furthermore, several circular offers will provide services rather than products, involving monthly fees. Hence, a more circular way of managing tenders would be to compare offers based on their total cost of ownership (TCO) rather than their CAPEX (*12*). A second aspect related to the upstream value network relates to the management of the supply chain of a company. In particular, adopting circular innovation often requires a strong engagement of partners, in particular suppliers (*13*). Supply chain collaboration (Soosay & Hyland 2015; Chen et al. 2017) can help greatly in the process. It can also allow for greater traceability of products (14), which will significantly ease the maintenance and reprocessing of such products. Nonetheless, such a circular supply chain collaboration has received little attention up until now and could benefit from further research (Farooque et al. 2019).

4.4.3 What can government do to support the adoption of circular oriented innovations by incumbent firms?

In addition to the advice for companies, interviewees also suggested several directions for governments to further support the adoption of circular oriented innovations by incumbent firms. A first dimension on which a government could play, relates to the

further adoption of circular procurement, following the often mentioned example of the Netherlands (Hartley, van Santen& Kirchherr 2020). Indeed, most public procurement policies do not integrate criteria that would support the selection of more circular offers. Doing so would increase the demand for such circular offers, while it has a symbolic value associated with the exemplary function of public authorities (what is, for example, integrated into the Brussels Regional Program for a CE). Nonetheless, the development of such circular procurements is not straightforward and requires further collaboration between the procurer and the supplier (Witjes & Lozano 2016). In addition to public procurement, further work could also be done to incentivise companies to adopt circular procurement policies. This can either be done on a voluntary basis or by increasing regulatory pressure, which has already been proven to influence companies' purchasing behaviour (Zhu & Sarkis 2007).

A second direction to support the adoption of circular oriented innovations by incumbent firms would be to focus on product design, and in particular supporting the design for circularity. Indeed, many companies mentioned linear product design (for example products glued, intensive use of alloys, et cetera) as a major issue for them to reprocess used products. Since the early 2000s, many extended producer responsibility (EPR) schemes were implemented to support design for circularity (in particular recycling). Extended producer responsibility (Lindhqvist 2000) is a policy strategy that makes producers responsible for the whole life cycle of the products they put on the market, including waste management. Such an approach is based on the assumption that making producers responsible for the end of life of products they put on the market would incentivise them to improve the design of products to ease their reprocessing. Nevertheless, the introduction of collective take-back schemes has often removed the intended eco-design incentive (van Rossem, Tojo& Lindhqvist 2006). Indeed, collective take-back schemes are financed through advanced recycling fees paid on each product sold. In most cases, such fees do not account for the real recycling cost (what is called eco-modulation) but are only based on the type of product. Under such circumstances, there is no incentive for producers to improve their product design. One way to reintroduce such eco-design incentive would be to change the way advanced recycling fees are calculated (Mayers et al. 2013) by integrating eco-modulation, and therefore reintroducing the individual producer's responsibility (Dempsey et al. 2012). However, there is no certainty that such an eco-modulation would provide a sufficient incentive for producers to adapt the design of their products (Micheaux & Aggeri 2021). Hence, other measures, such as a "CE" product label (Boyer et al. 2021) or marketing authorisations, could also be implemented.

A third direction would be to strengthen environmental legislation, for example by the introduction of a carbon tax or the extension of the European carbon market (EU ETS). Indeed, many circular oriented innovations are associated with a lower environmental impact (although this is not always the case, as exemplified by dockless e-scooters (Hollingsworth, Copeland& Johnson 2019; Moreau et al. 2020)). Therefore, policies supporting environmental sustainability are also likely to support many circular oriented innovations as a side effect.

Finally, other directions have not been directly suggested by the executives we interviewed, but have been mentioned in the literature. We can cite for example waste-related taxes (promoting waste reduction), measures to reduce labour cost (increasing the profitability of highly labour-intensive circular operations such as remanufacturing (Stahel & Reday 1976)) or VAT reduction (to support repair services and second-hand products, as is already the case in Belgium).

Another aspect that was mentioned, and deemed particularly important in the context of our study, is the need to harmonise circularity-related legislation, not only between countries but also within the same country. Indeed, in our case (Belgium), the division of power makes that several issues for the implementation of circular oriented innovations are to be dealt with at the federal level, while others relate to regional prerogatives. Nonetheless, all Belgian regions have different policies related to the CE, which can make it hard for a company operating in the three regions to comply. On the other hand, each region has a different circular strategy, which can create different opportunities for companies operating in different regions, especially as different sectors are prioritised in each region.

4.5 CONCLUSION

Across this chapter, we have seen that many factors can affect the development and adoption of circular oriented innovations in incumbent firms. Those factors were often characterised by the barrier, enabler and driver concepts, which integrate a directional aspect (positive or negative) on the impact the factor has on the adoption of circular oriented innovations. This aspect leads to the permeability of these concepts, the classification of a factor depending on the type of innovation considered and the company implementing it. To overcome this variability issue, we introduced a novel classification based on the origin of the factor (endogenous or exogenous) and the way it acts upon the adoption of a circular oriented innovation (directly or indirectly). Following those two aspects, the classification suggests considering three categories of factors: factors affecting the (intrinsic or extrinsic) motivation of a company, factors affecting its ability and factors affecting the opportunities provided. Doing so allowed for analogies with the MOA model, which is widely used for explaining pro-environmental behaviour (Ölander & Thøgersen 1995).

Following its development, we further used this novel classification to organise and compare factors identified both in the literature and in interviews we conducted with incumbent firms. This analysis led us to identify factors related to existing supply chains and customer bases, as well as organisational structures, as particularly challenging for incumbent firms. The interviews we conducted also led to the identification of advice to support incumbent firms in the adoption of circular oriented innovation and, overall, the transition to circular organisations. Finally, and based on our findings, we also suggested a few directions for the implementation of policy measures supporting incumbent firms in their circular oriented innovation efforts. Those directions, which are

well aligned with previous literature on policies supporting a transition to a CE (Milios 2017; Hartley, van Santen& Kirchherr 2020), particularly concern the development of circular procurement and the redesign of extended producer responsibility schemes.

The research we conducted presents several limitations. A first set of limitations relates to the sampling strategy used for the literature review. Indeed, the scope of the literature review was limited to peer-reviewed articles published in English. Furthermore, our search query focused on barriers, drivers and enablers, excluding other relevant concepts such as "challenge", "opportunity" or "impact". Due to its limitations, our sampling strategy cannot guarantee to be representative of the sampled publications, in which several types of circular oriented innovations or specific companies or sectors can be overrepresented. Another set of limitations relates to the sampling strategy used for interviews. This strategy was widely based on peer recognition. Hence, it only focused on companies acknowledged as being circular, but not on "circular companies" as a whole. Considering "circular companies" as a whole would have required the selection of a definition of the CE, which would also have introduced a bias given the many different definitions of the concept (Kirchherr, Reike & Hekkert 2017). In this sampling strategy, we favoured diversity over quantity, which led us to a final sample size that may barely lead to data saturation (Guest, Bunce & Johnson 2006). More interviews may be useful to further validate such data saturation. Finally, a last limitation can be found in the analysis of data, which was performed by a single researcher. Although it is usually advised to involve multiple coders (Barbour 2001) and to compare how those researchers coded the same data (O'Connor & Joffe 2020), such an approach was, unfortunately, not possible in the context of the present research.

The present qualitative analysis could be complemented by further quantitative research on the relative importance of factors for incumbent firms. Such importance could be further compared with the importance of factors for new entrants. In addition, it could also be further analysed by type of circular oriented innovation, which are not necessarily subject to the same issues. Finally, the analysis in the present chapter was purposefully designed to temper contextual issues other than incumbency. Yet, many other contextual aspects can influence the adoption of circular oriented innovations. Hence, the next chapter (**Chapter 5**) will further analyse the importance of context for the adoption of circular oriented innovations, using a case study focusing on the construction sector in Belgium.

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CHAPTER 5

FACTORS IMPACTING THE TRANSITIONING TO A CIRCULAR ECONOMY IN AN INDUSTRY: THE EXAMPLE OF THE CONSTRUCTION SECTOR

Giulia Caterina Verga & Ahmed Zaib Khan

5.1 INTRODUCTION

The main objective of this chapter is to identify and discuss the factors influencing the transitioning in a particular sector (in this case construction). To do so, we start by questioning which are the context-specific factors affecting the adoption of circularity oriented innovations in the Belgian construction sector, and what is their impact. While the second part questions how to engage in the transitioning of this sector within a specific national context (in this case Belgium). **Chapter 4** proposes a novel classification of factors affecting the implementation of circular oriented innovations, with a focus on incumbent companies. These factors are divided according to how they affect the motivation, opportunities and abilities (MOA) of companies in their adoption of circular oriented innovations. As previously explained (see **Section 4.2**), some factors could impact the implementation of circular oriented innovations positively (as enablers and drivers) or negatively (as barriers). Furthermore, some factors are internal to the company (affecting the capabilities and resources as well as the motivations to transition) and others external (creating or hindering opportunities and motivation to engage with circular oriented innovations). The kind of impact these factors have on different companies' adoption of such innovations may vary according to the economic sector and the business' ecosystems, the companies' characteristics (such as their size or position in the value chain) and the context in which they operate (international, national, regional, et cetera). Context and company-specific elements influence how these factors are perceived and, therefore, their effects. In order to discuss these factors in relation to a specific context, we take the example of an industry as a case study

(namely the construction sector) within a national context: Belgium. Thus, the research questions this chapter addresses are:

> *What are the context-specific factors affecting the adoption of circular oriented innovations in the Belgian construction sector? What is their importance in the adoption of circular oriented innovations, supporting a transition to a circular economy (CE)? How to engage in the transitioning of this sector in a specific national context (i.e., Belgium)?*

To answer these questions, this chapter is divided into three main parts. The methodology is based on a literature review and on interviews with stakeholders. The first part elaborates on the Belgian construction sector. This is articulated in four sub-parts: the first sub-part (**5.2.1**) presents circularity oriented innovations in the construction sector; the second sub-part (**5.2.2**) makes use of the framework of the ladder of value retention (see **Chapter 1**) and helps evaluate such innovations; the third sub-part (**5.2.3**) highlights business opportunities, while the fourth one (**5.2.4**) pinpoints sectorial stakeholders (actors). The content has been developed as part of an ongoing research on circularity ambitions at the urban level (Verga & Khan 2022) and is based on a literature review (scholarly and grey). The second part of the chapter focuses on factors affecting the successful adoption of circularity innovations by Belgian construction companies, based on the novel MOA framework elaborated in **Chapter 4.** This second part is divided into two main sub-parts: the first (**5.3.1**) is based on a qualitative analysis of the outcomes of semi-structured interviews, and the second (**5.3.2**) is based on a quantitative analysis of the answers of a survey. The discussion (**Section 5.4**) is developed around these factors, where two major outcomes of this investigation are highlighted: the first (in **Section 5.4.1**) being the relevance of spatial factors (which was not cited in the literature analysis we conducted yet emerged from the discussions with sectorial stakeholders). The major novel factor that emerged during the first round of interviews, was linked to lack of space, more precisely to the lack of affordable and suitable logistic spaces (most often in urban areas). The second outcome (in **Section 5.4.3**) is addressed to policymakers and discusses public support (current policies and advocated ones). Conclusions highlight limitations and proposes avenues for future research. All parts are based on a review of the literature (both scholarly and grey literature). The first and second parts are based on international literature, while the third part analyses the Belgian context in more depth. This latter section is based on a survey of Belgian companies (including companies' executives, but not only) operating in the construction sector, some of which are incumbent companies and others are new entrants (all working on circular oriented innovations). The decision to not only include incumbent firms (as in the previous chapter) allows us to assess a boarder spectrum of factors affecting the successful transitioning of this sector.

5.2 THE BELGIAN CONSTRUCTION SECTOR AS A CASE STUDY

There are multiple reasons for choosing the construction sector. First and foremost, this sector is put forward in all CE policies as it has a major impact on national and international resource consumption, and waste production. In Belgium, quantities of solid and liquid waste have been increasing over the years, as **Table 5.1** shows. The impact (in tons of waste) of the construction sector alone represents one-third of the overall waste produced on a national level. Nevertheless, accounting for waste alone gives only a partial view. To give a more complete overview of the impacts of such a sector, the quantification of resource consumption (and waste production) resulting from the use (exploitation) of buildings, should also be taken into consideration.

Waste production by economic activity in Belgium (2004-2018, in tons)	2004	2006	2008	2010	2012	2014	2016	2018
Total	53 013 275	59 294 999	48 615 551	61 323 320	53 839 470	57 965,403	63 152 377	67 429 779
Construction	11 051 218	13 089 649	15 441 861	16 852 662	17 132 769	18 347 259	19 573 149	22 658 151
Services	8 971 810	9 959 475	5 023 641	6 697 911	4 635 229	4 840 455	5 403 172	4 850 496
Households	5 337 002	4 745 162	4 459 161	5 865 753	5 294 743	5 419 043	5 041,208	4 885 123
Industry	26 466 600	31 138 888	23 409 597	31 707 672	26 611 266	29 046 813	32 865 656	34 778 422
Agriculture	1 186 645	361 825	281 291	199 322	165 462	311 833	269 192	257 587

TABLE 5.I: Tons of solid and liquid waste flows produced in Belgium between 2004 and 2018 divided per economic activity. Source: Statbel (Directorate-General Statistics – Statistics Belgium) based on surveys, administrative data (OVAM, IBGE-BIM, DGARNE) and models.

An interesting example of the impact of the construction sector and the operation of buildings on a European level and in the Brussels Capital Region is summarised in **Table 5.2**. It shows that, in this region alone, the built environment accounts for 98 % of the water flow, 75 % of the energy demand, 65 % of greenhouse gas emissions and 33 % of waste generated, and for an average of 628 000 tons of wasted construction materials in a year. If we then compare it with the rest of Europe, it clearly shows why the construction sector is an important one in regional, national and supra-national policies aiming at transitioning towards more circular (less consuming and wasting) paradigms.

The construction and operation of buildings in brussels represents	The construction and operation of buildings in the european union represents
20 % OF ENTERING MATERIALS FLOWS 98 % WATER FLOW 75 % OF ENERGY DEMAND 65 % OF GREENHOUSE GAS EMISSIONS 33 % OF WASTE GENERATED 628 000 TONS OF WASTE PER YEAR ARE GENERATED (Source: Bruxelles Environnement 2018)	50 % OF THE EXTRACTION OF ALL MATERIALS 33 % OF WATER CONSUMPTION 40 % OF ENERGY DEMAND 36 % OF GREENHOUSE GAS EMISSIONS 38 % OF WASTE GENERATED (Source: European Commission 2020)

TABLE 5.2: Statistics of resource consumption and waste production from the construction sector in Brussels and Europe.

5.2.1 Circularity oriented innovations in the construction sector

This part provides an overview of circularity oriented innovation, using the construction sector as a case study. The aim is to set the scene for the discussion on factors affecting companies' transitioning towards more circular paradigms. First, a consensus definition of circularity ambitions dealing with the built environment is given. The strategic definition we propose is from Brussels' regional agency for the environment:

> *The CE in the built environment aims to: (1) reduce the use of natural resources, (2) reduce greenhouse gas emissions from resource extraction, material production, logistics (3) reduce the production of waste. To achieve this, it is necessary to: (1) reuse and enhance the existing, (2) anticipate future needs to minimise the production of future waste, (3) promote sorting (from the construction site to the final use).*
> *(Bruxelles Environnement 2021a).*

Nevertheless, it is not straightforward to draw up a roadmap for the construction sector aiming at the implementation of virtuous circularity strategies. Within the construction sector, we have an incredibly complex and diverse ecosystem of stakeholders, approaches and logics (Hart et al. 2019). What also adds to the complexity of the picture is that the built environment is made up of very diverse types of stock (infrastructure and buildings). Each artefact making up the built environment is unique, made and used by people in specific contexts. The uniqueness of each architectural and engineering project is typical of this industry. Each project is also unique because it brings together a set of actors (clients, architects, engineers, consultants, contractors, builders, users, et cetera) who all collaborate together only once (or very rarely more than once). Standardisation is possible in the production of components and materials, but it becomes increasingly difficult to work with standardisation as the scale of the final artefact gets larger. Furthermore, if we look at the materiality of the built environment itself, we see it is composed of a very large set of different kinds of components and materials, placed in very different ways (for example, the same wooden floor can be interlocked, nailed, screwed, glued, etc). In addition, transitioning towards circular oriented practices in the construction sector includes tackling multiple aspects dealing

with different phases: the design, construction, maintenance, use, modification, renovation, deconstruction and demolition.

Having a larger view of the business ecosystem in which companies operate is important to prevent rebound effects. A narrow circular oriented innovation approach (only focused on one reality, or product, or service, et cetera) could be producing heavier environmental impacts than the ones it claims to improve. Hart et al. (2019) take as examples some technology-oriented solutions that for some are seen as drivers and for others as threats since they can imply large resource consumption linked to technological development. In fact, such remarks can also be seen as typical rebound effect risks, as discussed in **Chapter 1**. For example, a circular oriented innovation of the *service economy* (such as the "pay per lux") could result in a negative environmental effect if the company operating it does not take into consideration indicators that go beyond energetic performance. The company should therefore also include in their strategy the circular management of the dismounting, disassembly, upgrading of the goods, et cetera (Hart et al. 2019).

References of international literature:

Within the construction sector debate, we witness two main types of publications: holistic ones, tackling the construction sector in general (such as Benachio, Freitas & Tavares 2020; Bilal et al. 2020; Çimen 2021; Hart et al. 2019; Low et al. 2020), and others looking at specific circularity strategies linked to the different phases of projects (design, construction, deconstruction, reuse, recycling, waste management, economic model implementation) (see Adams et al. 2017). Some tackle circular materials (Morel & Charef 2019). Other focus on reuse (Coppens et al. 2016; Ghyoot et al. 2018), or on demolition waste management and treatment (Ghisellini et al. 2018; Mahpour 2018; Wahlström et al. 2020), or on the reuse of recycled parts in new constructions (Shooshtarian et al. 2020). A great body of work focuses on barriers, drivers and enablers of circular design (Gorgolewski 2008; Kanters 2020). Some articles and reports are more business-oriented and elaborate on circular real estate and value creation (Acharya at al. 2020; Fischer et al. 2019), while others are more policy oriented (ICEDD, FRDO-CFDD et al. 2020). Furthermore, literature on factors influencing the implementation of the CE is getting broader every day that passes (Joensuu et al. 2020). The more experimentations are carried out, the more knowledge is divulged, and the more feedback produced.

5.2.2 Circularity strategies in the construction sector: how to evaluate them

The CE discourse on the built environment is often structured within R-imperatives ladder (as described in **Chapter 1**). Nevertheless, in an intermediate scale dealing with the built environment, actors, phases and potential strategies multiply and the subsequent picture that emerges is complex. In this multifaceted panorama, we propose a roadmap of circularity strategies developed for the built environment. It follows the

R-imperatives ladder (Çimen 2021; Kirchherr et al. 2017; Reike et al. 2018): from the most virtuous strategies aiming at shrinking the loops, passing over a two-step "slow the loop" (first of the artefact as a whole, for example a building, and then of its parts) and then arriving at closing the loop. **Table 5.3** illustrates an attempt to delineate the value retention ladder for the built environment.

In the literature (both academic and grey), when it comes to defining circular oriented innovations in the construction sector, two main branches of approaches emerge. The first focuses on improving existing buildings and infrastructure (dealing with existing building stocks), while the second focuses on how to design and construct new buildings and infrastructure (thus generating new buildings and infrastructure stocks). The first branch looks at how to extend the life of existing buildings as well as infrastructure and promotes practices of "optimal" use, maintenance, reuse of artefacts in their integrity in the first instance, then recovery and reuse of dismantled components and materials, and finally their recycling. The second branch focuses on how to improve the quality of future stocks, through circular design concepts and approaches, as well as working on how new buildings can be conceived, planned and managed in a circular manner, in order to reduce waste (BAZED 2021; Galle et al. 2019b). These two approaches are shown in **Figure 5.1**.

	Strategies (Kirchherr et al. 2017; Reike et al. 2018)	**Aim(s)**	**Examples of actions**
1	**Narrow the Loop** Rethink Refuse Reduce	Tackling immaterial relationships humans have with buildings and infrastructures. Shifts in the perception of value, towards more sober behaviours, long-run visions & ambitions. New regulations and subventions supporting renovation over demolition, reuse rather than new products. Experimentation and knowledge development.	Promote resources-conscious behaviours and practices that aim at lowering resource inputs and waste outputs (in other words consuming less energy, water, materials, et cetera). change the perception of value, favouring the reuse of existing buildings, infrastructures, components and resources at proximity. Change regulations and subventions. Development of theoretical and practical knowledge: research programmes and hands-on experiences, with test phases and terrain experimentation Changing design and construction processes: introducing new roles, phases, practices, legislations, subventions, et cetera A different, more sustainable material alternative is proposed to replace "standard" and "linear" materials (for example, non-toxic materials instead of toxic ones, bio-sourced, low-embedded CO_2, compostable, endlessly reusable materials instead of toxic, oil-based, CO_2-intensive, energy-intensive to reuse and recycle ones). Shift of project ambitions, long-term view shall become the priority with a focus on developing the most "resilient", "long lasting", "adaptable" and "thriving" building, infrastructure and space. Renewing design briefs and strategies together with users/owners/contractors/technical consultants/et cetera In-depth materials and use analysis of the building/infrastructure
2	**Slow the Loop** (of buildings and infrastructures in their integrity) Share, Maintain Repair, Resell, Rent/ Reuse, Renovate, Refurbish	Keeping artefacts from physical and economic obsolescence, maximizing their integrity and longevity.	Optimal use against obsolescence of use (economic) Maintenance of the existing against materials obsolescence Resell of the whole Rent/Reuse of the whole Renovation of the whole Refurbishment of the whole
3	**Slow the Loop** (of parts of buildings and infrastructures) Share, Maintain, Repair, Resell, Reuse, Renovate, Refurbish	Salvaging parts of artefacts, minimizing rework and logistics. Striving for the integrity of parts, their longevity and future adaptability.	Test and research on materials to be salvaged Practices of salvaging parts Transport of parts Cleaning/Reparation of parts Refurbishing parts Storage of parts Resell of parts Reuse of parts
4	**Close the Loop** (of parts of buildings and infrastructures) Reuse of circular materials, Composting materials, Demolishing, Recycling, Recovery energy, Landfill	Down-cycling of parts and materials of artefacts. It implies a heavy rework and logistics in order to demolish, recycle, recover and landfill. These activities have important impacts on energy and space consumption and pollution.	Use of locally available materials that can be reused endlessly (for example pure clay) or materials that can be composted (for example pure straw, hemp, wool, wood without any glue, et cetera) Dismantling of salvageable components and materials Demolition and waste sorting Recycling of elements that are not salvaged Recovering energy (combustion) of elements that are not salvaged nor recycled Landfilling of elements that are not salvaged nor recycled nor burnt

TABLE 5.3: Circularity strategies evaluation framework applied to the construction sector, by the authors (2022).

