

## Article

# Open Circular Innovation: How Companies Can Develop Circular Innovations in Collaboration with Stakeholders

Anja Eisenreich <sup>1,\*</sup>, Johann Füller <sup>1</sup> and Martin Stuchtey <sup>2</sup>

<sup>1</sup> Department of Strategic Management, Marketing and Tourism, University of Innsbruck, Universitätsstr. 15, 6020 Innsbruck, Austria; Johann.Fueller@uibk.ac.at

<sup>2</sup> Department of Geography, University of Innsbruck, Universitätsstr. 15, 6020 Innsbruck, Austria; Martin.Stuchtey@uibk.ac.at

\* Correspondence: eisenreich.anja@gmx.net

**Abstract:** A transition toward the circular economy (CE) will be key to addressing future environmental and economic challenges, such as environmental pollution and resource scarcity. However, when introducing circular solutions, companies often face complex and disruptive changes that affect many stakeholders and require new innovation practices. This study investigates open circular innovation by analyzing the status quo of circular innovation, discussing the relevance and role of different stakeholders, and examining approaches for open circular innovation processes. The study employs a qualitative research design, including 14 in-depth interviews with CE and innovation experts. The findings indicate that companies currently focus on closed innovation approaches or collaborate with only one stakeholder at a time when developing circular innovations. Stakeholder groups, such as customers, suppliers, and academia, play a crucial role in the innovation process, whereas direct collaborations with governments and competitors are seen controversially. An open innovation network approach combined with crowdsourcing is regarded as the most promising for developing circular solutions. This study contributes to connecting open innovation with CE research and provides new knowledge at this interface. Additionally, this research gives managers guidance on how to approach open circular innovation and thus supports companies on their way toward a CE.

**Keywords:** circular economy; open circular innovation; circular innovation; open innovation; stakeholder collaboration; crowdsourcing; network



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## 1. Introduction

*“The transition to a circular economy (CE) may be the biggest revolution and opportunity for how we organize production and consumption in our global economy in 250 years.”* [1] (p. XV)

This transition refers to the shift from a linear to a CE that is gaining importance on a global scale [2]. Currently, our economic system is based on a linear approach, the “take-make-dispose model”, which creates high demand for resources and an increasing amount of waste [3] (p. 14). It describes the process of extracting raw materials, producing goods, and disposing of them after use [3,4]. Due to a rising world population [5], combined with the finitude of global resources, growth in this model will reach its limits [4,6]. Moreover, environmental problems will rapidly intensify [3]. Therefore, new systemic thinking is necessary to ensure our future success and well-being [7,8]. A CE is a regenerative industrial system that addresses these challenges by decoupling growth from resource consumption [9,10]. Circular solutions can generate biological and technical material cycles or refer to systemic solutions, such as product-service-systems (PSS) and connected mobility [3,9,11].

The transition toward a CE is a complex economic challenge strongly related to global environmental problems [3]. It can be described as a wicked problem [12] best tamed in

collaboration with diverse stakeholders. This collaborative approach is supported by stakeholder theory [13], which emphasizes the importance of stakeholders for value creation and innovation [14]. Correspondingly, the innovation literature addresses stakeholder collaboration in the context of open innovation (OI), a concept involving stakeholders from inside and outside a company in the innovation process [15,16]. As circular solutions are strongly interconnected with a wide network of external organizations and institutions [2], stakeholder involvement is considered as especially relevant for circular innovation management [17–19]. The CE implies a new way of thinking and substantially changes current business models such that CE-specific approaches will be required to develop circular innovations. For this reason, it is important to evaluate how previous insights from general innovation management are applicable in the context of a CE. However, the literature on circular innovation is still scarce. Therefore, this research focuses on CE-specific innovation approaches from an OI perspective.

To investigate open circular innovation (OCI), which considers stakeholder engagement in circular innovation, it is important to gain an understanding of the status quo of circular innovation in companies. First, the innovation approaches used for developing circular innovations have to be considered. The previous literature only points at the importance of involving external stakeholders in the innovation process [17,18] but does not discuss if and how companies are currently implementing OCI. Therefore, an empirical investigation of applied circular innovation approaches would be of great value. Second, CE-specific skills are necessary to develop and implement circular solutions [20,21]. Various studies acknowledge skills such as technical, regulatory, environmental, and Industry 4.0 knowledge as prerequisites for CE implementation [20,22–27]. However, the literature focusing on the skills for circular innovation management is scarce and primarily centers on circular design. Two studies identify competencies such as multiple life cycle thinking, skills in stakeholder collaboration, circular business models, user experience, or design for recovery as highly relevant for designing circular solutions [28,29]. Further insights regarding relevant skills for circular innovation management are still missing.

Third, drivers and barriers have an impact on a company's motivation in approaching circular innovation. A variety of studies provide factors influencing the implementation of a CE, including legislation, technology, user preferences, resource prices, corporate strategy, and corporate culture [2,17,20,30–32]. The drivers and barriers for CE implementation and circular innovation are closely linked. However, only two studies [17,32] examine the topic explicitly from a circular innovation perspective. Brown et al. [32] identify various influencing factors for circular innovation in a multiple case study, e.g., access to new markets or the complexity of integrating CE-related knowledge, but center more on the collaborative aspect of circular innovation. Pinheiro et al. [17], in a literature review, investigate the drivers and barriers for the development of circular products. However, they take a broader view of the topic as they also include research focusing on eco-innovation and CE implementation in their sample. A further study [33] examines the evaluation criteria for the selection of circular innovation projects which have a certain overlap with drivers and barriers but cannot be equated due to their different field of application. The low coverage of the circular innovation topic in CE literature, combined with the high importance of circular innovations for the future development of our economy, establishes a need to further investigate the status quo of circular innovation. Therefore, the currently applied innovation processes, the required skills, and the drivers and barriers for circular innovation are studied in the following research question:

RQ 1: What is the status quo of circular innovation at the firm level?

In the innovation literature, the OI approaches and relevant stakeholders are extensively discussed [34,35]. Conversely, in the field of circular innovation the authors merely mention the necessity of a collaboration with external stakeholders, such as customers, suppliers, technical experts, or research institutions, but do not examine the topic in depth [17,36–38]. However, considering the high interconnectedness of circular solutions with external stakeholder systems [2], it would be of great advantage to gain

detailed knowledge regarding the relevance and roles of different stakeholders in circular innovation management. This study explores the topic in the context of the following research question:

RQ 2: Who are relevant stakeholders for OCI?

For the involvement of stakeholders in the OI processes, the OI literature distinguishes between three main collaboration approaches: dyadic alliances, network relations, and crowdsourcing [39,40]. How these approaches can be implemented in circular innovation management is scarcely discussed in the literature. Several studies investigate co-creations with external stakeholders in circular business models and ecosystem innovation [41–43]. However, these studies focus on specific innovation types and offer few detailed insights on the involvement of stakeholders in the innovation process. For the effective and successful involvement of stakeholders in circular innovation management, a further investigation of the OCI process models and suitable collaboration approaches would therefore be of great value. Due to the lack of detailed insights in the OCI literature, a research gap can be identified regarding the approaches for multiple stakeholder engagement in OCI [44] which is addressed in the following research question:

RQ 3: How can stakeholders be involved in an OCI process?

The objective of these three research questions is to gain a deeper understanding of the status quo of circular innovation and to provide detailed insights regarding the stakeholders and process approaches for OCI. To investigate these research foci, a qualitative interview study was conducted with 14 CE and innovation experts, contributing comprehensive cross-industry experience in OCI. The findings reveal that companies currently focus on closed innovation or dyadic alliances to develop circular solutions. However, an OI network approach with crowdsourcing activities was found the most promising mode of collaboration. This study contributes to the literature by connecting the research streams of OI and the CE. It adds new knowledge to the CE research by analyzing different influencing factors on the current state of circular innovation and examining relevant stakeholders and process models for OCI. This perspective on circular innovation has not been investigated by the previous literature. Additionally, the study guides companies on how to choose the right collaboration partners for their OCI projects and how to integrate them in the innovation process. The following chapters are concerned with the theoretical background of the study, its research methods, results, discussion, and conclusion.

