4

EXPLORING THE ROLE OF COMPANIES IN TRANSITIONING TO A SUSTAINABLE AND CIRCULAR FUTURE

Insights and Reflections

Rupert J. Baumgartner, Pauline Deutz, Estephania Delgadillo, Anna Diaz Tena, Aodhan Newsholme, Erik Roos Lindgreen, Tomas Santa-Maria, Anna M. Walker and Tatiana Reyes

4.1 Introduction: companies as contributors to a CE

In recent years, the circular economy (CE) has emerged as a promising avenue for sustainable development (Geissdoerfer et al., 2017; Schroeder et al., 2019). Companies are a special form of social system with the goal to produce economic value by transforming tangible and intangible inputs to outputs for which customers will pay. Recent decades have seen the emergence of the 'triple bottom line' (Elkington, 1998) and other conceptualisations suggesting that companies also have social and environmental responsibilities (Baumgartner, 2014) (i.e. as part of a sustainability agenda and more recently specifically to help society to reach net zero). National and European Union (EU) policies set the regulatory context for companies, i.e. determining the minimum threshold of social and environmental standards they need to meet (see Chapter 9 in this volume for a discussion of CE policy). Companies may exceptionally take voluntary measures that exceed requirements, even to their own financial disadvantage (albeit potentially offset by reputational benefits) (Baumgartner, 2014). A further approach to implementing CE by companies, which has received much research attention, is how CE strategies can be incorporated with the core economic function of companies (Lüdeke-Freund et al., 2019), i.e. as part of the value generating proposition through which the company generates its profits. While the private sector has shown interest, the implementation of sustainable and circular approaches remains relatively low (Cristoni and Tonelli, 2018; OECD, 2019). Hence, it is still necessary to understand the factors that facilitate and hinder a wider adoption of a CE.

DOI: 10.4324/9781003295631-4

The core element of a company is its business model. A business model is a coherent construct that synthesises what a firm does and for whom (value proposition), how it does it (value creation and delivery), and why it does it (value capture) (Osterwalder and Pigneur, 2010; Teece, 2010). Circular business models follow the principles of the CE, incorporating elements that slow, narrow or close the loop of resources, so that the resource input into the company and its value network is decreased and the resulting waste is minimised (Bocken et al., 2016). One of the main strengths of circular business models (CBM) is their potential to reduce dependence on finite resources and fostering innovation (Kennedy and Linnenluecke, 2022). Nevertheless, the initial investments that are often required (Bauwens 2021), the unfamiliarity of existing customers with new business models and the logistical complexity of their implementation often limit their applicability.

Product service systems (PSS) are one specific type of circular business model consisting of value propositions oriented towards satisfying users through the delivery of functions or performance instead of products (Ceschin and Gaziulusoy, 2016). Since manufacturers maintain the ownership of the products and only offer the performance to customers, they have an economic motivation to enhance their resource utilisation. Examples of existing PSS involve the provision of mobility solutions instead of individual vehicles or lighting systems instead of lightbulbs (Ceschin and Gaziulusov, 2016). Consequently, complementing existing products with new services has drastic implications for the processes involved in designing the products in the first place, namely the product development process. In particular, the selection of new materials and design principles involved in the extension of product lifespans necessitates different revenue models and exchanges of information among new actors. As a result, some of the decisions involved in developing products for circularity are of a strong strategic nature, suggesting the need for additional insights into how design processes are reshaped (Baldassarre et al., 2020).

Besides the incorporation of CE elements into core company activities (i.e. value generation), successful implementation also requires additional activities to be developed. Evidence of the environmental and social impacts of such strategies must be proven. The newly proposed SCEIA (Strategic Circular Economy Impact Assessment) framework is designed to guide companies throughout the process of measuring their impacts. We describe the framework's objectives and its validation procedure in Section 4.3.4. A further consideration arising from CE approaches is the need for cooperation beyond the scale of the company (Deutz, 2009), and in particular in territorially defined approaches (e.g. when a public body such as a local authority is attempting to implement a CE within its jurisdiction (see Chapter 6 in this volume), or if a company seeks to incorporate priorities based on its location (i.e. territorial perspectives), then further stakeholders such as governmental bodies become relevant. These considerations

present additional obstacles to the effective implementation of CE approaches, which we consider below.

This chapter synthesises findings from research projects addressing specific aspects of the role of companies in the sustainable and circular transition (encompassing corporate implementation of the CE, CBM, PSS, product development, CE assessment and integration of territorial perspectives) in order to address the following questions: (1) what drivers and barriers do companies face regarding the implementation of CE approaches; (2) which approaches can be used by companies to innovate their business models and their products and services for a CE and to assess the environmental and social impacts of corporate CE activities; and (3) what is the relationship between companies and territory at the regional level?

In the following section methods are presented, as well as the results of six research contributions. A discussion of these results and final conclusions provides implications for theory and practice.

4.2 Methods

This chapter builds on the results of six PhD projects carried out by early stage researchers (ESRs) within the Cresting project, each addressing specific aspects of the role of companies in the sustainable and circular transition. Quantitative and qualitative methods were used and included case study research with companies, interviews, surveys, (focus group) workshops, systematic literature reviews, expert feedback and action design research (see Table 4.1).

TABLE 4.1 Research contributions and methods employed in the study of companies' approaches to the CE

Location	*Perspective and focus*	*Methods*
Italy, the Netherlands	Company: barriers to and drivers for the CE	Survey (n = 155) in three different languages with companies from different sectors
Austria and the Netherlands	Company: business model innovation	Multiple case study (n = 10), action design research
Austria	Company: product and service design	Interviews, participant observation, content analysis, morphological analysis
Italy	Company: CE assessment	Expert panel survey, focus group workshops
France, Switzerland, Taiwan	Company and region: territorial business models	Interviews, participatory social network analysis
The United Kingdom, Austria	Company and region: stakeholder and embeddedness	Interviews, discourse analysis, observation, survey

4.3 Cases addressing the business perspectives of a CE

The results of the six research contributions are presented in this section. First drivers for and barriers to corporate CE practices are presented. Based on this general view of corporate CE practices the focus is on innovation at the company level, with first circular business model innovation (CBMI) and second product and service design for a CE. The fourth contribution addresses the assessment of CE performance at the company level. Finally, the fifth and sixth contributions address the embeddedness of companies in larger systems using the example of territorial business models and a regional perspective of companies in a CE.

4.3.1 Corporate CE practices: drivers and barriers

While researching drivers for and barriers to the implementation of a CE an in-depth analysis of CE practices (strategies, solutions or business models) in companies across sectors located in Italy and the Netherlands was carried out in mid-2019. In a survey distributed in three languages 155 respondents from companies engaged with CE practices answered, among others, questions regarding their exact CE practices, the goal of pursuing these, as well as the drivers for and barriers to the implementation of a CE.

Regarding the planned and implemented CE practices, the respondents were presented with a list of 15 CE practices identified by Kalmykova et al. (2018) from which they could select multiple answers. As depicted in Figure 4.1, the most commonly applied CE practice is the *recovery of products, materials or energy from waste*. This is followed by 4Rs to increase energy and material efficiency, which could be attributed to process optimisation. The least applied CE practice in the sample is providing a sharing platform for consumer goods, tailing behind *repairing products*, *remanufacturing or refurbishing goods* as well as *PSS models*.

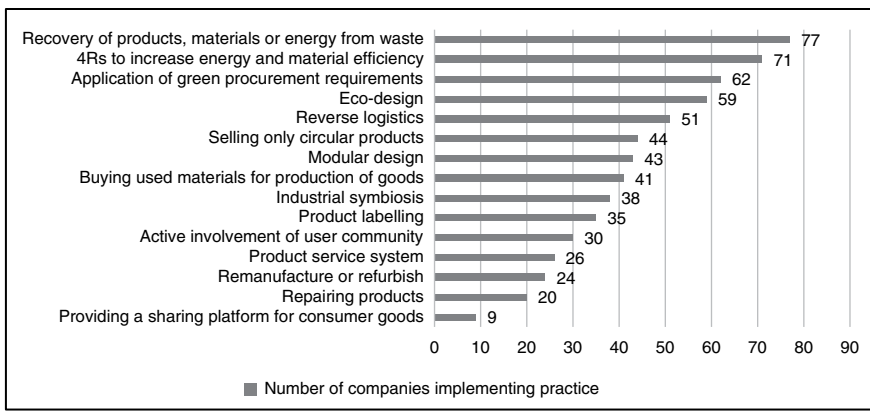

FIGURE 4.1 CE practices implemented or planned by respondents, n = 141

Some 72% of respondents indicated that they have implemented or plan to implement more than one CE practice. Regarding the main business activities of the respondents, the majority have a waste management focus, which is the sector that the CE has traditionally related to (Cecchin et al., 2020). In contrast, concepts such as the PSS or the sharing economy are less prevalent in the observed CE practices. Interestingly, CE practices that entail more manual labour such as repairing, remanufacturing and refurbishing products are also at the lower end of representation, potentially due to the higher employment costs (discussed in Chapter 7) as well as less predictable demand chains.

4.3.1.1 Goal of implementing CE practices

After identifying the most pertinent CE practices the respondents provided the three main goals they aimed to achieve with these strategies (Figure 4.2). The three goals were ranked from 1 to 3 and were captured in an open text field, meaning that the three ESRs who carried out the survey had to iteratively code the goals and define the categories, first individually and then by comparing their categorisation together. The weighted occurrence takes into account the ranking of the category by importance, attributed by the respondents, while the total occurrence represents how many times a category was mentioned irrespective of its rank. The responses offered can be divided between corporate goals, those directly related to the motivation of companies, and social goals, where respondents mentioned that they wanted to contribute to a broader cause. Corporate goals were sometimes in reality CE practices, as is exemplified by the first category including the value retention options (i.e. better seen as a means to an end such as resource efficiency, rather than an actual goal per se). Waste reduction was mentioned so often that it was placed in

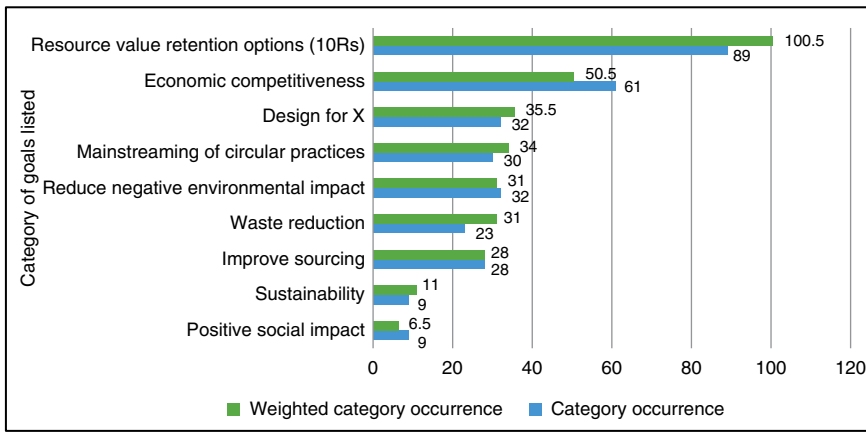

FIGURE 4.2 Company goals to be achieved through CE practices, ranked and weighted, n = 134