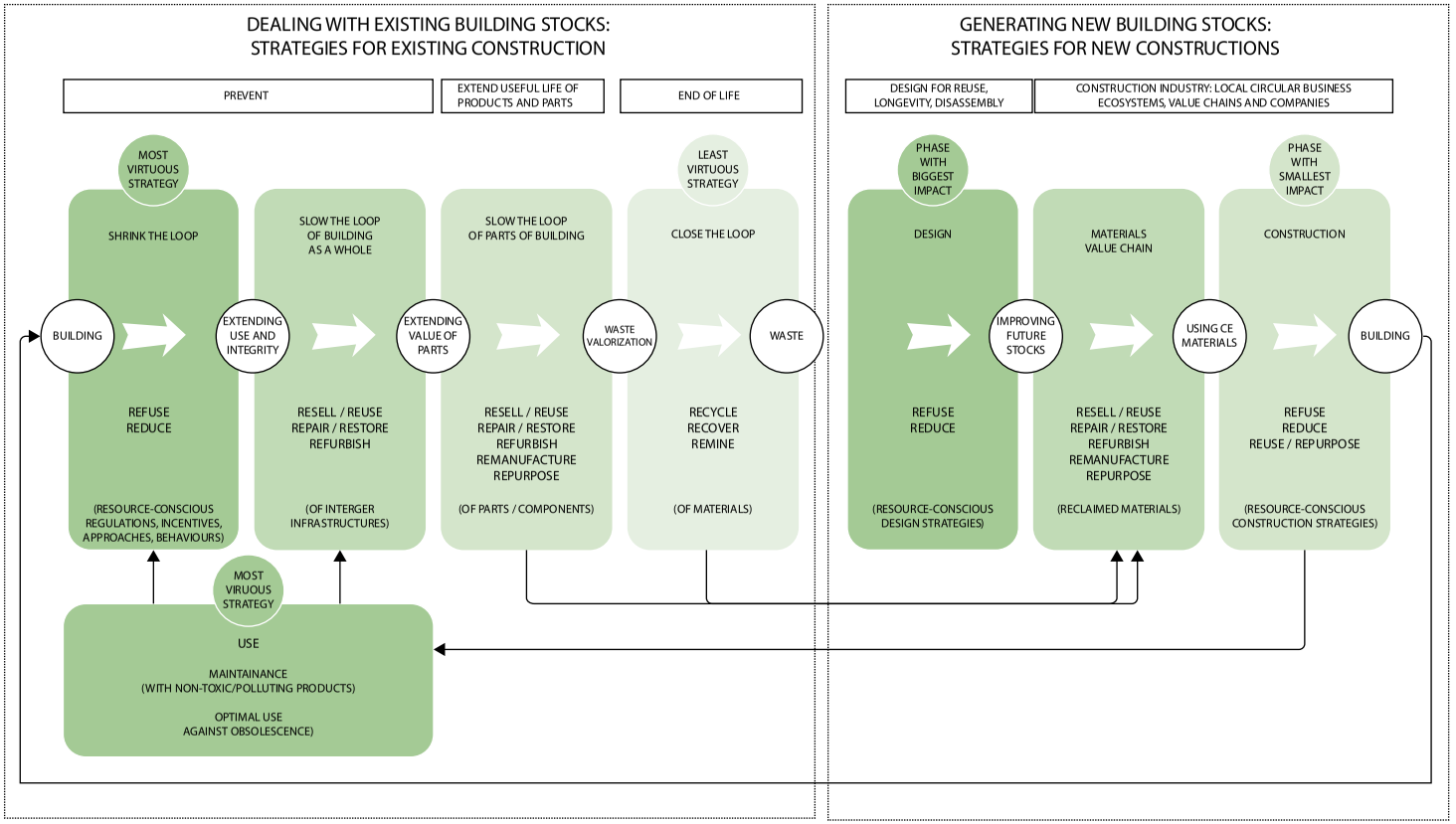

FIGURE 5.1: Diagram of the ladder of circularity strategies applied to the construction sector, by the authors (2022).

5.2.3 Circular business opportunities in the construction sector

Circularity practices linked to the built environment have always existed, yet many of them have disappeared over the last century or have become marginal. There are many reasons that have resulted in western societies wasting more and more construction materials while shaping (and reshaping) the built environment. The technological development of heavy machinery for demolition, together with the complexification of buildings' construction details, the rising of labour taxation in Europe (and more specifically in Belgium), and the lowering of globalised product prices, made the linear economy become the trend. The reuse of components and materials (as it is more labour-intensive) often became more expensive in comparison to new elements (even if the quality of reclaimed elements and new ones are often non-comparable). Furthermore, it is important not to oversee socio-cultural factors and the shift in value perception. An example is that generally signs of wear (or *patina* of time) on built elements are unwanted and there is a clear preference for new things (Ghyoot et al. 2018). The economic obsolescence of buildings often comes before the programmatic (functional) and physical obsolescence. Especially in office buildings, the cause of early demolitions of still functional buildings is not their technical or spatial obsolescence but rather an economic one. The European Union is well aware of the socio-ecological and economic consequences at stake when it comes to the obsolescence of buildings and neighbourhoods, as witnessed by the recently publishing handbook for the reuse of spaces and buildings (Urban Agenda for the EU et al. 2019). In this section, we present two schemes: the first shows how the construction sector currently works (**Figure 5.2**), while the second one shows potential circular business models in the current value chain (as business opportunities) (**Figure 5.3**). Three main approaches are outlined as types of circular business models: those dealing with circular design, circular use, and circular recovery (Carra & Magdani 2018). If we take the example of a circularity practice such as the selective deconstruction of construction components (in the graph indicated as the recovery provider), there are mainly three kinds of businesses that emerge: historical family-run businesses that have existed for more than a century, companies that work within the social economy and new companies that have emerged after 2010 in the increase of CE ambitions.

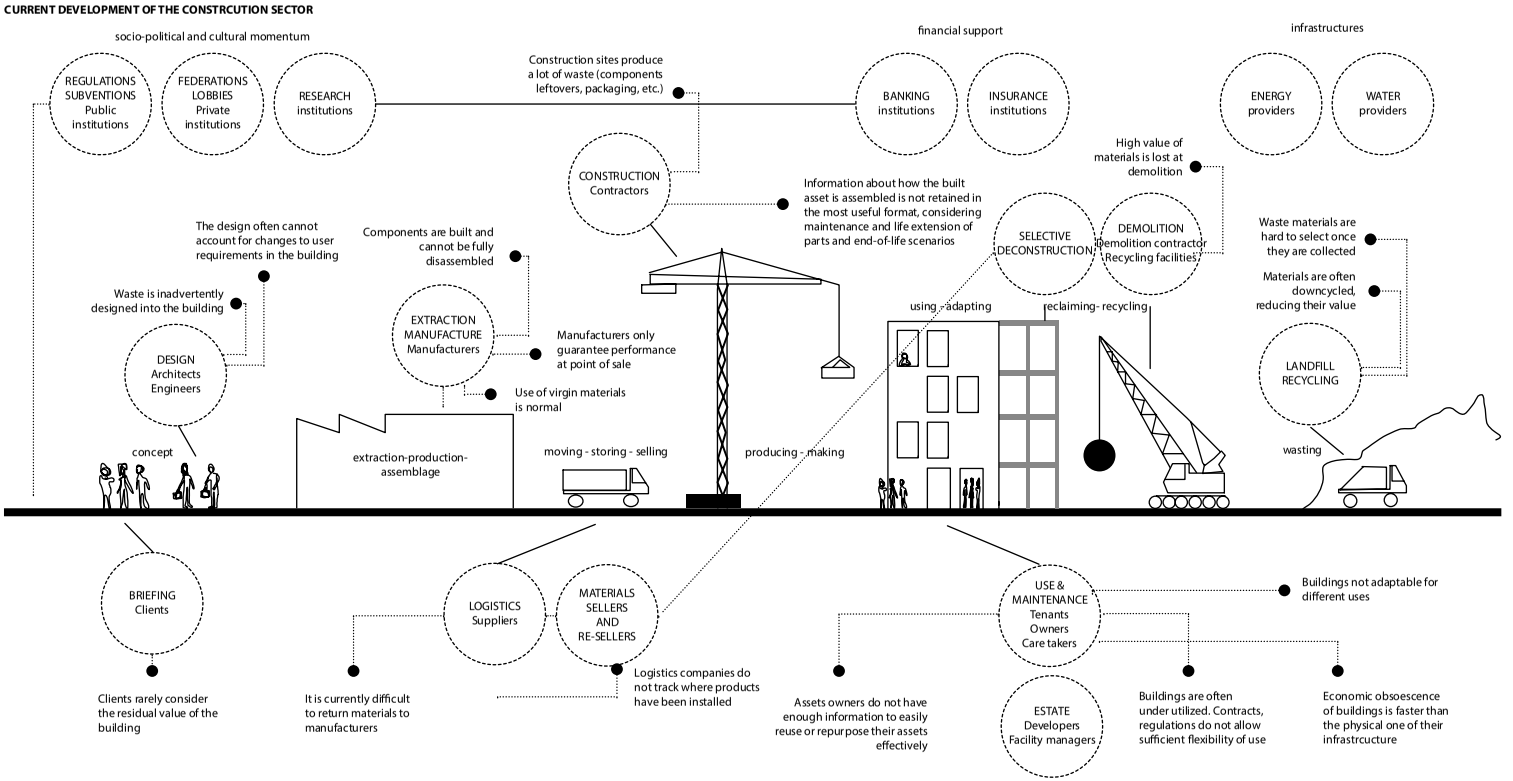

FIGURE 5.2: Outline of how the construction sector currently works, based on a re-elaboration and adaptation of a scheme from ARUP (2018), by the authors (2022).

CIRCULAR BUSINESS MODELS IN THE CURRENT VALUE CHAIN, DIVIDED INTO 3 CATEGORIES:

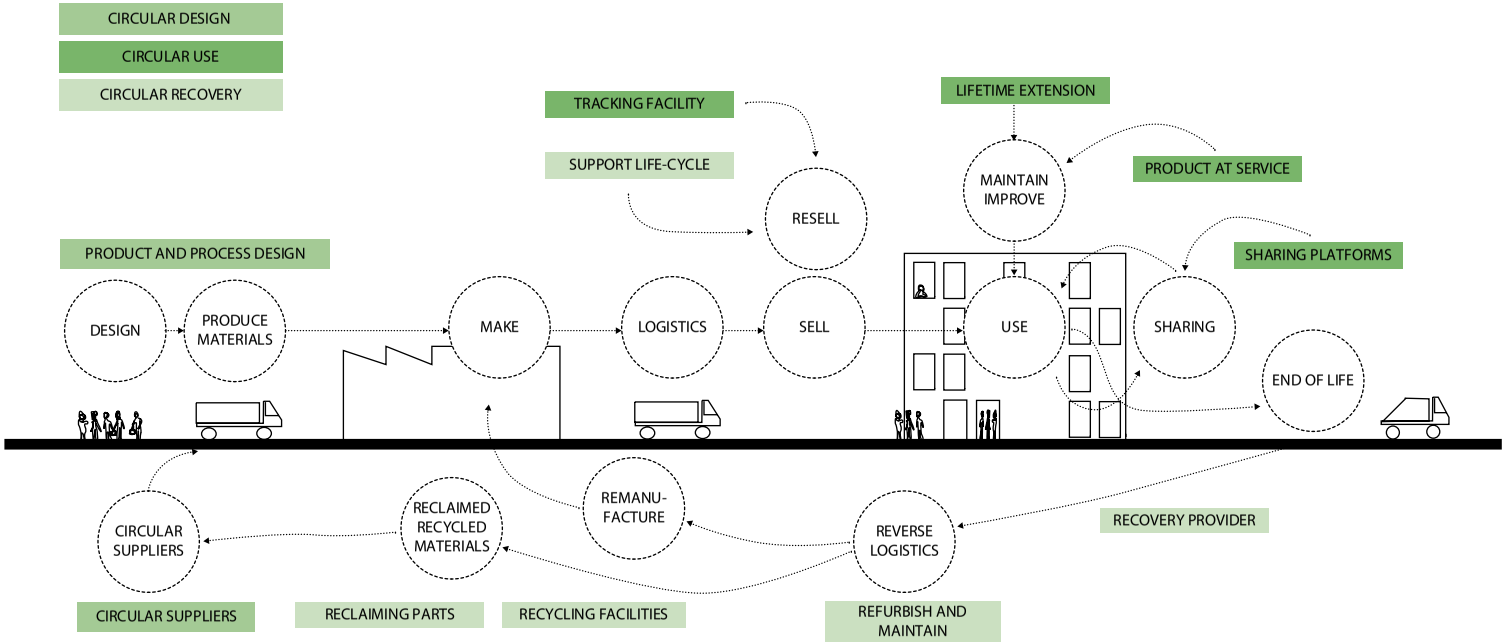

FIGURE 5.3: Potential circular business model in the current value chain based on a re-elaboration and adaptation of a scheme from ARUP (Carra & Magdani 2018), by the authors (2022).

5.2.4 Main actors in the construction sector

When referring to the main actors of the construction sector, we imply the group of actors involved in the activities shaping, managing and maintaining the built environment (buildings and infrastructures), as **Figure 5.4** shows. Buildings and infrastructures are characterised by a long lifespan, they are constituted by numerous components and materials, and they involve, during their lifespan, a very wide network of actors (Hart et al. 2019). Therefore, when we talk about the construction sector, we do not only refer to NACE-BEL (2008)[8] categories included in "construction" (coded F41-43), but we wish to address also real estate activities (coded L68) and specialised activities including architects and engineers (coded M71), which are often deeply connected with scientific research activities (coded M72). Research institutions as well are to be included among the actors currently contributing to the fostering of circular oriented innovation in the construction sector. When we consider the built environment, it becomes crucial to take into consideration manufacturing industries and extraction activities of prime materials (coded B). Logistics is also deeply connected to the transportation and storage of construction materials, both during the construction and deconstruction phases (coded H for transportation and storage). Service activities dealing with the maintenance of the built environment such as cleaning (coded T) should also be included in the sector value network. Lastly, we also take into consideration energy production and distribution (coded D), and water management and distribution (coded E)[9]. The economic feasibility of projects and the support of financing institutions are key elements that shape the built environment. Thus, it is important not to exclude banks and insurance providers dealing with the financial aspects of projects. Governance institutions (European, federal, regional and local ones) must also be included. Lobbies and business federations also contribute to the transitioning and play a role in policy-making. In such a multifaceted landscape of actors, synergies and collaborations across the business ecosystem can be seen as a major challenge in the transitioning toward circular oriented innovations.

The position of actors in the lifecycle of a construction artefact is therefore the classification used in this latter part (based on a readaptation of Adams et al. (2017)). It separates circular oriented innovations into five main phases: (1) "design", (2) "manufacture and supply", (3) "construction", (4) "in use and refurbishment", (5) "deconstruction", and (6) "end of life".

The following parts of this chapter will discuss only some of these actors. During the first round of semi-structured interviews, policymakers as well as clients have been included. While the respondents to the survey assessing the impact of factors on the successful adoption of circular oriented innovations were only companies' executives within six categories of the value chain.

8 https://statbel.fgov.be/en/open-data/nace-bel-2008-classification

9 Each of these economic activities has its own federation, logic and competences, and often smaller scale organisations team up: for example, construction activities are followed by the *Confédération Construction/Confederatie Bouw* gathering twelve local confederations, three regional confederations, eighteen trade federations and central services. These confederations could be part of an even larger federation, in this case the VBO FEB. Federating actors becomes a crucial issue if we are to question the linearity-driven models upon which our society is built.

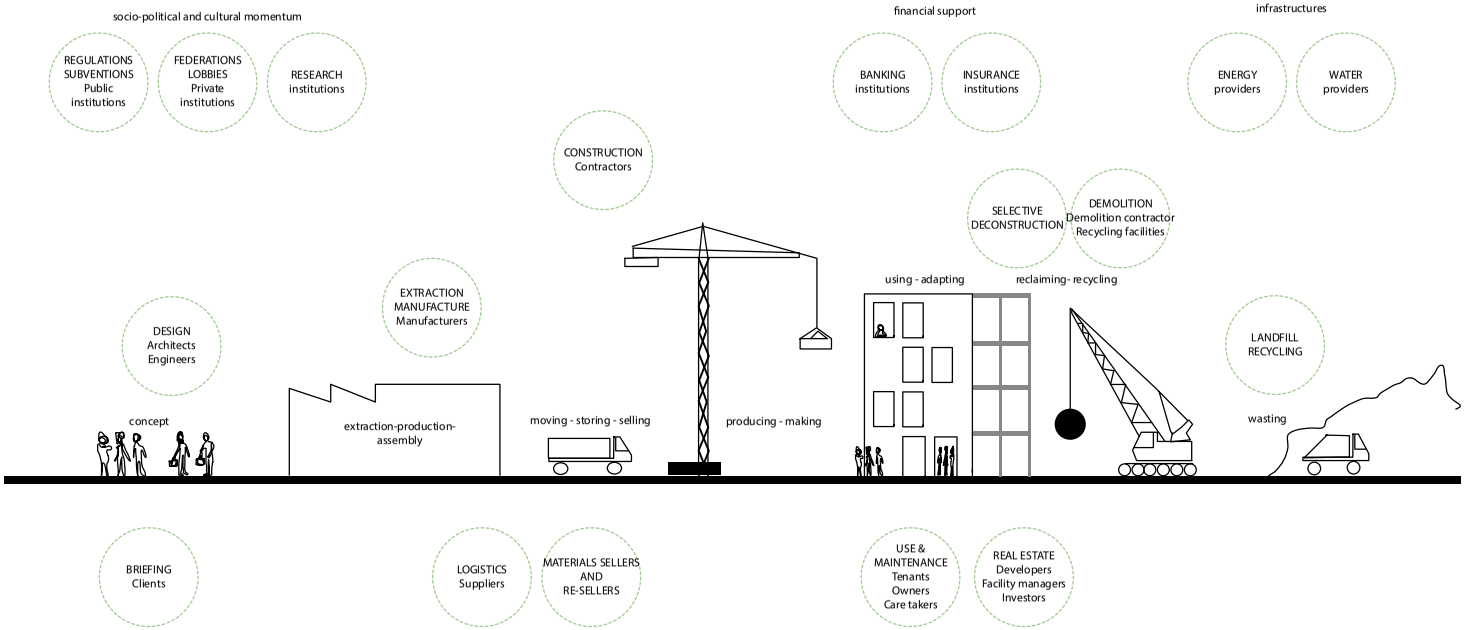

FIGURE 5.4: Main actors in the construction sector / built environment, based on a re-elaboration and adaptation of a scheme from ARUP (2020), by the authors (2022).

5.3 FACTORS AFFECTING THE SUCCESSFUL IMPLEMENTATION OF CIRCULAR ORIENTED INNOVATIONS IN THE BELGIAN CONSTRUCTION SECTOR

Identification of factors in international literature:

In literature we find factors affecting the transitioning towards circular oriented innovations grouped according to dimensions, a common methodological framework to summarise elements and structure information. Hart et al. (2019) have identified four categories of barriers and enablers in their exhaustive literature review, and were able to include all the ones they had found in other articles: cultural, regulatory, financial and sectoral. Other authors proposed different ones: Jesus and Mendonça (2018) used two kinds of dimensions: soft ones (addressing governance and social issues) and hard ones (based on technical and economic factors). Kirchherr et al. (2018) divided them into cultural, regulatory and technological. Adams et al. (2017) categorised according to building phases: barriers and enablers were organised into "legislation and policies", "awareness and understanding", "manufacture of products", "designing and operating buildings", "recovery", "business models", "economic". Arup, in a report focusing on real estate circular value, proposes five topics: "collaboration", "knowledge", "policy", "leadership" and "finance" (Acharya et al. 2020); while addressing the more general public in a second report, they use: "education, awareness and communication", "policy and regulations", "technology and innovation", and "collaboration" (Zimman et al. 2016). As also explained in **Chapter 4**, in the literature most factors are divided into three main categories: drivers, enablers and barriers. Limits of the categorisation of barriers, drivers and enablers had been pointed out by Hart et al. (2019) in their extensive literature review. They underline that some factors can have two opposite effects, either helping or hindering the progression towards the CE. When dealing with complex systems (such as the construction sector value chain), it often becomes difficult to separate factors into barriers, enablers and drivers, as they are deeply interconnected as they vary from one company to another. A last important element to point out is the interdependencies of factors. For example, one enabler can help solve more than one barrier, in more than one dimension.

5.3.1 Qualitative analysis of factors based on semi-structured interviews

Methodology

The first round of semi-structured interviews was conducted (in 2020-2021) with a broad set of stakeholders (we included a public institution, clients of a circular project, a worker in the field of deconstruction and companies operating in the sector in Belgium), selected using a convenience sample. **Table 5.4** presents the actors interviewed. The aim of these preliminary

interviews was to get an overview of the issues emerging from the circular transitioning of this sector. In this way, we were able to collect and check whether other factors (than those appearing in the international literature) would be cited. The outcome of the interviews is integrated with a national and international (scholarly and grey) literature review of sector-specific contributions. The aim of this section is the identification of context-specific factors affecting companies' success in the adoption of circular oriented innovations.

A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12
new entry cooperative	*incumbent company*	*policy makers*	*public client*	*public client*	*private client*	*new entry cooperative*	*university*	*incumbent cooperative*	*company employee*	*incumbent cooperative*	*incumbent company*
Reclaimed materials resellers	*Consultant office on circularity assesments and procedures*	*Public institutions supporting CE action*	*Clients of circularity buildings*	*Clients of circularity buildings*	*Clients of circularity buildings*	*Circular materials producers*	*Research Institution working on an urban circular project*	*Contractors*	*Workers in circular construction*	*Designers experienced with circularity*	*Consultant firm in circularity materials*

TABLE 5.4: Overview of the stakeholders operating in the construction sector that have been interviewed by the authors.

Seven major factors emerged from our interviews: the regulatory framework, customer support, support of supply (or value) chain partners, skills and knowledge, standards and guidelines, financial resources and the support of public institutions. Among these, the **regulatory framework** appeared in our query as the most impactful factor for the successful adoption of circular oriented innovations. To move from the "pilot phase" to the "market phase" of CE in the (Belgian) construction sector, regulatory actions are favoured over support and activation actions. In international literature, the lack of a consistent regulatory framework and the lack of targets beyond the basics of waste diversion from landfills, are cited as barriers. It is mentioned that current policies largely ignored the upstream consequences of resource extraction. Furthermore, the presence of obstructing laws and regulations can create problems for example with the handling and categorisation of waste (Hart et al. 2019). In Belgium it is the case for soil, which is considered as waste in Brussels and not legally reusable. It becomes a material to be reused (for example in raw-bricks and finishing) if it crosses the regional border with Flanders, where more nuanced legislation allows extracted non-polluted soil from construction sites to be used in manufacturing (from the interviews realised by the authors, A8 and A3). The evaluation tools for environmental performances did not take into account embodied energies until recently. While nowadays the Belgian regions are working on a performance tool to also be able to evaluate material impacts (*Totem*, n.d.). Furthermore, a critique of the current performance assessment system is that it is difficult to comply with energetic norms in "soft-interventions" and reuse practices. The lack of flexibility in building codes and regulations for example, poses important limits on reuse (Makkink 2020). Thus, the implementation of a consistent regulatory framework could oblige more actors to embrace CE (ICEDD, FRDO-CFDD et al. 2020).