## 2. Theoretical Background

### 2.1. The Concept of a Circular Economy

The concept of a CE belongs to the field of sustainability [45] and has its origin in the notion of circular material flows [46] that was further developed by Pearce and Turner [47]. The CE relates to approaches such as industrial ecology [48], regenerative design [49], performance economy [50], and cradle-to-cradle design [51]. Despite the rising number of CE publications, there is no consensus definition of the CE [52,53]. In many academic studies, the applied CE definition is based on the CE understanding of the Ellen MacArthur Foundation [11,52] that describes the CE “as an economy that is restorative and regenerative by design and aims to keep products, components, and materials at their highest utility and value at all times” [9] (p. 46). For the transition toward a CE at the firm level, new circular solutions must be developed, supported by effective circular innovation management [3,18]. However, which products and services can be referred to as circular solutions is controversially discussed in the literature. The narrowest view of the CE concept is represented by the 3R framework (reduction, reuse, recycling) [8,54,55]. Other approaches aim at implementing circularity throughout all material life cycles and acknowledge the relevance of PSS without including them in the CE core definition [56]. Conversely, a variety of authors regard PSS as crucial for the implementation of a CE [6].

This research is based on a broad CE understanding that categorizes circular solutions into closed cycle and systemic solutions. Closed cycle solutions refer to biological material cycles, for example those created by the extraction of biochemicals from waste water, or to

technical material cycles, generated by reuse, remanufacturing, or recycling [3]. Systemic solutions comprise PSS, such as leasing, pay-per-service, or sharing models [57,58] and larger systemic solutions such as connected mobility, which combines different, multi-modal forms of transportation [9]. Closed cycle and systemic solutions cannot always be clearly distinguished but provide a useful classification of two approaches often discussed separately by scholars and practitioners [6].

### 2.2. *The Circular Economy as Wicked Problem*

For complex societal and public policy problems that are difficult to approach and almost impossible to solve, Rittel and Webber [12] developed the term “wicked problems”. Wicked problems exhibit specific characteristics. They are essentially unique, lack a definitive formulation, usually connect with another problem, and have no stopping rule or set of potential solutions that are measurable as true or false [12]. As wicked problems are insoluble in the narrower sense, they must be tackled and tamed by concentrating on manageable sub-problems in the first place [59]. Wicked problems usually entail diverse values and perspectives [60], such that they are best approached in a collaborative stakeholder dialogue [61]. The aim is to create a shared understanding of the problem and of each other’s positions to arrive at a shared commitment to possible solutions [59]. The transition toward a CE is strongly related to global environmental and resource problems (Ellen MacArthur Foundation, 2013). Due to its complex nature and its entanglement with different fields of business, it lacks tangible formulation and cannot easily be implemented with definable solutions. Managing the transition toward a CE can therefore be categorized as a wicked problem that poses considerable challenges at the macro, meso, and micro levels. CE implementation and circular innovation at the corporate level could be regarded as feasible sub-problems that might be approached with stakeholder collaboration.

### 2.3. *Stakeholder Theory*

Stakeholder theory [13] is also based on the idea of stakeholder collaboration. Companies should focus not only on their shareholders to achieve corporate objectives, but also on the interests and well-being of their stakeholders [14,62,63]. As this way of thinking leads to a fluid boundary between a company and its surroundings, one of the theory’s main concerns is to define the boundaries of an organization [64]. Understanding and considering stakeholder perspectives helps companies to improve value creation, product and process innovation, and their interconnectedness with stakeholders [14]. Product and service innovation can profit from the stakeholder approach, especially by leveraging the knowledge and expertise of different stakeholders and gaining their acceptance for later market launch [14,65,66].

A stakeholder is “any group or individual who can affect or is affected by the achievement of the firm’s objectives” [13] (p. 25). The literature distinguishes between primary and secondary stakeholders: primary stakeholders are involved in value creation, and their continued participation is needed for the survival of the firm [14,67]. Most management attention is concentrated on these stakeholder groups, which include internal stakeholders, such as employees, and external stakeholders, such as customers, suppliers, and financiers [14,67,68]. Secondary stakeholders do not contribute directly to a firm’s value creation processes and are, therefore, unnecessary for its survival; however, they have a legitimate interest in the firm’s actions and can influence the interests of the primary stakeholder groups [14,67,68]. Secondary stakeholders mainly include external stakeholders from the company’s ecosystem, such as NGOs, unions, the media, special interest groups, competitors, regulators, and the government [14,67]. The importance of secondary stakeholder groups varies depending on the firm’s nature. In specific contexts, for example for sustainable innovations, secondary stakeholders can play a crucial role [69].

#### 2.4. Open Innovation

The involvement of stakeholders in product and service innovation is closely linked to the idea of OI, “a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market” [15] (p. XXIV). It centers on the notion that knowledge is distributed all over the economy [70]. Therefore, companies look for expertise inside and outside their company [16]. A distinction can be made between inside-out OI that makes internal knowledge accessible to others and outside-in OI that integrates knowledge of external sources into a company’s innovation activities [71]. Examples of external sources are customers, suppliers, competitors, cross-sector companies, start-ups, consulting firms, and universities [35]. OI is applicable throughout the innovation process [34,72]. Various studies demonstrate the positive effects of openness toward external stakeholders on innovation performance and innovation novelty; however, the impact depends on various circumstances, such as the type or heterogeneity of the stakeholders [35,73,74].

As this research mainly concerns the involvement of stakeholders in developing circular solutions, it focuses on outside-in OI. For a co-creation with external stakeholders, different modes of collaboration come into question. The first is a dyadic form, referring to interaction with one partner, often in a formally contracted long-term alliance [39]. Second, extending those partnerships to multiple alliances means building networks to interact with various, independent actors who create value together and coordinate their innovation efforts [39,75]. Companies can either foster deep network relations with repeated, trust-based interactions or establish wide, diverse connections to a larger set of network partners [76]. A third mode of collaboration is crowdsourcing, which uses “IT to outsource any organizational function to a strategically defined population of human and non-human actors in the form of an open call” [77] (p. 152). Crowdsourcing often involves communities [40] such as online consumer groups [34] or brand communities [78] and includes formats such as innovation contests on virtual co-creation platforms [79].

#### 2.5. Factors Influencing the Development of Circular Innovations

The development of circular innovations is influenced by different factors. First, the type of innovation approach used by companies has an impact on the success of the circular innovations. Various authors point at the importance of involving external stakeholders in circular innovation activities [17,18]. However, the existing literature does not further discuss if and how companies use OI to develop circular solutions. Considering the high relevance of the external stakeholder system for the implementation of a CE, it is of great interest to examine the state-of-the-art of the currently applied OCI process approaches in companies (RQ 1).

Second, CE-specific skills are required to develop and implement circular solutions [20,21]. However, the skills required for circular innovation are scarcely discussed in the literature, and when they are, the findings are restricted to circular design. Sumter et al. [28] examine circular design competencies in a qualitative interview study and explain that multiple life cycle thinking, the understanding of circular business models, skills in design for recovery, stakeholder collaboration, and communication are highly significant. Although the authors find that the existing literature identifies systems thinking from a wider ecosystem perspective as being relevant for CE implementation [3], this capability was not confirmed in their empirical study for circular design. De los Rios and Charnley [29] add customer- and service-related competencies and technical knowledge to the desirable skill set of designers in a CE. As more general competencies for circular innovation have not yet been researched in the literature, the topic is investigated in this study (RQ 1).

Third, various drivers and barriers affect a company’s motivation to introduce circular solutions. Both the external and the internal factors are examined in the CE literature. On the external side, legislation and technology can positively or negatively influence CE implementation, depending on the circumstances [20,30,31]. The same is true of customer attitudes that might be CE-friendly due to rising environmental awareness and shifting



user preferences, but that can also be detrimental when consumers show a lack of interest or have a negative perception of circular products [2,17,80,81]. The currently low price of resources still enables successful linear business models; so, many companies do not feel the pressure to switch to a CE [82]. Other firms see the expected resource scarcity and rising resource prices as strong arguments to introduce circular solutions [20,30]. On the internal side, a company's strategic agenda can favor circular innovation [17], but a strong focus on linear business practices, the absence of top-management support, and an oppositional organizational culture might lead to the rejection of circular business models [2,20,26,31,82]. In economic terms, the high investment costs and uncertain future benefits of circular solutions must be weighed against lower operating costs, competitive advantages, and growth opportunities [17,20,30,32].