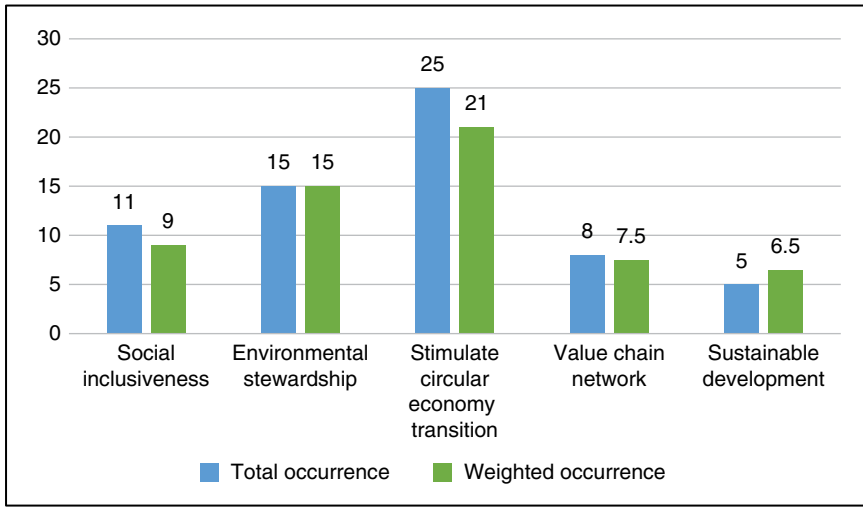

FIGURE 4.3 Society goals to be achieved through CE practices, ranked and weighted, n = 134

a separate category, also showing that the connection of the CE and waste was still very strong in the understanding of the respondents. The second goal, economic competitiveness, is noteworthy because, while it was not always mentioned as the first goal, it was often present in the second or third rank. What was also interesting is that the reduction of negative environmental impacts was considerably higher than the more holistic category of sustainability or bringing about positive social impacts through business activities.

The society-related goals (Figure 4.3) were mainly related to helping to create a system change towards a CE transition, followed by environmental stewardship, social inclusiveness, creating fairer value chain networks and contributing to sustainable development.

4.3.1.2 Drivers for and barriers to CE implementation

The final part of the questionnaire was dedicated to uncovering the drivers for and barriers to implementing CE practices for companies that were early adopters and/or strongly engaged with the CE. As they differ considerably by country, the results are displayed comparatively in Figures 4.4 and 4.5. The most dominant CE drivers are the potential to reduce the environmental impact, the use of critical raw materials and the coherence with company sustainability image. In contrast, the main barrier to CE implementation is external, namely legislative constraints. These were especially extensive among the Italian respondents, a topic that was later discussed in interviews with companies. The main issues are related to the rigidity of waste regulations and the definition of waste, forbidding

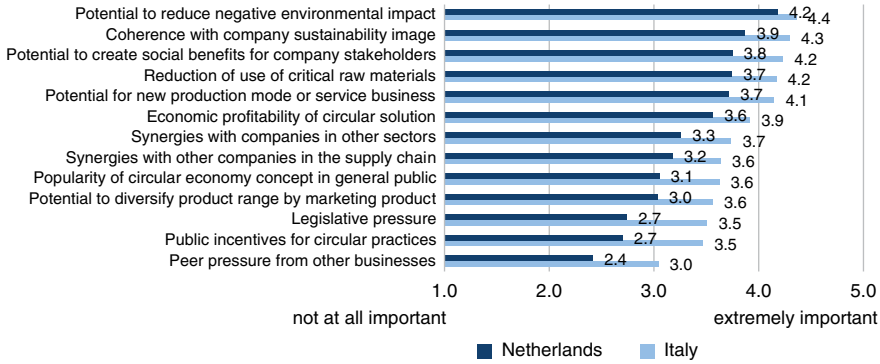

FIGURE 4.4 Respondents' perceived importance of CE drivers to respondents, on a scale of 1 (not at all important) to 5 (extremely important), 'I don't know' responses were excluded, n = 105

its further use as a material input. Therefore, it is often necessary to go through the process of recategorising waste as a by-product to enable trade with other companies. The next highest ranked barriers, however, are internal, connected to the uncertain and long-term economic gains of implementing CE practices as well as the high investment costs (limited access to finance is ranked in fifth place). It needs to be stressed that the respondents generally accorded less importance to the barriers than to the drivers, indicating that the proposed barriers are not seen as heavily interfering with the implementation of CE practices within the companies under study.

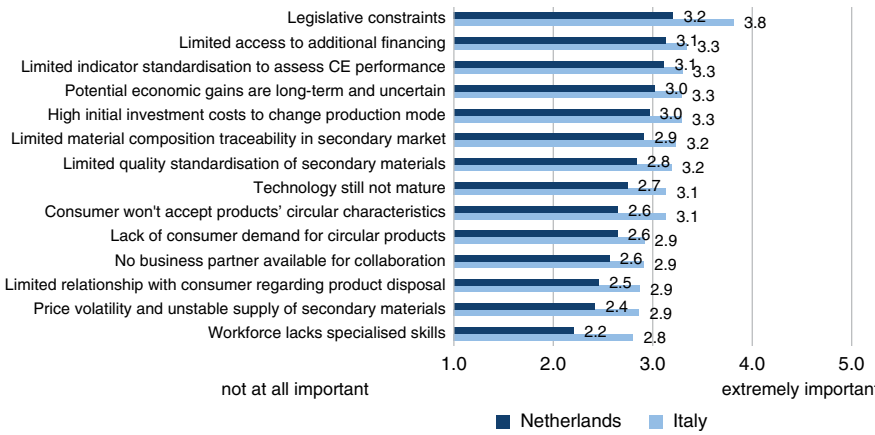

FIGURE 4.5 Respondents' perceived importance of CE barriers to respondents, on a scale of 1 (not at all important) to 5 (extremely important), 'I don't know' responses were excluded, n = 105

4.3.2 Business model innovation

This research contribution focused on the topic of CBMI, particularly on the capabilities needed by incumbent firms (i.e. those already established in the market) to transform or diversify their business portfolios, and the challenging process of designing these new business models. The development of sustainable and circular business models has been described as a leverage point in the circular transition; however, the process of designing and implementing circular business models remains underexplored in the literature, which calls for further empirical insights and concrete guidelines for firms (Centobelli et al., 2020; Pieroni et al., 2019; Santa-Maria et al., 2021).

In order to explore how incumbent firms transform or diversify their business models for the CE, a multiple case study of ten successful cases of CBMI was conducted within the Cresting project (Santa-Maria et al., 2022a). Building on the explanatory potential of the theory of dynamic capabilities to understand how firms innovate, adapt and transform in changing environments (Teece et al., 1997; Eisenhardt and Martin, 2000;), 26 specific practices relevant for CBMI have been abductively identified, which were grouped into 12 microfoundations of the conventional dynamic capabilities of sensing, seizing and reconfiguring (see Figure 4.6). Through an additional step of cross-case analysis and focusing on those sustainability-oriented innovation practices present in 80% or more of the cases, the six most relevant practices for CBMI were identified. These include (i) adopting a life cycle perspective; (ii) implementing environmental management tools (e.g. life cycle assessment, ISO 14001); (iii) ideating and developing value propositions with environmental and/or social impacts; (iv) developing a sustainability strategy and culture; (v) engaging strategic partners in collaboration and co-creation; and (vi) integrating stakeholders and coordinating partners in the business ecosystem (Santa-Maria et al., 2022a).

Two insights were derived from this cross-case analysis: first, by comparing innovation processes centred on different CE R-value retention options (Reike et al., 2018) four practices were proposed which are particularly relevant for innovations focusing on short and medium loops (R0–R5),[1] i.e. early customer engagement, understanding the needs of key stakeholders, experimenting with validating assumptions and promoting an innovation culture; and four practices particularly relevant for innovations focused on long loops (R6–R9),[1] i.e. engagement with strategic partners, effective coordination of the business ecosystem, being open to external expert support and having fact-based external communication. Second, the analysis also allowed the researchers to propose seven practices particularly relevant for long-term sustainability-oriented business module transformations (in contrast to business module diversifications), i.e. articulation of a clear and ambitious sustainability vision, counting on full support from the CEO, guiding the transformation journey through the use of a sustainability framework, receiving support from external experts, training and empowering workers in sustainability topics, being proficient at organisational change management and having a fact-based consistent external communication.

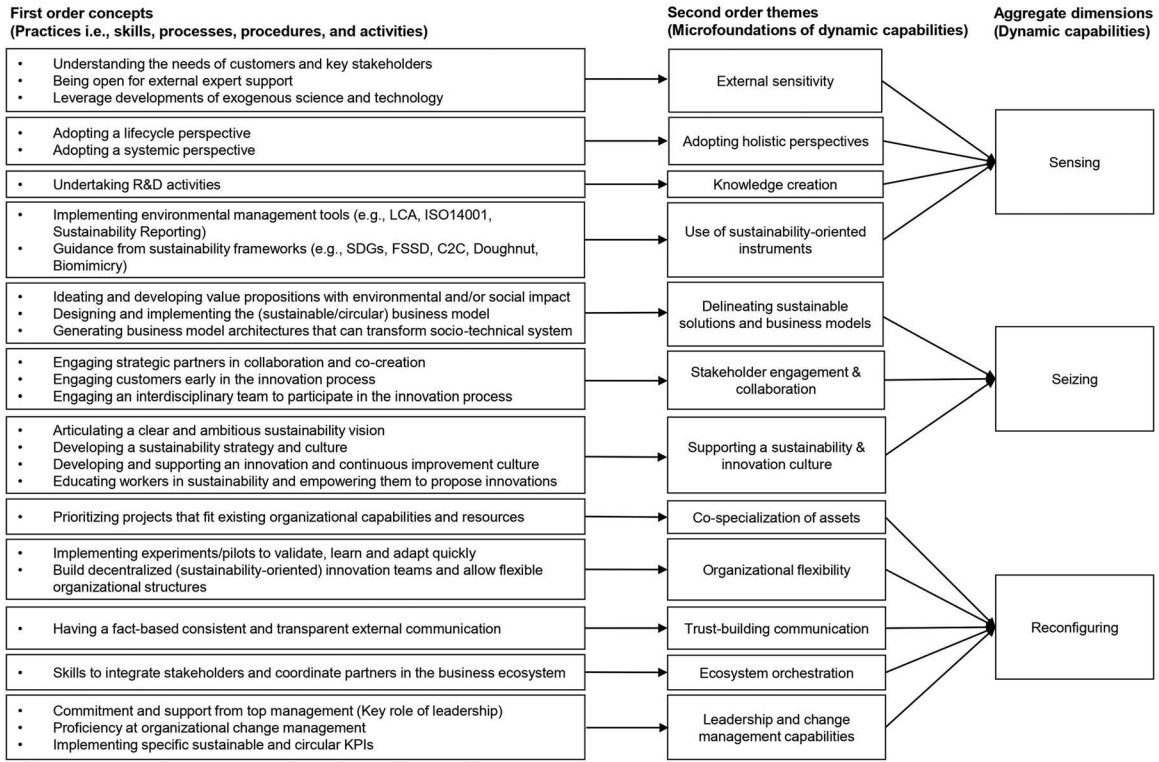

FIGURE 4.6 Data structuration and analysis process, following the Gioia method, which allowed the researchers to group the 26 identified best practices for CBMI into 12 microfoundations of dynamic capability, and the three main dynamic capability categories

Source: Santa-Maria et al. (2022a) used under CC BY license 4.0.

