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Review

Conceptualizing How Collaboration Advances Circularity

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Abstract: The Circular Economy (CE) is heralded as an important concept with the potential to guide businesses and society toward a more sustainable future. However, while collaboration is widely accepted to play a central role in advancing circularity, little is known about how organizations effectively work together to achieve these outcomes. This is particularly problematic given that any shift toward collaboration requires systematic approaches based on effective collaborative processes between organizations. This conceptual paper addresses this gap by providing a comprehensive investigation of collaboration and circularity. The paper is based on a systematic literature review of 66 scientific publications as the foundation for analysis. Based on the analysis, the paper contributes to the CE literature by offering a novel approach to conceptualizing collaboration and circularity. A conceptual framework is provided which differentiates CE strategies at three stages of the product lifecycle. The paper makes a second contribution to the CE literature by examining the role that multilevel collaboration plays in facilitating a transition from a linear economy to a CE and, in particular, the significance of government in managing collaboration opportunities between partners. We highlight intermediaries as important accelerators in this transition. Future research directions are provided, including how government and intermediaries—among others—collaborate for CE transitions.

Keywords: circular economy; circularity; collaboration; CE transitions; multilevel; intermediaries

Citation: Danvers, S.; Robertson, J.; Zutshi, A. Conceptualizing How Collaboration Advances Circularity. *Sustainability* **2023**, *15*, 5553. https://doi.org/10.3390/su15065553

Academic Editors: Ronald Wennersten and Getachew Assefa

Received: 31 January 2023
Revised: 2 March 2023
Accepted: 18 March 2023
Published: 22 March 2023

1. Introduction

Organizations globally are facing rising commodity prices as increased demand for the world's resources outpaces disrupted or diminishing supply. A growing middle class in developing nations and a global population projected to reach 10 billion by 2050 exacerbate the situation, bringing serious economic and environmental consequences [1]. A concept that shows promise in addressing these pressures is Circular Economy (CE). CE proposes a sustainable economic system wherein resources are restored and regenerated based on three principles of circularity: (1) designing out waste and pollution, (2) keeping products and materials in use, and (3) regenerating natural systems [2]. Advancing circularity is an important area of inquiry since it can address sustainability challenges including biodiversity loss, greenhouse gas emissions, and resource scarcity [3,4].

However, technological, social, and institutional barriers limit circularity [5,6]. In fact, the world economy remains less than 10% circular [7]. To advance circularity, collaboration is a key factor [8,9]. Collaboration is important to organizations looking to implement and advance circularity because it supports knowledge integration, access to resources, and assists to build organizational capabilities [10,11]. For the purposes of this paper, collaboration is defined as:

> A process in which autonomous or semi-autonomous actors interact through formal and informal negotiation, jointly creating rules and structures governing their relationships and ways to act or decide on the issues that brought them together;

it is a process involving shared norms and mutually beneficial interactions. [12] (p. 25)

Collaboration can be highly complex, especially for advancing circularity. Collaboration is required to make changes in business processes, practices, and norms, to move away from the current unsustainable linear economic models toward more sustainable circular approaches [13,14]. Managing this change collaboratively demands greater levels of communication, negotiation, coordination, and cooperation to systematically change the behaviours of networks of actors [15]. For example, recycling strategies require collaboration between organizations to develop new processes to collect recyclable materials, process these materials into usable forms, and then use these recycled materials as inputs to create new products [16]. Collaboration is also required to reconfigure the ways that value can be created and captured from products and services [16,17]. These examples illustrate the complexity involved in collaboration to advance circularity. It is therefore important to address this complexity by explaining how collaboration works.