The existing CE research does not converge on which drivers and barriers are most important. The main drivers range from legislation to strategy, and the main barriers include technological constraints, lack of consumer acceptance, and legislation [17,30,82]. Although various studies are concerned with drivers and barriers, most do not examine them in the context of circular innovation but that of CE implementation in general. A systematic literature review that explicitly investigates drivers and barriers for circular innovation has been conducted by Pinheiro et al. [17]. However, the authors' focus on CE is wider than that of this research and includes the adjacent sustainability concept of eco-design. Eco-design aims at a positive environmental impact in general and is not to be equated with the CE [83,84]. The review also comprises studies not specifically focused on circular innovation but on CE implementation. Brown et al. [32] published a case study on OCI to analyze the factors influencing collaborative circular innovation. The results variously touch upon drivers and barriers for circular innovation, but the study has a slightly different orientation due to the collaboration-oriented focus of the interview questions. Therefore, a need for further research on the drivers and barriers for circular innovation can be identified and will be addressed in this study (RQ 1).

## 2.6. Open Innovation Approaches for a Circular Economy

CE literature points at the importance of applying open innovation approaches in circular innovation [17,18] but neither provides a model for OCI nor discusses the characteristics of OCI in detail. Various authors acknowledge the significance of multiple stakeholder engagement in circular innovation management [17–19]. To develop circular solutions, they propose co-creations with the supply chain, especially customers, suppliers, and distributors [17,36–38,85]. Other stakeholders can also be integrated, including government, nongovernmental organizations (NGOs), research institutions, technical experts, recyclers, or designers [17,36,86]. Government is regarded as particularly significant for circular innovation but usually plays a rather passive role, for example by providing EU product policy regulations [17,87]. Additionally, employees from different departments should be a part of the process, participating in cross-functional collaboration [18]. The CE literature recommends the involvement of various stakeholder types in circular innovation management [17]. However, the authors mention different stakeholders merely as a side issue. They do not investigate and compare their relevance and roles in OCI; so, it is of great interest to examine this topic in depth with an empirical approach (RQ 2).

How stakeholders can be integrated into the OCI approaches is scarcely discussed in the literature. Circular innovation processes are commonly studied in the context of circular product design, e.g., [88,89], circular business model innovation, e.g., [43], and circular ecosystem innovation, e.g., [41]. Research on circular product design usually does not discuss stakeholder involvement, apart from the market studies of consumer interests at the beginning of the innovation process [88]. With regard to circular business model innovation, several conceptual and empirical studies suggest an internally led process with the sporadic involvement of external stakeholders [42,43,90]. Key stakeholders, such as customers, cross-sector companies, municipalities, retailers, or research institutions, can be involved to co-create business models in formats such as idea-generation workshops [42,43,90]. In

addition, crowdsourcing initiatives with potential customers are proposed for concept proof and a better market understanding throughout the process, conducted, for example, as experiments in social media communities [43,90].

In relation to circular ecosystem innovation, Konietzko et al. [41] have conducted a case study to analyze how a new mobility system was developed at the meso level. The starting point was a group of approximately 15 cross-sector partner organizations that steered the innovation process. The group included a variety of different players from business, politics, and academia. Most decision making occurred in sub-working groups that regularly reported their results to the general assembly. As important prerequisites for this collaboration, the authors identify trust, aligned strategy and interests, contracts for just value capture, and the clear definition of roles. They recommend involving customers regularly in market studies, for concept proof and for pilot testing. An analysis of the existing literature shows that detailed insights on stakeholder collaboration in circular innovation processes are scarce and restricted mainly to circular business model and ecosystem innovation. Accordingly, Chiappetta Jabbour et al. [44] identify a need for further CE research on multiple stakeholder engagement. This need will be addressed in an in-depth examination of potential OCI processes that involve different stakeholders (RQ 3).

### 3. Research Method

As a research design, a qualitative interview study was chosen to identify themes and patterns in the empirical data and to gain deep insight into the perceptions of the participants [91]. The study examines the status quo of circular innovation and investigates the relevant stakeholders and process approaches for OCI. It does not aim to examine variance [92]. The sample consists of 14 company representatives, consultants, and researchers with a strong expertise in the fields of the CE and/or OI (Table 1). Most experts unite both perspectives and have already implemented OCI approaches in practice, often in different industries. Eleven experts had already implemented OCI approaches in practice, nine of them in more than one company across different sectors, either as consultants or in the course of their careers in industry. One expert had mainly been involved in closed circular innovation, whereas two had gained deep experience in OI, which they were asked to transfer to the field of circular innovation. To take advantage of the experts' comprehensive knowledge, the interviews did not refer to a single case but aimed at the overall experience of the interview partners with open and circular innovation. Therefore, the findings of this study are not based on 14 specific cases of circular innovation but include a large variety of cross-industry company perspectives.

Suitable key informants were searched for in purposeful sampling [93]. Potential interview partners were identified in an internet search on CE pioneer organizations and knowledgeable managers as well as via snowball sampling [93]. Three interviewees were contacted again after participating in a previous study by the authors [33] and proving their experience in circular innovation. The expertise of each interview partner was assessed in advance by other CE and innovation experts. Twenty potential interviewees were contacted via email, of which 14 agreed to participate in the study. To ensure that results were applicable to a broad range of circular solutions, the sample covered experience in closed cycle as well as systemic solutions. All the experts were based in Europe, mainly in Germany, but also in the Netherlands, Belgium, Switzerland, Austria, and the United Kingdom. For data triangulation, experts from various industries with business-to-business (B2B) and business-to-consumer (B2C) backgrounds were included. Furthermore, the perspectives of the industry representatives, consultants, and researchers were combined to avoid a one-sided view. The interviews were conducted in March and April 2020 via telephone or video conference and lasted between 45 and 70 min. They were recorded and transcribed, amounting to 330 pages of transcripts. The interview language was English or German. All citations originating from a German interview were translated literally into

English. The interviewees agreed to disclosing their company, position (at the time of the interview and relevant former positions), and expertise in an overview.

**Table 1.** Overview of interview partners.

Company	Expertise	Position	Country
BMW Switzerland	CE and innovation practices in industry (connected mobility)	Specialist New Mobility Services and Digital Solutions	Switzerland
Borealis	CE practices in industry (biological and technical material cycle, PSS)	Head of Sustainability and EU Affairs	Belgium
Deloitte Garage	Innovation consulting	Senior Manager	Germany
Deloitte Germany	CE and innovation consulting	Manager Sustainability Advisory Practice	Germany
Desso + Procter & Gamble	CE practices in industry (biological and technical material cycle, PSS)	Former CEO Desso; former senior leading positions Procter & Gamble; CE speaker and advisor	Netherlands
Orbia + Philips	CE practices in industry (biological and technical material cycle, PSS)	Global Director CE and Regeneration Orbia; former Project Manager CE Philips	Netherlands
Salzburg University of Applied Sciences	Innovation and CE research	Professor, Head of Marketing and Innovation Management	Germany
Siegwerk	CE practices in industry (technical material cycle)	Head of CE Hub	Germany
Swarovski	CE practices in industry (technical material cycle)	Senior Sustainability Manager	Austria
SYSTEMIQ	CE consulting	Founder	Germany
SYSTEMIQ	CE consulting	Senior Project Leader	Germany
Unilever TLC + Shell Foundation	CE practices in industry (biological and technical material cycle, PSS)	Former Chief Sustainability Officer Unilever; Chair Shell Foundation; CE advisor for global CE projects	United Kingdom
Volkswagen	CE practices in industry (technical material cycle)	Expert for Sustainability and Decarbonization	Germany
Zeppelin University	Innovation research (innovation and family businesses)	Professor for Innovation, Technology and Entrepreneurship	Germany