This empirical study facilitates a better understanding of the complexities of business model innovation for the CE, and makes it possible to identify the needed organisational capabilities for its success. However, acknowledging the difficulties of CBMI and the lack of concrete guidelines, a complementary research project was conducted with the aim of developing a design thinking-based framework to guide firms in CBM development. Design thinking has gained popularity in innovation management fields (Kolko, 2015), offering principles and tools capable of addressing complex problem-solving challenges through multidisciplinary collaboration (Brown, 2008; Carlgren et al., 2016).

Following an Action Design Research approach (Sein et al., 2011), a framework entitled the Circular Sprint has been developed (Santa-Maria et al., 2022b). The process iteratively combined four streams of literature, feedback from 16 experts and six workshops that involved a total of 107 participants working in 14 teams. The Circular Sprint aims to facilitate early stage CBM development in a time-efficient and online-based manner and is composed of seven innovation phases and 12 complementary and purposefully adapted activities (see Figure 4.7). The Circular Sprint framework and its activities are described in detail in Santa-Maria et al. (2022b), which includes a step-by-step user guide in its supplementary material.

Beyond the development of the framework and its activities, our research allowed us to reflect on the inclusion of a sustainability perspective within business innovation activities. Conventional wisdom could consider sustainability as an additional constraint within a creative process. However, analogous to Deutz et al. (2010) with respect to design, our study supports the notion that sustainability orientation is an opportunity, one that can open the solution space during divergent thinking phases, and one that can help to filter proposed solutions during convergent thinking phases. Furthermore, we argued that sustainability-oriented business innovation should be guided by the three conventional lenses of desirability, feasibility and viability, complemented by the fourth lens of sustainability (see Figure 4.8).

4.3.3 Product and service design for a CE

The adoption of circular approaches drives significant changes in the way companies operate. Therefore, here we provide insights to the impact that value retention strategies have on sustainable product development (SPD) processes. Thus, the starting point was to interview product developers engaged in SPD and eco-design to highlight the main limitations of existing approaches with respect to enabling products' circularity (Diaz et al., 2021).

The findings are outlined as follows. First, product developers mainly discussed sustainability principles once the design of the product was finished. The reason for this is two-fold: on the one hand, development processes are frequently *evolutionary*, which means that companies very often start developing new products from existing designs (see also Deutz et al., 2013, for a survey of product designers in the United Kingdom). On the other hand, the assessment of a sustainability performance

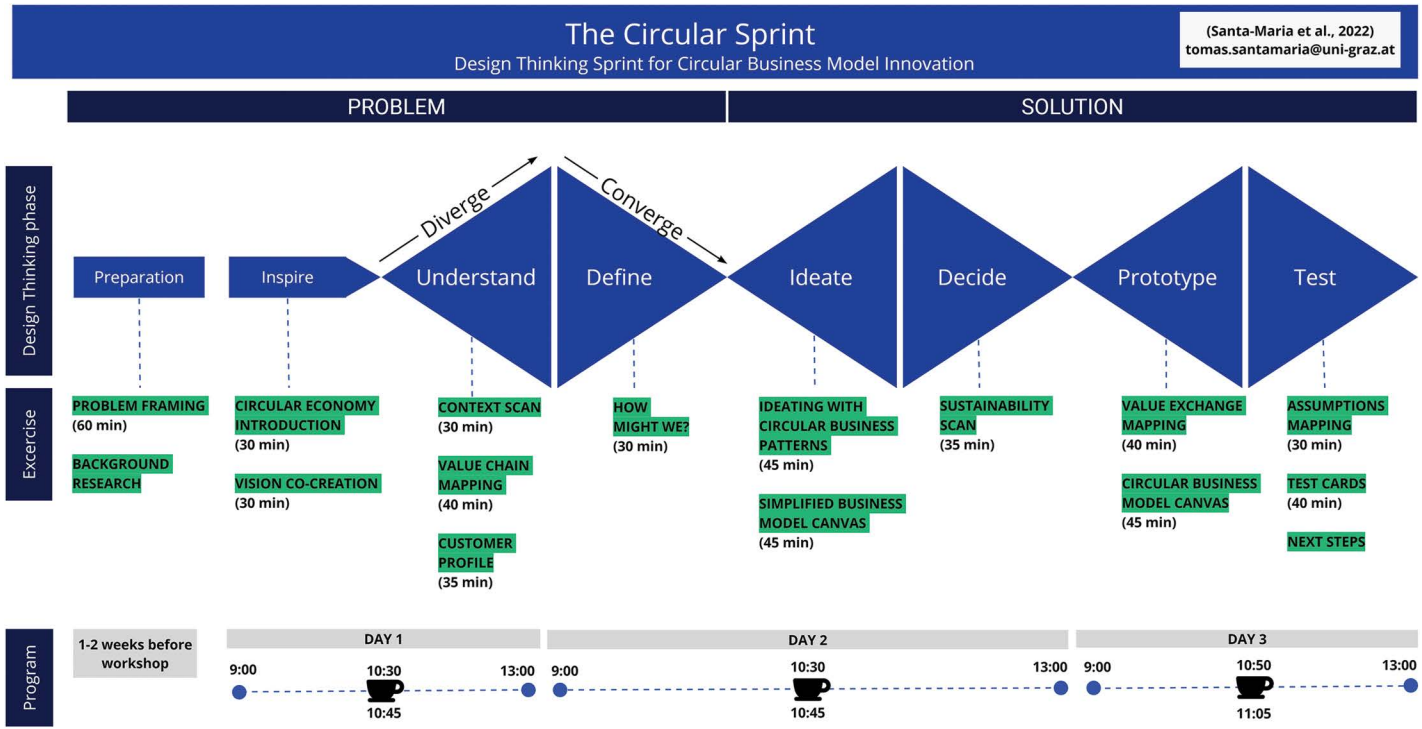

FIGURE 4.7 The Circular Sprint framework. The figure contains the process phases, its 12 activities and a proposed timeframe, which could be adapted according to the use case

Source: Santa-Maria et al. (2022b) used under CC BY license 4.0.

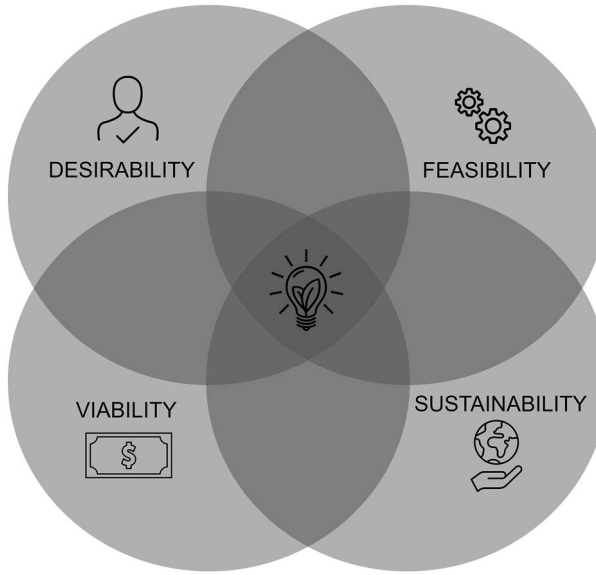

FIGURE 4.8 The four lenses of sustainable innovation

Source: authors' elaboration, inspired by Brown (2008) and Shapira et al. (2017), in Santa-Maria et al. (2022a) and used under CC BY license 4.0.

was only feasible once the product design had been completed, since only then did the product evaluation information become available. This issue has been previously reported and acknowledged as the eco-design paradox (Lettner et al., 2021). The result of these SPD practices prevents product planners from discussing systemic sustainability concerns or reconsidering value propositions, which could be delivered in some instances through an alternative ownership model arrangement or without the use of a physical product. Starting the conversations later in the design process results in only minor improvements towards sustainability. Second, while the CE literature has developed many indicators, it was found that these were not applied in product evaluation routines. Indicators are important metrics to monitor if the circular economy design traits are effectively engineered into product designs. The lack of indicator integration was partly aggravated by a concomitant lack of industrial standards on CE assessment in the context of manufacturing companies at the time the research was conducted. Thus, at best, practitioner-developed indicators such as the Material Circularity Indicator (MCI) (Ellen Macarthur Foundation, 2015) or the Circular Transition Indicator (CTI) (World Business Council for Sustainable Development, 2021) were seldomly used in niche design projects. Third, a strong prevalence for cradle-to-gate lifecycle thinking was found when it comes to monitoring the sustainability impact of products. In practice, it was possible to find relatively mature information exchanges with actors belonging upstream in the value chain (such as suppliers or manufacturers of parts) and insufficient or non-existent

exchanges with actors belonging to the use phase or the end-of-life phase. This hinders the sustainability assessment of circular innovations due to the subsequent lack of transparency of assumptions and reliability of data in sustainability assessment efforts (Peña et al., 2020). The fourth and the fifth shortfalls are of an interpersonal nature. Transformative circular design strategies consider more than just material and architecture – they often innovate at the service or ecosystem level. Thus, SPD processes also need to involve inter-organisational actors (suppliers, users, end-of-life managers, outsourced service providers, and so on). Similarly, management actors need to be further engaged as well, due to the need to reconfigure elements pertaining to the corporate strategy such as a product's revenue model. These new exchanges imply the use of a wide range of communication styles, background expertise to be deployed in new cross-functional dialogues and inter-organisational relationships. Exchanges with other market participants or questions about consumers' linear expectations necessitate not only changes in the processes or the structure, but also a shift in organisational attitude. Thus, a strong requirement for these exchanges to take place is to align organisational cultures with new processes.

In the second phase of research, it was investigated how companies were implementing a CE. For this, 24 instances of value retention strategy implementations were analysed to examine implementation patterns (Diaz et al., 2022). An overview of an aggregated implementation process can be found in Figure 4.9 (Diaz et al., 2022).