However, little attention has been given towards explaining the collaborative processes and structures needed to advance circularity. Previous reviews provide narrow explanations of collaboration. For example, some have provided industry-specific accounts (e.g., [18–20]). Some have looked at product-oriented (e.g., [21,22]) or supply chain-oriented collaborations (e.g., [23–25]), or attempted to explain how circular value is created and captured collaboratively (e.g., [26,27]). Therefore, there is a gap in the literature of a comprehensive understanding of how collaboration advances circularity at the organizational level (i.e., firms and their supply chains) and across multiple levels and industrial domains [24,28]. Addressing this gap is important because a multilevel perspective of collaboration and circularity may help to conceptualize the transition from the current linear economy (i.e., one that takes, makes, and wastes resources) to the CE which restores and regenerates resources. For example, collaboration with the government (e.g., in cities and regions) may explain important 'top-down' collaboration enablers [29]. Furthermore, research on circularity and collaboration with eco-industrial parks may shed light on inter-firm clusters covering multiple sectors [6,30]. Therefore, the purpose of this paper is to provide an in-depth conceptualization of collaboration and circularity. This conceptualization enables a novel appreciation for key characteristics of collaboration based on different CE strategies. Such as approach may contribute towards imagining how CE's 'game changer' and 'systems builder' potential for a sustainable future might be realized [4,31,32].

The current paper conceptualizes the role of collaboration in advancing circularity based on the following questions:

1. How does collaboration advance circularity for organizations?
2. What role does collaboration play in the transition from a linear economy to a circular economy?

In response to these research questions, the paper makes two novel contributions to the CE literature. Firstly, it conceptualizes how the nature of collaboration changes at different stages of the product lifecycle. Understanding how the needs of collaboration change through the product lifecycle are important because it enables managers to more effectively develop circular business practices. Secondly, this paper highlights the role that collaboration plays in facilitating the transition from a linear economy to a CE. This is important since it informs diverse stakeholders about the potential for collaboration opportunities as well as the competencies required to collaborate. In this process, key roles are played by the government and intermediaries in the availing of collaboration opportunities and brokering collaborations between different parties. The next subsections explain circularity and collaboration in organizations and the role of collaboration in circularity.

1.1. Circularity and Collaboration in Organizations

The CE concept is commonly divided into two streams: biological cycles and technical cycles [14]. A biological cycle is about regenerating the biosphere by enabling the natural

cycling of biological nutrients (e.g., food organics) [33]. Technical cycles are concerned with technical waste produced by industry (e.g., metals, polymers, textiles). Technical cycles are shaped by an organization's business model and the strategic choices involved in how new products and services propose, create, and capture value [34,35]. The value proposition of the new circular products will require new business models designed to both deliver value and capture any new forms of value [36].

Organizations essentially face two business model choices, both of which require collaboration: slowing or closing resource loops. Slowing resource loops is about extending product utility and value [13]. For example, product-life extension design strategies enable the reuse of components and materials for the remanufacturing and refurbishing of 'as new' products [16]. Collaboration is established by the manufacturer with partners providing collection points and logistics. Automotive, E-product manufacturers, and other producers may consider such approaches as viable alternatives to sourcing virgin resources and, hence, will require collaborative arrangements with partners possessing the necessary capabilities [37]. Slowing resource loops also include post-purchase services such as repair and maintenance. Product-service system (PSS) business models, for example, provide customers access to products rather than ownership from a one-time sale [8]. Here, collaboration is required between producers, service providers and customers [38]. Closing resource loops is an end-of-life circular strategy focused on recovering value from biological or technical 'nutrients.' Ideally, closing resource loops aims at multiloop reintegration of recovered resources to substitute for the use of virgin resources [14]. This would involve collaboration with partners capable of recovering and managing the flow of used resources. Together, slowing and closing resource loops represent new ways to create and capture value collaboratively, and hence, their viability even at a small scale provides important templates for disrupting traditional linear systems [17,39]. It is, therefore, important to understand the role that collaboration plays in advancing circularity.

1.2. The Role of Collaboration in Circularity

In this paper, the focus is on collaboration and its role in advancing circularity. Collaboration is distinguished from related terms, such as cooperation and coordination. These are both important facets of the collaboration process [40], yet collaboration is strategic in focus and concentrates on mutual goals and shared outcomes. Additionally, collaboration is achieved through shared power arrangements negotiated by all parties via formalized layers of governance and administration [41].