Systematizing expert interviews were chosen as interview types [94], which were conducted as semi-structured open interviews [95]. An interview guideline was used with a set of questions, adapted to the respective interview situation if necessary. One test interview preceded the study to ensure the comprehensibility of the questions. The interview guideline covers four main sections: status quo of circular innovation, stakeholders for OCI, process approaches for OCI, and success factors (Table 2). To ensure a common CE understanding, the CE was conceptualized at the beginning of the interviews. First, the interviewees were given a CE definition that relates to that of the Ellen MacArthur Foundation [9] (pp. 5, 14, 46) and was formulated as follows: “The CE is a restorative industrial economy that keeps materials at their highest value at all times and decouples growth from resource use”. Second, the classification of circular solutions, including closed cycle and systemic solutions, was described and briefly discussed. At two points



in the interviews, key words were provided to stimulate further ideas. First, potentially relevant stakeholders for OCI were suggested that had been derived from the literature in consultation with a CE expert (partner at a CE consulting firm). They included customers, suppliers, shareholders/investors, special interest groups, NGOs, competitors, government/politics, cross-sector companies, consulting firms, start-ups, universities, and employees [2,14,17,35]. Second, three types of OI approaches—dyadic alliances, networks, and crowdsourcing [39]—were presented to the interviewees to facilitate the accessibility of the discussion on the OCI processes.

**Table 2.** Interview guideline (core questions, shortened).

1. Introduction: Opening Questions and CE Definition
2. Status Quo of Circular Innovation
<ul style="list-style-type: none"> <li>• What are the drivers and barriers for circular innovation in companies?</li> <li>• Which skills are necessary for circular innovation on a corporate level?</li> <li>• Are these skills currently available in companies?</li> <li>• How relevant is circular innovation for companies now? How relevant will it be in 10 years?</li> <li>• How are circular innovations usually developed? Are closed or OI approaches applied?</li> </ul>
3. Stakeholders for OCI
<ul style="list-style-type: none"> <li>• Which stakeholders from inside and outside the company should be involved in OCI?</li> <li>• Which expectations would you have from the stakeholders?</li> </ul>
4. Process Approaches for OCI
<ul style="list-style-type: none"> <li>• Which OI approaches would be suitable for the development of circular solutions?</li> <li>• Should crowdsourcing be applied for circular innovation?</li> <li>• How should the process look, ideally?</li> </ul>
5. Success Factors
<ul style="list-style-type: none"> <li>• What are success factors of OCI in companies?</li> <li>• What are typical mistakes?</li> </ul>

The data analysis followed the approach of a qualitative content analysis [96]. First, the main categories were defined along the interview questions through structural coding [97]. Second, sub-categories were developed on different hierarchical levels. In this step, inductive and deductive coding were combined [96], with the majority of the sub-categories being generated inductively from the data. For the drivers, barriers, stakeholder types, and OI approaches, concept-driven sub-categories were derived from the literature and then refined in a data-driven way. The coding was performed in the program MAXQDA. To enhance the coding process, the data were examined twice to ensure that all the relevant findings were included and appropriately coded.

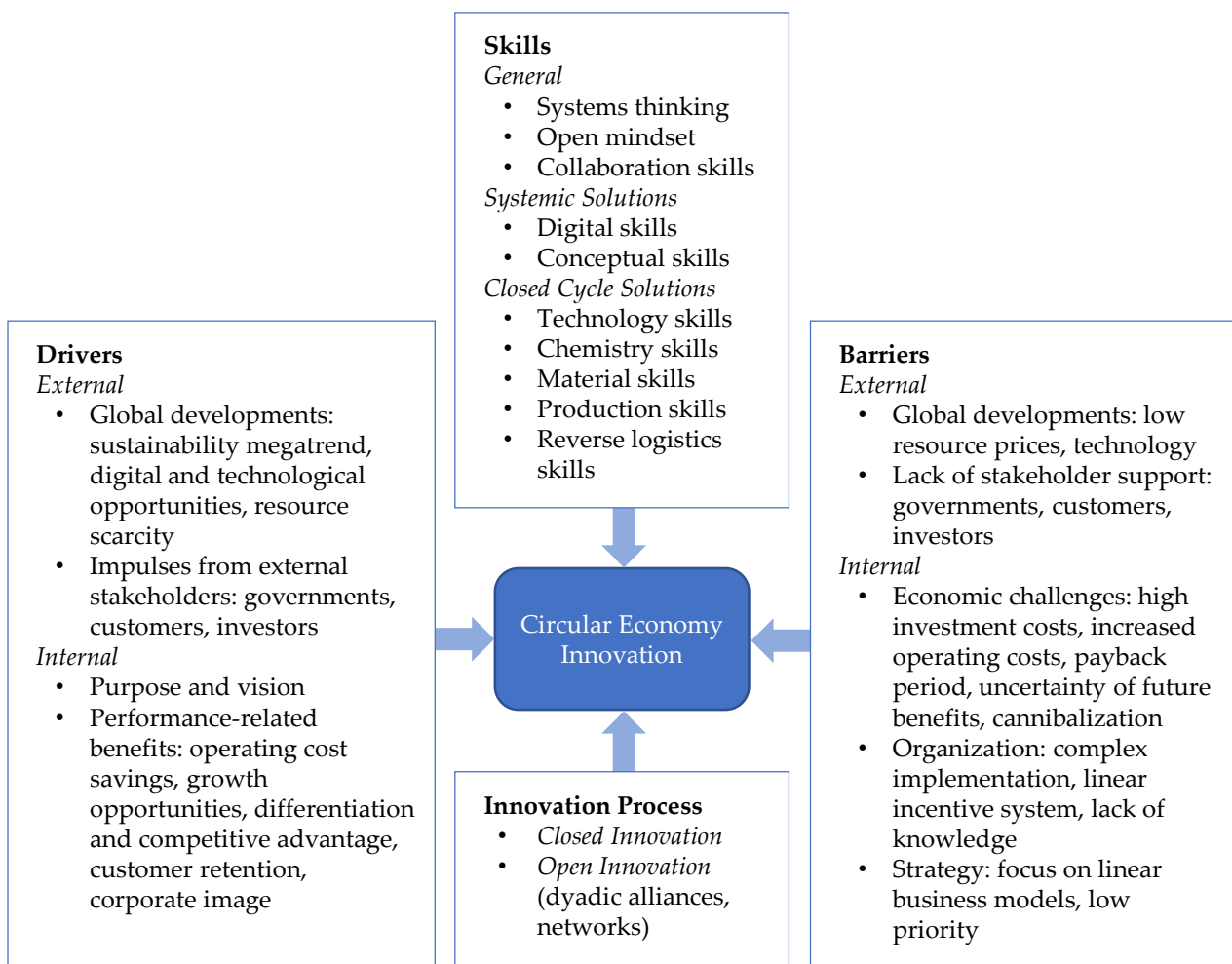
## 4. Results

The findings of this study are presented in three main chapters. The first focuses on the status quo of circular innovation (RQ 1). The second chapter discusses relevant stakeholder types (RQ 2), and the third addresses their involvement in an OCI process (RQ 3).

### 4.1. Status Quo of Circular Innovation

The empirical results reveal that circular innovation can be regarded as extremely relevant for companies in 2020. However, although firms show growing interest in the topic, they do not always recognize the extent to which a CE might influence their future. Compared to European countries such as the Nordics, the Netherlands, or the United Kingdom, companies in Germany are rather “lagging behind” in their CE development

(Interviewee 5). For family businesses, it is easier to prioritize circular innovation as their strategy is sustainability and is long-term oriented, and they specifically emphasize the well-being of future generations. In addition, the conviction of the business owner has a strong impact; so, they require less internal justification for CE decisions than other companies do. As Figure 1 shows, circular innovation activities are currently influenced by drivers and barriers from inside and outside the company. External drivers tend to be more important than internal drivers for circular innovation. The highest relevance is attached to global developments, especially sustainability megatrends in society, but also new digital or technological opportunities and resource scarcity. Interviewee 6 describes the societal uptake of the CE as follows: “I think that the concept of a CE is slowly but surely being embedded in society like climate change”. Interviewee 7 adds: “No one can ignore it anymore [ . . . ] because as CEO you get under pressure if you don’t have anything to show in this field”. Further impulses for circular innovation can come from stakeholders, such as government, customers, and investors. The main internal drivers are purpose and vision, as well as performance-related benefits. This last includes cost savings, revenue growth, differentiation and competitive advantage, long-term customer retention, and improved corporate image in the eyes of customers and employees.