An early observation points to the fact that developing products for a CE starts before product development and design, i.e. during product planning. In this regard, value retention strategies were found to play a two-fold role. During planning processes, they are part of the corporate competitive and sustainability strategies

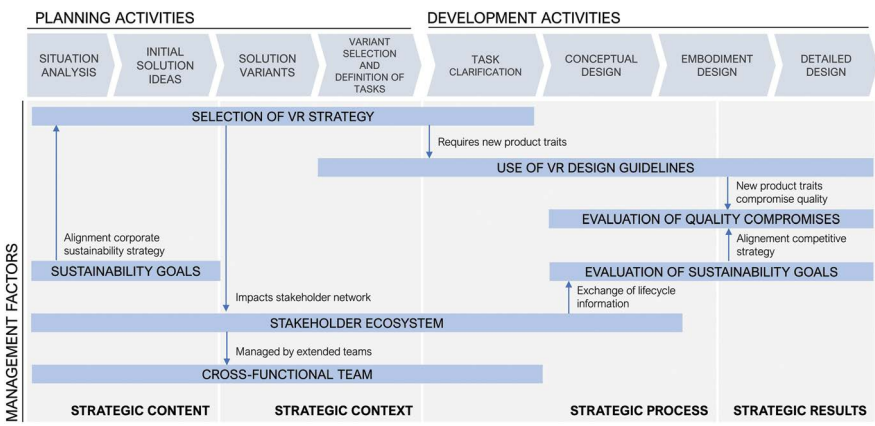

FIGURE 4.9 Overview of management factors influencing circular product design emerging at different stages of product planning and development and main interactions between them

Source: Diaz et al. (2022) used under CC BY license 4.0.

and thus need to deliver on corporate sustainability goals. This is an important step, since the integration of circularity will not always be economically favorable (Bauwens, 2021) and thus a balance between strategic trade-offs needs to be decided upon. A second observation is the fact that value retention strategies determine the stakeholder ecosystem surrounding the product. On the one hand, this includes stakeholders who directly interact with the physical product artifact (e.g. distribution, customers, end-of-life managers, etc.) and whose interventions and decisions largely determine the sustainability implications of circular functionalities embedded in products. The direct involvement of many of these lifecycle actors during product planning and development was observed, e.g. the customers. On the other hand, the involvement of a wider set of stakeholders is needed to secure a certain degree of societal embeddedness of a disruptive circular product innovation (e.g. cultural actors, political actors, regulatory actors and market actors). Managing these wider networks requires the involvement of a varied range of company functions (e.g. marketing, communications, management) and thus a strong element of cross-functional coordination.

The main management factors and conditions needed to implement a CE during SPD processes were systematised in a management framework (Table 4.2). In addition, the framework was applied as a categorisation principle to explore value retention strategy implementation patterns across organisations, again confirming a strong correlation between sustainability strategies and the implementation of value retention strategies.

In sum, value retention strategies need to be managed and integrated into product designs by formulating value retention-based functional requirements. These then need to be translated into design traits and working principles. To verify the effectiveness of a circular design strategy, product evaluation routines need to assess the extent to which the circular product can perform the functions for which it was first ideated (product quality) so that the organisation remains competitive in the market. To verify that corporate sustainability goals are met, sustainability assessments are part of product evaluations as well. It is therefore crucial to conduct thorough product evaluations aligned with circular design principles and sustainability assessments to ensure the product's competitive edge and also to verify the organisation's alignment with long-term sustainability goals.

4.3.4 Measuring circularity at the corporate level

Companies are increasingly adopting CE practices to align with international sustainability agendas such as the United Nations Sustainable Development Goals (SDGs) (Opferkuch et al., 2021). However, a common thread is that the relationship between CE strategies and their sustainability impacts is quite ambiguous (Walker et al., 2021). The latest Intergovernmental Panel on Climate Change (IPCC) report has corroborated this point, stating that 'claims on the benefits of the circular economy for sustainability and climate change mitigation have limited evidence' (IPCC, 2021).

TABLE 4.2 Management framework for the integration of value retention options during SPD processes. The top row shows the number of managerial factors enabling the implementation of value retention strategies. The columns display the corresponding range of factor conditions observed.

Sustainability values	*Value retention strategy*	*DfX guideline focus*	*Quality compromises*	*System stakeholders*	*Extended team*
Meaning-making	Refuse	Socio-technical system	Performance	Policymakers, media, non-profit, research	Communication
Impartiality	Reduce	Product ecosystem	Features	Market players	Strategic management
Competence	Resell/Reuse	Revenue model	Reliability	Suppliers	Procurement
Influence	Repair	Revenue model	Conformance	Distribution network	Development and production
Health	Refurbish	Service	Durability	Customers	Logistics
Biosphere physical degradation	Remanufacture	Architecture	Serviceability	Local depots, repair services	Marketing and sales
Anthropogenic substance accumulation	Repurpose	Material	Aesthetics	Local waste managers	Aftersales
Earth crust substance depletion	Recycle	Process	Perceived quality		
	Recover energy				
	Re-mine				

Source: Diaz et al. (2022) used under CC BY licence 4.0.

The reality of persisting global environmental and social crises has prompted an increased assessment of the sustainability impacts of CE strategies by companies (Corona et al., 2019). Such assessments will offer additional benefits in terms of both communication and internal impact improvements (Roos Lindgreen et al., 2022). However, CE assessments seem to be applied relatively infrequently (Das et al., 2022; Stumpf et al., 2021). Two reasons for this are a lack of understanding of company needs and capabilities for assessment, and the complexity of the currently available methods (Das et al., 2022). To address these issues, one research aim was to design a new CE assessment framework to assist with the strategic decision-making process of selecting the optimal CE solution. This framework is called the Strategic Circular Economy Impact Assessment (SCEIA). Here we summarise its design, validation and content. The applied research methodology consisted of three phases: (1) setting the objectives of the framework, determining its methodological content and its application routine; (2) validating the framework using an expert panel survey and a series of focus group sessions with practitioners; and (3) applying the framework in practice. See Roos Lindgreen (2022) for a detailed description of each phase.

Following a critical assessment of the available literature on CE assessment, five objectives for the framework were formulated:

- *Enable a holistic (multidimensional) assessment*: the CE is interpreted as a toolbox of resource-efficiency strategies to achieve positive impacts on the three dimensions of sustainable development.
- *Prevent burden shifting to other parts of the supply chain or lifecycle (lifecycle perspective)*: to avoid burden shifting to other parts of the supply chain, a lifecycle view of corporate sustainability is promoted.
- *Provide flexibility in terms of scale and sustainability maturity*: the scale on which the framework can be applied is flexible and depends on the goal of the assessment (Ceschin and Gaziulusoy, 2016). The framework intends be feasible for companies with different levels of knowledge about assessment by being modular and adjustable to the sustainability maturity of the applying firm.
- *Build on existing assessment tools*: the use of methods such as Material Flow Analysis and Life Cycle Assessment (LCA) to assess the CE, as recommended by several authors, is promoted in the framework.
- *Assist strategic decision-making processes*: strategic decision-making in firms is characterised by high stakes and long-term repercussions (Bushan and Rai, 2004). The strategic level of decision-making is considered here to be particularly relevant due to urgency to move away from business-as-usual patterns of production and consumption.

After defining the objectives and deciding on a preliminary application routine, the resulting preliminary framework was validated. Extensive stakeholder engagement, explained in Chapter 2 in this volume, involved both an expert panel survey (Kravchenko et al., 2021) and qualitative practitioner focus groups (Nyumba et al., 2018).

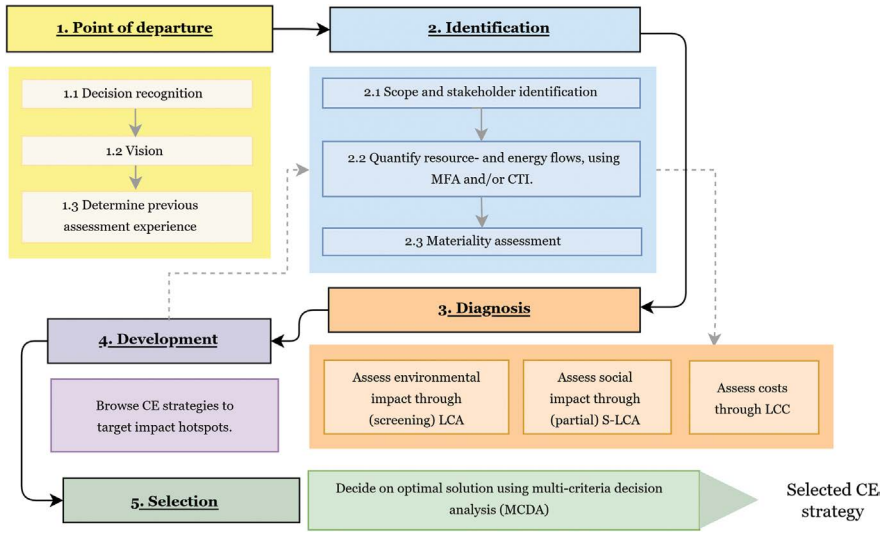

FIGURE 4.10 Overview of the SCEIA framework

Source: developed by the authors based on Roos Lindgreen (2022).

Next, a brief overview of each of the different steps that form the SCEIA framework is presented, together with a visualisation of the framework (Figure 4.10).

Step 1: point of departure. The company decides that a decision on CE must be made, and that assessment will play a role in this. The company formulates its (broad) sustainability goals and determines its starting point, following from its previous experience with assessment.

Step 2: Identification. The company sets the scope for the assessment and identifies relevant stakeholders that play a part in collecting data and determining the included dimensions. Next the company collects data on resource and energy flows relevant to the set scope. Optionally, the company identifies impact areas important to its stakeholders through a materiality assessment.

Step 3: Diagnosis. In the diagnosis step, the baseline assessment is undertaken. It can include an assessment of the environmental, social or economic impacts of the previously selected system. The diagnosis step will identify impact hotspots within the selected system's value chain. The recommended methods are LCA, Life Cycle Costing and Social Life Cycle Assessment.

Step 4: Development. In the development step, a CE strategy will be selected to target the previously identified impact hotspot(s). This can be done using an extensive list of available CE strategies, available as part of the framework. The appropriateness of a certain CE strategy is highly dependent on the company's context.

Step 5: Selection. In the optional selection step, a choice is made on which of the previously evaluated CE strategies is most preferred in terms of feasibility and impact.

Finally, the framework was applied in a real-world setting, in collaboration with a company with the ambition to lower its environmental impacts through the implementation of CE strategies. Due to the modular nature of the previously designed and validated framework and feasibility, the primary focus of the application was the use of LCA in assessing the environmental impacts of to-be-introduced CE strategies. These scenarios were based on market conditions and meetings with the company's management team. While the process of assessment is still challenged by the complexity of the available methods, the assessment of the sustainability impacts of the selected scenarios using the SCEIA framework provided the company with insights that supported its decision-making process. In a next phase of this work, the framework was used with a selection of CE companies in different African countries to further optimise its design and application.