We can see the current political momentum (embracing the CE while aligning all levels of institutions such as Europe, the federal state, and the three Belgian regions) as the main driver for more coherent and ambitious regulatory frameworks. Thus, the progressive development of regulatory pressure will first encourage, then oblige the transitioning of this sector to other more circular (and less wasteful) paradigms.

Circular construction projects and regulations: How to make a flexible building? How to integrate second-hand components into the town planning permit?

> *At a certain point we said to ourselves that if we work on a flexible and modular facility, the building will be able to accommodate all future possibilities. We decided to submit what we called the 'XXL building permit'. It's a bit theoretical, of course, but the idea was that nothing had to be impossible in the future. The project we submitted was. The permit is in an XXL version, very flexible. We were as broad as possible in the labelling of spaces and their allocation, for example we sometimes put "workshops" instead of "offices". We still had to limit the occupation during the week, so not everything will be 100% possible, but we have succeeded in putting together a renovation project that allows hosting other groups, other projects, and other organisations in the future. Furthermore, when it comes to window creation towards the interior of the blocks, we were not subject to a permit because the back façade is more than thirty metres from the street front. We drew indicatively the sizes of the windows but not their shape, as the shape would change according to what we would have found in the second-hand market during the construction phase. This was what we call an XXL urban permit.*
>
> *(Extract from the interview, conducted and translated by the authors, A5).*

Support of customers is the second most cited factor. In scholarly literature, Kirchherr et al. (2018) suggest that CE is still a niche and that significant effort needs to be undertaken for the concept to maintain its momentum, as there is a lack of interest and awareness among consumers, and a hesitant company culture. This lack of interest and commitment is detected in both internal factors (organisational culture) and external ones, dealing with supply chains and customers (Hart et al. 2019). The dominant logic of "the cheaper the better" can then be challenged by other logic such as "the more local the better", "the less polluting the better", and so on. This shift in the notion of value will be crucial for value chains and businesses, as for now the lack of interest and knowledge in the CE from value chains and clients is the main barrier to overcome. Aesthetics play a key role in circularity ambitions in the built environment. Behavioural patterns of attachment or repulsion for certain materials and wears can become major obstacles to the prevention of demolition and reuse of reclaimed elements (Pomponi & Moncaster

2017). The lack of conceptual clarity behind the notion of CE is also a barrier to its development. Confusion in CE's overarching ambitions and strategies could discourage actors. There are suspicions that this concept could become the rebranding of existing greenwashing operations ("circular-washing"). In conclusion, fear of green-circular washing can be an obstacle to this notion becoming widepread, refraining people from embracing it due to scepticism towards the broader CE discourse.

Support of supply (or value) chain partners is ranked as very impactful. A major challenge is the development of new collaborations between businesses. The presence of competitive practices and the tendency to establish vertical collaborations rather than horizontal ones (Hart et al. 2019) can hamper the successful adoption of circular oriented innovations. As practices working on the circularisation of the construction sector are still marginal in the panorama nowadays, it takes time and resources to find new CE partners. Linear interdependencies (in this well-structured sector) can become barriers. For example, the sector is based on large quantities of waste created in very short delays, as demolition is still the main practice when transformations are planned.

Resistance to change in a sector:

> *The construction sector is very complex in its organisation and is difficult to change (…) there is a generalised resistance to change. Furthermore, all projects are over budget and running behind, two aspects that make the integration of CE reflection not so evident.*
> *(Extract from the interview, conducted and translated by the authors, A2).*

Skills and knowledge of employees play a key role in the ability of companies to embrace CE. There is a generalised lack of qualified labour in the construction sector, as a 2018 report of the Brussels Capital Region by Bruxelles Environnement also illustrates. In a 2020 report by the Institute of Consulting and Studies in Sustainable Development (ICEDD) on *Circular Construction and Renovation* recommends a series of actions to the Federal government to accelerate the implementation of CE in this sector. They stressed the need to foster education and training of students and workers, with a particular focus on small (and very small) and medium enterprises (SMEs and VSMEs). A series of actions were suggested exclusively aimed at supporting the coverage of training costs (ICEDD, FRDO CFDD et al. 2020). Nevertheless, if previous examples are mainly referring to manual labour, the transitioning to a CE in the construction sector can generate different types of jobs for diverse profiles, ranging from low-skilled and manual jobs to medium and high-skilled jobs. Scholars pointed out, for example, that the use of digital tools to share information and metrics, could facilitate maintenance, disassembly and adaptability of infrastructures and buildings.

The time it takes to develop hands-on knowledge, the example of salvaging construction components and materials:

> *"It took us around ten years to develop enough knowledge on certain types of materials. We realise that we are seriously increasing the masses and the volumes sold. The fact of being able to resell a material depends to a large extent on this knowledge, which is technical and cultural, and which plays on many levels. We may have been chasing too many hares at the same time at the beginning saying, "we're going to do this, we're going to do that, the tiles, the marble, the glass partitions, the parquet floors, the hardware, the lighting …". But in fact, each of these fields requires in-depth knowledge, restoration techniques, trial and error. You learn from all this: it's not for nothing, there are quite a few resellers who are family businesses, with almost artisanal methods of transmission. Their father or mother taught them how to clean a brick, how to recognise a good brick from a bad one, how to tell if it is porous or not … All this knowledge, sometimes sensorial, allows them to develop fine knowledge and skills over time."*
>
> *(Extract from the interview, conducted and translated by the authors, A1).*

Standards and guidelines also appear to be relevant factors. An example can be the recurrent issues of liability and guarantee on elements that are not new but are reused or refurbished. In the contemporary context, this poses a lot of problems when it comes to public procurements (and also private projects). Either clients are highly motivated to engage with "experimental" reuse of existing equipment and materials without a guarantee (or with a limited one) or this becomes a main impediment in these practices. The development of sectoral expertise verifying the performance of reused components and advising on legal frameworks is needed to provide circular options in all projects (under the right liability terms). Furthermore, the lack of **standardisation** could hamper CE practices as each operation could require a specific knowledge development, and hands-on practices and tests. Nevertheless, Kirchherr et al. (2018) did not rank such technological issues among the most pressing ones. In fact, often what hampers the reuse of elements is more of an economic factor than a technical one. What has emerged in the interviews and survey discussions was the fact that **procurements and specifications** are not adapted yet to the implementation of CE. This can become an impediment to the valorisation of existing buildings stocks, parts, components and materials.

Legal guarantee and risk management:

> *In the development of the specifications, the principle was to say for example that if we had a hundred or so items, there are ten where we oblige the company to reuse. Yet, for a whole other series of reasons, we didn't make it compulsory, but*

we put a small paragraph saying that at any time, the client can propose a reused material. (…) If an opportunity arises during the course of the project, the space for this negotiation exists, it is possible and legally covered. All the questions linked to guarantees, responsibilities, protection of the company, are more or less covered. The problem was to find a way to reassure the construction company while playing this game, because we have thought about all the consequences and impacts that this can have. The client (us) decided to take a lot of risk related to the final liability on the reused materials. For example, we have a ventilation unit that has just arrived from a tower in the city centre. The company in charge of special techniques went to see it, made an assessment, dismantled the unit, transported it and installed it here. The company will be responsible for the work related to the installation, and they have no liability on operating the unit. It's part of the reuse experiment, and that's the risk we take. If there is a problem that we did not anticipate, it becomes our responsibility. Afterwards, we have carried out a whole series of analyses upstream, which gives us an 80 % guarantee that we will not have any problems: the risk is reduced. And economically it was a very advantageous action to take.

(Extract from the interview, conducted and translated by the authors, A5).

Financial resources are also cited as a factor significantly impacting the ability to embrace circular oriented innovations, as inherent extra costs to CE operations could often appear. These extra costs might be related to the need for additional guidance from circularity experts, or to the need for local labour to rework local stocks of material. Often, in reuse practices, salvaged materials can be taken for free (within a specific timeframe), nevertheless inherent extra costs are a threat to the reuse of available materials as the cost of labour in Belgium is high, while the price of new materials coming from countries with lower labour costs is (too) low. Also, the high automatisation of production processes plays a role in lowering the price of new products, while the reparation, refurbishment and reuse of existing ones can result in more crafty and smaller scale interventions, which are therefore more expensive. Extra costs can also be non-inherent when they are linked to redesign (in case of mistakes or lack/inadequacy of available materials, unforeseen delays, et cetera). This barrier is not always present as it depends on the material and the specific situation. For example, the reuse of technical installations in a good state can be much cheaper than a new ones (while it is not always the case for bricks, tiles, toilets, et cetera). Inherent extra costs are also linked to market immaturity and the lack of economies of scale. Extra costs are influenced by the non-homogeneity of existing building stocks, where their management and valorisation changes from case to case. The development of secondhand construction components and materials is constrained by the inconstant flows of materials and their heterogeneity. High prices of storage spaces in cities also influences the ability to offer a wider service and is perceived as an economic barrier (Makkink 2020).

Competition with globalised (generally) very low prices of new construction materials, if compared to reclaimed ones:

> *One of the big obstacles we face is the price of new materials. Today it costs more to dismantle a concrete paving stone and put it on a pallet when there is no technical issue, no logistical problem behind it, than buying a new concrete block. New concrete is too cheap, it doesn't take into account all the externalities that are harmful to the environment and to society (…) Today, what we recover is what there is a demand for. Some slightly exceptional materials can be sold at very interesting prices, since there is no real new equivalent. But for the majority of materials, you have to be more or less on a par with the new price, and ideally even cheaper than that. There are few customers who would be prepared to pay more for something that is not new, because it makes installation more difficult. This means that today, we don't even take 1 % in mass of what comes out of a building site, whereas the potential for reuse could be 25 % or even more.*
> *(Extract from the interview, conducted and translated by the authors, A1).*

Since the Covid-19 pandemic, further exacerbated by the Ukrainian war, the rising price of primary materials and fossil fuels has as an effect on the generalised increase of new construction materials. The fact that new materials are becoming more expensive (especially if they have to travel from afar) could be identified as a driver for the development of CE.

Extra costs can also occur in circular design processes, as was the case with a non-profit organisation refurbishing their headquarters with the ambition of pushing reuse at all phases of the project's development.

Circular design processes could take longer than "standard" ones:

> *The design process developed in several phases, because the project was on a large scale (4.000m2) and the materials being reused at the detailed scale. There were cross studies: a team worked on the spatial vision and a second one worked on the building as 'materials respository' (as a resource). The more abstract vision intersected with the more down to earth vision of the reused materials. This back and forth was done constantly during the design and allowed us to move forward at the same time. But it's still very difficult because you're drawing something, and these drawings don't represent at all what is going to be done in the end. The staircase you're going to find on the reuse market is going to change your whole design. The architects found themselves drawing, drawing, re-drawing … In the end, it was very successful, we made a plan for the permit which shows the guidelines of the modifications to the building, but that left some flexibility, allowing some variations in accordance with the reused materials which we find. We applied to be.exemplary*

along the way. We were awarded the prize and received four hundred thousand euros more. A whole part of it was used to pay for the architect's extra work.
(Extract from the interview, conducted and translated by the authors, A5).

Internal financial factors are mainly related to the need for investments and support for upfront costs, while external ones are linked to the banking and insurance companies. The latter become barriers when banking institutions do not financially support CE operations in the built environment. The main issue is the fact that circularity entails long-run visions and investments and experimentations, while the current banking system favours fast returns and certainties.

Long term visions, risks and returns on circular investments:

The business and investment communities are frequently accused of operating with short-term blinkers (capital expenditure is prioritised over operational expenditure) and rapid returns on investment are expected. This tends to favour transactional relationships over long-term collaborations and works against projects with wider social and environmental objectives but longer financial paybacks.
(Hart et al. 2019).

There is currently insufficient investment in the CE. While alternative financing struggles to fund all large-scale projects, banks often find them too risky and complex. Banks use the same evaluation tools for innovative business models as for traditional business models. They therefore tend to underestimate the economic potential of CE projects. For example, banks are sometimes reluctant to grant a leasing contract to a company with very specific equipment. The risk for the bank is that it will not be able to reuse the equipment with another company afterwards.
(Extract translated by the author, taken from the workshop report of ICEDD, FRDO CFDD et al. 2020)

The **support of public institutions** (throughout subventions and support services) is not listed among the most impacting factors. Almost all actors agreed that it was relevant, but the assessment of the impact was high only for companies that were currently being subsidised. In the following **Section 5.4.2**. a more detailed evaluation of public support is provided. The internal ability-related factor dealing with **infrastructures and assets** (physical resources such as infrastructures and spaces) is also debated in more depth in the discussion part (see **Section 5.4.1)**. This factor had emerged as a novel and particularly concerning one, especially for the deployment of CE activities in cities. We have therefore decided to ask a few supplementary questions during the elaboration of the survey and to discuss the findings in more depth further on.

Limits to "temporary occupations" as a formula for developing circularity oriented value chains for the construction sector:

> *After three or four years we observe that there are many obstacles to the activity we propose (…). For example, the fact that we want to stay in the city. The urban environment, and Brussels in particular, is not a welcoming environment for activities of this type. It is not for nothing that you have to travel thirty kilometres to find the first dealer in reused building materials. A century ago, or maybe even fifty years ago, many of these people were in Brussels. The pressure of real estate is driving everything that needs space out of the region's borders. (…) About temporary occupation contracts: the idea is that they guarantee us a presence for four years, at preferential rates below the market price, unfortunately the economic balance in the end is not so advantageous. The infrastructures they offer us are not entirely suitable, so we have to invest a lot of money to occupy it in the first place, to install even only the offices and ensure that there is a minimum of comfort for the workers and materials. We also had to file an environmental permit with the Region and a building permit because these are new activities on this site. All of these are investments that are amortised over a very short period of time (less than four years). If we look at the whole picture, it was not that advantageous. On the other hand, without this advantageous rent, we would not have been able to face a real Brussels rent, especially with the constant increase in land prices and developments.*
>
> *(…) On the one hand, there is the price of new products, which forces us to limit the type of materials we can recover, and on the other hand, there is the price of land, which means that we have to produce a very high added value in order to be able to afford land in the city. Either you are very compact, or you have to produce a huge added value to stay in Brussels, this limits our capacity to recover large amounts of less valuable materials and makes us select only what we know is viable."*
>
> *(Extract from the interview, conducted and translated by the authors, A1).*

Many CE actors are federating and looking for a space to settle down for a longer period instead of a mere temporary occupancy. For businesses, the appropriate time frame would be at least ten years, in order to amortise costs and consolidate the market. Ownership of infrastructure gives a certain resilience to businesses, implying also that they would have control over their functioning, renovation, et cetera. Interviewees identified public authorities as the main actor able to create the conditions for urban CE operations. Those CE practices and businesses are needed in urban contexts, whether this means creating "circularity zones" with shared infrastructures, proposing long-run contracts at convenient rates, or assuring affordable prices.

Where to store salvaged components and materials during construction works?

> *At the beginning of the project we stored elements in-situ. You walked around the building and there were storage areas everywhere. Today, storage needs are getting too great. We have an agreement with a public company that owns warehouses in the area. We have a lease agreement for a large warehouse of 500m2 for storage during the construction period. If all of a sudden, a stock of insulation was made available from the northern district's towers, we needed to be able to say yes to the request directly. For this kind of exceptional arrivals, we had to be able to have room to absorb stocks, not to have to make transport arrangements twice in addition to it. Now we have everything at our disposal and the workers go there when they need it, they know the place and they use it.*
> *(Extract from the interview, realised and translated by the authors, A5).*

Finding available space to store things during renovation works can be a real challenge and can become expensive. Spatio-temporal factors influence greatly the extent to which reuse operations can be implemented, as typically selecting, dismounting, cleaning, transporting, storing and redesigning with salvaged elements can be very time-consuming and costly. The on site management of materials that need to be stored (and reworked) for reuse can add a layer of complexity to the deployment of a construction site. A context of scarce space does not favour such activities. Furthermore, the management of large volumes of secondary materials, and tight projects' schedules, constitute a recurrent issue in circularity implementations. In general, working with existing artifacts (from a valorisation perspective) implies the development of adaptive strategies, including the ability to absorb unstable and non-homogeneous materials' stocks.

5.3.2 Quantitative analysis of the impact of factors based on a survey

The factors this section analyses are based on the preliminary results of **Chapter 4**, also including new contextual factors that emerged during the interviews (namely space-related factors). A survey with Belgian actors in the construction sector was carried out between March and June 2022, in collaboration with the authors of the previous chapter (Jean Mansuy, Philippe Lebeau, & Cathy Macharis). While the qualitative analysis presented in the previous section aimed to explore the specificity of contextual factors (providing readers with practical examples as well), the results of the survey discuss the importance of all the factors previously identified.

Methodology

The first criterion for the selection of companies answering the survey was the fact that they operate in the Belgian construction sector (our case study). Secondly, their activity should integrate some circular oriented innovation in the sector. Thus, all stakeholders that contributed to this research are already taking part in the CE trajectory. Respondents were identified using CE networks such as companies awarded by regional CE subsidies, or prominent national CE businesses (for example, "new entrant" companies, often cited in Belgium's CE "good practices") and selected using a convenience sampling approach. Thirdly, they should be differentiated in terms of size (small and medium enterprises and large ones) and they should occupy a wide spectrum of companies with different positions within the value chain. **Table 5.5** shows the profiles of the respondents. Some are incumbent companies, while others have been shaped from the start by circular oriented innovations (new entrants).

Afterwards, a survey has been developed in collaboration with the authors of **Chapter 4**. Respondents were asked to imagine their organisation had developed a circular oriented innovation. We have provided examples of possible innovations they could implement in the construction sector, such as: (i) improving the products (for example, with second-hand materials or with locally bio-sourced ones); (ii) improving processes (for example, waste management); (iii) increasing quantities of circular elements or materials or services; (iv) getting specialised in a specific valorisation of a building or component or material ; (v) using refurbished tools instead of new ones; (vi) developing more circular logistic strategies (for example, reverse logistics, reducing transportations, shared storages, et cetera). They were then asked to rate the importance of several factors on the adoption of circular oriented innovations by their company, using "5-level Likert scales". The ranking was organised in five categories: impacting a great deal (5/5), considerably (4/5), moderately (3/5), slightly (2/5) and not at all (1/5). Respondents could rate the factors (from 1-5) and we present the results as the average scores of each factor. Data was collected using structured interviews with company executives and sustainability managers. During the structured interviews, the researchers filled in a prewritten form, while the interviewees elaborated their answers orally (with the visual support of slides presenting the factors to be evaluated).

The categorisation of factors is based on the MOA framework elaborated in **Chapter 4**: factors impacting the motivation, ability and opportunity of companies. In the last section, respondents were asked to select (a maximum of 3 out of a set of 9) policies that could best support a transition to circularity in the construction sector from a set of nine policy options.

			C 1	C 2	C 3	C 4	C 5	C 6	C 7	C 8	C 9	C 10	C 11	C 12
COMPANY PROFILE	interview identifier													
	type legal structure		incumbent cooperative	incumbent cooperative	new entry cooperative	new entry cooperative	incumbent company	incumbent company	new entry cooperative	incumbent company	incumbent cooperative	new entry company	incumbent company	new entry company
	size		2-9 employees	10-49 employees	10-49 employees	2-9 employees	250 and more employees	250 and more employees	2-9 employees	10-49 employees	10-49 employees	10-49 employees	250 and more employees	10-49 employees
	POSITION	design				x		x		x	x			
		material supply (incl. secondary)			x	x			x			x		
		construction	x				x	x						
		maintenance and use						x					x	
		deconstruction	x	x	x									
		waste management		X										x
	location(s) of operations		Brussels	Wallonia, Brussels, outside of Belgium	Brussels	Brussels	Flanders, Wallonia, Brussels, outside of Belgium	Flanders, Wallonia, Brussels, outside of Belgium	Brussels	Flanders, Wallonia, Brussels, outside of Belgium	Wallonia, Brussels	Flanders, Wallonia, Brussels, outside of Belgium	Flanders, Wallonia, Brussels, outside of Belgium	Flanders, Wallonia, Brussels, outside of Belgium
RESPONDENT	position		top manage-ment	top manage-ment	top manage-ment	top manage-ment	first line manager	top manage-ment	top manage-ment	top manage-ment	top manage-ment	top manage-ment	middle manage-ment	middle manage-ment
	experience (knowledge) and daily engagement with CE		working on CE several days a month	working on CE every day	working on CE every day	working on CE every day	working on CE every day	working on CE every day	working on CE every day	working on CE every day	working on CE several days a week	working on CE every day	working on CE every day	working on CE every day
			good CE knowledge	very good CE knowledge	very good CE knowledge	good CE knowledge	good CE knowledge	good CE knowledge	very good CE knowledge	good CE knowledge	good CE knowledge	very good CE knowledge	good CE knowledge	good CE knowledge

TABLE 5.5: Overview of the respondents to the survey on factors impacting the adoption of circular oriented innovations.

Figure 5.5 shows the profiles of the companies that participated in the survey. Due to difficulties with the outreach, the sample is not representative of the whole value chain as some categories (for example, "maintenance and use" and "waste management") are underrepresented. Nevertheless, respondents from all other positions in the value chain have three to four respondents, so they can be considered a more consistent sample.

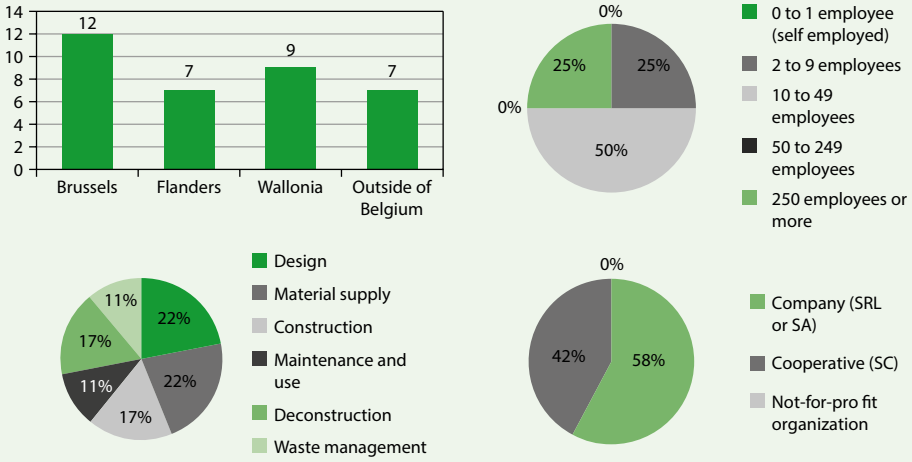

FIGURE 5.5: Overview of the profiles of the respondents in regard to the context where they operate, their size, their location in the value chain (or life cycle), and their legal status.

Table 5.6 provides an overview of the respondents' profiles in relation to the factors they have (or not) selected as impactful. The "x" means that the respondent considered the factor as having at least a moderate impact on the adoption of circular innovations ("moderately", "considerably" or "a great deal"). This table provides a more strategic understanding of the responses based on the characteristics of the companies.