**Figure 1.** Status quo of circular innovation.

Most barriers for circular innovation seem to originate within the company. Companies might be deterred by economic challenges, such as high investment requirements, increased operating costs, a longer payback period, the uncertainty of future benefits, and the cannibalization effects of circular solutions. “When you consider connected mobility, you

*finally talk about needing less cars per person. For a car producer, this is a difficult concept*” (Interviewee 4). Organizational barriers relate to incentive systems favoring linear solutions, complex implementation, and a lack of technological or CE knowledge. Strategy can hinder circular innovation if companies focus intently on linear business models. External barriers mirror external drivers, with reverse effects. A lack of stakeholder support—for example through unsupportive legislation, uninterested customers, or risk-averse investors—can prevent companies from circular innovation. Moreover, global developments such as low resource prices or technological uncertainty can raise barriers.

Other influential factors for circular innovation include relevant skills and their availability in companies (Figure 1). Important skills consist of systems thinking from an ecosystem perspective, collaboration skills, and an open, courageous, and creative mindset. Other skills depend on the type of circular solution. Systemic solutions often require digital and conceptual skills, whereas closed cycle solutions call for more technological, chemical, material, production, and reverse logistics expertise. When asked whether these skills are currently available in companies, the interviewees distinguished between pioneer firms that are ready for circular innovation and laggards that lack the relevant capabilities. Hard skills such as technology expertise tend to be more available than soft skills. Relevant soft skills that are often missing include systems thinking, a visionary, open mindset, and collaborative competencies.

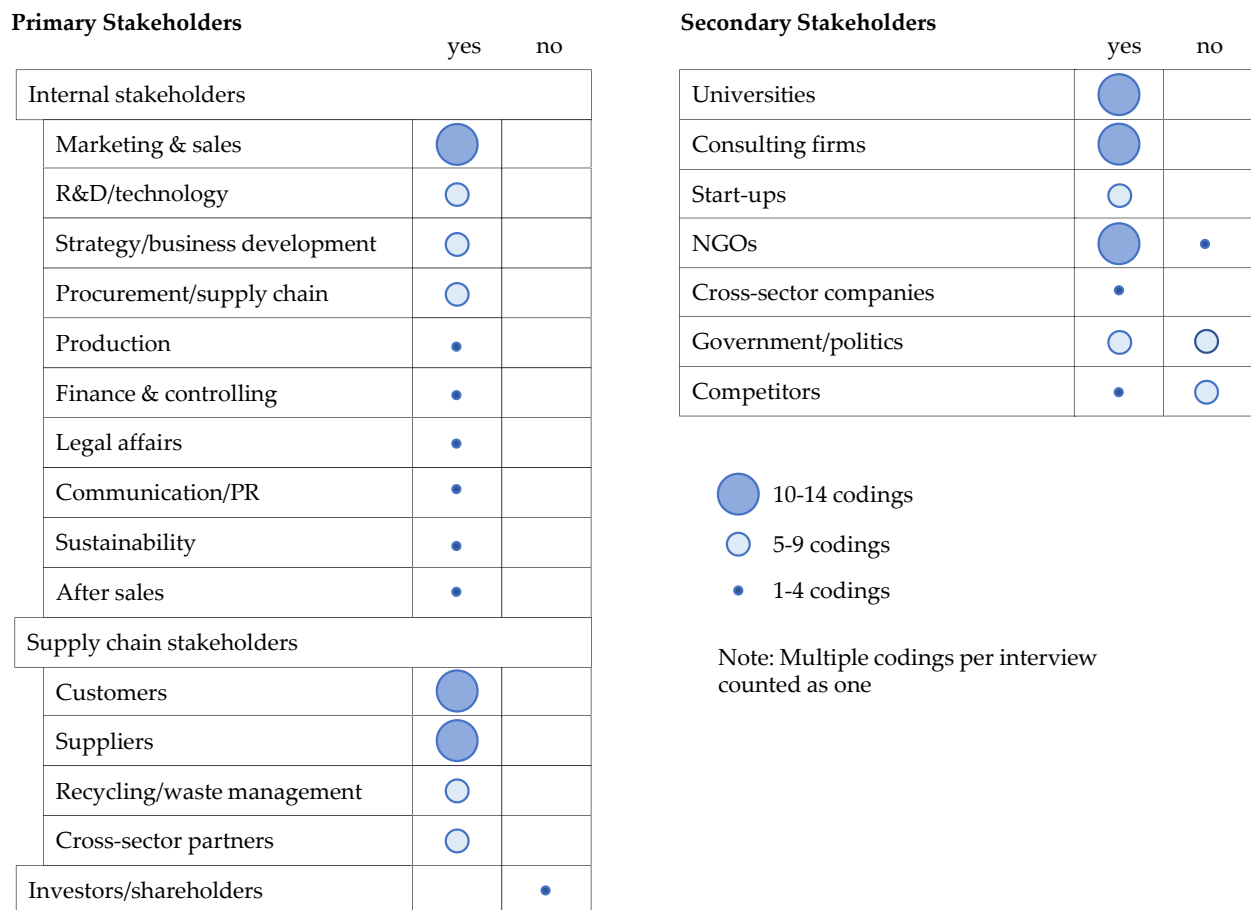
The choice of innovation approach also impacts the status quo of circular innovation. The findings include divergent views regarding the extent to which OCI has already spread. Some of the interviewees see closed innovation approaches as currently prevalent: *“As soon as the concrete product development is concerned, almost no one is ready to apply a complete OI approach”* (Interviewee 11). If stakeholder collaboration occurs, it is often in dyadic alliances with customers, suppliers, academia, technology companies, start-ups, or non-profit organizations such as the Ellen MacArthur Foundation. Other experts observed a trend toward the stronger and earlier involvement of external stakeholders in circular innovation, along the supply chain, for example, or across industries. The development of complex closed cycle solutions and of systemic solutions usually leads to the involvement of more diverse stakeholders.

When the experts were asked about the future outlook, they predicted that circular innovation would grow in significance before 2030. Three interviewees even expressed that, by then, the linear economy would be completely substituted by a CE. The increasing relevance will mainly be caused by rising environmental awareness regarding topics such as plastics in the ocean or food waste. This trend affects society as a whole, but also future generations of leaders who are or will be more purpose-driven. As Interviewee 2 assumes, *“with every storm that is too strong and with every winter that is too warm, something will move”*. The rising importance of circular innovation might also be triggered by stricter legislation in the EU, by advances in digitalization, and by increasing resource scarcity. Another significantly influential factor could be the COVID-19 crisis. On the one hand, companies have temporarily shifted their priorities to other topics. On the other hand, the crisis could drive CE-friendly legislation if governments decide to fund a change of the economic system instead of strengthening the linear economy with subsidies. Furthermore, the crisis might fuel a rethinking away from pure efficiency and toward circularity.

#### 4.2. Stakeholders for Open Circular Innovation

The following chapter focuses on relevant stakeholders for OCI. The findings suggest that involving different primary and secondary stakeholders [67] is crucial for the success of circular innovation. Figure 2 provides an overview of stakeholder groups and their significance for direct participation in OCI. Primary stakeholders comprise employees, supply chain stakeholders, cross-sector partners, and investors. The results reveal that inside the company employees from different departments should be part of the OCI process, especially those from marketing and sales but also those from R&D, strategy/business development, and the procurement/supply chain. Interviewee 10 explains: *“Marketing*

and sales are very important, as they have to adopt another role and rethink completely. It is all about taking products back at the end of their life time or, even better, not selling products at all but only offering the service". Further relevant departments include production, finance and controlling, sustainability, legal affairs, communication/PR, and after sales.