4.3.5 Territorial circular business models

Companies can design innovations for sustainability at different levels. Recent studies show how the innovations for sustainability have evolved from narrow technical product and process-centric processes towards large-scale system-level changes (Adams et al., 2016; Brezet, 1997; Ceschin and Gaziulusoy, 2016). Currently, sustainability and CE innovations in companies have focused exclusively on a limited range of innovation types (products and technologies), predominantly on environmental challenges (Adams et al., 2016). Therefore, to contribute to sustainability and CE transitions companies need to adopt a higher level of systems innovation, including developing PSS design strategies, sustainable organisation design strategies and sustainable collaboration design strategies (Baldassarre et al., 2020).

PSS are integrated offerings of products and services which can have innovative potential, securing competitiveness while at the same time allowing companies to address environmental concerns (Annarelli et al., 2020). PSS are value propositions oriented towards satisfying users by delivering functions or performance instead of products (Ceschin and Gaziulusoy, 2016), e.g. from selling cars to selling mobility solutions, from selling light bulbs to selling lighting solutions. Since manufacturers retain the ownership of the products and deliver performance to their customers, they are economically incentivised to optimise their resource utilisation through improving resource efficiency, increasing product lifetime, or reducing the total number of products needed to provide that performance (Tukker, 2004, 2015; Vezzoli et al., 2015).

Despite the sustainability potential of PSS, recent studies highlight that these offerings are not always sustainable (Boucher et al., 2016; Doualle et al., 2016; Pigosso and McAloone, 2016) nor contribute to the CE. Companies might adopt the business model for their economic interests without internalising environmental or social concerns. Thus, for PSS to contribute to the transition towards sustainability, they need to be carefully designed, developed and delivered for this purpose (Bertoni, 2019; Boucher et al., 2016; Ceschin, 2013).

While gains in resource productivity are essential in designing a sustainable PSS offering, sustainable PSS design should integrate a systemic approach to attain a range of environmental and social performances (Kristensen and Remmen, 2019; Reim et al., 2015; Vezzoli et al., 2015). Therefore, the performance and potential value of the PSS should be understood from specific contexts, such as the socio-technical systems and the territories and multiple stakeholders perspectives integrating customers, suppliers, employees and society (Costa Fernandes et al., 2020; Pezzotta et al., 2018; Yang and Evans, 2019). However, the current approaches to multi-stakeholder relations in PSS for sustainability and the CE studies do not explore their contextualisation, which poses obstacles to the design and implementation of PSSs as the environmental and social outcomes of these stakeholders' relations are a matter of local interpretation (Cook, 2018, 2014). Moreover, sustainability does not fall evenly across space (Castree, 2005). Thus, successful PSS design and implementation need to consider stakeholder relations situated in space.

For companies to develop PSS for sustainability, they must question whether their operations contribute to territorial resilience (Buclet, 2014). Therefore, it is vital for companies when developing a PSS not to focus solely on developing new PSS but also on understanding the contextual conditions that may favour or hinder the societal embedding of the PSS themselves (Ceschin, 2013; Cook, 2018). Without contextualising PSS solutions as part of the wider economic systems their sustainability potential remains unclear and jeopardised. In this study, territories are not only 'neutral' locations where economic activities are developed; they are also considered PSS co-constructors and resource providers (Allais and Gobert, 2019). The territory is an organisation inscribed in space and is socially constructed (Pecqueur, 2014).

In order to ensure the territorial anchoring of the solution, PSS must provide integrative capabilities to companies moving towards integrated offerings of products and services while understanding users' and society's needs in a given context (Joore and Brezet, 2015). Thus, the research identified three main leverage points for practically supporting the integration of the territorial dimension in PSS designs for sustainability:

1 Support the understanding of complex systems for organisations and their particular PSS. PSS designs for territorial sustainability require a multi-level approach, in which companies need to identify and understand the socio-technical and territorial systems their PSS activities belong (Joore and Brezet, 2015; Pereno and Barbero, 2020). Without an understanding of these larger systems, companies might lack a clear understanding of their societal function (socio-technical system), and their interrelations with other systems in the territory, i.e. a bike-sharing offering needs to consider how this offering complements the local mobility (societal function) and wellbeing of citizens in a specific city or region (territorial system). Identifying higher system levels is vital for identifying specific territorial needs and challenges concerning societal function, key territorial actors and local capabilities.
2 Support the understanding of how the PSS can create societal and environmental values at the organisational, network and territorial level. The current

narratives of the value of PSS in design are related to resource efficiency (Cook, 2018, 2014). This might reinforce PSS innovation design practices focused on technological fixes and insular innovation (Cook, 2018, 2014). This obstructs the reflection process of companies on how companies can innovate for transformations at higher system levels with their PSS offerings (Joore and Brezet, 2015). Thus, supporting companies in understanding the sustainable value opportunities and outcomes in PSS must be understood from multidimensional (economic, social and environmental) and multi-level (organisational, network and territorial) perspectives (Delgadillo et al., 2021). The use of immaterial capitals and territorial capitals facilitates an understanding of a broader range of value benefits of PSS (Allais and Gobert, 2016; Delgadillo et al., 2021), resulting in compelling narratives of the innovation benefits for stakeholder engagement and concept design discussions and assessment.

3 Develop concepts that tackle customer and territorial needs. The coupling of customer/user-focused (zooming in) and the systemic perspective of the territorial approach (zooming out) is an essential practice for enhancing the sustainability of business models (Hofmann and Jaeger-Erben, 2020). This process ensures that the business offerings are desirable, feasible, viable and correspond to the local sustainability challenges.

The design and development of territorial PSS imply companies make efforts to think beyond their products and services as well as redefining their purpose in terms of how they function from an economic and operational standpoint. In addition, companies need to develop collaborations with different territorial actors from the private, public and civil spheres to identify local sustainability challenges and business opportunities. Therefore, the design and implementation processes need top-down policy changes and bottom-up initiatives (companies and citizens of the territories) and more democratic and participatory approaches. The role of governments is critical for developing local, regional and national programmes focused on developing platforms and resources for PSS adoption. Governments can enhance the creation of institutional environments in which local governments, businesses, academia and civil society actors come together to develop a PSS for their territory. Particularly for designers, it means adopting a systemic position that is also more critical. They must be able to engage with socio-political questions and frameworks to create the conditions for forming networks around sustainability issues (Forlano, 2016).

4.3.6 Business and the CE: a spatially defined approach

As discussed in Chapter 6 in this volume, the relationship between companies and the places where they operate is rarely considered in a CE context. Focusing on a specific place, e.g. the territory of a city or region, introduces additional stakeholders, including local government and other public agencies, which requires collaboration between businesses and policymakers to transition to a regional CE. This research examined the perspectives of large companies on a potential regionally

focused CE by making comparisons between Hull, UK, and Graz, Austria[2] (see Newsholme, 2023; Newsholme et al., accepted).

The companies under study initially showed an interest in engaging with other companies and organisations in the region where they are located; they often took part in local networking groups on the topic of resource efficiency and environmental issues. These networks are aimed at mutually beneficial discussions, not direct collaborations in CE or more conventional commercial relationships. The companies are linked to global sourcing strategies, as was evident in both Hull and Graz. Even those companies with a strong attachment to the region (through historical and family connections) were driven by cost-focused decisions in terms of supply chain operations, which provided little potential to negotiate more closed loop production systems with regional partners. Through their public reporting and in interviews, the companies expressed the view that CE collaboration is something they would undertake with their value chain partners or internally (namely branches of the company located at the global scale). The idea that value chain partners would be willing to collaborate for the overall success of CE activities seems to be an assumption. Although large companies can exert some influence over smaller customers, building effective relationships for complex CE practices could be challenged by the lack of spatial proximity.

Similarly, downstream disposal mechanisms tend not to be focused on the regional level, but are more tailored towards national or international targets due to the economies of scales needed to manage waste efficiently. Notably, however, some companies were also involved in donating unwanted materials to local social enterprises and are therefore effectively part of a local network of organisations using CE practices to support the community (Pusz et al., 2023; see also Chapter 6 in this volume). These donations are firmly to the benefit of the companies (e.g. to avoid disposal costs), albeit that they are advantageous to the recipients.

This research highlights the global companies' value chain configurations and the lack of current interest in exploring the potential to pursue proximal CE activities, often due to prior long-term strategic commitments to globally distributed suppliers. However, companies are participating in local environment-related networks and in voluntary arrangements with social enterprises. Local public bodies may be able to build on these existing arrangements to help foster social capital for companies and other local stakeholders in order to develop functional and collaborative regional CE activities (Deutz et al., 2024). However, local public bodies may struggle with the funding of authorities tasked with bringing about such activities without additional support at the national level (see Chapter 8 in this volume).

4.4 Discussion

The contributions presented in this chapter shed light from different perspectives on the topic of business engagement and the CE. The first research contribution addressed drivers for and barriers to corporate engagement for a CE using the

results of a survey of companies conducted in Italy and the Netherlands that are engaged in CE practices. The survey asked respondents about the CE practices they have implemented or plan to implement, the goals they hope to achieve through these practices, and the drivers and barriers they face in implementing a CE. The most implemented CE practices were recovery of products, materials or energy from waste, and increasing energy and material efficiency through reuse, reduction and repurposing. The least implemented CE practices were providing a sharing platform for consumer goods, repairing products, remanufacturing or refurbishing goods, and PSS models. This is in line with results from a survey carried out among manufacturing companies in Austria and confirms that higher value retention strategies are less frequently implemented than recycling-based approaches (Schöggl et al., 2023a, 2023b). The most common goals for implementing CE practices were waste reduction, economic competitiveness and reducing the negative environmental impact. The most common drivers for CE implementation were the potential to reduce the environmental impact, the careful use of critical raw materials and the conformity with the company's sustainability image. The most common barriers to CE implementation were legislative constraints, uncertain and long-term economic gains, and high investment costs. These findings suggest that companies should focus on CE practices that have the potential to achieve their specific goals, and that they should be aware of the potential barriers to implementation.

The second research contribution discussed the practices and organisational dynamic capabilities required to innovate a firm's business model(s) for the CE. Based on a multiple case study of ten successful cases of CBMI the most relevant practices for CBMI have been identified. In particular, the six most relevant practices for CBMI are adopting a life cycle perspective, implementing environmental management tools, ideating, and developing value propositions with environmental and/or social impacts, developing a sustainability strategy and culture, engaging strategic partners in collaboration and co-creation, and integrating stakeholders and coordinating partners in the business ecosystem. The cross-case analysis performed in this case study resulted in two sets of complementary insights:

- Four practices are particularly relevant for innovations focusing on short and medium loops (R-strategies R0–R5; see Reike et al., 2018): early customer engagement; understanding the needs of key stakeholders; experimenting to validate assumptions; and promotion of an innovation culture.
- Four practices are important for innovations focused on long loops (R-strategies R6–R9; see Reike et al., 2018): engagement with strategic partners; effective coordination of the business ecosystem; being open to external expert support; and having a fact-based external communication.