The quantitative outcomes of the survey are presented in the **Figure 5.6**. This quantitative analysis is used to assess the relevance of the newly identified factors: are those factors indeed important, or were they not mentioned because they are marginal? Results of the survey show that **spatial factors** (highlighted in the graphs) appear to be relevant in the respondents' overall assessment, especially for those who operate in densely populated areas.

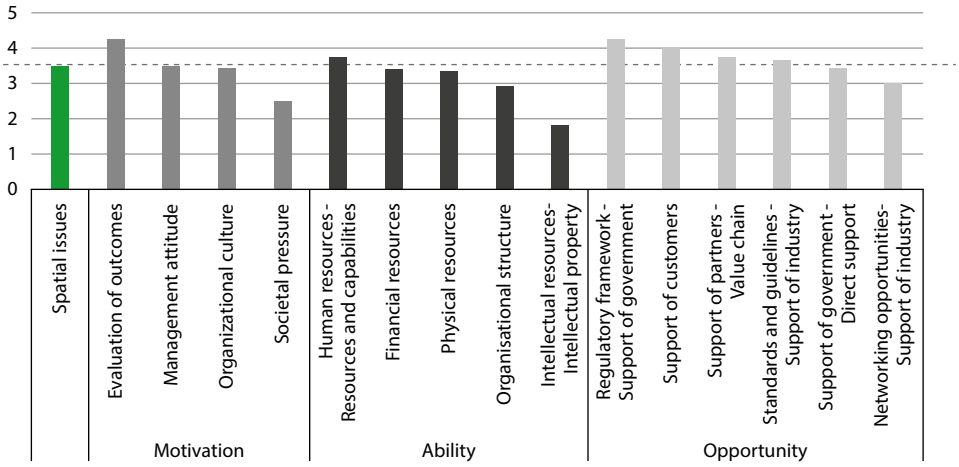

FIGURE 5.6: Overview of the impacts of different factors on the influencing the adoption of circularity oriented innovation by the respondents of the survey.

In general, the survey's respondents identified the **evaluation of outcomes** as the internal factor that affect their company's motivation to engage with circular oriented innovations the most. This factor could be regarding positive "economic expectations" (also customer-related), "operational expectations" (for example, increase of quality or time saving), and "environmental expectations" (for example, lowering environmental impacts). We did not ask the interviewees to make a separation between these sub-factors, yet we remarked that respondents of "new entrant" businesses clearly acknowledged that **environmental benefits** motivated them the most. The **regulatory framework** (support of governments) is on the other hand the most important external factor that can influence the opportunity to adopt circularity oriented innovations. This factor has emerged also in the qualitative analysis and is confirmed by the outcomes of the survey. **Support of customers** results as the third in order of importance, this external factor was also highlighted in the qualitative analysis. The **human and intellectual resources**

			C 1	C 2	C 3	C 4	C 5	C 6	C 7	C 8	C 9	C 10	C 11	C 12
COMPANY PROFILE		interview identifier	C 1	C 2	C 3	C 4	C 5	C 6	C 7	C 8	C 9	C 10	C 11	C 12
		type legal structure	incumbent cooperative	incumbent cooperative	new entry cooperative	new entry cooperative	incumbent company	incumbent company	new entry cooperative	incumbent company	incumbent cooperative	new entry company	incumbent company	new entry company
		size	2-9 employees	10-49 employees	10-49 employees	2-9 employees	250 and more employees	250 and more employees	2-9 employees	10-49 employees	10-49 employees	10-49 employees	250 and more employees	10-49 employees
	POSITION	design				x		x		x	x			
		material supply (incl. secondary)			x	x			x			x		
		construction	x				x	x						
		maintenance and use						x					x	
		deconstruction	x	x	x									
		waste management		X										x
MOTIVATION		Evaluation of outcomes (expected benefit: environmental, economic, etc.)		x	x	x	x	x	x	x	x	x	x	x
		Organisational culture			x	x			x	x	x	x	x	x
		Management attitude towards the CE	x	x		x		x	x	x	x	x	x	x
		Societal pressure		x			x	x					x	
ABILITY		Resources and capabilities												
		Skills and knowledge of employees	x	x	x	x	x	x	x	x	x	x	x	x
		Intellectual property							x	x				x
		Infrastructures and assets	x	x	x	x	x	x	x			x	x	
		Financial resources	x	x	x	x	x		x	x		x	x	
		Organisational characteristics												
		Organizational structure	x	x		x	x				x	x	x	
OPPORTUNITY		Customer's support	x	x	x	x	x	x	x	x	x	x	x	
		Partners' support (value chain)		x	x	x	x	x	x	x	x		x	x
		Government's support												
		Regulatory framework	x	x	x	x	x	x	x	x	x	x	x	x
		Support of public institutions	x			x	x		x	x	x		x	x
		Networking opportunities	x					x	x		x			x
		Standards and guidelines	x		x	x		x	x	x	x	x	x	x

TABLE 5.6: Overview of survey responses, assessing the impact of different factors.

(skills and knowledge of employees) was the second most relevant internal factor, while the **support of value chain partners** and **standards and guidelines** (support of the industry) were ranked as the two most prominent external factors after the above mentioned regulatory framework and the support of costumes. Continuing in order of importance, the **management's attitude to innovate** (also confirmed by the discussion in the previous chapter) appears as a key-internal factor.

We then find **spatial issues**, that emerged in the qualitative analysis based on semi-structured interviews, and that we have addressed in the quantitative analysis. A specific part of the survey was dedicated to spatial factors, in order to assess and understand this phenomenon more precisely. Spatial factors were not explicitly discussed in the international literature review conducted, yet it seemed very relevant for local companies and projects operating in dense urban centres. It appeared to have a great influence on businesses' value propositions and to significantly constrain businesses' development.

Right after spatial issues, we see ranked two more internal elements affecting the ability of companies to innovate: **financial resources**, and **physical resources** (assets). While the external factor linked to network opportunities was mentioned across different profiles, yet not everyone agreed on its importance. In the replies, we also noticed that **organisational culture** (an internal factor impacting businesses' motivation) appeared more impactful mainly in small (and new) companies, with a very low-risk aversion. In the interviews and in literature, it was mentioned that transparency and collaboration between different functions of the same business appeared to be essential for circularity oriented innovations to be developed (de-compartmentalisation). **Support of governments** (direct support) was not unanimously mentioned as a key factor, yet it was considered very important by those who are currently receiving such support (e.g., in the form of subventions). To conclude on motivational factors, we have witnessed that incumbent firms are more concerned by **societal pressure**, while "new entrant" companies (born within CE ambitions) are less. This is understandable because the new circular businesses are often the result of the collaboration between people who are aware of the need for a transition. Therefore, they do not mention such pressure as being a factor affecting their motivation because they already embed societal pressure at the heart of their projects' ambitions, since the beginning. In general, all internal factors (abilities) were unanimously considered relevant, except for the **intellectual property**, cited mainly by companies working in highly competitive processes (for example, industrial processes or large projects' tendering).

The outcomes of the section of the survey on spatial factors are shown in **Table 5.7** and in **Figure 5.7**. The table allows correlating company characteristics with their specific answers. The first table clearly shows that space is important for companies having circularity operations in **urban areas**, and especially for logistic activities. The factor that has the greatest influence is **spatial features** (such as their scale, ceiling height, access, et cetera) followed by **real estate prices**, and **contractual issues** (as their duration). The first graph on the left-hand side ranks activities that are mostly experiencing a lack of space, while the second one evaluates the factors influencing

the lack of space. The main activity for which companies experience a lack of space is **logistics**. Companies manufacturing products (for example, construction materials and components) are interested in spaces to **manufacture and store** their products, partially in urban areas and/or in industrial parks and suburban areas. The implementation of more circular oriented innovations for them is also based on their ability to recuperate unused products in reverse logistic value chains (as is the case of respondent *C12*). The architecture offices that were interviewed did not need space for their office work, but they claimed a lack of space for circularity oriented operations on the construction sites of their projects. The lack of storage space, for example, on a construction site determines greatly their capacity to apply reuse. Real estate prices vary greatly if we compare for example Brussels with Charleroi. In cities like the latter, industrial and storage spaces are abundant and at affordable prices. For companies operating in both kinds of context, the lack of space was experienced only in urban and expensive contexts (as respondent *C2* explained).

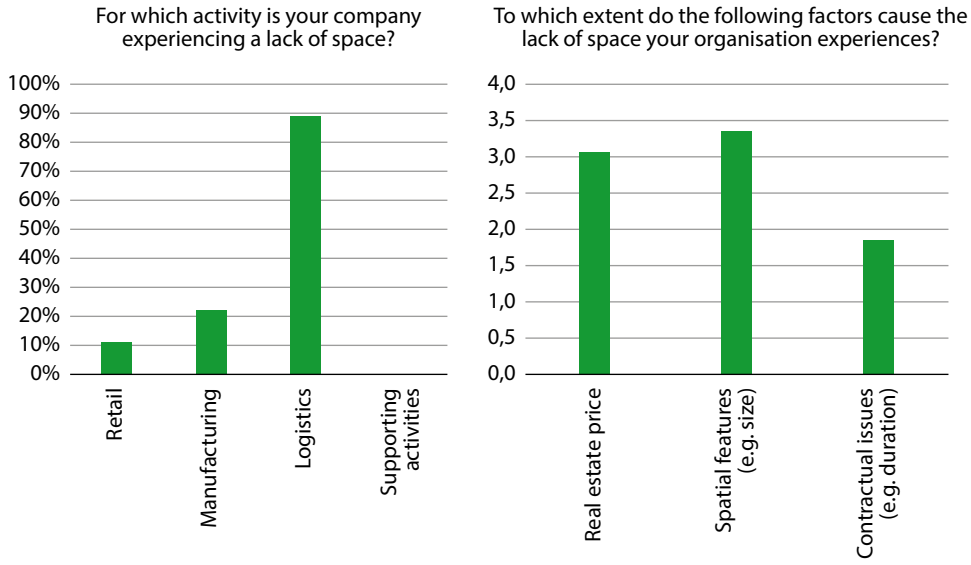

FIGURE 5.7: On the left, an overview of the survey response indicating for which activity they most often felt a lack of space. On the right, three sub-factors influencing the lack of space are ranked.

COMPANY PROFILE		interview identifier	C 1	C 2	C 3	C 4	C 5	C 6	C 7	C 8	C 9	C 10	C 11	C 12
		type legal structure	incumbent cooperative	incumbent cooperative	new entry cooperative	new entry cooperative	incumbent company	incumbent company	new entry cooperative	incumbent company	incumbent cooperative	new entry company	incumbent company	new entry company
		size	2-9 employees	10-49 employees	10-49 employees	2-9 employees	250 and more employees	250 and more employees	2-9 employees	10-49 employees	10-49 employees	10-49 employees	250 and more employees	10-49 employees
	POSITION	design				x		x		x	x			
		material supply (incl. secondary)			x	x			x			x		
		construction	x				x	x						
		maintenance and use						x					x	
		deconstruction	x	x	x									
		waste management		x										x
		location(s) of operations	Brussels	Wallonia, Brussels, outside of Belgium	Brussels	Brussels	Flanders, Wallonia, Brussels, outside of Belgium	Flanders, Wallonia, Brussels, outside of Belgium	Brussels	Flanders, Wallonia, Brussels, outside of Belgium	Wallonia, Brussels	Flanders, Wallonia, Brussels, outside of Belgium	Flanders, Wallonia, Brussels, outside of Belgium	Flanders, Wallonia, Brussels, outside of Belgium
ABILITY / OPPORTUNITY	SPATIAL FACTORS	Extent of the impact of lack of space	a great deal	considera-bly (in Brussel)	a great deal	slighlty	not at all	a great deal	a great deal	not at all	moderately	considera-bly	not at all	considera-bly
		Real estate prices	x	x	x	x			x			x		x
		Spatial features of available spaces			x			x	x		x	x		
		Contractual issues (e.g., duration)												
		lack of space for	logistics	logistics	logistics and retail	logistics		logistics	logistics		logistics	manufactu-ring logistics		logistics
		in which context	urban areas	urban areas	urban areas	urban areas		urban	urban		urban	industrial parks (manufact.) suburban areas (logistics)		industrial parks

TABLE 5.7: Overview of respondents' answers on "spatial factors" affecting their ability and opportunity to develop circular oriented innovations.

5.4 DISCUSSION

After having identified and ranked the contextual factors that affect the adoption of circular oriented innovation in the Belgian construction sector, we discuss the main results in light of the research questions included in the introduction.

5.4.1 The emergence of spatial factors affecting the ability and (or) opportunity to implement circularity oriented innovations in urban contexts

The lack of available and (or) affordable space has been mentioned more than once during the semi-structured interviews with a broad spectrum of stakeholders. Interviewees operating in urban contexts had encountered a major issue: the closer to secondary material mines (large and dense urban centres), the harder it appeared to find affordable and suitable spaces for circularity logistics. This led to the following paradox: the closer one is to the "urban mine" of secondary materials, the more difficult it is to organise circularity oriented innovations (especially if they are based on reverse logistics and the valorisation of secondary materials). Not moving too far from the dense centres is essential because as distances increase, so do the associated transport trajectories (inbound and outbound), the resulting pollution and the costs. The need to relocate practices closer to large centres of consumption to reduce the impact of logistics appears embedded in circularity oriented innovations. Thus, if one of the main CE challenges is to create and develop more local value chains and services, the issue to address is the lack of logistic space in dense urban contexts (and in general in places where real estate pressure is high).

Urban renewal policies influence real estate dynamic (thus, prices) a great deal. Each context is subject to very specific economic laws. Nevertheless, if CE aims to relocalise activities, goods and services nearer to their users and consumers, it means that spaces and suitable infrastructure need to be made available and affordable (Williams 2020; Verga & Khan 2022). The lack of space influences the kind and the scale of CE operations. Not only is space needed to collect, sort, clean and store elements to grant them a longer lifespan, but, if we take the example of the construction sector, storage space is also needed on construction sites to allow the reuse of salvaged and second-hand components and materials. Low value-added CE activities are essential to foster thorough transitioning (Williams 2020). Williams (2020) points out that the economic viability of material reuse and recycling depends on the location of the flows (for example, for loops to be closed locally, producers and "consumers" of "waste" should be co-located in the same city-region). Also Verga and Khan (2022) underline the importance of not focusing mainly on the recirculation of high value-added goods, but also promoting low value-added circular activities. These could allow more people to access circular services and products, thus increasing the overall quantities of goods recirculated, while creating an economy of scale. Furthermore, if the construction sector

could be considered one pillar of the foundational economy (Bentham *et al.* 2013), De Boeck et al. write that it is time to claim back urban spaces for such activities (De Boeck, Bassens & Ryckewaert 2019). Temporary uses of "vacant" space are often cited as a solution to the disappearance of industrial space in dense urban areas. On the other hand, there is much criticism based on the difficulties that companies face in finding more stable settings after beginning these "precarious" contractual frameworks (Williams 2020; Verga & Khan 2022). Nevertheless, contractual issues did not emerge as prominent in our survey, wheareas spatial features and real estate processes were highlighted as the most impactful factors.

5.4.2 How to engage in the transitioning of the construction sector in Belgium?

An overview of international (European), national and regional policies is essential to know the objectives and schedule for the transitioning of sectors. Such policies translate into many initiatives supporting companies, which then could constitute a set of exemplary "good practices". Furthermore, for the Belgian context, it is important to mention the European territorial cooperation program Interreg (international regions) aimed at fostering the sustainability (including circularity) and attractiveness of European regions. The Interreg North-Western Europe program is based on cooperation across industrial sectors and key economic players across Belgium, the Netherlands, the North of France, the West of Germany, Switzerland, and Irland. The proposed programs and outcomes of such EU-financed projects could be of relevance, (i.e., the Interreg project "Facilitating the circulation of reclaimed building elements in North-Western Europe").

Policies supporting a transition to the CE in the Belgian construction sector

Public institutions, from the European Union to the individual the Belgian regions, are working on the translation of CE ambitions into sectorial actions (a summary of the three Belgian Regions' policies can be found in Section 1.3; while an overview of European policies can be found in Section 1.1.6 and Section 1.1.7). As said, the construction sector was identified every time as a key one to transitioning into circularity. In the ***European CE Action Plan*** the focus was on resource-intense industries, namely textiles, construction, electronics and plastic. The construction sector was part of a comprehensive new strategy for a more sustainable built environment, in order to ensure coherence across relevant policy areas such as climate, energy and resource efficiency, management of construction and demolition waste, accessibility, digitalisation and skills (European Commission 2015, 2020a). The Brussels Capital Region CE policy program, the ***Programme Régionale Economie Circulaire*** (PREC 2016-20), focused as well on key sectors considered to be the most impactful. The construction industry was targeted, and it had been the object of a few in-depth studies that resulted in a series of publications done in collaborations with

universities and field experts (Bruxelles Environnement 2016, 2018a, 2018b). The region developed a subvention framework called *BeCircular* dedicated to four sectors (construction, resources and waste, logistics and retail). Since 2016, BeCircular *Chantiers Circulaires* awards contractors engaging with CE in the construction sector. This subvention covers part of the extra costs linked to CE implementation, for example, the costs linked to the extra processes needed to recuperate and clean flooring before reusing it compared to just buying it anew. Furthermore, in September 2021 the Brussels Capital Region has launched a new policy under the name of ***Alliance Renolution***, allowing more actors to have access to tailor-made guidance and financial support, with the aim of supporting a more inclusive and widespread energetic transitioning of the existing built environment. *Renolution* is an attempt to make energetic and circularity transitioning ambitions converge into one approach. It claims to be fully in line with circular oriented logic as it will allow users to calculate (in a more comprehensive manner) the environmental impact of the building: taking into consideration not only energy consumption but also the production, transportation and disposal of the materials involved in an architectural project. This new tool favours the maintenance of existing building stocks, and favours the reuse of dismantled construction materials on site or in other projects, rather than putting them into waste treatment circuits. In Flanders the initiative ***Vlaanderen Circulair*** federates governments, companies, civil society and the knowledge community. In line with the Flemish governmental objective to transform Flanders into a circular trendsetter in Europe by 2030, they aim to reduce their footprint by 30 % within an economic growth perspective (Vlaanderen Circulair 2021). Also, in the Flemish CE agenda, the construction sector is prominent. A total of six sectors are targeted: circular construction, chemicals and plastics, water cycles, biobased economy, the food chain, manufacturing (textiles, furniture, electronics, batteries, et cetera). In Wallonia a new CE plan ***Circular Wallonia*** was approved in February 2021 and ten priority ambitions were outlined. Wallonia has adopted CE plans at different levels: at the level of waste prevention and management (with the Walloon Waste-Resources Plan), at the level of reuse with the social economy sector, at the level of accompaniment, financing and support of projects and focusing on the Green Deal for Circular Purchasing. In this policy, the construction sector is one of the six value chains targeted, namely construction and buildings, plastics, metallurgy and batteries (including rare and critical metals), water, textiles, the food industry and food systems (Service Public Wallonie 2021).

5.4.3 What actions and policies are most needed to support the transitioning?

Many actions and policies can be promoted in order to foster circularity oriented innovations in the construction sector. In this section, we will discuss the policy for the Belgian context in more detail.

We note that until about ten years ago, the emphasis has been on recycling activities, whereas today the emphasis is more on the reuse of components and materials, even if the quantities of elements actually reused remain anecdotal (estimated at the moment at about 1 % of construction waste in Belgium). Recycling involves the down-cycling

of elements that could still be recovered. Moreover, it uses a significant amount of energy (and sometimes water) and has heavy impacts on logistics. So far in Belgium recycling operations have been very well developed (around 90 % of the sectorial solid waste is recycled), while the operations on reclaimed products are less developed, yet constantly, growing.

Many drivers can be identified for the deployment of more circularity innovations in the Belgian construction sector: from the current political momentum for CE praising the development of more local economic activities, to the gradual development of regulatory pressure aiming at lowering environmental impacts. There are significant efforts put into governments' support of circularity oriented activities (e.g., subventions and possibilities for tailored guidance to develop and implement circularity strategies). Realities that embrace circular strategies from an early stage can benefit from a pioneer position, gaining visibility and recognition.

Policy evaluation:

The last part of the survey focused on the evaluation of specific policies. We asked respondents to evaluate a set of potential policies (ranking them from 1-3). They could also propose policies they found crucial but were not included in our original list (composed by: (a) the EU ETS (carbon market); (b) Customs tariffs on primary raw material imports; (c) VAT; (d) Professional taxes; (e) Waste-related taxes; (f) Public procurement regulations; (g) Legal guarantees (on products); (h) Eco-design regulations/incentives). **Table 5.8** provides an overview of the results. The most cited one was **waste-related taxes** (cited nine times). The reason is that demolition operations are cheaper nowadays compared to more circular operations. Supplementary taxation (for example, taking into consideration environmental aspects) would increase the cost of (construction) waste production. The assumption is that in this way CE operations would be stimulated, as they would become economically more competitive and therefore attractive. The **carbon market** (European Union Emissions Trading System) is listed as the second most cited factor (cited seven times). **Public procurement regulation** policies are in the third position (cited six times), followed by **regulations and incentives on eco-design** (cited five times). European policies play a major role in setting an international trend, which affects global markets, while the evolution of local public authority procedures and subsidies (supporting the CE) is seen as essential for the development of national circularity oriented companies. One example would be the inclusion of companies' environmental scores (or environmental scores of design proposals or materials) in public tendering, allowing more environmentally friendly (and circular) companies and solutions to compete with cheaper ones. Public subventions supporting the choice of more ecological (and circular) solutions and materials over "standard" ones are advocated. An example could be the redesign of the mandatory energy performance scores by adding more parameters able to assess the broader environmental impact of future projects (for example, by taking into consideration the embodied energy of the chosen materials). Such a policy would stimulate the recovery (refurbishment and

resale) of local materials as well as the local production of bio-sourced (and geo-sourced) materials. Adding taxation at the European and national level to increase **custom tariffs on raw materials** was highlighted in particular by deconstruction companies, as well as by local material producers and second-hand retailers. Their claim is that by making raw materials more expensive on the market, local material supplies could become more economically competitive on the market.

We also asked companies, that if they had to choose between two kinds of public support (in-kind – for example, provision of infrastructure – or in cash – for example subsidies – which one they would favour and for which activity. The outcome shows that the majority of companies would prefer subsidies in cash.