**Figure 2.** Relevance of stakeholders for a direct involvement in circular innovation.

Supply chain stakeholders are identified as the most significant external stakeholder group. Various interviewees emphasized the importance of involving the whole supply chain in the innovation process. Customers are central for OCI; however, experts disagree on the customers' specific contributions. Collaboration in the idea phase can be important, where customers take an active part in systemic solutions: "Right at the beginning you should ask: 'Do you want a car or mobility? Do you want an i-phone or connectivity?' It has to be clarified which utilities you offer and how you define the market understanding" (Interviewee 1). For solutions with closed material cycles, it can be recommendable to start with suppliers and involve customers only in the later stages of the innovation process. Some experts recommend co-creation with customers throughout the innovation process for concept proof. Others take a more critical view of customer centricity, as "users often think they know what is good", but this is "not necessarily beneficial to the circular idea" (Interviewee 9). Interviewee 13 adds: "Look at Apple. If Steve Jobs had only listened to consumers, we would not have these brilliant products".

Suppliers, as well as the recycling and waste management sector, can be crucial for closed cycle innovations. Interviewee 1 offers the following example: "With suppliers you move step by step further upstream. If you notice, the converter is not sufficient anymore, you need the recycler. If the recycler is not sufficient, either, you have to enter waste management. And to get waste management organized, you might practically have to buy the Green Dot". In the past, "recycling used to be sort of a stepchild, meaning that it was regarded as dirty

*industry*" (Interviewee 8). However, more and more companies have already realized the importance of considering recycling in product design. Hence, involving recyclers and waste management in the innovation process becomes a clear added value. For developing systemic solutions, cross-sector companies are often more relevant than suppliers, as they become part of the new supply chain. Solutions such as connected mobility can, for example, be enabled by mobility providers, IT specialists, or sharing platforms as direct business partners. In contrast, investors and shareholders are not regarded as valuable sources in the circular innovation process, although they are highly relevant to the implementation success of circular solutions.

The most important secondary stakeholder groups are universities, consulting firms, and start-ups. Universities can provide technical, CE, or marketing expertise, whereas consulting firms might contribute special knowledge on CE, technology, strategy, or project planning. Start-ups can be chosen either for collaboration or for corporate venturing due to their knowledge of technology, IT, or alternative business models. Cross-sector companies are valuable as primary stakeholders and business partners but also as think-tanks for idea generation. They can, for example, support ideation by referring to similar solutions from other industries. Three secondary stakeholder groups were assessed controversially by the experts: NGOs, government/politics, and competitors. Collaborations with NGOs might be problematic because of the slower pace of their work, due to a tension between the NGO and the company, or because *"the innovation is too subject-specific"* (Interviewee 8), such that the NGO cannot make valuable contributions. Despite these challenges, most experts recommend collaboration with organizations such as the World Wildlife Foundation, the Ellen MacArthur Foundation, Greenpeace, or Friends of the Earth. NGOs can help companies to gain a better understanding of trends and market needs, provide broad CE experience, or play the devil's advocate. In addition, NGOs might mediate the interests of different stakeholder groups, especially in the context of larger systemic solutions such as connected mobility.

Most interviewees underline the importance of government and politics for the success of circular innovations. However, opinions on their involvement in the innovation process differ. Some experts supported a direct collaboration with government and politics because of their expertise and systems view. This collaboration can be crucial for systemic solutions such as connected mobility or new usage systems that require public infrastructure. However, integrating politicians and regulators in OCI processes might be difficult because they have another way of thinking and a longer time horizon: *"We worked with political players in both India and China and tried to get them to contribute, but it was impossible for them because political considerations outweigh anything else"* (Interviewee 12). Therefore, other experts prefer to collaborate with governments only on fundamental issues, such as legal frameworks, standardization measures for recycling rates, or large topics such as digitalization resources and public data bases. Cooperation with competitors was also discussed controversially. Two experts supported the involvement of competitors in the innovation process, for example, by creating a platform for new business models that was open to competition. However, such a co-creation can lead to trust issues, conflicts, and strong divergent interests. Therefore, the majority of interviewees would not collaborate directly with competitors in product development but recommended cooperation on pre-competitive and logistic issues, overarching topics such as digitalization, or legal frameworks. *"In the early days of the packaging regulation, intelligent recycling collection systems had to be established. [ . . . ] This is only possible in alliance with competition"* (Interviewee 14).

#### 4.3. Open Circular Innovation Process

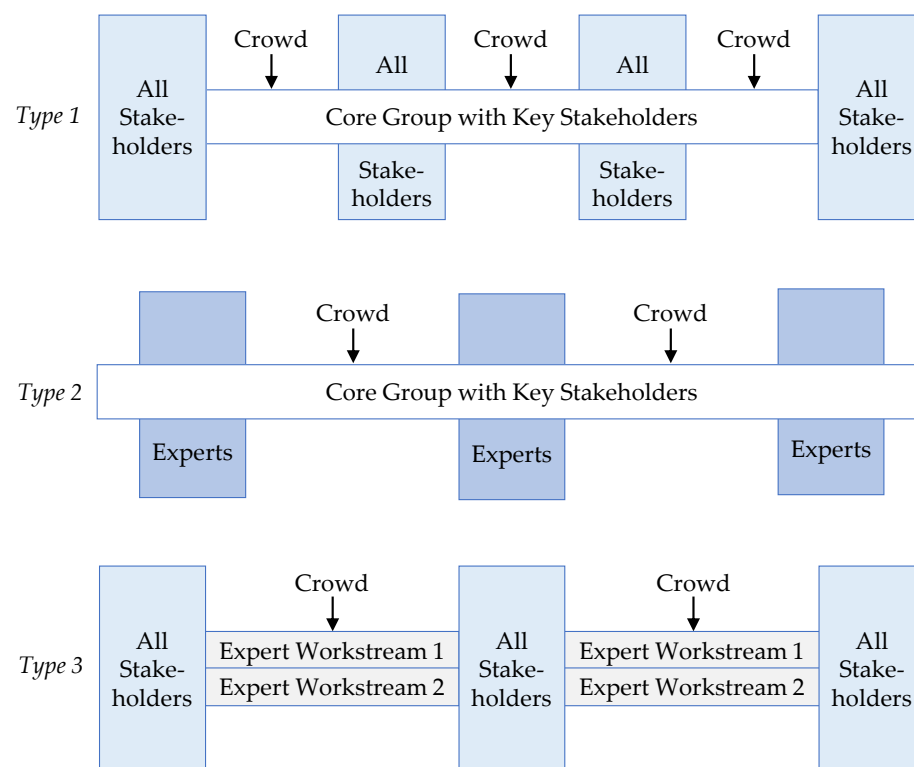
To identify suitable approaches and processes for OCI, the experts were asked how they would integrate stakeholders into a circular innovation process. They were supposed to explain which OI approaches they would choose, how the process should look, and which success factors they regarded as important. Based on the literature, three types of OI can be distinguished: dyadic alliances, networks, and crowdsourcing with communi-



ties [40]. As described in Section 4.1, dyadic alliances are currently a common approach for OCI in companies. However, none of the interviewees named this mode of collaboration as preferable. The experts agreed that circular solutions can best be developed in a network approach with stakeholders from inside and outside the company. The majority additionally proposed to integrate crowdsourcing in the innovation process.

Expert crowds are regarded as the most appropriate for circular innovation because they can contribute specialized knowledge to idea generation and technical, material, digital, or design topics. Crowds that are open to everyone are seen more critically because the development of circular innovations usually requires specific expertise. Interviewee 2 is a strong supporter of crowdsourcing and implemented a circular innovation contest for idea generation with a general crowd. He described his experience as follows: *“It is quite sobering what you get as result, as you need strong expertise for the contest. The contributions are rather flat. I find approaches like Innocentive a lot more interesting, where you address real experts worldwide”*. However, in addition to expert crowds, some interviewees recommend crowdsourcing with consumer crowds for market analysis, customer acceptance, and concept proof. Consumer crowds can be especially valuable for circular solutions that require a change of user behavior, such as B2C PSS or refillable packaging. In contrast, three interviewees generally advised against crowdsourcing in the innovation process. They preferred a pure network approach to guarantee the selection of knowledgeable partners. One of these interviewees implemented various circular crowdsourcing initiatives that fell short of her expectations regarding idea generation. However, the initiatives unexpectedly caused strong marketing effects that were highly advantageous for the companies.