The third research contribution focused on SPD and the CE, especially how to integrate value retention strategies and how to enable product sustainability and

circularity. The starting points are the limitations of existing approaches to SPD. The first limitation is that sustainability principles are often discussed only once the design of the product is finished. This is because development processes are often evolutionary, which means that companies often start developing new products from existing designs. The second limitation is that there is a lack of industrial standards on CE assessment in the context of manufacturing companies. This means that there are no agreed-upon metrics to monitor whether the CE design traits are effectively engineered into product designs. The third limitation is that there is a strong prevalence of cradle-to-gate focus when it comes to monitoring the sustainability impact of products. This means that there is insufficient or non-existent exchange with actors belonging to the use phase or the end-of-life phase. The fourth limitation is that transformative circular design strategies often innovate at the service or ecosystem level. This means that SPD processes need to further involve inter-organisational actors (suppliers, users, end-of-life managers, outsourced service providers, and so on). The fifth limitation is that management actors need to be further engaged as well, due to the need to reconfigure elements pertaining to the corporate strategy such as a product's revenue model. To overcome these limitations value retention strategies need to be integrated strategically into the product designs. Thus it was identified that value retention strategies play a two-fold role in product planning. First, they are part of the corporate competitive and sustainability strategies and thus need to deliver on corporate sustainability goals. Second, they determine the stakeholder ecosystem surrounding the product. The starting point is the formulation of value retention-based functional requirements. These then need to be translated into design characteristics and working principles. To verify the effectiveness of a circular design strategy, product evaluation routines need to assess the extent to which the circular product can perform the functions for which it was first ideated (product quality) so that the organisation remains competitive in the market. To verify that corporate sustainability goals are met, sustainability assessments are part of product evaluations as well.

Leaving aside the product focus the next contribution concerned the development of a new CE assessment framework, namely the SCEIA framework, which aims to assist companies in the strategic decision-making process of selecting the optimal CE solution for the company itself. The framework was developed in three phases (setting the objectives of the framework; determining its methodological content and its application routine; validating the framework using an expert panel survey and a series of focus group sessions with practitioners; applying the framework in practice).

The SCEIA framework builds on existing assessment tools, which makes it more accessible to companies that are new to CE assessment. The SCEIA framework provides a modular approach that can be tailored to the specific needs of a company. It can be used to assess the sustainability impacts of both current and future CE strategies. This allows companies to make informed decisions about which CE strategies are most likely to achieve their sustainability goals. Furthermore,

the SCEIA framework can be used to identify and prioritise impact hotspots. This information can be used to focus resources on the areas where CE strategies can have the greatest impact. And the SCEIA framework can be used to communicate the sustainability impacts of CE strategies to stakeholders. This can help to build support for CE initiatives and ensure that they are implemented effectively.

The fifth research contribution discusses the importance of considering the territorial dimension when designing and developing a PSS for sustainability. It is argued that a PSS can contribute to sustainability and a CE by reducing resource consumption and waste, but that their full potential can only be realised if they are embedded in the local context. Three main leverage points for practically supporting the integration of the territorial dimension in PSS design for sustainability have been identified (i.e. understanding of the territorial system; understanding of territorial value generation opportunities; and alignment to customer and territorial needs).

The design and development of a territorial PSS requires a multi-stakeholder approach, involving collaboration between companies, governments, academia and civil society. Usually, these design and implementation processes need to be bottom-up, with companies and citizens working together to identify and address local sustainability challenges.

The regional perspective was employed in the last research contribution. Companies, especially large ones, are often linked to global supply chains and sourcing strategies, which makes it difficult for them to collaborate with local stakeholders on CE initiatives. An additional challenge for regional collaborations of companies can be a lack of trust and social capital between companies in a region. To overcome these challenges and to foster regional collaborations for a CE it is suggested that, first, national policymakers need to provide more support for CE initiatives at the regional level. This could include providing financial incentives, technical assistance and regulatory support. Second, companies need to be more willing to collaborate with local stakeholders on CE initiatives. This could be done by building trust and social capital between companies, and by developing shared goals and objectives. The transition to a CE will require a concerted effort from both companies and policymakers. By working together, it is possible to develop effective CE initiatives that benefit both businesses and the environment.

In sum, these studies highlight how important it is for companies to match their practices with the principles of a CE in order to minimise their negative effects on the environment and improve sustainability. An often overlooked factor is the importance of regional and collaborative efforts to fully harness the potential of the CE in corporate strategies.

4.5 Conclusions

The focus of the research activities presented in this chapter was on companies and their role in a CE. Companies are a special form of social system with the goal to produce economic value by transforming tangible and intangible inputs to

outputs for which customers will pay. Typical management tasks are the definition of a strategy and of business models as basis for the long-term orientation of companies and their market success. Furthermore, companies need competent and motivated employees, and they need products and services they can offer on the market. Companies should use a performance measurement system to understand the economic consequences of their decisions and activities. All these topics are of extreme interest from a sustainability and CE perspective and have thus been covered in this chapter. The first research question is answered with a detailed analysis of the drivers for and the barriers to the implementation of a CE at the corporate level. Regarding the second research question, CBMI and circular product design have been identified as useful approaches. Practices like adopting a life cycle perspective, implementing environmental management tools, developing value propositions which have environmental and social impacts, creating a sustainability strategy and culture, engaging strategic partners, and integrating stakeholders within the business ecosystem are useful. These practices help companies to innovate in a way that aligns with CE principles and allows them to assess the environmental and social impact of their CE activities. The research answering the third research question shows that the full potential of CE practices can only be realised if they are embedded in the local context. To support this integration, understanding the local socio-technical and territorial systems, recognising specific territorial needs and challenges, and designing products and services that align with the local context are vital. Multi-stakeholder collaboration is therefore essential, involving companies, government bodies, academia and civil society, to address local sustainability challenges and develop territorial solutions.

Companies can be both contributors and inhibitors in the transition to a sustainable and circular future. They have the potential to drive change and support sustainability efforts but can also hinder progress or oppose initiatives. This research showed that it is necessary to consider a company's internal issues but in particular to go beyond the corporate boundaries and to consider the entire value chain (from a product life cycle perspective, i.e. including the use phase and the end-of-life phase), the broader stakeholder network and ecosystem, and the region a company is embedded in. The case studies on CBMI and on circular product development revealed the strong role of an organisational culture which is open to sustainability, the CE and innovation. This goes hand-in-hand with a quest for a more strategic cross-departmental collaboration, but also for education and training. This education and training should go beyond corporate boundaries, as CE practices and initiatives, being that CBM, PSS or circular products and services, need to be understood and supported by customers, other stakeholders, and policymakers. This also requires the effective communication of the benefits and challenges of these initiatives.

The transition to a CE will require a change in the way that companies think about their supply chains, the use phase of their products and services, and the respective end-of-life phase. Value retention strategies, ranging from recycling to

the complete redesign of business models, products and services, must become a core objective for companies if they are to make a positive contribution to sustainability and the CE. Furthermore, they should be more open to working with local suppliers and communities. The present volume seeks to simplify this complexity through the provision of frameworks that aim to systematise these processes (i.e. arranging business model innovation practices in a structured manner, describing PSS development processes, and organising managerial factors and conditions in a coherent framework) to ease effectiveness, consistency, and ease of understanding. Nevertheless, the context-specific nature of these tools (e.g. building on specific cultural settings, organisational sizes and structures, the human factor, etc.) is important to keep in mind when it comes to the corporate adoption of circularity. This transition will ultimately vary on a case-by-case basis. Given the exploratory nature of the applied research methods future research is needed to validate and complement our proposals in different contextual settings or in larger quantitative studies.

The research also revealed the potential of more standardised metrics to measure and monitor the sustainability impacts of companies, products and services. This would help companies to make more informed decisions about the design of their products. Support in the form of the new SCEIA framework could offer businesses guidance with the impact measurement process when introducing CE strategies. While the complexity of life cycle measurement methods is still a barrier to their implementation, we expect future research to focus on the core business capabilities necessary to successfully implement measurement approaches. Such research has the potential to produce insights that allow for more effective generation of impact evidence, allowing companies to make decisions that will benefit both the environment and social value chains.

Governments can play a key role in supporting the development and adoption of a CE. This can be done through policies that promote resource efficiency, encourage collaboration between stakeholders, and provide financial support for CE initiatives and projects. This collaboration largely depends on interpersonal factors. Therefore, future research might focus on incorporating approaches from organisational behaviour studies, which could offer valuable insights into enhancing the successful implementation of CE strategies by considering individual and group attitudes towards the adoption of a CE among organisations. In addition, the effect of increasing legal obligations, as seen for instance in the European Union in terms of the ambitions and outcomes of corporate CE engagement, is of interest.

Companies have the potential to play an important role in the transition to a sustainable and circular future, but they must be willing to identify the CE and sustainability as being of strategic importance to their business. In addition, companies should strive to become more active in advocating for sustainability and the uptake of CE initiatives, to take risks, invest in research and development into new innovative solutions, and accept their responsibility in creating a more sustainable future.

Notes

1 R0: Refuse, R1: Reduce, R2: Reuse, R3: Repair, R4: Refurbish, R5: Remanufacture, R6: Repurpose, R7: Recycle, R8: Recover, R9: Re-mine.
2 See Chapter 6 in this volume for further information on the case study areas.

References

Adams, R., Jeanrenaud, S., Bessant, J., Denyer, D. and Overy, P. (2016) Sustainability-oriented innovation: A systematic review. *International Journal of Management Review*, 18, 180–205. https://doi.org/10.1111/ijmr.12068

Allais, R. and Gobert, J. (2016) A multidisciplinary method for sustainability assessment of PSS: Challenges and developments. *CIRP Journal of Manufacturing Science and Technology*, 15, 56–64. https://doi.org/10.1016/j.cirpj.2016.04.007

Allais, R. and Gobert, J. (2019) Conceptual framework for spatio-temporal analysis of territorial projects. *Environmental Impact Assessment Review*, 77, 93–104. https://doi.org/10.1016/j.eiar.2019.03.003

Annarelli, A., Battistella, C., Nonino, F., 2020. Competitive advantage implication of different Product Service System business models: Consequences of 'not-replicable' capabilities. *Journal of Cleaner Production* 247, 119121. https://doi.org/10.1016/j.jclepro.2019.119121

Baldassarre, B., Keskin, D., Diehl, J.C., Bocken, N. and Calabretta, G. (2020) Implementing sustainable design theory in business practice: A call to action. *Journal of Cleaner Production*, 273, 123113. https://doi.org/10.1016/j.jclepro.2020.123113

Bassi, F. and Dias, J.G. (2019) The use of circular economy practices in SMEs across the EU. *Resources, Conservation and Recycling*, 146, 523–533. https://doi.org/10.1016/j.resconrec.2019.03.019

Baumgartner, R.J. (2014) Managing corporate sustainability and CSR: A conceptual framework combining values, strategies and instruments contributing to sustainable development. *Corporate Social Responsibility and Environmental Management*, 21, 258–271. https://doi.org/10.1002/csr.1336

Bauwens, T. (2021) Are the circular economy and economic growth compatible? A case for post-growth circularity, *Resources, Conservation and Recycling*, 175, 105852. https://doi.org/10.1016/j.resconrec.2021.105852

Bertoni, M. (2019) Multi-criteria decision making for sustainability and value assessment in early PSS design. *Sustainability*, 11. https://doi.org/10.3390/su11071952

Bianchini, A., Rossi, J. and Pellegrini, M. (2019) Overcoming the main barriers of circular economy implementation through a new visualization tool for circular business models. *Sustainability*, 11, 6614. https://doi.org/10.3390/su11236614

Bocken N.M.P., Short S.W., Rana P. and Evans S. (2014) A literature and practice review to develop sustainable business model archetypes. *Journal of Cleaner Production*, 65, 42–56. http://dx.doi.org/10.1016/j.jclepro.2013.11.039

Boucher, X., Brissaud, D. and Shimomura, Y. (2016). Design of sustainable product service systems and their value creation chains. *CIRP Journal of Manufacturing Science and Technology*, 15, 1–2. https://doi.org/10.1016/j.cirpj.2016.09.005

Brezet, Hemel, V. (1997) *Eco-design: A Promising Approach to Sustainable Production and Consumption*. Paris: UNEP United Nations Publications.