			C 1	C 2	C 3	C 4	C 5	C 6	C 7	C 8	C 9	C 10	C 11	C 12
COMPANY PROFILE	interview identifier													
	type legal structure		incumbent cooperative	incumbent cooperative	new entry cooperative	new entry cooperative	incumbent company	incumbent company	new entry cooperative	incumbent company	incumbent cooperative	new entry company	incumbent company	new entry company
	size		2-9 employees	10-49 employees	10-49 employees	2-9 employees	250 and more employees	250 and more employees	2-9 employees	10-49 employees	10-49 employees	10-49 employees	250 and more employees	10-49 employees
	POSITION	design				x		x		x	x			
		material supply (incl. secondary)			x	x			x			x		
		construction	x				x	x						
		maintenance and use						x					x	
		deconstruction	x	x	x									
		waste management		x										x
PUBLIC SUPPORT	Public support		probably in cash (subsidies)	probably in cash (subsidies)	probably in kind (provision of infra-structures)	probably in kind (provision of infra-structures)	definitely in cash (sub-sidies)	probably in kind (provision of infra-structures)	definitely in kind (provision of infra-structures)	definitely in cash (subsidies)	definitely in cash (subsidies)	definitely in cash (subsidies)	definitely in cash (subsidies)	no preference
	for which activity		deployment	deployment	development	deployment	development	deployment	deployment	research	research	development deployment	deployment	development
	Three main policies that could drive the transitioning		EU ETS (carbon market)	EU ETS (carbon market)	VAT	EU ETS (carbon market)	Public procurement regulations	Public procurement regulations	Legal guarantee (on products)	Public procurement regulations	Public procurement regulations	Public procurement regulations	EU ETS (carbon market)	EU ETS (carbon market)
			Waste-related taxes	Waste-related taxes	Custom tariffs on raw materials	Waste-related taxes	Regulations and incentives on eco-design	Regulations and incentives on eco-design	Public procurement regulations	EU ETS (carbon market)	EU ETS (carbon market)	Custom tariffs on raw materials	Waste-related taxes	Waste-related taxes
			Custom tariffs on raw materials	Regulations and incentives on eco-design	Environ-mental tax on new materials	Custom tariffs on raw materials	Waste-related taxes	Waste-related taxes	Regulations and incentives on eco-design	Waste-related taxes	Waste-related taxes	Regulations and incentives on eco-design		VAT

TABLE 5.8: Overview of respondents' ranking of the top three most impactful CE policies to adopt in order to accelerate the transitioning towards more circular oriented innovations in the Belgian construction sector.

The interdependencies of enablers are evident, as well as their potential downsides and rebound effects. Thus, solutions are to be discussed in relation to their potential downsides as well, in order to propose nuanced and informed solutions. Results from a survey on solutions to increase reuse in the construction sector in Brussels outlined that all the most important barriers are related to each other (Makkink 2020). Therefore, tackling one issue can help solve more than one obstacle, for example, inherent extra costs influence the economic ability to pay for storage space and can limit supply and demand potentials. Nevertheless, it remains difficult to evaluate the effects of enablers. An interesting methodology is the one applied in a research commission by the Federal Council of Sustainable Development in Belgium (FRDO-CFDD) questing how to accelerate circular economy in the construction sector from a governance perspective (ICEDD, FRDO-CFDD, et al. 2020). They list obstacles and propose actions, each action was then discussed with multiple stakeholders in order to understand the interdependencies of enablers and to foresee their rebound effects. In the ICEDD (2020) final report ten points outline the main priority actions that need to be implemented by the federal government: (1) the discussion of the status of waste and products around cooperation agreements and legal provisions; (2) the prescription in public procurement of the extraction and integration of reuse materials and the use of environmental assessment tools ; (3) the establishment of a framework for the performance evaluation of reusable materials and the principles for carrying out a resource inventory; (4) VAT reduction on circular products; (5) the internalisation of environmental and social costs in the cost of products; (6) financial support for circular projects; (7) taxing raw materials; (8) imposing a percentage of reused products; (9) training and awareness-raising for public planners; (10) integrating modules about the circular economy into training programmes (ICEDD, FRDO CFDD, et al. 2020). An example of the multifaceted outcomes of different enablers (for example on taxation) can be found in the report from the FRDO-CFDD:

> *The tax framework needs to be reviewed, for example by shifting from taxation on labour to taxation on raw materials (or on CO2 emissions or other environmental impacts); by tax deductions for donations in kind of second-hand materials or for deconstruction work or inventory of reusable materials or by reducing VAT on recycled or reused building materials (…). However, this change in the tax regime on raw materials will have to be integrated into the rules of the European single market, which prevents any discrimination against materials coming from abroad, whether through fiscal measures, the closing of borders or any other measure that limits their free movement. In fact, adapting taxation by increasing the tax on raw materials would only affect the competitive position of local producers of new materials vis-à-vis their foreign competitors, without promoting reused materials, which will remain in competition with new materials produced abroad.*
> *(ICEDD, FRDO CFDD, et al. 2020).*

5.5 CONCLUSIONS

By focusing on a specific sector (construction), we could identify the contextual factors that affect companies' transitioning towards circular oriented innovations. The aim of this chapter is to provide an overview of the construction sector and to help companies, organisations and policymakers accelerate the transitioning toward more circularity oriented innovations. The results also underline the relevance of the "spatial" factor, which is rarely discussed in the literature, yet emerges often in interviews as a crucial one in dense urban contexts, such as the Brussels Capital Region.

If the focus on the Belgian context is seen as a major limitation of this work, especially for international readers, we could see Belgium as part of a broader geographical and socio-economic area: northwest Europe. We do not suggest that findings would be transposable to the other national contexts comprised in this part of Europe, but the outcomes of this research could enrich the understanding of a large part of this area. In addition, Belgium is a densely populated region. This is probably an element that influenced the emergence of space scarcity problems by the respondents. Dense countries (such as Belgium) experience strong competition for space, and if we take the example of small regions, such as Brussels, we can see that the effect of space scarcity is amplified (Verga & Khan 2022). These phenomena cannot be generalised on a global scale, but it would be relevant to extend the analysis of the influence of spatial factors on the development of circular innovation to hedge cities (Williams 2020) and other dense contexts. Spatial issues may not have been identified in other studies due to the choice of the context. Therefore, they should be studied further in future research, making comparisons with other contexts. Urban and architectural analysis of morphologies, typologies and location could help to identify elements to be addressed at the urban planning level.

The limitations of this research lie in the sampling of respondents. Such convenient sampling (used for the first round of exploratory semi-structured interviews and for the survey) could have been expanded. Unfortunately, timewise was not possible. The limited number of respondents is probably not fully representative of the population we target. Future research could improve the sampling of respondents (more varied and more numerous). A specific bias in the discussion about factors could have been the differences between "factors affecting the adoption of circular oriented innovations by companies" and "factors affecting the development of circular projects". We noticed that for companies working in the design field, it was difficult to answer questions about the generic "internal factors" that affect their business. They tended to mix factors inherent to the projects with factors inherent to their organisation (whereas in our framework it is the "external factors" that affect their opportunity to push circularity innovations in their projects). Therefore, deepening the understanding of specific factors (by asking more questions on sub-factors) could be interesting and provide more nuanced answers. Moreover, it would also be interesting to open up the survey to one or a few

other national contexts and (or) to some other industries. A comparative analysis could then nuance the discourse and pinpoint specific local factors and other transitional ones. By increasing the sample population and asking more detailed questions, more conclusions could be drawn about the influence the position in the value chain has on the adoption of circularity oriented innovations.

In conclusion, the construction sector has a growing impact on the consumption of resources, and it generates almost 40 % of the waste in the European Union every year. Urgent measures must be taken to tackle such over-consumption and excessive waste production, yet circularity oriented practices dealing with the built environment are still marginal. European, national and regional institutions are formulating more concrete objectives and tools to accelerate the process. The challenge is great and requires a radical change in behaviour and socio-cultural paradigms. Public authorities play a pivotal role in accelerating the transition to the CE in this sector. For example, by increasing taxes on demolition waste, they can encourage the retrofitting and adaptation of existing buildings and limit high waste flows and inputs of new materials. Other examples include changing tendering procedures and readjusting specification requirements to facilitate circularity practices, or requiring a minimum percentage of circular materials and components to be included in future public projects. Furthermore, cities need to provide space for businesses to (re)develop local value chains, not only through temporary occupations, but also by ensuring affordable prices and long-term leases for businesses to establish themselves in non-precarious conditions. Cultural change can also be achieved through regulation, for example by requiring a study of the environmental impact of materials (in addition to the energy performance assessment). Still, significant efforts should be done in order to improve the current situation. Nevertheless, remarkable advancements have been made in the last five to ten years: the debate is getting more multifaceted, shifting from recycling to more holistic approaches. Local knowledge and know-how are being developed through pioneering pilot projects and many more will certainly follow.

As discussed in **Chapter 1**, a growing number of scholars point out the fact that the main challenge ahead is therefore behavioural, rather than technological (Hobson 2016; Korhonen et al. 2018; Merli et al. 2018; Pomponi & Moncaster 2017). Regulatory and technological solutions are not the only answer to address the phenomena and "*a shift is required in business models and stakeholders' behaviours and attitudes*" as Hart et al. write (2019). A cultural, societal, political and economic shift is needed, as it would allow people to question how they interact with the built environment. Each space user, manager, owner, designer, constructor (or other), could play a role in the fostering of circularity oriented ambitions. By integrating circular innovations (such as optimal use and maintenance, lowering energy and water consumption, tackling waste production at all levels, supporting local value chains, reducing logistics, et cetera) in reflections and practices in private domiciles, enterprise headquarters, public buildings and infrastructures, everyone could become a transitioning actor in the construction sector and more in general in the built environment.

Realities that adopt circularity strategies from the beginning can benefit from a pioneering position, gaining visibility and recognition. Furthermore, the aggregation of projects through collaboration might turn barriers into opportunities (e.g., the economy of scale, for example when the large quantities of the available materials could finally become cost-effective and overcome the barrier derived from inherent extra costs (Hart et al. 2019)). In addition, the needed investment in rethinking and restructuring companies should be seen as essential in the reshaping of a new value proposition. Motivation can be boosted by enhancing communication and collaboration in the organisation itself and also towards value-chain partners, in business ecosystems, and with institutions. One of the main challenges can be identified in the need for a more synergic sector, where information is shared and mutual support is given. More circularity oriented logistics should also be developed, based on shared and optimised platforms: an example is the Brussels Construction Consolidation Centre (BCCC 2020).

The motivation of employees:

> *What interests me is to do work that makes sense and that limits waste and pollution.*
> *(Extract from the interview, conducted and translated by the authors, A10).*

Companies working on the circularisation of the construction sector should promote a company culture of pride in working within inspiring and relevant societal and environmental engagements. Meaningful jobs are a good motivational element to build durable collaborations. Furthermore, the use of collaboration and design tools, for example BIM modeling and material passports, is often cited in the literature as a key solution for future assessment methods for building for reuse and integrating resource cycles' design in industries (Hart et al. 2019). In addition, investments in time and resources to develop research and design units, in collaboration with multiple stakeholders (public institutions, research institutes, value chains, et cetera), can bring best practices to interesting levels of innovation and help restructure collaborations. Grants and public support can also be found in regional research institutions that encourage synergies between universities and companies, for example, to develop applied research. A final strategy to get started could be to take advantage of easy wins, by looking first at the cost-saving inputs (Hart et al. 2019). An example could be the development of circular business models that optimise what is already there (for example under-utilised floor space). Another low-hanging fruit could be seen in the anticipation of things that would have happened regardless of any CE agenda (i.e., the framing of inevitable actions). Looking for "easy wins" could be seen as a way to subvert more systemic changes, but "if there is a choice between no action and taking a fragmented approach, then the latter is probably preferable" (Hart et al. 2019). A way of fostering CE could also be developed through experiments within temporary tests, for example, only on some selected buildings or infrastructures (Urban Agenda for the EU et al. 2019).

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CHAPTER 6

TRANSFORMING WASTE INTO RESOURCES: TOWARD A METHODOLOGICAL FRAMEWORK FOR CIRCULAR BUSINESS MODEL DIVERSIFICATION

Jean Mansuy, Philippe Lebeau & Cathy Macharis

Establishing new business models and stakeholder collaboration along the product lifecycle will become the 'match-winner' for a true CE. We won't, then, have any more 'upstream' or 'downstream' value chains, but 'round stream'.
[raw materials producer]

6.1 INTRODUCTION

Amongst the different types of circular oriented innovations included in **Chapter 4**, business models have a key role to play in the transition to a CE (Suchek et al. 2021). In particular, business models can either support the adoption of circular oriented innovations by the market or be considered themselves as innovations (Bidmon & Knab 2018). A business model is "*a simplified and aggregated representation of the relevant activities of a company* […]" (Wirtz et al. 2016). Such relevant activities are usually subdivided into three dimensions: (1) the value proposition, which considers what the firm delivers to its customers; (2) value creation and delivery, which defines how the firm creates and delivers the value proposition; and (3) value capture, which describes how the company makes a profit out of its value proposition (Richardson 2008; Teece 2010).

Business models supporting the CE are called circular business models (or CE business models). They describe

> *how a company creates, captures, and delivers value with the value creation logic designed to improve resource efficiency through contributing to extending useful life of products and parts (for example, through long-life design, repair and remanufacturing) and closing material loops.*
> *(Nußholz 2017)*

The conceptualisation and implementation of circular business models are performed through a business model innovation process. Business model innovation refers to "*designed, novel, and nontrivial changes to the key elements of a firm's business model and/or the architecture linking these elements*" (Foss & Saebi 2016). Such business model innovations are more complex to adopt than product or process innovations. This difficulty can explain the low uptake of circular business models in practice: in a recent survey of the World Business Council for Sustainable Development (WBCSD), less than 20 % of companies were engaged in business model innovation because of circularity, against more than 65 % because of product or process innovation (WBCSD 2018). As seen in **Chapter 4** and **5**, barriers to the implementation of circular oriented innovations are either internal to a company, related to the intrinsic motivation of its executives or to the ability of the company to adopt or develop an innovation, or external, related to extrinsic motivation or the opportunities provided to the company. The high involvement of companies in other types of circular oriented innovation attests that a lack of motivation is likely not a major reason for the low adoption of circular business model innovation. In addition, and as discussed in **Chapter 1**, the interest in the CE is constantly increasing among practitioners and policy-makers, thus providing opportunities for companies. Hence, it is likely that the low development of business model innovation processes is related to the inability of companies to execute such processes.

Indeed, successfully executing a business model innovation process requires specific capabilities to (1) identify opportunities for new business models, (2) design new business models to address such opportunities, and (3) implement new business models (Mezger 2014). Those are dynamic capabilities (Teece 2007), in other words referring to the capability of a company to adapt its resource base to a changing environment by (1) sensing and (2) seizing opportunities and (3) reconfiguring (or transforming) their business accordingly. A lack of such capabilities prevents companies to adapt their organisation and implement circular business models. To compensate for such a lack, companies can use methodological frameworks (or process models (Pieroni, McAloone& Pigosso 2019b)), that aim to guide users through a process, using stages or a step-by-step approach (McMeekin et al. 2020).

As suggested in **Chapter 4**, several approaches are available for companies to adopt circular business models. On the one hand, they can decide to either develop

the business model innovation outside of their corporate boundary, using structural separation (Kuhlmann, Bening& Hoffmann 2022). On the other hand, they can decide to develop a business model innovation affecting their core business or to rather extend the scope of their activities. This leads to four possible strategies for companies to adopt a circular business model (**Table 6.1**): transformation, diversification, start-up or acquisition (Geissdoerfer et al. 2020).

		Is the circular business model innovation developed within the focal company?	
		Yes	***No***
Does the circular business model concern the core business of the focal company?	***Yes***	Circular business model transformation	Circular start-up
	No	Circular business model diversification	Circular business model acquisition

TABLE 6.1: Strategies for circular business model innovation (adapted from Geissdoerfer et al. 2020)

Among the abovementioned business model innovation strategies, most methodological frameworks supporting the development of circular business model innovations either support a business model transformation or fail to specify the strategy they adopt (Mansuy 2022a). This lack of specification of the strategy associated with a given methodological framework is likely to influence its effectiveness, seeing business model innovation strategies are subject to different constraints. For example, and as discussed in **Chapter 4**, a business model transformation is more likely to be impacted by lock-ins, associated with an existing supply chain or existing assets. On the other hand, a business model diversification is less likely to be impacted by the suppliers of a company but requires specific care to ensure the alignment of the innovation with a company's resources and capabilities.

A diversification strategy can be promising for incumbent firms as it enables them to keep their current business model (and hence their customers). At the same time, the newly developed business model will provide an opportunity to "get" new customers and to "grow" existing ones through cross-selling (Blank & Dorf 2012). Nonetheless, and as discussed above, business model diversification may face different issues than other strategies, which requires the development of specific frameworks. The present chapter aims to develop an approach to circular business model diversification. To do so, it introduces a methodological framework supporting companies in the identification, design and implementation of circular business models transforming waste into new resources.

After providing a brief overview of existing frameworks supporting circular business model innovation (6.2), this chapter presents the novel methodological framework, including activities and tools supporting the business model innovation process (6.3). Finally, the limitations and practical implications of the methodological framework are discussed (6.4).

6.2 OVERVIEW OF METHODOLOGICAL FRAMEWORKS SUPPORTING CIRCULAR BUSINESS MODEL INNOVATION[10]

Business model innovation can either be seen as an outcome or as an organisational change process (Foss & Saebi 2016; Santa-Maria, Vermeulen& Baumgartner 2020). Within the stream of research focusing on business models as a process, much work has been done to identify the different stages of such a process (Wirtz & Daiser 2018). Among the many business model innovation processes proposed, some were specifically developed from a sustainability (Roome & Louche 2016; Geissdoerfer 2019) or circularity (Frishammar & Parida 2019) perspective. Those processes are, however, descriptive and require further operationalisation to be used by practitioners. Several methodological frameworks provide such an operationalisation by offering step-by-step guidance (through activities) to companies for the development or adaptation of business models to circularity. **Table 6.2** provides an overview of existing frameworks supporting circular business model innovation.

Methodology

To identify methodological frameworks available for practitioners, we used a data collection approach based on the two most used web search engines with their own indexes, in other words Google and Bing. Such search engines produce a huge number of suggestions with decreasing relevance. Hence, we browsed search results until saturation (which we operationalised as the absence of relevant results in the next five pages). To identify methodological frameworks in those search engines, we searched for results containing the terms "business model", "CE", and either "guide", "toolkit", "framework", or "workbook". The web search was performed in early May 2022.

To extend the sample further, a snowballing procedure was performed from the sources identified in the review process. This snowballing procedure is supported by the idea that practitioners might dig further into data they identified in their web search.

The final sample (consisting of sixteen frameworks presented in **Table 6.2** and **Figure 6.1**) only includes prescriptive frameworks considering several stages of a business model innovation process. Hence, purely descriptive approaches (focusing on what is usually done without provision of guidance) and frameworks focusing on a single stage were not considered.

Identified methodological frameworks were classified based on their targeted users (sector and audience), expected usage (scope and setting), purpose (business model innovation strategy), and authorship. In addition to their characteristics, methodological frameworks were also compared based on their content, in particular (1) the business

10 For a more complete overview, see Mansuy (2022a)

model innovation stages they considered and (2) the tools they suggested. To simplify the comparison between stages, we decided to compare all methodological frameworks to the same business model innovation process. Among the many existing processes, we opted for the one suggested by Geissdoerfer (2019) due to its recency, its focus on sustainability, its consideration of previously suggested processes and its empirical grounding.

Name of the framework	Original publication	Authors	Year	Sector	Audience	Scope	Setting	Strategy	Origin
The Circular Toolbox		Circle Economy	2021	Fashion	Incumbents	Company	Group	Not defined	Practitioners
Circular Business Model Innovation Process Framework for electrical and electronic equipment sector manufacturers	A CE business model innovation process for the electrical and electronic equipment sector	Pollard, Jennifer; Osmani, Mohamed; Cole, Christine; Grubnic, Suzana; Colwill, James	2021	Electrical and electronic equipment	Incumbents	Company	Not defined	Transformation	Academics
Circular Business Model Design Guide	Circular Business Model Design Guide	Lancelott, Mark; Haines-Gadd, Merryn	2020	Generic	Incumbents	Company	Individual	Transformation; Diversification	Mixed
CE-Driven Business Model Configurator	CE Business Modelling: CIRCit Workbook 2	Pieroni, Marina P.P.; Jensen, Thomas H.; Pigosso, Daniela C.A.; McAloone, Tim C.	2020	Manufac-turing	Incumbents	Company	Group	Transformation	Academics
Circular Navigator	Circular Ecosystems: Business Model Innovation for the CE	Takacs, Fabian; Stechow, Richard; Frankenburger, Karolin	2020	Generic	Incumbents	Business ecosystem	Not defined	Transformation	Mixed
CE Guidelines		Business Models Inc; Whole Earth Future	2019	Generic	Incumbents	Company	Group	Not defined	Academics
Design thinking framework for CBMI	A Design Thinking Framework for Circular Business Model Innovation	Guldmann, Eva; Bocken, Nancy M P; Brezet, Han	2019	Generic	Not defined	Company	Group	Not defined	Academics
CELLL	CELLL – a toolkit for co-creating CE business models	Purola, Aletta; Nevmerzhitskaya, Julia; Santonen, Teemu	2019	Generic	Incumbents	Business ecosystem	Group	Not defined	Academics
Business Models for the CE	Organising for the CE	Jan Jonker; Ivo Kothman; Niels Faber; Naomi Montenegro Navarro	2018	Generic	New entrants; Incumbents	Company	Individual	Not defined	Academics
CE Playbook	CE business models for the manufacturing industry	SITRA	2018	Manufac-turing	Incumbents	Company	Individual	Transformation	Practitioners
AARRE Business Model Innovation Process	CE Business Model Innovation Process – Case Study	Antikainen, Maria; Aminoff, Anna; Kettunen, Outi; Sundqvist-andberg, Henna; Paloheimo, Harri	2017	Generic	Incumbents	Company	Group	Transformation	Academics

Name of the framework	Original publication	Authors	Year	Sector	Audience	Scope	Setting	Strategy	Origin
BS 8001:2017	Framework for implementing the principles of the CE in organizations	BSI	2017	Generic	Incumbents	Company	Not defined	Transformation	Practitioners
BECE Framework	Integrating Backcasting and Eco-Design for the CE: The BECE Framework	Mendoza, Joan Manuel F.; Sharmina, Maria; Gallego-Schmid, Alejandro; Heyes, Graeme; Azapagic, Adisa	2017	Generic	Incumbents	Company	Group	Transformation	Academics
Five steps to achieve a CE	Unlocking More Value with Fewer Resources: A practical guide to the CE	WBCSD	2016	Generic	Incumbents	Company	Individual	Transformation	Practitioners
CE Business Toolkit	CE Business Toolkit	National Zero Waste Council	2015	Generic	Incumbents	Company	Individual	Not defined	Practitioners
Guided Choices Towards a Circular Business Model	Guided Choices Towards a Circular Business Model	Douwe Jan Joustra; Egbert de Jong; Frits Engelaer	2013	Generic	Incumbents	Company	Individual	Transformation	Practitioners

TABLE 6.2: Overview of existing frameworks for circular business model innovation (Mansuy 2022a)