The process set-up which should be chosen to involve stakeholders in OCI depends on the specific project. Therefore, process concepts can be only proposed to a certain level of detail. Three main process types were identified in the data analysis (Figure 3). Type 1 is based on a core group that steers the process in an ongoing collaboration from beginning to end. It consists of the relevant internal stakeholders and the external key partners, such as customers, suppliers, start-ups, or universities. At certain points in the innovation process, a larger group of stakeholders is involved in online or offline workshops to discuss and challenge the project progress. *“I would not integrate the other stakeholder groups directly to develop solutions but rather contact them repeatedly as a sounding board during the project. [ . . . ] I would distinguish who is in the core team and who in the periphery. Both roles are important”* (Interviewee 6). To answer particular questions along the innovation process, crowdsourcing can be applied with expert or consumer crowds. Process type 2 also includes ongoing core group and sporadic sessions with further stakeholders. However, the latter refer to collaborations with experts such as suppliers or consultants on a specific topic. *“For battery design you can involve customers but for questions of battery recovery [ . . . ] the customer is usually not so relevant. You have representatives of the whole supply chain on board. However, as this makes meetings quickly too large, you rather schedule case-related meetings with the stakeholder concerned”* (Interviewee 4). Crowdsourcing with expert or consumer crowds can substitute or complement these expert collaborations, where appropriate.



**Figure 3.** Innovation processes for open circular innovation.

Process type 3 corresponds with type 1 in so far as a company has general meetings with a large group of stakeholders at regular intervals throughout the innovation process. In between these meetings, various workstreams are established with experts working on sub-problems. *“You start with a large project involving everyone. Then you have in-depth work streams with partners that have strong expertise. You have two or three touch points in the middle of the project with everyone at the table to ensure that you still have the same goal. Afterwards, you continue your in-depth work with actors relevant for the sub-topics. At the end, all come together again”* (Interviewee 11). General meetings that consist of diverse internal and external stakeholders are responsible for the definition of goals and for an out-of-the-box concept proof. *“You really benefit from involving different disciplines. If you explain the tax situation to a material scientist, this is extremely helpful”* (Interviewee 9). As these meetings with a rather large stakeholder group take the leading role, specific decision makers should be appointed because *“not everyone can have the same voting right”* (Interviewee 9). Crowdsourcing with expert or consumer crowds can contribute knowledge on sub-topics to the individual workstreams.

The interviewees gave various additional recommendations on how to implement the OCI processes. First, the stakeholder partnerships should be set up long-term. Second, not too many stakeholders should collaborate at the same time to avoid inefficiencies, steering problems, team conflicts, and a lack of focus. Therefore, the proposed processes include the alternating involvement of smaller and larger stakeholder groups. Third, a needs-based stakeholder selection is the best way to identify the right partners: *“You define the problem, you figure out what each player needs to bring to the table, and you only have people involved that can actually solve the problem”* (Interviewee 12). Alternatively, an open call to the ecosystem or a crowdsourcing approach is possible in the recruitment of suitable partners. For closed cycle solutions, the selection should consider supply chain stakeholders, in particular, whereas systemic solutions often require a broader range of partners.

The success factors for OCI can be clustered into three main topics: strategy, organization, and innovation process. The interviewees agreed that the most important success factor is strategic priority. High relevance must be attached to circular innovation projects,

top management has to show honest commitment, and financial resources must be provided. Circular innovation should not be driven “as sustainability and thus as cost agenda” but “as central business agenda” (Interviewee 1). Other strategy-related success factors are to think broadly enough, to plan long term, and to be ready for change. Interviewee 7 adds that one must “see this as a business opportunity and not as something to save the world”. Within the organization, the support of leadership and employees is required, and a powerful CE department should be established. “The question is, who takes the decision in the company? Larger companies have departments for CE but do they really have a voice in company-relevant decisions? Or do they only write nice press articles?” (Interviewee 11). As circular innovations represent competition for core products, they might be usefully developed in separate units, “detached from daily business and equipped like a start-up in a large company” (Interviewee 14). Various experts also suggested introducing special performance measures adapted to sustainability, allowing longer deadlines, and using separate budgets for circular innovation projects. Regarding the innovation process itself, it is important to clearly define goals, collaborate with the network from the beginning, and show serious commitment as you have to “be able to play the honest broker role” (Interviewee 12) to keep stakeholders motivated and to lead the co-creation to success.

## 5. Discussion

Many companies still do not recognize the significance of circular innovation, although it could be crucial to ensuring their future success. The majority of firms that currently decide to develop circular solutions are motivated by external factors, most importantly by a sustainability megatrend in society. This trend has recently been strengthened by the global “Fridays for Future” movement [98] and influences the mindset of younger employee generations, of customers, and of society in general. Only a few publications in the CE literature acknowledge societal sustainability trends as CE drivers [2,20]. The authors prefer to discuss a lack of consumer interest and awareness in society as barriers for a CE [17,31,80,82]. This discrepancy could result from the fact that sustainability megatrends gained momentum, especially in 2019 through “Fridays for Future”, a development that was not fully considered in earlier studies. Another driver for circular innovation is legislation that proved to be important in the empirical data and in the CE literature [17,30]. Since 2015, the EU has been strongly engaged in laws and regulations that support the CE. In 2020, the Green Deal was passed [99], which will revolutionize future business practices in European industries. Internal drivers, such as strategy and purpose, can also initiate circular innovation [17]; however, the findings suggest that they have less impact than external drivers do.

Conversely, the barriers for circular innovation come mainly from inside the company. The identified economic, strategic, and organizational barriers correspond with those in the existing research, e.g., [3,17,82]. However, various authors regard external barriers, such as technological restraints, unsupportive legislation, or a lack of consumer interest, as more important than the internal barriers [17,30,100]. This difference might be due to the fact that several CE studies combine macro, meso, and micro levels in their analyses. If the focus is not set on circular innovation but on a general transition toward the CE, external barriers carry more weight. A further factor influencing circular innovation is CE-related skills. This study reveals systems thinking, collaboration skills, and an open mindset as crucial to the development of circular solutions. However, these competencies are still not sufficiently available in companies. The literature confirms the high relevance of collaboration skills for circular design [28] but discusses systems thinking and an open mindset only in the context of CE implementation [3]. Furthermore, the empirical data point to an increased significance of digital and conceptual skills for systemic solutions, whereas closed cycle solutions mostly require strong technological and chemical knowledge. This distinction cannot be found in the literature.

Companies still do not unleash the full potential of OCI as they often focus on closed innovation or dyadic alliances to develop circular solutions. However, experts agree that

multiple stakeholder involvement is a key success factor for circular innovation. This significance accords with various theoretical arguments in the literature. First, wicked problems such as the CE transition are supposed to be approached by involving diverse stakeholders [59,61]. Second, stakeholder theory acknowledges the importance of multiple stakeholder perspectives for innovation, including primary and secondary stakeholders [14]. The results of this study demonstrate that both the primary and the secondary stakeholders are central to circular innovation, as has been found for sustainable innovation in the literature [69]. The findings identify customers and suppliers as relevant primary stakeholders, but also recyclers, waste managers, and employees from different departments. Secondary stakeholders for OCI comprise universities, consultants, and NGOs. Additionally, start-ups, government, and competitors are named.