Brown, T. (2008) Design thinking. *Harvard Business Review*, 86(6): 84.

Buclet, N. (2014) L'économie de fonctionnalité entre éco-conception et territoire: Une typologie. *Développement durable Territ*. 5, 0–17. https://doi.org/10.4000/developpementdurable.10134

Bushan, N. and Rai, K. (2004) *Strategic Decision-Making*. London: Springer.

Campagnaro, C. and d'Urzo, M. (2021) Social cooperation as a driver for a social and solidarity focused approach to the circular economy. *Sustainability*, 13, 10145. https://doi.org/10.3390/su131810145

Carlgren, L., Rauth, I. and Elmquist, M. (2016) Framing design thinking: The concept in idea and enactment. *Creativity and Innovation Management*, 25(1): 38–57. https://doi.org/10.1111/caim.12153

Castree, N. (2005) *Nature*. Abingdon: Routledge.

Cecchin, A., Salomone, R., Deutz, P., Raggi, A. and Cutaia, L. (2020) Relating industrial symbiosis and circular economy to the sustainable development debate. In R. Salomone, A. Cecchin, P. Deutz, A. Raggi, and L. Cutaia (eds), *Industrial Symbiosis for the Circular Economy: Operational Experiences, Best Practices and Obstacles to a Collaborative Business Approach, Strategies for Sustainability*. Cham: Springer, pp. 1–25. https://doi.org/10.1007/978-3-030-36660-5_1

Centobelli, P., Cerchione, R., Chiaroni, D., Vecchio, P. and Del Urbinati, A. (2020) Designing business models in circular economy: A systematic literature review and research agenda. *Business Strategy and the Environment*, 29(4): 1–16. https://doi.org/10.1002/bse.2466

Ceschin, F. (2013) Critical factors for implementing and diffusing sustainable product-service systems: Insights from innovation studies and companies' experiences. *Journal of Cleaner Production*, 45, 74–88. https://doi.org/10.1016/j.jclepro.2012.05.034

Ceschin, F. and Gaziulusoy, I. (2016) Evolution of design for sustainability: From product design to design for system innovations and transitions. *Design Studies*, 47, 118–163. https://doi.org/10.1016/j.destud.2016.09.002

Cook, M. (2014) Fluid transitions to more sustainable product service systems. *Environmental Innovation and Societal Transitions*, 12, 1–13. https://doi.org/10.1016/j.eist.2014.04.003

Cook, M. (2018) Product service system innovation in the smart city. *The International Journal of Entrepreneurship and Innovation*, 19, 46–55. https://doi.org/10.1177/1465750317753934

Cornwall, A. and Jewkes, R. (1995) What is participatory research? *Social Science and Medicine*, 41(12): 1667–1676. https://doi.org/10.2167/md073.0

Corona, B., Shen, L., Reike, D., Carreón, J.R. and Worrell, E. (2019) Towards sustainable development through the circular economy: A review and critical assessment on current circularity metrics. *Resources, Conservation and Recycling*, 151, 104498. https://doi.org/10.1016/j.resconrec.2019.104498

Costa Fernandes, S., Pigosso, D.C.A. and McAloone, T.C. (2020) Towards product-service system oriented to circular economy: A systematic review of value proposition design approaches. *Journal of Cleaner Production*, 257, 120507. https://doi.org/10.1016/j.jclepro.2020.120507

Cristoni, N. and Tonelli, M. (2018) Perceptions of firms participating in a circular economy. *European Journal of Sustainable Development*, 7(4): 105–118. https://doi.org/10.14207/ejsd.2018.v7n4p105

Das, A., Konietzko, J. and Bocken, N. (2022) How do companies measure and forecast environmental impacts when experimenting with circular business models? *Sustainable Production and Consumption*, 29, 273–285.

de Jesus, A. and Mendonça, S. (2018) Lost in transition? Drivers and barriers in the eco-innovation road to the circular economy. *Ecological Economics*, 145, 75–89.

Delgadillo, E., Reyes, T. and Baumgartner, R.J. (2021) Towards territorial product-service systems: A framework linking resources, networks and value creation. *Sustainable Production and Consumption*, 28, 1297–1313. https://doi.org/10.1016/j.spc.2021.08.003

Deutz, P. (2009) Producer responsibility in a sustainable development context: Ecological modernisation or industrial ecology? *The Geographical Journal*, 175(4): 274–285.

Deutz P., Neighbour, G. and McGuire, M. (2010) Integrating sustainable waste management into product design: Sustainability as a functional requirement. Sustainable Development, 18 229–239. doi: 10.1002/sd

Deutz, P., McGuire, M. and Neighbour, G. (2013) Eco-design practice in the context of a structured design process: An interdisciplinary empirical study of UK manufacturers. *Journal of Cleaner Production*, 39, 117–128. http://dx.doi.org/10.1016/j.jclepro.2012.08.035

Deutz, P., Jonas, A.E.G., Newsholme, A., Pusz, M., Rogers, H.A., Affolderbach, J., Baumgartner, R.J. and Ramos, T.B. (2024) The role of place in the development of a circular economy: A critical analysis of potential for social redistribution in Hull, UK. *Cambridge Journal of Regions, Economy and Society*. doi: 10.1093/cjres/rsae002

Diaz, A., Schöggl, J.P., Reyes, T. and Baumgartner, R.J. (2021) Sustainable product development in a circular economy: Implications for products, actors, decision-making support and lifecycle information management. *Sustainable Production and Consumption*, 26, 1031–1045. https://doi.org/10.1016/j.spc.2020.12.044

Diaz, A., Reyes, T. and Baumgartner, R.J. (2022) Implementing circular economy strategies during product development. *Resources, Conservation and Recycling*, 184. https://doi.org/https://doi.org/10.1016/j.resconrec.2022.106344

Doualle, B., Medini, K., Boucher, X., Brissaud, D. and Laforest, V. (2016) Design of sustainable product-service systems (PSS): Towards an incremental stepwise assessment method. *Procedia CIRP*, 48, 152–157. https://doi.org/10.1016/j.procir.2016.04.074

Eisenhardt, K.M. and Martin, J.A. (2000) Dynamic capabilities: What are they? *Strategic Management Journal*, 21(10–11): 1105–1121. https://doi.org/10.1002/1097-0266(200010/11)21:10/11<1105::AID-SMJ133>3.0.CO;2-E

Elkington, J. (1998) *Cannibals with Forks: The Triple Bottom Line of the 21st Century*. Oxford: Capstone Publishing.

Ellen Macarthur Foundation (n.d.). 'MCI'. https://ellenmacarthurfoundation.org/material-circularity-indicator

Fonseca, L.M., Domingues, J.P., Pereira, M.T., Martins, F.F. and Zimon, D. (2018) Assessment of circular economy within Portuguese organizations. *Sustainability*, 10. https://doi.org/10.3390/su10072521

Forlano, L. (2016) Decentering the human in the design of collaborative cities. *Design Issues*, 32, 42–54. https://doi.org/10.1162/DESI_a_00398

Gaziulusoy, A.I. (2015) A critical review of approaches available for design and innovation teams through the perspective of sustainability science and system innovation theories. *Journal of Cleaner Production*, 107, 366–377. https://doi.org/10.1016/j.jclepro.2015.01.012

Gaziulusoy, I., Boyle, C. and McDowall, R. (2013) System innovation for sustainability: A systemic double-flow scenario method for companies. *Journal of Cleaner Production*, 45, 104–116. https://doi.org/10.1016/j.jclepro.2012.05.013

Geissdoerfer, M., Savaget, P., Bocken, N. and Hultink, E.J. (2017) The Circular Economy: A new sustainability paradigm? *Journal of Cleaner Production*, 143, 757–768. https://doi.org/10.1016/j.jclepro.2016.12.048

Ghisellini, P. and Ulgiati, S. (2020) Circular economy transition in Italy: Achievements, perspectives and constraints. *Journal of Cleaner Production*, 243, 118360. https://doi.org/10.1016/j.jclepro.2019.118360

Govindan, K. and Hasanagic, M. (2018) A systematic review on drivers, barriers, and practices towards circular economy: A supply chain perspective. *International Journal of Production Research*, 56, 278–311. https://doi.org/10.1080/00207543.2017.1402141

Gusmerotti, N.M., Testa, F., Corsini, F., Pretner, G. and Iraldo, F. (2019) Drivers and approaches to the circular economy in manufacturing firms. *Journal of Cleaner Production*, 230, 314–327. https://doi.org/10.1016/j.jclepro.2019.05.044

Hofmann, F. and Jaeger-Erben, M. (2020) Organisational transition management of circular business model innovations. *Business Strategy and the Environment*, 29, 2770–2788. https://doi.org/10.1002/bse.2542

Intergovernmental Panel on Climate Change (IPCC) (2021) Working group III contribution to the IPCC sixth assessment report (AR6): Technical Summary. https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_TechnicalSummary.pdf (accessed 7 July 2024)

Jonker, J., Stegeman, H. and Faber, N. (2017) *The Circular Economy: Developments, concepts, and research in search for corresponding business models*. Nijmegen: Randbout University.

Joore, P. and Brezet, H. (2015) A multi-level design model: The mutual relationship between product-service system development and societal change processes. *Journal of Cleaner Production*, 97, 92–105. https://doi.org/10.1016/j.jclepro.2014.06.043

Kalmykova, Y., Sadagopan, M. and Rosado, L. (2018) Circular economy: From review of theories and practices to development of implementation tools. *Resources, Conservation and Recycling*, 135, 190–201. https://doi.org/10.1016/j.resconrec.2017.10.034

Kennedy, S. and Linnenluecke, M.K. (2022) Circular economy and resilience: A research agenda. *Business Strategy and the Environment* 31(6): 2754–2765. https://doi.org/10.1002/bse.3004

Kolko, J. (2015) Design thinking comes of age. *Harvard Business Review*, September, 66–71.