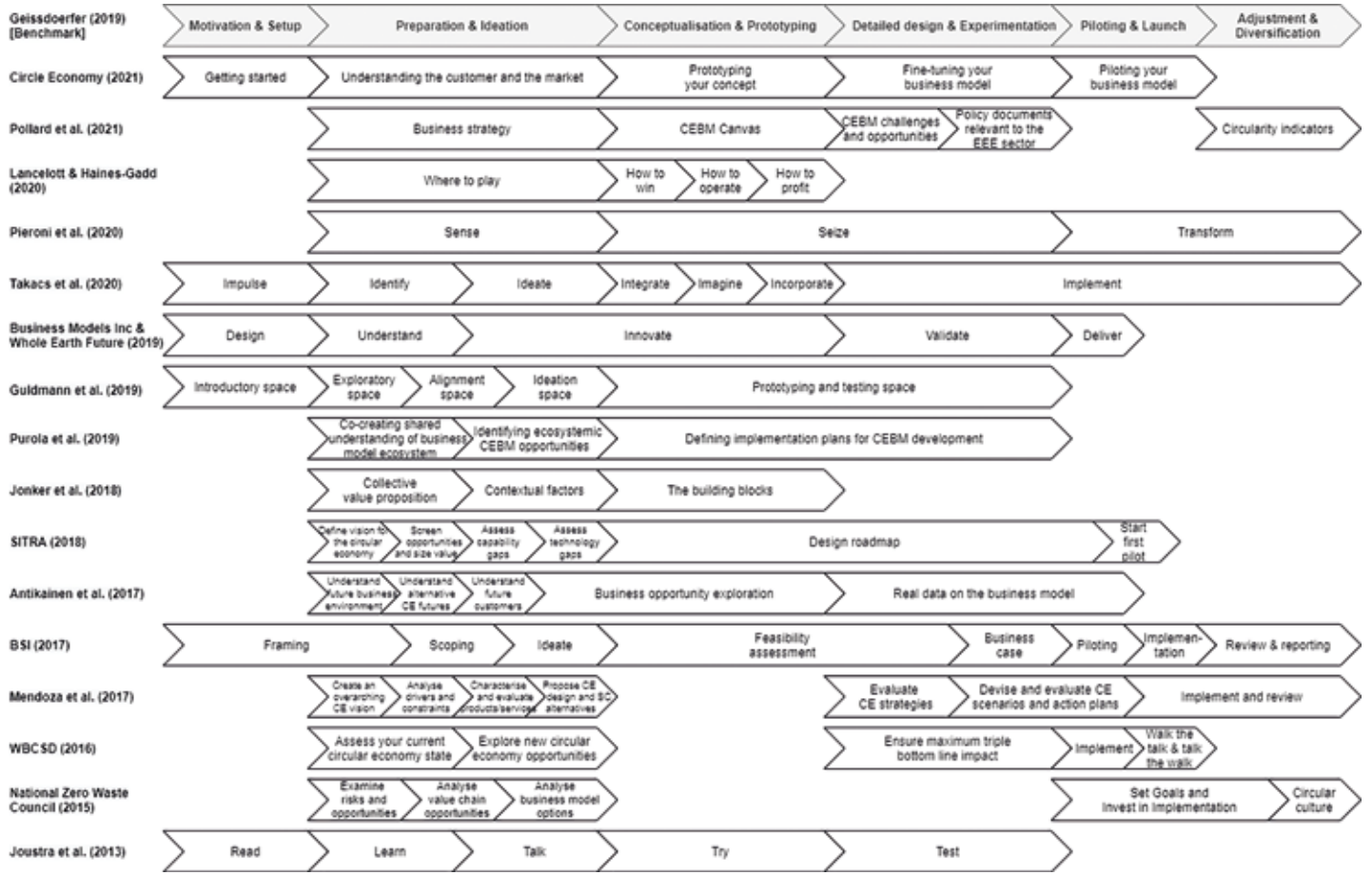

FIGURE 6.1: Comparison of the business model innovation processes used by methodological frameworks (Mansuy 2022a)

All identified frameworks focus primarily on incumbent firms, suggesting an internal development of circular business models, which sets aside the start-up and acquisition strategies (**Table 6.1**). In addition, and as mentioned in the introduction of this chapter, frameworks either do not specify any business model innovation strategy or imply a business model transformation. Only one framework considers business model diversification, although not exclusively. Therefore, further work is required to develop methodological frameworks supporting alternative business model innovation strategies to business model transformation. The present chapter aims to fill this gap by introducing a methodological framework supporting circular business model diversification.

Although all methodological frameworks target incumbent firms, a couple of them (for example Purola, Nevmerzhitskaya& Santonen (2019) or Takacs, Stechow& Frankenberger (2020)) do not limit their scope to a focal company and rather take an extended business ecosystem perspective, considering not only the business model of the focal company but also the ones of its partners (Adner 2017). Despite having long been introduced in the business literature (Moore 1993)), the business ecosystem concept has only recently known a renewed interest from the literature on circular business models (Konietzko, Bocken& Hultink 2020b; Asgari & Asgari 2021; Bertassini et al. 2021; Kanda, Geissdoerfer& Hjelm 2021). Business ecosystems do not only involve companies that directly contribute to value creation (the value network) but expand to companies (called complementors) that provide complementary products and services indirectly contributing to such a value creation (Kapoor 2018). Value networks (Allee 2000) are a value creation logic (Stabell & Fjeldstad 1998) that progressively substituted the value chain concept (Ricciotti 2020). In particular, they encompass supply chains but also consider actors that participate in intangible value creation.

Despite a lack of focus on external collaboration, many methodological frameworks require collaboration within a focal company, which usually takes the form of group activities. Such activities involve actors with a wide variety of backgrounds, not always "speaking the same language". Hence, further collaboration requires boundary work, which can include the use of boundary objects, in other words texts, concepts and tools that help actors share the same references (Velter et al. 2020). In the frame of circular business model innovation, boundary objects usually take the form of visual representations (Täuscher & Abdelkafi 2017). There exist many tools supporting the different phases of circular business model innovation processes but few fit companies' needs, limiting their adoption. These tools might be too complex, too time-consuming, or too context-specific (Bocken et al. 2019). The integration of easy-to-use, generic and adaptable tools in frameworks supporting circular business models is likely to ease their adoption. Existing methodological frameworks encompass a wide range of such tools (between 3 and 28 tools per framework, with a median of 7). Nonetheless, several of those frameworks do not provide any link between the tools they suggest, therefore resembling more an aggregation of tools than a methodological framework.

Business model innovation processes can encompass many stages (up to ten in the BECE framework proposed by Mendoza et al. (2017), limited to seven in **Figure 6.1** for sake of clarity). Stages can be gathered into three main phases: (1) the analysis of

problems and the identification of opportunities; (2) the development and evaluation of business models from identified opportunities; and (3) the implementation and improvement of a business model (Chen, Hung& Ma 2020). The transition between the last two phases is subject to a design-implementation gap: of the many designed circular business models, only a few manage to reach the market, and far much less manage to be successful (Baldassarre et al. 2020). Much work has been done to support the first two phases (identifying opportunities and designing new business models), but far less work has been done to implement new business models (Pieroni, McAloone& Pigosso 2019b). While a good business model design can help overcome the design-implementation gap, implementation is still a complicated issue, strongly related to the resources and capabilities of a company (Geissdoerfer, Savaget& Evans 2017). This suggests that business model innovation frameworks should integrate the implementation (operational) phase to account for its complexity. Nonetheless, half of the identified frameworks do not and limit themselves to business model design (**Figure 6.1**).

Almost all frameworks suggest stages in chronological order. In addition, many suggest taking an iterative approach, going backwards to reproduce previous stages when necessary. Nonetheless, very few provide guidance on when to switch between stages (in one direction or the other). Only the framework from BSI (2017) considers a stage-gate process (Cooper 1990), a type of process that allows limiting expenses until the uncertainty about a project's success decreases but that is often considered (possibly wrongfully so (Cooper 2008)) rigid and linear. The lack of decision-making processes to navigate within methodological frameworks is aligned with previous findings, Pieroni and her co-authors (2019a) identifying only one approach integrating such decision-making procedures (Girotra & Netessine 2013) in their review of process-based frameworks.

6.3 INTRODUCTION TO THE 6IS CIRCULAR BUSINESS MODEL INNOVATION FRAMEWORK

The 6Is circular business model innovation framework (**Figure 6.2**) is a methodological framework supporting companies (and more specifically incumbent firms) in circular business model diversification. It is composed of six consecutive stages, based on the descriptive business model innovation process proposed by Geissdoerfer (2019) and adapted to fit the terminology of Frankenberger et al. (2013). Each stage is associated with a specific objective, the achievement of which further supports the decision to move to the next stage, go back to a previous stage, or stop the project. The methodological framework suggests tools to serve as boundary objects and to help in meeting the different objectives. Those tools have been chosen for their large adoption among practitioners and ease of use, and have (when needed) been adapted to best meet circularity principles. In addition, the number of tools has been limited to limit the complexity of the framework.

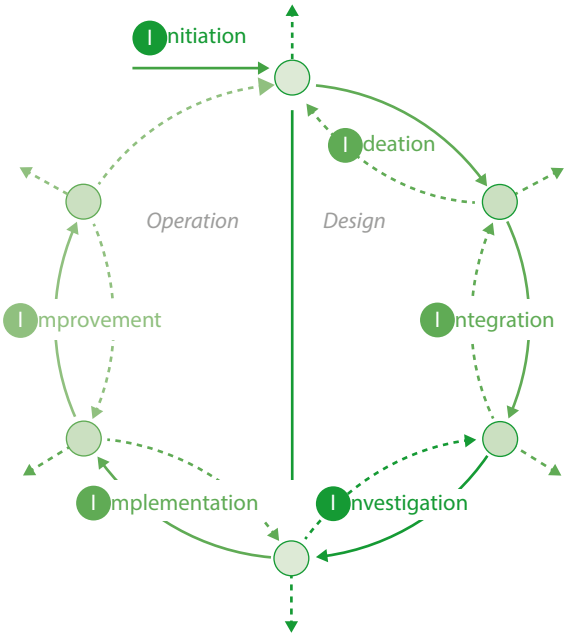

FIGURE 6.2: The 6Is circular business model innovation framework

The 6Is framework differs from other methodological frameworks mainly by two key aspects. First, it considers a product stewardship approach. Indeed, the 6Is assumes that the impact of a business model is not limited to the one directly induced by the activities of a focal company, but also includes the impact of other activities performed across the value network. Hence, it suggests that all value network actors share responsibility for the impact of a product or service provided by a given business model. Under such an approach, reducing the environmental and social impacts of a business model involves reducing the impact of its value creation process. The second distinctive aspect of the 6Is framework is related to the consideration of waste (or by-products from the production process) as an opportunity for business model diversification, combining waste minimisation with the development of economic activities. In doing so, the 6Is framework focuses on the post-use phase of the value hill (Achterberg, Hinfelaar& Bocken 2016), and supports the development of value recovery strategies by (1) reducing waste and by-products of the value network through the creation of loops within it (leading to closed-loop supply chains) and (2) valuing waste and by-products of the value network by creating products and services for actors outside it (leading to open-loop supply chains). The joint consideration of these two approaches is aligned with the principles of circular value creation (Ellen MacArthur Foundation 2013) and further supports the development of circular supply chains (Batista et al. 2018; De Angelis, Howard& Miemczyk 2018).

The first stage of the 6Is framework, **Initiation**, aims to **identify circular opportunities** through an analysis of the context in which the company operates ("as is") and of the goal the company aims to achieve through the implementation of a

circular business model ("to be"). To identify such circular opportunities, we suggest an approach building on the business cycle canvas of Mentink (2014).

The second stage, **Ideation**, aims to **identify circular value propositions** from the identified circular opportunities. To achieve this, we developed a circular ideation tool that classifies circular value proposition ideas by secondary resource suppliers and potential customers.

The third stage, **Integration**, aims to **design a circular business model** from the identified value propositions. To achieve this, we introduce an adaptation of the well-known business model canvas (Osterwalder & Pigneur 2010) to circularity.

The fourth stage, **Investigation**, aims to **evaluate and refine a circular business model design**. To achieve this, we propose an approach based on circular business model experimentation (Bocken, Schuit& Kraaijenhagen 2018; Bocken, Weissbrod& Antikainen 2021).

The fifth stage, **Implementation**, aims to **launch** a selected circular business model. The sixth stage, **Improvement**, aims to **adjust** the implemented business model to best meet market constraints. Both stages require an evaluation procedure to analyse how the business model design performs and to identify components of the business model that can be redesigned. To perform such an evaluation procedure, we suggest using a balanced scorecard (Kaplan & Norton 1992) adapted to circularity.

Stage I: Initiation

Objective: Identify circular opportunities

Activities:
1. Define objectives and success criteria of the business model innovation process
2. Map the business ecosystem of the focal company
3. Evaluate the access to secondary resources

Setting: Individual or Group

Scope: Focal company

Suggested tool(s):
Business Cycle Canvas (Mentink 2014)

Alternative tool(s):
- Value network analysis (Allee 2000)
- Ecosystem Pie Model (Talmar et al. 2020)

The first stage of the 6Is framework, **Initiation**, sets the scene for the rest of the business model innovation process. A process is a goal-oriented series of actions that aims to shift from an existing situation to a desired outcome. Initiation, therefore, analyses the existing situation (the company's current value proposition and the business ecosystem around it) and the desired outcome (the company's objectives regarding circularity).

Activity 1.1: Define objectives and success criteria of the business model innovation process

First, the company should define the objectives that motivate its willingness to implement a circular business model. A company should be able to answer the following two key questions:

- *Which additional value do we expect to capture from a new circular business model?*
- *Under which conditions will we consider circular business model innovation a success?*

The objectives of a company regarding the achievements of a circular business model must be SMART: Specific, Measurable, Achievable, Relevant and Time-bound. Achievability is particularly important, as unfeasible objectives will lead to a systematic cancellation of a circular business model innovation project and the loss of engaged resources.

Objectives can be derived from a circular strategy if the company already has one. Else companies can use and adapt the table presented in **Table 6.3** to support the definition of their objectives[11]. This table considers three main types of value that can be captured by a circular business model: economic, environmental and social. To use this table, companies should first select (or add, if not present in the list) outcomes from a circular business model that would be the most important for them. The number of targeted outcomes should be limited and not overlap.

Sustainability	Subgroup	Impact	Direction	Strategic?	Rank
Environmental	Input	Raw materials extraction	Reduction		
		Energy use	Reduction		
		Water use	Reduction		
		Land use	Reduction		
	Output	Waste production (total)	Reduction		
		Waste production (hazardous)	Reduction		
		Air emissions (greenhouse gases)	Reduction		
		Air emissions (local pollutants)	Reduction		
		Water effluents	Reduction		
		Biodiversity loss	Reduction		

11 Please note that this table, obtained from a literature review, is not exhaustive. In addition, several outcomes are overlapping (for example local air pollution and impact on health).

Sustainability	Subgroup	Impact	Direction	Strategic?	Rank
Economic	Profit	Profitability	Increase		
		Return on investment time	Reduction		
		Economic efficiency	Increase		
	Direct cost	Variable costs	Reduction		
		Fixed costs	Reduction		
		Productivity	Increase		
	Indirect cost	Inventory	Reduction		
		Lead time	Reduction		
		Predictability of return flows	Increase		
	Direct revenues	Revenues	Increase		
		Market share	Increase		
		Product sales	Decrease		
	Indirect revenues	Brand reputation	Increase		
		Level of service	Increase		
		Product quality/attractiveness	Increase		
Social	Employees	Engagement of employees	Increase		
		Employement	Increase		
	Communities	Engagement with local communities	Increase		
		Negative impacts on health	Reduction		
		Poverty	Reduction		
		Food security	Increase		
		Transparency	Increase		

TABLE 6.3: Potential outcomes of a circular business model

One might be tempted to define "Increased circularity" as an overarching objective. We advise against this option. Indeed, circular business models can be seen as a subset of sustainable business models (Bocken et al. 2014; Geissdoerfer et al. 2017). In such an approach, circularity serves as a means to an end, sustainability. Hence, we believe it is best to directly consider economic, environmental and social objectives. This does not mean, though, that circularity should be left aside. Material circularity remains an important aspect of environmental sustainability. As such, companies can jointly consider material circularity with economic, environmental and social objectives (Blum, Haupt& Bening 2020).

Activity 1.2: Map the business ecosystem of the focal company

After defining its objectives, the company should map the business ecosystem (or more specifically the value network) that revolves around its value proposition. Contrary to a business model transformation strategy, the existing business ecosystem of a company

is less likely to impact business model diversification. Yet, and as mentioned earlier, one of the main distinctive aspects of the 6Is framework lies in the consideration of the business ecosystem as a source of circular opportunities for incumbent firms, for example under the form of simplified access to key resources. To achieve this, the 6Is framework suggests using the "business cycle canvas" proposed by Mentink (2014).

Business cycle canvas

The business cycle canvas (**Figure 6.3**) is an adaptation of the business model canvas (Osterwalder & Pigneur 2010) to integrate systems thinking. It provides an overview of the business ecosystem of a company, displaying its partners, customers, their activities and the exchange of resources between the different members of the ecosystem. As such, this approach is very similar to a value network analysis (Allee 2000), differing from it by displaying additional information on the activity of companies and less on the nature of the resources exchanged. Three types of resources are considered: material (in red), information (in purple) and financial (in blue). Internal key resources and capabilities are considered within the company boundaries (in the yellow box).

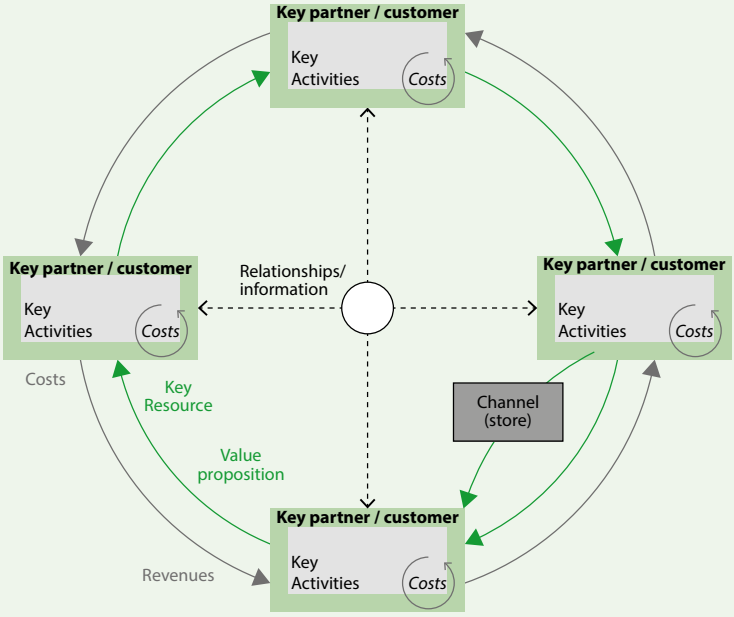

FIGURE 6.3: Business cycle canvas (extracted from Mentink (2014))

Newly developed circular business models can later be included in this representation through the addition of a loop. In addition, an extension of the tool can further integrate waste streams (as uncaptured secondary resources), displayed using red arrows with no destination.

Activity 1.3: Evaluate the access to secondary resources

After identifying the company's business ecosystem and its actors, one can further identify secondary resources produced alongside the value creation process. At the level of the focal company, this can be done using a waste audit. For secondary resources produced by others, this may require further collaboration with value network actors for accessing data. Secondary data can be used to list typical by-products of processes performed by partners. Yet, if no collaboration can be reached at this stage, access to secondary resources from reluctant partners is unlikely, limiting opportunities to develop circular business models from them. Hence, it is necessary to understand the interests of stakeholders and engage them to increase the likeliness of support and adoption of a new business model. Discussions can revolve around what partners would consider opportunities (additional value captured, that needs to be maximised) and threats (value lost, that needs to be minimised) for them. These discussions could support assessing whether there can be an alignment between the interests of the focal company and the ones of (some of) its partners, an alignment which can further uncover mutual sustainability interests (Hörisch, Freeman& Schaltegger 2014).

In addition to external business ecosystem actors, it must be noted that companies should also assess the support of internal stakeholders. Indeed, many business model innovation projects fail due to a lack of internal support. Hence, building such support and engaging employees in the project is another key activity to perform.

Stage 2: Ideation

Objective: Identify circular value propositions

Activities:
1. Select circular opportunities
2. Generate circular value proposition ideas
3. Evaluate ideas

Setting: Group

Scope: Focal company (+ partners)

Suggested tool(s):
Circular value proposition map

Alternative tool(s):
Value mapping tool (Bocken et al. 2013; Geissdoerfer, Bocken& Hultink 2016)

The second stage of the 6Is framework, **Ideation**, aims to support companies in identifying circular value propositions that can lead to the company's objectives. Such value propositions can be summarised in a circular value proposition map (**Figure 6.4**). A circular value proposition map is best filled out during a circular ideation workshop,

which can either be internal to a focal company or in collaboration with other value network partners. The identification of the waste and by-products produced by the value network of a company is a prerequisite for such a workshop.

Circular value proposition map

The circular value proposition map (Mansuy, Lebeau& Macharis 2021), presented in **Figure 6.4**, is a matrix that aims at supporting and summarizing circular idea generation. The columns represent the strategic waste streams produced within the value network of a company. The top row represents value network actors (as secondary resource suppliers), while the row below synthesises the secondary resources that are considered the most critical to value by each actor. The left column consists of potential customers for these secondary resources. In line with the lifecycle approach taken by the 6Is framework, the top cells of the left column represent the actors of the value network. The bottom cell(s) should include organisations (or more broadly sectors) outside the value network. One row corresponding to one actor or sector, the total number of rows will depend on the number of actors the ideation participants want to investigate.

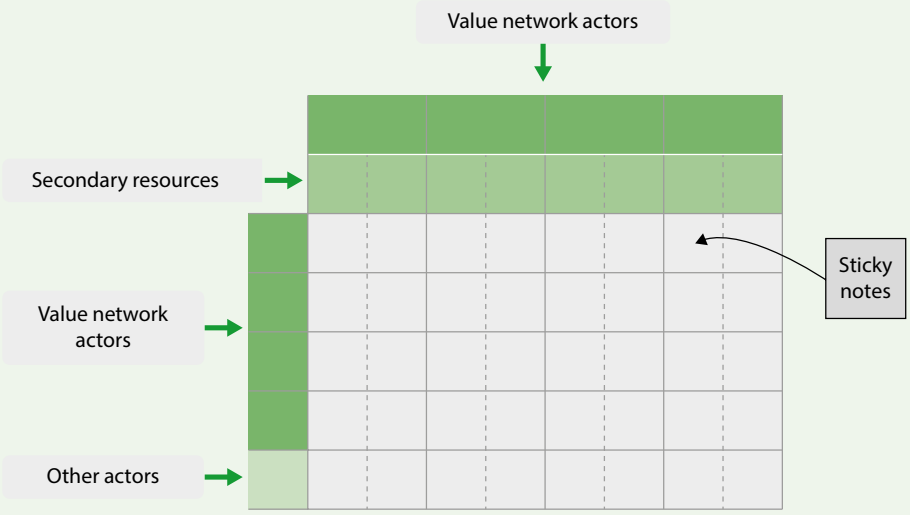

FIGURE 6.4: Circular value proposition map

The middle cells should be filled with value proposition ideas. These ideas should make use of a waste stream of interest (column) and should be valuable for the customers (row). The choice of a value retention option is left to the user, and a given waste stream can be reused rather directly or indirectly (reprocessing involved). Ideas can address the whole waste stream, or only some parts of it.