The CE literature recommends some of these stakeholders for a collaboration in circular innovation management, including internal cross-functional teams, customers, suppliers, recyclers, research institutions, NGOs, and government [17,18,38]. In the literature, government is assessed as an important stakeholder for circular innovation, but its influence is restricted mainly to providing a favorable legal framework [17,87]. This research suggests a more active role for government, either through direct involvement in the innovation process or through collaborating on fundamental and legal issues. Consultants, start-ups, and competitors are not mentioned in the existing CE research but have been proposed for co-creation in the OI literature [35]. In the empirical study, consultants and start-ups are seen as suitable collaboration partners, whereas the direct involvement of competitors in the OCI process is mostly rejected. Furthermore, suppliers are found to be especially relevant for the development of closed cycle solutions, whereas customers are indispensable for systemic innovations. The final choice of stakeholders depends on the individual project context. However, it can be generally concluded that in the context of OCI, it is highly recommendable to collaborate with multiple external stakeholders and to foster cross-functional collaboration.

The findings reveal that a network approach [39,75] combined with crowdsourcing [77] is most promising for circular innovation. This mode of collaboration enables the integration of external knowledge in the innovation process to complement missing expertise, utilize broad crowd wisdom, and optimize the innovation performance [16,34,70]. Additionally, many OCI collaborations aim for a joint value creation because external stakeholders are involved in the final solution as business partners. The interests of these stakeholders should be analyzed, considered, and integrated to negotiate a win-win solution [14]. Based on the combination of a network approach and crowdsourcing, three different process types can be distinguished for OCI. All include an alternating involvement of large and small stakeholder groups that utilizes extensive external knowledge but at the same time reduces inefficiencies and conflicts in large teams. The results show that the proposed process types apply for both the systemic and the closed cycle solutions. However, the choice of stakeholders can differ. Notably, systemic innovations require a broader range of stakeholders because they often relate to cross-industry expertise and infrastructure.

The empirical results suggest crowdsourcing to gain insight into selected topics along the innovation process. It supplements ongoing cooperation with the company's stakeholder network. The OI literature often focuses on crowdsourcing with consumer crowds [34,101]. In the study, this type of crowd is particularly recommended for systemic solutions and consumer-oriented closed cycle solutions. Even more importance is attached to expert crowds because many circular innovations require specialized CE knowledge. Consequently, crowds that are open for everyone are seen critically, due to their lack of CE knowledge. If non-expert crowds are to be involved, sustainability-oriented social movements such as "Fridays for Future" [98] might be a suitable choice as the participants are often well-educated and knowledgeable with respect to sustainability topics [102]. Due to its mobilization potential, "Fridays for Future" itself could be regarded as a crowdsourcing initiative at the macro level that is also valuable for circular innovation at the firm

level. Social sustainability movements could be used as idea pools for netnographies [103], for the generation of circular ideas, for the testing of change readiness among younger generations concerning radical circular solutions, or for the achievement of greater market acceptance for circular innovations.

Few studies have so far investigated the processes for OCI. Whereas the processes for open circular product and service innovation are rather neglected, some authors are focused on OCI in the context of the circular business model and ecosystem innovation. For circular business model innovation, the literature suggests an internal innovation process involving external stakeholders for specific questions [42,43,90]. This collaboration can take place in idea generation workshops with external stakeholders from the company's wider ecosystem [43]. Alternatively, regular crowdsourcing initiatives with consumer communities are proposed for concept proof [90]. How the innovation process is managed within the company and who the process owners are is not further elaborated in the studies. Although they are concerned with business models instead of product innovation, the described processes are similar to process type 1 of this research, with two differences: First, in the business model innovation processes, the ongoing core group does not include external but only internal stakeholders. Second, the larger stakeholder sessions are not regular meetings with the same stakeholders but refer to changing stakeholder groups or crowds that are sporadically involved for specific topics.

A process for ecosystem innovation is suggested by Konietzko et al. [41]. This process was designed for a new mobility system and resembles process type 3 of this study, with two deviations. First, the ecosystem innovation process is not managed at the firm level but at the meso level with a core group of cross-sector organizations that are equivalent partners. Second, the individual workstreams are not conducted with additional experts but in sub-groups of the core group. The process type to be preferred cannot generally be determined but depends on the project context. However, four recommendations on the design of the OCI processes can be deduced from the interviews: first, multiple and diverse external stakeholders are to be involved to consider different perspectives. Second, internal stakeholders should be united in a cross-functional team. Third, the innovation process should switch between larger and smaller stakeholder groups to find the optimum trade-off between diversity and governance. Fourth, the applicability of crowdsourcing, especially with expert crowds, but also with consumers and social sustainability movements, should be assessed.

This study offers a theoretical contribution by connecting the research streams of OI and CE and by adding new insights to the CE research. Previous studies have often indicated the importance of involving external stakeholders in circular innovation [17,19], but they scarcely discuss OCI in detail [41]. This research provides three new insights to the CE literature: first, it gives a comprehensive overview of the current status quo of circular innovation and its influencing factors. In contrast to the existing literature, the focus of this analysis lies explicitly on circular innovation in companies and is not mixed with CE implementation at the meso and macro level. The findings reveal that companies are still hesitant to apply full OCI approaches but that they involve external stakeholders not at all or only in dyadic alliances. CE-specific skills for circular innovation, such as systems thinking and collaboration skills, are often not sufficiently available, and different skill-sets can be required depending on the type of circular solution. Furthermore, the results show that external drivers usually motivate companies to circular innovation, whereas the barriers mostly come from within the organization. Second, the study examines and compares the relevance and roles of different stakeholders for the development of circular solutions. In contrast to the previous literature, which only mentions potentially relevant stakeholder types, this research analyzes the stakeholders in more detail. The results demonstrate that primary and secondary stakeholders from inside and outside the company are similarly important for OCI and that the roles of stakeholders can differ in closed cycle and systemic innovations. Third, this research proposes three different process types for OCI. Whereas the CE literature provides few insights regarding OCI



processes in business models and ecosystem innovation, this study centers on product and service innovation. It indicates that a network approach with multiple internal and external stakeholders combined with crowdsourcing is the most promising form of collaboration for OCI. Moreover, this research makes a strong practical contribution, as it orients companies on how to approach OCI. Managers can take the identified process types as a basis and specify them for their own innovation projects. Additionally, the study offers suggestions regarding which stakeholders might be involved and how crowdsourcing initiatives could be integrated. These insights are a valuable support for companies on their way toward a CE.

The study has two main limitations. First, its qualitative research design restricts generalizability. Therefore, the influential factors for circular innovation and the roles of different stakeholders in OCI should be tested in a quantitative research design as soon as OCI is more widespread. Second, this study discusses appropriate OCI processes based on expert assessments. In comparison to case studies focused on implemented cases, this approach provides solutions that are a step ahead of current practice, but that might be more subjective. Therefore, future research should consider case studies on OCI that include network and crowdsourcing approaches. A comparison between different stakeholder perspectives, types of circular solutions, industries, and B2B vs. B2C offers would also be valuable. Despite its limitations, the study makes a relevant contribution by enhancing CE knowledge with insights from OI research and by adding new and previously uninvestigated perspectives to the CE literature.

## 6. Conclusions

This research comprises three main topics. First, the status quo of circular innovation is discussed, providing a detailed overview of influencing factors and current forms of circular innovation. Second, the relevance and roles of primary and secondary stakeholders for OCI are investigated and compared. Third, three process types are developed that describe how stakeholders can be involved in OCI. To comprehensively understand OCI, much more research will be necessary. However, this study offers valuable insights on suitable stakeholders and processes for OCI at the firm level. It distinguishes between different types of circular solutions and contributes new perspectives to CE research. Many companies are still unexperienced in both circular innovation and multiple stakeholder engagement so implementing OCI approaches involves great uncertainties. These companies can strongly benefit from the practice-oriented guidance provided in this research. As the CE gains more and more importance worldwide, companies will be forced to deal with it sooner or later. To benefit from the long-term opportunities made available by a CE, it is essential for organizations to engage with circular innovation now and commit themselves to a sustainable, future-oriented strategy.

**Author Contributions:** A.E. is the corresponding author of this manuscript. As primary author she was in charge of conceptualizing the study, collecting and analyzing the interview data, and writing the initial draft of the full paper, as well as producing the figures and tables for the manuscript. J.F. supported the primary author in conceptualizing the study, supervising her in the whole process, and reviewing the paper internally. M.S. was involved in conceptualization and data collection. All authors have read and agreed to the published version of the manuscript.

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