Kravchenko, M., Pigosso, D.C. and McAloone, T.C. (2021) A trade-off navigation framework as a decision support for conflicting sustainability indicators within circular economy implementation in the manufacturing industry. *Sustainability*, 13(1): 314. https://doi.org/10.3390/su13010314

Kristensen, H. and Remmen, A. (2019) A framework for sustainable value propositions in product-service systems. *Journal of Cleaner Production*, 223, 25–35. https://doi.org/10.1016/j.jclepro.2019.03.074

Lettner, M., Chebaeva, N., Wenger, J., Schöggl, J.-P., Holzer, D., Hesser, F. and Tobias, S. (2021) Dealing with the eco-design paradox in research and development projects: The concept of sustainability assessment levels. *Journal of Cleaner Production*, 281. https://doi.org/10.1016/j.jclepro.2020.125232

Lüdeke-Freund, F., Gold, S. and Bocken, N.M.P. (2019) A review and typology of circular economy business model patterns. *Journal of Industrial Ecology*, 23, 36–61. https://doi.org/10.1111/jiec.12763

Mura, M., Longo, M. and Zanni, S. (2020) Circular economy in Italian SMEs: A multi-method study. *Journal of Cleaner Production*, 245, 118821. https://doi.org/10.1016/j.jclepro.2019.118821

Newsholme A. (2023) *Developing a Circular Economy at the Regional Scale: A Case Study of Stakeholders in North Humberside, England and Styria, Austria* [doctoral thesis]. University of Hull.

Newsholme, A., Deutz, P., Baumgartner, R.J. and Affolderbach, J. (accepted) Building collaborations for a regional circular economy: A comparison of North Humberside, England with Styria, Austria. In S. Bourdin, E. van Leeuwen and A. Torre (eds), *Cities, Regions and the Circular Economy: Theory and Practice*. Cheltenham and Northampton, MA: Edward Elgar.

Nyumba, T.O, Wilson, K., Derrick, C.J. and Mukherjee, N. (2018) The use of focus group discussion methodology: Insights from two decades of application in conservation. *Methods in Ecology and Evolution*, 9(1): 20–32. https://doi.org/10.1111/2041-210X.12860

Organisation for Economic Co-operation and Development (OECD) (2019) *Business Models for the Circular Economy*. Paris: OECD Publishing. https://doi.org/10.1787/g2g9dd62-en.

Opferkuch, K., Caeiro, S., Salomone, R. and Ramos, T.B. (2021) Circular economy in corporate sustainability reporting: A review of organisational approaches. *Business Strategy and the Environment*, 30, 8. https://doi.org/10.1002/bse.2854

Ormazabal, M., Prieto-Sandoval, V., Puga-Leal, R. and Jaca, C. (2018) Circular Economy in Spanish SMEs: Challenges and opportunities. *Journal of Cleaner Production*, 185, 157–167. https://doi.org/10.1016/j.jclepro.2018.03.031

Osterwalder, A. and Pigneur, Y. (2010) *Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers*, vol. 1. Hoboken, NJ: John Wiley and Sons.

Pecqueur, B. (2014) Esquisse d'une géographie économique territoriale. *Espace Géographique* 43, 198. https://doi.org/10.3917/eg.433.0198

Peña, C., Civit, B., Gallego-Schmid, A. et al. (2021) Using life cycle assessment to achieve a circular economy. *Int J Life Cycle Assess* 26, 215–220. https://doi.org/10.1007/s11367-020-01856-z.

Pereno, A. and Barbero, S. (2020) Systemic design for territorial enhancement: An overview on design tools supporting socio-technical system innovation. *Strategic Design Research Journal*, 13, 113–136. https://doi.org/10.4013/SDRJ.2020.132.02

Pezzotta, G., Cavalieri, S. and Romero, D. (2018) Collaborative product-service systems engineering: Towards an active role of customers and stakeholders in value creation. 2017 International Conference on Engineering, Technology and Innovation (ICE/ITMC).

Pieroni, M., McAloone, T. and Pigosso, D. (2019) Business model innovation for circular economy and sustainability: A review of approaches. *Journal of Cleaner Production*, 215, 198–216. https://doi.org/10.1016/j.jclepro.2019.01.036

Pigosso, D.C.A. and McAloone, T.C. (2016) Maturity-based approach for the development of environmentally sustainable product/service-systems. *CIRP Journal of Manufacturing Science and Technology*, 15, 33–41. https://doi.org/10.1016/j.cirpj.2016.04.003

Pusz, M., Jonas, A.E.G. and Deutz, P. (2023) Knitting circular ties: Empowering networks for the social enterprise-led local development of an integrative circular economy. *Circular Economy and Sustainability.* https://doi.org/10.1007/s43615-023-00271-4

Ranta, V., Aarikka-Stenroos, L., Ritala, P. and Mäkinen, S.J. (2018) Exploring institutional drivers and barriers of the circular economy: A cross-regional comparison of China, the US, and Europe. *Resources, Conservation and Recycling*, 135, 70–82. https://doi.org/10.1016/j.resconrec.2017.08.017

Reike, D., Vermeulen, W.J.V. and Witjes, S. (2018) The circular economy: New or refurbished as CE 3.0?: Exploring controversies in the conceptualization of the circular economy through a focus on history and resource value retention options. *Resources, Conservation and Recycling*, 135, 246–264. https://doi.org/10.1016/j.resconrec.2017.08.027

Reim, W., Parida, V. and Örtqvist, D. (2015) Product-service systems (PSS) business models and tactics: A systematic literature review. *Journal of Cleaner Production*, 97, 61–75. https://doi.org/10.1016/j.jclepro.2014.07.003

Rockström, J., Steffen, W., Noone, K., Persson, Å. et al. (2009) Planetary boundaries: Exploring the safe operating space for humanity. *Ecology and Society*, 14(2): 32.

Roos Lindgreen, E. (2022) *Methods and Tools to Measure Sustainability and Circular Economy (CE) at the Company Level*. PhD thesis for degree in Economics, Management and Statistics, Cycle XXXIV, University of Messina.

Roos Lindgreen, E., Opferkuch, K., Walker, A., Salomone, R., Reyes, T., Raggi, A. and Caeiro, S. (2022) Exploring assessment practices of companies actively engaged with circular economy. *Business Strategy and Environment* 31(4): 1414–1438. https://doi.org/10.1002/bse.2962

Santa-Maria, T., Vermeulen, W.J.V. and Baumgartner, R.J. (2021) Framing and assessing the emergent field of business model innovation for the circular economy: A combined literature review and multiple case study approach. *Sustainable Production and Consumption* 26, 872–891. https://doi.org/10.1016/j.spc.2020.12.037

Santa-Maria, T., Vermeulen, W.J.V. and Baumgartner, R.J. (2022a) How do incumbent firms innovate their business models for the circular economy? Identifying micro-foundations of dynamic capabilities. *Business Strategy and the Environment*, 31(4): 1308–1333. https://doi.org/10.1002/bse.2956

Santa-Maria, T., Vermeulen, W.J.V. and Baumgartner, R.J. (2022b) The Circular Sprint: Circular business model innovation through design thinking. *Journal of Cleaner Production*, 132323. https://doi.org/10.1016/j.jclepro.2022.132323

Schöggl, J.-P., Rusch, M., Stumpf, L. and Baumgartner, R.J. (2023a) Implementation of digital technologies for a circular economy and sustainability management in the manufacturing sector. *Sustainable Production and Consumption*, 35, 401–420. https://doi.org/10.1016/j.spc.2022.11.012

Schöggl, J.-P., Stumpf, L. and Baumgartner, R. J. (2023b) The role of interorganizational collaboration and digital technologies in the implementation of circular economy practices: Empirical evidence from manufacturing firms. *Business Strategy and the Environment*. https://doi.org/10.1002/bse.3593

Schroeder, P., Anggraeni, K. and Weber, U. (2019) The relevance of circular economy practices to the Sustainable Development Goals. *Journal of Industrial Ecology*, 23(1): 77–95. https://doi.org/10.1111/jiec.12732

Sein, M.K., Henfridsson, O., Purao, S., Rossi, M. and Lindgren, R. (2011) Action design research. *MIS Quarterly*, 35(1): 37–56. https://doi.org/10.2307/23043488

Shapira, H., Ketchie, A. and Nehe, M. (2017) The integration of design thinking and strategic sustainable development. *Journal of Cleaner Production* 140, 277–287.

Stumpf, L., Schöggl, J.-P. and Baumgartner, R.J. (2021) Climbing up the circularity ladder?: A mixed-methods analysis of circular economy in business practice. *Journal of Cleaner Production*, 316, 128158. https://doi.org/10.1016/j.jclepro.2021.128158

Teece, D.J. (2010) Business models, business strategy and innovation. *Long Range Planning*, 43, 172–194. https://doi.org/10.1016/j.lrp.2009.07.003

Teece, D. J., Pisano, G. and Shuen, A. (1997) Dynamic capabilities and strategic management. *Strategic Management Journal*, 18(7): 509–533. https://doi.org/10.1002/(SICI)1097-0266(199708)18:7<509::AID-SMJ882>3.0.CO;2-Z

Tukker, A. (2004) Eight types of product-service system: Eight ways to sustainability? Experiences from SusProNet. *Business Strategy and the Environment* 13, 246–260. https://doi.org/10.1002/bse.414

Tukker, A. (2015) Product services for a resource-efficient and circular economy: A review. *Journal of Cleaner Production* 97, 76–91. https://doi.org/10.1016/j.jclepro.2013.11.049

Tura, N., Hanski, J., Ahola, T., Ståhle, M., Piiparinen, S. and Valkokari, P. (2019) Unlocking circular business: A framework of barriers and drivers. *Journal of Cleaner Production*, 212, 90–98. https://doi.org/10.1016/j.jclepro.2018.11.202

Tyl, B., Vallet, F., Bocken, N.M.P. and Real, M. (2015) The integration of a stakeholder perspective into the front end of eco-innovation: A practical approach. *Journal of Cleaner Production*, 108, 543–557. https://doi.org/10.1016/j.jclepro.2015.07.145

Vezzoli, C., Ceschin, F., Diehl, J.C. and Kohtala, C. (2015) New design challenges to widely implement 'Sustainable Product-Service Systems'. *Journal of Cleaner Production*, 97, 1–12. https://doi.org/10.1016/j.jclepro.2015.02.061

Walker, A.M., Opferkuch, K., Roos Lindgreen, E., Raggi, A., Simboli, A., Vermeulen, W.J.V. and … Salomone, R. (2021) What is the relation between circular economy and sustainability? Answers from frontrunner companies engaged with circular economy practices. *Circular Economy and Sustainability*. https://doi.org/10.1007/s43615-021-00064-7

World Business Council for Sustainable Development (2021) 'Circular Transition Indicators'. https://www.wbcsd.org/Programs/Circular-Economy/Factor-10/Metrics-Measurement/Circular-transition-indicators

Yang, M. and Evans, S. (2019) Product-service system business model archetypes and sustainability. *Journal of Cleaner Production*, 220, 1156–1166. https://doi.org/10.1016/j.jclepro.2019.02.067