The circular value proposition map is a tool to structure ideation and organise ideas. It does not, per se, impose any idea generation technique. It can be complemented by other, more inspirational, ideation tools for circularity, such as the Circularity Deck (Konietzko, Bocken& Hultink 2020a) for example.

Activity 2.1: Select circular opportunities

The first step of the workshop is to select a set of secondary resources whose valuation potential will be investigated. An approach to select secondary resources among those identified in the Preparation stage can be to analyse (1) their impact on the current business model of the company and (2) their valuation opportunities. For example, two waste streams' characteristics that usually impact the business model of a company are their weight and their hazard potential. Companies must pay for waste management, and waste management operators usually price by weight collected. In addition, hazardous waste streams must be managed following specific regulations, and are therefore more expensive to treat. On the contrary, two characteristics that can influence valuation opportunities are the reuse potential and the reason for obsolescence. The reuse potential (Park & Chertow 2014) is an economic indicator associated with the revenues one could get if reprocessing a waste stream with a given technology. The reason for obsolescence (Schallmo et al. 2012) impacts the feasibility and viability of future circular business models by limiting the recovery processes that can be performed. Similar streams with different reasons for obsolescence should be distinguished. We suggest secondary resources be evaluated using these two dimensions (current impact and valuation opportunities). Secondary resources can then be placed in a graph to visually support their selection.

Activity 2.2: Generate circular value proposition ideas

The principles of the CE suggest an order of preference amongst different options to retain the value of products, parts and materials[12] (Reike, Vermeulen& Witjes 2018). The options to prioritise focus on avoiding or reducing waste production (what Bocken et al. (2016) refer to as "narrow the loop"). The first ideation activity must, therefore, look for solutions to reduce waste production. In the frame of the 6Is framework, we suggest focusing on the ***direct reuse of by-products*** by the company producing them. Indeed, a by-product becomes waste only when leaving the boundaries of a company after being discarded without any intention to be valued. Hence, no waste is produced if resources are reused within the company. Results of this activity can be added to the diagonal of the circular value proposition map.

12 See part 1.2.1 for further details on value retention hierarchies

In the second ideation activity, participants should reflect on how (under which form) they could (1) ***value secondary resources produced by other value network actors*** and (2) ***transform their own secondary resources to be valued by other value network actors***. This forces participants to think about alternate use for what they consider waste. To limit the scope of the activity, only a limited number of waste streams must be selected, depending on the number of actors listed in the value network. Ideas found at this stage can be placed (using sticky notes) in the circular value proposition map (**Figure 6.4**), at the intersection between the actor supplying the secondary resource and the one thought to value it. In a collaborative setting, this activity can be done through a nominal group technique (Van de Ven& Delbecq 1974; Girotra, Terwiesch& Ulrich 2010), in which participants first generate ideas individually, before brainstorming. Starting with individual idea generation allows participants to get familiar with the ideation task before group work and reduces the common issues of production blocking and evaluation apprehension (Diehl & Stroebe 1987). After individual ideation, participants are paired to brainstorm, and paired sessions are reproduced until all participants have met. In the case of an internal workshop, a company can focus mostly on the row and the column corresponding to it. Such cells are easier to fill, the company knowing more about the characteristics of its waste and about its needs. The company also has more control over ideas in those cells. Another option would be to use role play, defining internal stakeholders as the representatives of value network members. In such a case, the workshop should be organised as depicted in the collaborative setting.

The third ideation activity could consist of a brainwriting session where participants think of ways ***other value networks can value selected waste streams***. Brainwriting is a group technique that consists of generating ideas silently and writing them out. The interest of a brainwriting technique, and what differentiates it from individual idea generation, is that ideas of others are made visible to help foster creativity. This technique, as the nominal group technique, avoids the problems of production blocking and evaluation apprehension (Paulus & Yang 2000). This activity, like the previous one, starts with potential customers for a secondary resource. This aims at maximizing future product/market fit. Potential customers can either be suggested during the workshop or picked randomly from a pool of options defined beforehand. Ideas are generated for a few minutes per potential customer, before focusing on another customer segment. Different sets of customer segments can be investigated by different groups of participants.

Activity 2.3: Evaluate ideas

Following the generation and summary of ideas in the circular value proposition map (**Figure 6.4**), participants must evaluate ideas. While ideas can be selected using more quantitative multi-criteria decision analyses (Gabriel et al. 2016), the potentially high number of alternatives, the difficulty to compare them, and the high uncertainty of their outcomes, tend to support the use of more qualitative selection procedures in such an early stage (Mansuy 2022a). Nonetheless, the use of a qualitative procedure

does not oppose an analytical approach, although such approaches must be used with caution as they may lead to the selection of less original and less useful ideas than more intuitive approaches (Rietzschel, Nijstad& Stroebe 2010; Zhu et al. 2017). In the 6Is framework, we suggest participants grade generated ideas using a three-level scale ranging from -1 to +1 [-1;0;1] based on whether they expect the idea to be successful or not. After summing up the grades given by all participants, ideas are ranked based on their total score, and those with a negative score are rejected. For smaller groups, the number of levels in the grading scale can be increased to ease the ranking of ideas.

Stage 3: Integration

Objective: Design circular business models

Activities:
1. Analyse competing linear business models
2. Design alternative circular business models
3. Select one circular business model design

Setting: Group

Scope: Focal company (+ customers + secondary resource supplier)

Suggested tool(s):
Value recovery business model canvas

Alternative tool(s):
- Circular business model canvas (Lewandowski 2016)
- Circular business model mapping tool (Nußholz 2018)
- Any of the many other circular oriented visual business model representations[13]

The third stage of the 6Is framework, **Integration**, focuses on the development of a business model design building on a circular value proposition. Such a development is best achieved during a co-creation workshop, co-creation serving as a coping mechanism to reduce uncertainty (Schneckenberg et al. 2017). This workshop can involve a focal company and its potential customer segments, but also the foreseen secondary resource supplier. Co-creation is not mandatory to complete this stage but will increase the alignment of the business model with the interests of customers.

13 To select one such representation, we refer the reader to the selector developed by Mansuy (2022b)

Activity 3.1: Analyse competing linear business models

The first Integration activity consists in describing the business model(s) (if any) the circular business model will substitute. Indeed, targeted customers may already adhere to a business model that provides a linear value proposition addressing the same needs as the ones the newly developed circular business model aims to meet. Hence, those linear business model(s) should be used as a benchmark for circular business models to provide additional value. They can be modelled in a conventional business model canvas (**Figure 6.5**), using available information on the operations of the company running such business models.

Activity 3.2: Design alternative circular business models

The second Integration activity aims at designing alternative business model designs for a circular value proposition using an adapted business model canvas called the *value recovery business model canvas* (**Figure 6.6**). Workshop participants can be divided into groups working on different dimensions of the business model, namely (1) value delivery (distribution system), (2) value collection (collection system), and (3) value creation (recovery system). An overview of business model components used in circular business models, such as the one provided by Lüdeke-Freund, Gold& Bocken (2019), can be used to inspire participants. Several options can be developed for each dimension, and those different options can be combined to form different circular business model designs. Once the value delivery, value collection and value creation dimensions are combined into circular business model designs, participants should reflect on whether the proposed combinations make sense, and, if needed, adapt the preliminary business model design. Additionally, participants should jointly develop the value capture dimension for each alternative business model design, in light of the other dimensions. A co-creation setting can help in finding the balance between the value captured by the focal company and the one provided to its customers. In case business model dimensions cannot be analysed simultaneously (for example because of a lack of participants), we suggest filling in the *value recovery business model canvas* in the following order: (1) value proposition, (2) value delivery, (3) value collection, (4) value creation, and (5) value capture).

Value recovery business model canvas

To model their business models, many companies use a business model canvas (Osterwalder & Pigneur 2010). This popular tool consists of nine components, that can be gathered in four dimensions (aligned with the framework of Richardson (2008)) (see **Figure 6.5**).

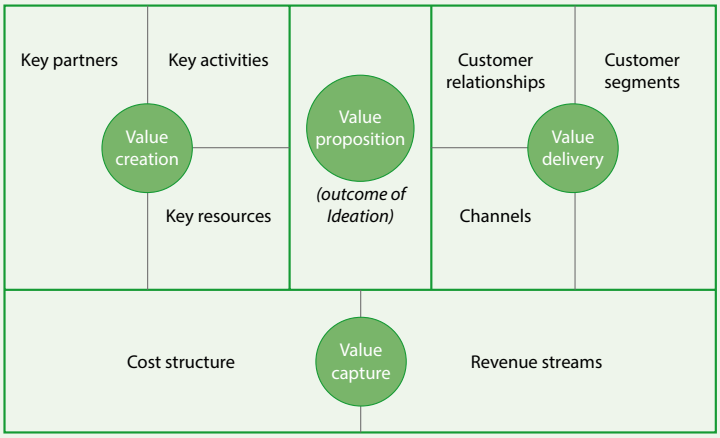

FIGURE 6.5: Business model canvas (adapted from Richardson 2008; Osterwalder and Pigneur 2010)

The component on the top right corner represents the **customer segments** a company aims to serve, in other words for whom the company creates value. This component is strongly related to the central component, which defines the **value proposition** (composed of a set of products and services) the company aims to provide to meet the needs of specific customer segments. A value proposition can differ for different customer segments. The two components between the customer segments and the value proposition define how the company delivers value to its customers. One describes the **channels** through which a company reaches its customer segments, while the second focuses on the types of **customer relationships** a company has. These four previous components represent the customer side of the business model, which leads to different **revenue streams** for each customer segment.

While the right part of the Business Model Canvas relates to how the company delivers value, the left part relates to how it creates value. **Key resources**, in the form of physical, financial, intellectual or human resources, can be required to perform the **key activities** upon which the value proposition depends. These key resources and key activities can be performed in-house or be obtained through **key partnerships** with other organisations. The way value is created by the focal company induces a different **cost structure**. A major goal of this component is to assess how the company access to key resources and key activities (in other words internally or through partners) impacts costs.

The Business Model Canvas was not designed for sustainability. Hence, many sustainability-oriented derivatives (for example the Sustainable Business Model Canvases from CASE or from Bocken, Schuit& Kraaijenhagen (2018), the Flourishing Business Model Canvas

(Upward & Jones 2016), the Triple-Layered Business Model Canvas (Joyce & Paquin 2016), the Value Triangle (Biloslavo, Bagnoli& Edgar 2018), or the framework for sustainable circular business model innovation (Antikainen & Valkokari 2016)) were developed.

Several circularity-oriented derivatives of the business model canvas were also developed[14]. For example, Lewandowski (2016) distinguishes take-back channels from other channels, while Nußholz (2018) considers take-back as a business model on its own. We rather suggest an adaptation of the business model canvas to circularity (the *value recovery business model canvas* (**Figure 6.6**)) that considers take-back operations in an intermediary manner, in other words by distinguishing take-back from other channels and by considering that take-back "customers" (those who dispose of their products) are targeted by a different value proposition than customers acquiring a circular product or service. We also consider customer relationships to differ. While Braun, Schöllhammer& Rosenkranz (2021) consider value recovery as a side dimension of traditional business models, we rather consider it as the value creation dimension of a different, yet supplementary, business model. As such, the *value recovery business model canvas* depicts business models that complement traditional, linear, business models. The new business model being based on the valuation of a secondary resource, we considered secondary resources as distinct key resources. The value capture part could have been further divided to distinguish value collection activities. Yet, the cost structure of the business model canvas already includes contributions from value creation and value delivery activities. Hence, we considered this adaptation unnecessary. Nonetheless, we transformed the "cost structure" into "costs" and the "revenue streams" into "benefits" to allow for the inclusion of non-financial value.

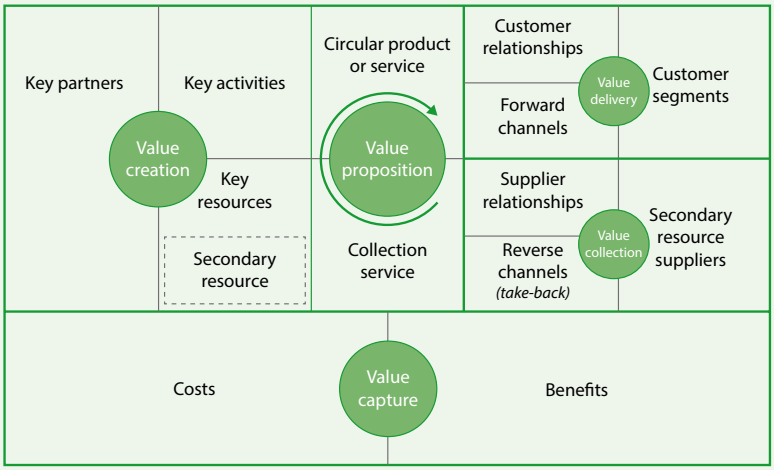

FIGURE 6.6: Value recovery business model canvas

14 Using a systematic literature review, Mansuy (2022b) listed 29 such derivatives (among 37 visual business model representations used for modeling circular business models). Many such derivatives focused on sustainability, only integrating circularity principles to a limited extent.

Activity 3.3: Select one circular business model design

The Integration stage should end with the selection of a circular business model design to be further refined in Investigation. In case several business model designs are developed and a consensus on which one to select cannot be reached, alternative designs can be compared using a semi-quantitative multi-criteria decision analysis (MCDA), alternatives being mutually exclusive (Belton & Pictet 1997). Only once a circular business model design deemed satisfactory (in other words potentially successful) is selected, can the company move to the next stage.

Stage 4: Investigation

Objective: Evaluate and refine a circular business model design

Activities:
1. Identify and prioritise business model hypotheses
2. Test business model hypotheses

Setting: Individual

Scope: Focal company

Suggested tool(s):
- Value Recovery Business Model Canvas
- Test cards

Alternative tool(s):
Feasibility study frameworks (for example TELOS)

The fourth stage of the 6Is framework, **Investigation**, aims to assess the desirability, feasibility and viability (Konietzko et al. 2020) of the circular business model design developed in Integration, and to refine it based on the learnings of this assessment. Desirability refers to how desirable a value proposition is for customers. In the present methodological framework, two types of value propositions are considered and will be analysed distinctively. Feasibility refers to value creation, and whether a value network with the necessary resources and activities can be set to create the value proposition. Viability focuses on value capture, and mostly considers whether the business model can generate enough revenues to cover its costs. In the 6Is framework, we consider that value capture is not limited to financial value and can also be extended to different types of value (and different types of costs and benefits).

This stage is based on (circular) business model experimentations (Bocken, Weissbrod& Antikainen 2021), a concept that has been embraced by several popular business approaches such as Lean Startup (Ries 2011; Blank 2013) and Effectuation (Sarasvathy 2008). Circular business model experimentation is an iterative approach

for testing and adapting a circular business model design to a real-life context. It aims at providing empirical evidence on the desirability, feasibility and viability of a circular business model.

Activity 4.1: Identify and prioritise business model hypotheses

The first step in Investigation is to identify the hypotheses that are necessary for a business model design to be successful. These hypotheses are related to the alignment between the business model design and the context in which it is to be applied and are, therefore, highly case-specific. Hypotheses can be developed for each component of the business model design using the *value recovery business model canvas*.

In addition to identifying hypotheses to test, one also needs to rank them by order of importance. Such a ranking is crucial, as the most important hypotheses are more likely, if not supported, to lead to business failure. The most important aspect is usually the desirability of the business model, desirability driving market demand. Many companies tend to undervalue desirability, focusing on feasibility instead. Nonetheless, feasibility is also important. More than the existence of required technologies, it implies that the company has access to it. Partners that do own needed or useful resources should be willing to collaborate. Viability is usually an issue of sufficient financial benefits. Yet, such an aspect can be further extended to also encompass non-financial values, particularly environmental or social ones.

Activity 4.2: Test business model hypotheses

The second step in Investigation consists in testing all hypotheses by decreasing order of importance. There exists no one fits all procedure to test hypotheses. The choice of the methods to use will depend both on the hypothesis to test and on the resources (particularly skills and knowledge) available internally. Nonetheless, the experimentation process follows the same steps for each hypothesis: first, a procedure needs to be developed to either validate or reject the hypothesis. This procedure should not be overly expensive, and developing it often requires creativity. Then, an indicator should be selected to measure the outcomes of the procedure. This indicator can be quantitative or qualitative. Finally, a threshold is defined on the indicator, specifying the levels of the indicator for which the hypothesis can be considered validated. These steps can be summarised in a structured outline, for example, the test cards proposed by Strategyzer (see **Figure 6.7**). The decision to move forward to the Implementation of a business model design must be taken when all hypotheses have been validated.

Test cards

Test cards (**Figure 6.7**) are a very simple tool developed by Strategyzer to summarise all information needed to conduct a (business) experiment. Test cards are used to test and validate assumptions (hypotheses) that are to be true for a business model to be successful. To test these assumptions, one must define a procedure to validate the assumption. Procedures are highly context-specific and must be defined case by case. They rely on the measurement of a metric that, if meeting a predefined criterion, validates the assumption. Several additional data can be captured, such as the criticality of the assumption for the business model to succeed, the cost of the test, the data reliability associated with the measurement of the metrics, as well as the time required to perform the experiment. The cost and time investment must be as little as possible but depend on the criticality of the assumption. Indeed, it is more acceptable to allocate more resources to critical assumptions than to benign ones.

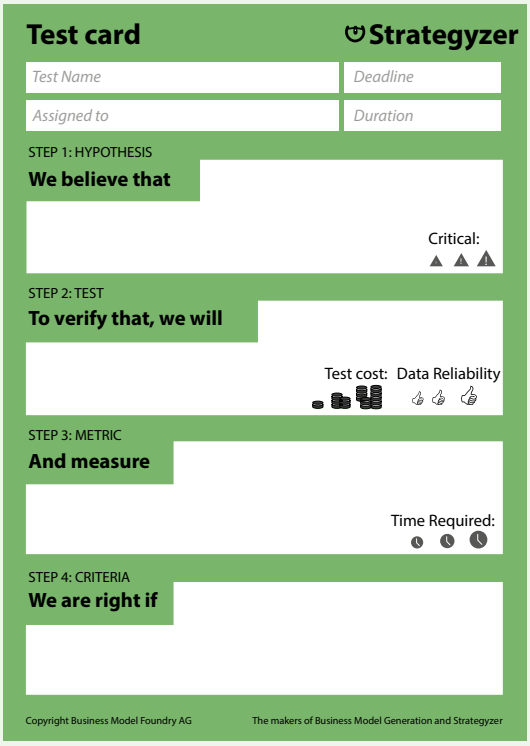

FIGURE 6.7: Test card (Strategyzer)

Stage 5: Implementation

Objective: Launch a circular business model

Activities:
1. Select key performance indicators
2. Plan implementation
3. Conduct and review pilot
4. Scale-up

Setting: Individual

Scope: Value network

Suggested tool(s):
Value recovery balanced scorecard

Alternative tools:
- Other sustainability balanced scorecards (see Hansen & Schaltegger (2016))
- Performance Prism (Neely, Adams& Kennerley 2002)
- Circulytics (Ellen MacArthur Foundation)

The fifth stage of the 6Is framework, **Implementation**, is the first operational stage. Companies often face a design-implementation gap (Baldassarre et al. 2020). This design-implementation gap is highly related to stakeholders' support. By engaging stakeholders in the design part, the 6Is framework increases the chances for a circular business model to bridge the design-implementation gap. Yet, implementing a circular business model remains complex, the combination of assumptions behind the business model design being further confronted with a real-life setting. This requires flexibility and agility to adapt the business model design.

Activity 5.1: Select key performance indicators

Before conducting any implementation activity, a first activity to perform consists of defining the key performance indicators (KPIs) to be used for monitoring the success of the business model across its launch process and beyond. Indicators are a particularly efficient tool in supporting decision-making, notably when related to sustainability assessments (Ness et al. 2007; Waas et al. 2014; Pope et al. 2017). A large number of indicators to measure circularity (Corona et al. 2019; Moraga et al. 2019; Parchomenko et al. 2019; Saidani et al. 2019; Kristensen & Mosgaard 2020; Harris, Martin& Diener 2021; de Oliveira, Dantas& Soares 2021; Vinante et al. 2021) or sustainability of circular practices (Kravchenko, Pigosso& McAloone 2019; Walzberg et al. 2021) have been listed in literature. In addition, several standards, like the GRI, have been developed and can further be used to measure the sustainability of circular initiatives (Rahdari & Anvary Rostamy 2015). Nonetheless, those standards should not replace the selection

of indicators at the organisational level (Keeble, Topiol& Berkeley 2003). Given the high number of available indicators, such a selection can be quite complex. To support this selection of KPIs, we suggest using an adapted balanced scorecard, such as the *value recovery balanced scorecard* (see below). Strategic objectives used within such a scorecard can be based on those defined in Initiation. The KPIs defined at this stage could further be reviewed alongside the implementation process, either to compensate for a lack of usefulness or changing strategic objectives.

Value recovery balanced scorecard

A common tool used for performance evaluation is the "balanced scorecard" (Kaplan & Norton 1992). This tool helps managers in defining their strategic objectives, and in setting up key performance indicators (KPIs) and targets to meet these objectives. The popularity of the tool came from the inclusion of non-financial aspects in performance measurement. The balanced scorecard adds three additional perspectives to the traditional "financial" one: "customers", "internal process", and "learning and growth". While perspectives were originally considered independently, Kaplan and Norton later added cause-and-effect relationships, leading to strategy maps (Kaplan & Norton 2004). These strategy maps usually assume a hierarchical organisation of cause-and-effects, shown in **Figure 6.8**.

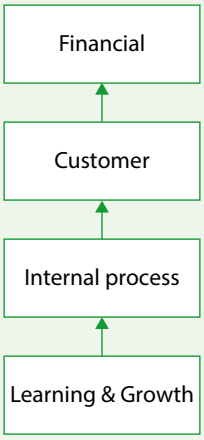

FIGURE 6.8: Usual cause-and-effect relationships in strategy maps

The balanced scorecard is not, as such, adapted to sustainability, and many attempts have been made to integrate sustainability within this approach. This led to many alternative sustainability balanced scorecards, differing by the way they reorder perspectives and integrate triple bottom line aspects (Hansen & Schaltegger 2016).

The development of any balanced scorecard starts with the definition of a few strategic objectives. Strategic objectives are classified according to the balanced scorecard perspectives and can

be linked to develop a strategy map. Within the 6Is framework, we suggest an adaptation of the balanced scorecard (the *value recovery balanced scorecard*) based on a novel strategy map architecture (**Figure 6.9**). In line with the *value recovery business model canvas* (**Figure 6.6**), this adaptation distinguishes, and accounts for, the perspective of both customers and (secondary resources) suppliers. We also removed the growth attribute and replaced it with "employees", as suggested by the "responsive business scorecard" (van der Woerd & van den Brink 2004). Additionally, and in line with the suggestion of Figge et al. (2002), we did not consider distinct environmental and social components. Instead, we transformed the financial perspective into a broader "outcome" one (integrating a triple bottom line approach), as recently suggested by Kaplan himself (Kaplan & McMillan 2020). Finally, we adapted the relationships between the perspectives of the balanced scorecard to relate internal processes directly to outcomes (instead of customers), leading to a semi-hierarchical scorecard.

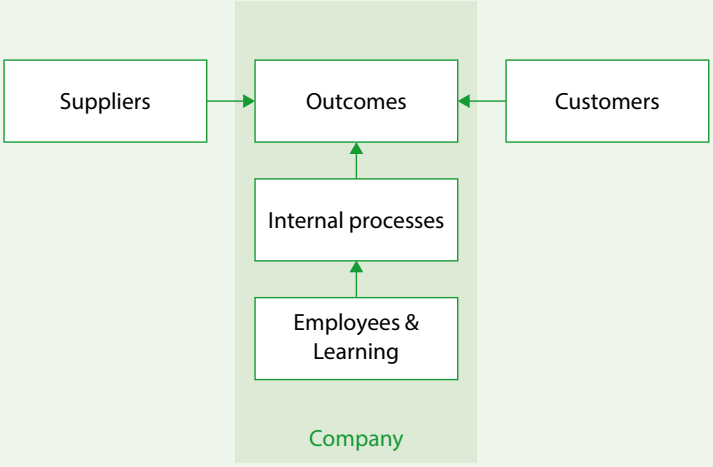

FIGURE 6.9: Value recovery strategy map architecture

The defined strategic objectives should be used to select indicators able to measure their achievement. Once an indicator is defined, a target should be specified. Such a target defines the conditions under which a strategic objective is considered as fulfilled. Strategic initiatives can also be defined to support the achievement of targets.

Activity 5.2: Plan implementation

Before starting implementation, one needs to carefully plan the process in advance. This can be done through the use of project management plans and roadmaps. The latter approach has been particularly used in existing methodological frameworks supporting circular business model innovation. This includes the definition of preliminary deliverables and a frequency for monitoring the business model.

Activity 5.3: Conduct and review pilot

The first implementation activity relates to the implementation of a pilot test case. This consists of testing the business model at a small scale, with a limited sample of target customers. Such a pilot can, for example, take the form of a living lab. This activity will further validate assumptions on the desirability of the business model (which was likely tested in a more controlled setting during the Investigation stage). It will also provide information about the feasibility and viability of the business model, although it cannot account for economies of scale that are likely to happen after full launch. The performance of the pilot should be regularly monitored to adapt the business model if needed. Hence, the test period should be long enough to allow for such a refinement, but not too long to prevent competitors from entering the market first. Once the pilot test period is over, a decision to further scale up the business model needs to be made based on reported performances.

Activity 5.4: Scale-up

Once a decision is made to launch the business model at full scale, work must be done to scale up the pilot. The goal of this scaling up is to make the business model available to all targeted customer segments. A crucial aspect of scaling up relates to promotion. Indeed, the release of the business model should be communicated effectively to potential customers in order to increase revenues and break even as soon as possible.

Stage 6: Improvement

Objective: Adjust a circular business model

Activities:
1. Plan
2. Do
3. Check
4. Act

Setting: Individual

Scope: Focal company

Suggested tool(s):
PDCA cycle

Alternative tools:
DMAIC method

The last stage of the 6Is framework, **Improvement**, occurs when a circular business model is implemented and running at full scale. At this point, the business model innovation process could be considered finished. However, the business context is continuously evolving, and adapting the business model is required to allow the company to keep its competitive advantage. Hence, we advise companies to adopt a continuous business model innovation (Mitchell & Coles 2003) and to perform frequent business model improvements (changing individual business model components). While several techniques exist to adopt a continuous improvement approach, the 6Is framework further suggests using PDCA (Plan-Do-Check-Act) cycles.

Activity 6.1: Plan

Plan is concerned with the development of an action plan to improve the circular business model. This starts with the identification of a problem within the business model. This identification can be based on monitoring of the KPIs defined in Stage 5. Indeed, KPIs might uncover aspects of the business model that do not perform as well as expected. In such a case, the reasons for such an underperformance should be looked for. Once those reasons are identified, changes in the business model components should be suggested to address the problem, and an action plan should be built.

Activity 6.2: Do

Do consists of implementing the action that has been previously developed. This step is highly case-specific. However, one must ensure that data required for measuring KPIs are collected along the way.

Activity 6.3: Check

Check consists of verifying that the action implemented induced the expected effects. This means analysing the KPIs that were primarily targeted, but also all the other KPIs to ensure the action has not significantly hampered other objectives. This phase is particularly complex, in that it is hard to prove a causal relationship. Hence, context-related data should optimally be collected, in addition to data required for KPIs measurement, to cancel out contextual effects.

Activity 6.4: Act

Act consists of drawing conclusions on the effects of the action that was set up; this means validating the changes or, on the contrary, rejecting them. In case of a rejection, a new PDCA cycle can be conducted to further adapt the implemented action or test another one. It is quite unlikely that an action perfectly achieves its objectives the first

time. Hence, several iterations might be required before reaching a suitable solution. It might also be that a circular business model has been extensively disrupted and cannot be further improved through PDCA cycles. In such a case, the 6Is methodological framework can be reproduced to find new business models out of the same secondary resource.

6.4 DISCUSSION AND CONCLUSION ON THE 6IS FRAMEWORK

In the present chapter, we have proposed a 6Is business model innovation framework to support companies (and specifically incumbent firms) in diversifying their business model portfolio to further integrate circularity. The originality of this framework both lies in its focus (circular business model diversification) and in the approach it takes. This approach is based on two key assumptions, which are that (1) minimisation of waste is a joint responsibility of the value network and (2) waste and by-products can be opportunities for circular business model development. Therefore, the framework supports business model diversification through the development of new business models recovering waste and by-products from the value creation process of an existing business model. Such an approach has similarities with industrial symbiosis (Saavedra et al. 2018) but differs from it by the development of new business offers instead of a mere supply substitution.

The business model innovation process used in the 6Is framework is built on existing literature, notably on the process proposed by Geissdoerfer (2019). As such, the novelty of the 6Is framework does not lie in the proposition of yet another business model innovation process, but rather in the operationalisation of such a process to address a particular challenge (transforming waste and by-products into business opportunities). This operationalisation is performed through the specification of intermediary activities and the selection of tools supporting such activities. To limit bias, we mostly selected widely used tools, considering their widespread adoption as some sort of validation from practitioners.

The content of Stage 1 (Initiation) does not fundamentally differ from that of the other methodological frameworks, many of which also analyse a company's current practice and define its strategic objectives. Yet, a particularity of the 6Is framework lies in the selection of the tool for analysing the current business model of a company. Indeed, several frameworks suggest the use of a value network mapping tool, while a few others suggest using a graphic organiser (Mansuy 2022a). The 6Is framework goes a step further by combining those two aspects and selecting a visual business model representation that integrates both a transactional view (provided by value network mapping tools) and an elements view (provided by graphic organisers) (Täuscher & Abdelkafi 2017). This integration of a transactional view was considered particularly relevant given the goal of Stage 1 to identify circular opportunities in the form of waste. Indeed, waste can be more easily added in tools with a transactional view (as a new resource flow)

than in other visual business model representations. In addition, tools including such a view can usually be further adapted to integrate complementary business models. Yet, such tools are still rather scarce, only 3 integrating a transactional view among the 37 visual business model representations for circular business models reviewed by Mansuy (2022b). Among them, one (the BM^3C^2 from Boldrini & Antheaume (2021)) was more relevant for dyadic relationships while another one (from Board of Innovation) did not include an elements view. Hence, only the business cycle canvas from Mentink (2014) met our selection criteria for this stage. That tool, however, has a few limitations and could be further improved. Next to those visual business model representations dedicated to circular business models, several more generic representations could have also been considered. For example, the Value Blueprint (Adner 2012) and the derived Ecosystem Pie Model (Talmar et al. 2020) display many interesting aspects. However, those mostly focus on risk evaluation and management, which is crucial for a business model transformation but less relevant for a business model diversification strategy.

The structure of Stage 2 (Ideation) is quite similar to the ones provided by other methodological frameworks (Mansuy 2022a). The main difference rather lies in the nature of the opportunities considered and in the choice of the tool to support idea generation to value those opportunities. Indeed, one of the main assumptions of the 6Is framework lies in the consideration of waste (and by-products) as opportunities for value creation. This approach is aligned with the concept of value uncaptured, which consists of potential value that has not been captured. Among the four different types of value uncaptured identified by Yang et al. (2017), waste relates to value missed, in other words value that exists and is required, but that is not exploited. The development of value propositions from uncaptured value can be supported by the Value Mapping Tool (Bocken et al. 2013). Although such a tool can support the development of circular value propositions (Geissdoerfer, Bocken& Hultink 2016), it has not been purposefully developed for circularity and, therefore, does not fully meet the first point of the checklist suggested by Bocken et al. (2019). Another tool has also been provided by Lancelott and Haines-Gadd (2020) but only safeguards CE principles to a limited extent. Therefore, we decided to develop a new tool, the *circular value proposition map*, to help structure the generation of circular value proposition ideas. A particularity of this approach is that it does not only consider the value missed to be captured in the idea generation process but also customers, which is aligned with a design thinking approach (Brown 2008). This consideration of customers is, however, not as developed as in the Value Proposition Canvas from Strategyzer.

Most methodological frameworks suggest visual business model representations (Täuscher & Abdelkafi 2017), often derived from the business model canvas (Osterwalder & Pigneur 2010), to structure their circular business model prototype. Most visual business model representations used by methodological frameworks are purposefully designed, almost no frameworks adopting an existing visual business model representation (Mansuy 2022a). Such a decision to design novel visual business model representations, instead of adopting existing ones, may be related to the limited integration of circularity principles within the latter. Indeed, only a few existing

representations safeguard circularity principles, and those which do are either quite complex (for example Nußholz (2018)) or take a systems thinking perspective (for example Mentink (2014) or Board of Innovation) that may not be the most relevant in the Integration stage. In particular, many representations do not account for take-back services, and those that do (such as Lewandowski (2016)) do not always account for the many different types of customer relationships in take-back systems (Östlin, Sundin& Björkman 2008). The closing of resource loops being considered a key aspect of the 6Is framework, we decided to further adapt the business model canvas (due to the high familiarity of practitioners with such a representation) and some of its circular oriented derivatives (in particular Nußholz (2018) and Lewandowski (2016)) to best account for closed-loop supply chain relationships. This does not mean that other visual business model representations cannot be selected by the users of the 6Is framework, but rather that we consider the *value recovery business model canvas* we suggest as most aligned with the specificities of the 6Is framework and of the business model innovation strategy it supports.

The *value recovery business model canvas* takes a perspective similar to two-sided markets, considering the focal company as an intermediary between secondary resource suppliers and more "conventional" customers. The same actor can alternate between those two roles, for example in the case of repair services (McCollough 2009; Riisgaard, Mosgaard& Zacho 2016) or product-service systems (Tukker 2015). While being, like the business model canvas, rather firm-centric, the *value recovery business model canvas* displays a value creation logic for two types of customers (secondary resource suppliers and "conventional" customers) instead of one, which allows for value co-creation with both types of customers. Contrary to existing collaboration tools (for example the Circular Collaboration Canvas (Brown et al. 2021)), the *value recovery business model canvas* predefines the types of actors to collaborate with. This approach is considered more appropriate than other co-creation approaches like the BM^3C^2 (Boldrini & Antheaume 2021) which is more flexible but also more complex.

Aside from the 6Is framework, several methodological frameworks aimed at supporting circular business model innovation, also use a business model experimentation approach to validate the design of their circular business model. This approach has been particularly advocated in the business literature, notably by the Lean Startup method (Ries 2011; Blank 2013). This method is strongly associated with the business model canvas (Osterwalder & Pigneur 2010), usually used to generate hypotheses and test cards. Despite ongoing academic debates around it (Bocken & Snihur 2020; Felin et al. 2020), Lean Startup gradually replaced more classical approaches such as business plans and feasibility studies in many companies. Thanks to the flexibility and reduction of risk allowed by its iterative nature, this approach has also been considered relevant for the 6Is framework. Its limitations should, nevertheless, not be overlooked. Indeed, its focus on hypotheses directly related to the success of a business model might lead to neglecting issues that may not directly affect this success but that may have a direct societal impact. This may explain the lack of environmental impact assessments before implementation by companies involved in business model

experimentation (Das, Konietzko& Bocken 2022). Compensating for such a deficiency could be done either by integrating a triple bottom line approach in business model design (for example, as proposed by Bocken, Schuit& Kraaijenhagen (2018) in their adaptation of the business model canvas) or by further developing simplified (but not simplistic) sustainability assessment tools.

Most methodological frameworks fail to provide a selection process for key performance indicators (KPIs). Those that do suggest KPIs rather use a selection of indicators not necessarily aligned with the objectives of a company (Mansuy 2022a). The 6Is framework rather suggests using a method to select KPIs based on strategic objectives (defined in Stage 1), since ones should measure what they value, not value what they measure (Meadows 1998). One of the most widespread tools to select KPIs based on strategic objectives is the balanced scorecard (Kaplan & Norton 1992). Such an approach has the advantage of being quite flexible, not specifying any indicator but predefined perspectives on which to evaluate the performance of an organisation. Yet, the use of such a tool, and its perspectives, has been recently debated, notably related to the measurement of sustainability performance (Hansen & Schaltegger 2018). While the original balanced scorecard is likely outdated, much work has been performed to develop sustainability balanced scorecards (Hansen & Schaltegger 2016), leading to many alternatives with different perspectives and architectures. In particular, the architecture of sustainability balanced scorecards influences the hierarchy of objectives (Hansen & Schaltegger 2018). In the 6Is framework, we selected a semi-hierarchical architecture to set the objectives of stakeholders at the same level of importance as the ones of the focal company. While several such semi-hierarchical architectures existed, we decided to rather develop an alternative balanced scorecard (the *value recovery balanced scorecard*, borrowing mostly from the responsive business scorecard (van der Woerd & van den Brink 2004) and the recent update of Kaplan & McMillan (2020)) to best align our strategy map with the *value recovery business model canvas*. This implied not considering stakeholders at large, but rather focusing on consumers and (secondary resources) suppliers. Due to this alignment between the *value recovery balanced scorecard* and the *value recovery business model canvas*, users deciding to select an alternative visual business model representation in Stage 3, could also decide to select an alternative multidimensional performance measurement system. We, nonetheless, suggest keeping a semi-structured architecture with stakeholders at the highest level, which is aligned with suggestions from the sustainable business model literature, to account for stakeholders' interests (Stubbs & Cocklin 2008; Evans et al. 2017; Geissdoerfer, Vladimirova& Evans 2018).

The 6Is framework aims to support a business model diversification strategy. Such a strategy has the advantage of building on the existing key resources and capabilities of an incumbent firm – resources and capabilities that are a major source of competitive advantage according to the resource-based view of the firm (Barney 1991) – which strategies built on external development (for example start-up or acquisition) cannot. In addition, it is less disruptive than approaches transforming the core business of a company. Yet, one aspect to carefully consider when adopting a circular business model

diversification strategy, is related to the Waste-Resource Paradox, and in particular to potential linear economy lock-ins (Greer, von Wirth& Loorbach 2021). Indeed, the 6Is framework supports the development of new business models from waste. However, by creating a demand for waste from a linear business model, a circular business model might create a dependency on such a linear business model, and therefore prevent its necessary exnovation (see **Chapter 3**). It is therefore crucial, when applying the 6Is framework or any other approach supporting the creation of value from waste, to build on linear business models that will not have to be exnovated (due to answering basic needs for example). In addition, one should differentiate waste streams that are required to create value (value missed) – and are suitable for business model diversification – from those that are not (value surplus) – and should rather be avoided (Yang et al. 2017).

The main limitation of the 6Is framework lies in its insufficient testing. Indeed, the effectiveness of each tool in supporting the predefined objectives has only been validated to a limited extent. Such a validation is complex and can be time-consuming, developing a new business model (and thereby collecting data on its performance) takes much time (Chesbrough 2007). In particular, we tested the proposed tools with only a limited number of students and not with potential users. The major risks associated with the provided tools being user-related, a "Human Risk and Effectiveness" evaluation strategy could further be adopted (Venable, Pries-Heje& Baskerville 2016). Under such an evaluation strategy, formative evaluations should be reproduced with potential users to further align the proposed tools with users' needs. In theory, a summative evaluation should also be performed at the end of the design process to compare the performance of companies using the tool with those of companies using other tools or no tools. Such an evaluation would, however, be almost impossible to perform, as it would require the involvement of many companies and the consideration of many factors to establish causality between the use of the tool and a company's performance. Overall, the selection of widely used tools limits the risks associated with their use, and we can infer the effectiveness of adapted tools to be higher than no tool. Yet, proposed adaptations should be further investigated to assess their impact on the effectiveness of the original tool and the safeguarding of circularity principles. In addition, the effectiveness of the novel circular value proposition map should also be further evaluated.

Despite its limitations, the 6Is framework is among the first methodological frameworks dedicated to circular business model diversification, providing a way to design and implement new business models to value the waste generated by linear business models. As such, it can support incumbent firms in reducing their environmental impact while developing novel economic activities. To reach its full potential, we encourage practitioners and researchers to further use the 6Is framework and refine it in the process. We also suggest further developing methodological frameworks to support the development of start-ups creating value from existing waste streams, what is currently missing due to the high focus of existing methodological frameworks on incumbent firms.

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CONCLUSION

Wouter Achter, Ahmed Zaib Khan & Cathy Macharis

The CE has proven to be a powerful, stimulating and mobilizing concept. Yet it is notoriously difficult to operationalise. Transitioning towards CE is evolving into a broader societal quest, in which, amongst multiple actors, companies play an important role. Our ambition behind this handbook has been to facilitate companies navigate this emerging landscape at multiple levels. With this handbook we brought together both the theoretical frame that is necessary to understand this transition, and the obstacles and opportunities that come along with it and its operationalisation. For this operationalisation, a methodology is proposed that supports companies in developing new business models from "waste".

In the **first chapter** we elaborate on the complexity of the CE concept, its historical evolution and its current state of play and potential future trajectories with the intention to help companies to contextualise their circularity.

The next two chapters elaborate on this emerging landscape of CE visions in terms of transition processes. Mobilizing insights from sustainability transitions research, it is emphasised first of all that we should shake off the infatuation with ideal solutions and distant future visions of circularity. Or in any case, these visions should not distract us from the hard tasks of *transitioning towards* these visions. The **second chapter** shows the metabolic design principles, impact assessments and circular solutions provide useful strategic guidelines – yet they do not tell us much about the ways in which the various solutions and circular business models can survive in business ecosystems. The chapter highlights how the metabolic analyses of "circularity gaps" even tend to discourage those who try – the discrepancy between circularity visions and the de facto increases in circularity remains dramatic. Thinking big, the little steps seem quite irrelevant. By contrast, the insights from transitions governance provide a more appreciative view on the multitudes of little steps that together allow broader processes of system innovation to unfold. The chapter describes how transitioning involves a multitude of innovations across business ecosystems. Businesses are key actors in the CE transition, but the transitioning does require a certain bridging between market-based thinking and other institutional logic.

Focusing on the requisite innovations, this perspective of transitions governance makes the case for a creative, forward-looking, business-led process of societal transformation. **Chapter 3** provides a deepening of perspective in this regard. CE transitioning is not simply a matter of "innovating our way out": In recent years, the

transitions governance mindset is shifting towards a more balanced handling of the bright and the shadow sides of sustainability transitions – innovation and exnovation. Even if not particularly prominent in CE policies, toolkits and visions, it is striking how exnovation developments occur throughout business ecosystems: As shifts in cultures and lifestyles, in the form of market dynamics, but also as elements of business model innovation and corporate strategy. Considering the apparent political taboos that keep governments from rigorous exnovation strategies, it appears that businesses could also become particularly important actors in the handling of this transitioning challenge.

Through researching CE case studies and best practices, we identify and analyse the factors influencing the adoption and mainstreaming of circularity innovations in companies (**Chapter 4**) and take stock of the barriers, drivers and enablers in a particular sector – construction – as an example (**Chapter 5**) to highlight the challenges and opportunities for embedding circularity in the built environment. Based on learning across these multiple levels of understanding CE transition, we propose a methodological framework (**Chapter 6**) for businesses and companies to (a) rethink their existing processes and practices, and (b) conceptualise, redesign, and develop CE based new business models.

Based on the work performed for, and reported in, this book we could bring forward several elements. To start with, it is clear that trajectories of sustainable CE transitions are case (product, service, company, sector, …) specific. There is no one-size-fits-all. However, we would like to highlight three main messages:

1) **Exnovation.** The transition towards circularity means not only adopting new methods of production, new business models, new materials, et cetera, but also abolishing existing methods, materials and models. Exnovation as the latter is just as necessary to create and innovate. This inconvenient truth is often difficult for companies to communicate and live by.
2) **Business models and organisational culture.** Although there is no one-size-fits-all approach, and although it is a challenge for companies to identify the "right" CE configuration to implement, the factor that affects successful implementation of a transition to sustainable circularity, is first of all the intention and full engagement to really do it. And that means that top management should explicitly engage in it and be willing to leave other things behind. Circular products or services should not be a new commercial line next to the existing ones. This also has to do with the organisational culture which should be aligned with sustainability. Many companies make this turn because of the societal pressure but also because of internal forces and CEOs with vision. Next to the intention, also the ability to conduct a circular innovation process and to evaluate the outcome of these processes is important. This is affected by company characteristics and its resources (physical, intellectual, human and financial).

3) **Supply chains and business ecosystems.** Even though they play a central and primordial role, companies (which already include different actors) cannot be considered, or act, as isolated entities. For a sustainable CE transition process, different actors must be considered as they can influence or will be influenced by the outcome. These external stakeholders can represent barriers, but can also bring about opportunities: Customers (B2B, B2C or B2G) create the demand for circular products and services, suppliers/partners that already adopted circular innovations, or are ready to do so, are needed to develop circular products and services and public institutions can provide incentives for circular practices (or barriers for linear practices). Existing examples of circular practices pave the way by reducing uncertainty.

The 6I-methodological framework, in which the whole business model innovation process is covered, is considered a valuable tool in this context. It is composed of six stages and contains the most appropriate tools to analyse each step within the process. It also enables exactly taking into account the different actors in the chain and within the ecosystem of the company. Procedures are provided to identify, design and evaluate circular business models. Although promising, the 6I-methodological framework would still need to be sufficiently tested and calibrated in practice.

Finally, the work carried out over the last three years in the context of this chair and the preparation of this handbook has unfolded several pathways that we consider necessary for future mainstreaming of CE transitioning. These could be grouped into three areas of relevance: Research, Policy and Management. In terms of future research, we have observed that assessment and evaluation of circularity benefits in terms of sustainability remain uncertain and complex: While sustainability assessment methods for product and process innovation exist, methods for ex-ante sustainability assessment of business model innovations are not as developed. This necessitates the need for the development of new methods for systemic circularity impact evaluation, which can be found in the 6I-methodological framework. In terms of policy implications, we observe that many companies lack resources and capabilities, and therefore, exploring policy incentives and ways to support companies in their circularity endeavours is key to foster CE. Harmonised legislation (for example related to labour costs, taxation, level playing field, et cetera) is needed for mainstreaming CE in Belgium, which requires strong collaboration between the regions and the federal level. In terms of management support, there is a need to provide and support platforms that facilitate local networks and actors across the different levels of CE configurations.