Collaboration is notoriously difficult [42]. A central endeavour remains in understanding the complexity, dynamism, and variability which happens behind the scenes in various collaborative relationships [41]. Complications hampering collaboration include inertia [43], opportunistic behaviour [44], and an inability to achieve short-term success [12]. Therefore, attention has turned to explain the activities that underpin successful collaborations based on two aspects: collaborative processes and structures [45,46].

Collaborative processes relate to the creation and maintenance of mutually beneficial relationships. Collaboration is often required to share knowledge and resource capital, and hence, becomes highly reliant on the processes that create and maintain commitment [12]. Collaborative processes include important relational competencies, such as trust building, promoting inclusiveness, and developing effective communication mechanisms [46–48]. Therefore, to advance circularity, collaborative processes are likely to be important to ensure that partners remain open and committed to sharing knowledge, processes, and resources for mutual gain. In addition to the collaborative processes to build and sustain collaborations, formal structures are also necessary.

Structures are the rules designed and updated during a collaboration. Collaborations start by establishing controls designed to share decision-making, power, financial risk, and return [44,49]. After a collaboration is established, structures may need to accommodate various changes such as in strategy, terms, or roles [50]. In addition, the complications of collaboration, such as opportunistic behaviour, can be guarded against, but at least

should incentivize knowledge-sharing routines and establish formalized rules to prevent conflict [40]. Therefore, to advance circularity, structures are likely to be important in developing and holding together collaborations, for example, for ongoing resource-sharing arrangements between partners. Together, collaborative processes and structures are likely to be crucial for setting up and maintaining mutually beneficial relationships to advance circularity.

However, how collaborative processes and structures advance circularity for various purposes between various parties has yet to be investigated. For example, the nature and extent of collaboration required for both the slowing and closing of resource loops is unclear [51]. It should be noted that collaboration for circularity requires multiple actors within and between supply chains and sectors and can include public agencies, research institutions, and other third parties (e.g., universities) [4,5,8,52]. As mentioned earlier, transitioning from a linear economy to a CE will require an understanding of the role multi-actor, multilevel collaboration plays. Yet questions remain about collaborations that occur between diverse actors and stakeholders, and how various relationships are managed [22,52]. For example, a collaboration between government and organizations is important for understanding the potential for advancing circularity, and ultimately, transitioning to a CE—a facet of the literature that also remains poorly understood [53].

This paper is organized as follows. The methods used in this paper are explained. Then, descriptive findings are analyzed, and a conceptual framework is offered to visualize key collaborative processes and structures required at three stages of the product lifecycle. The paper then moves on to discuss the role of collaboration n transitioning from a linear economy to a CE. Finally, conclusions are drawn, and future research directions are discussed.

2. Methods

This is a conceptual paper; however, it is based on the foundation of a systematic literature review (SLR) approach to understand collaboration and its potential for advancing circularity. This approach was adopted to ensure a rigorous search for all relevant literature supported by a transparent step-by-step commentary on the evaluation of the knowledge chosen [54].

The search was undertaken in two databases (SCOPUS & Web of Science). The broad search was undertaken for two reasons. First, to avoid possible bias in any specific field, and second to ensure the most comprehensive coverage of the field possible. The search was conducted in July 2022 and was not limited by any timespan constraints. In the respective databases, searches were undertaken using different combinations of the word stems "circular*" and "collaborat*" (where * was used to include various word forms such as circularity and collaborating). The results were delimited to the English language.

The search results (2265) were filtered to include scientific publications (specifically, articles or reviews or early access articles) in journals. The database searches yielded 1026 from SCOPUS and 1239 from Web of Science. A total of 784 duplicates were then removed, leaving 1481 for a careful title and abstract examination. A total of 1327 were then excluded for not meeting the inclusion criteria, and 154 remained for full-text screening. Finally, the publication's search and screening process yielded 66 relevant scientific publications which were used as the foundation of analysis and conceptual framing in this paper (see Figure 1).

To further ensure the transparency and reliability of the literature screening, the COVIDENCE® (COVIDENCE, Melbourne, Australia) software was employed as it has been shown to be a useful tool to improve inter-rater reliability (e.g., [55]). Three independent reviewers screened the initial 1481 articles. An inter-rater reliability score (derived using Fleiss' kappa) of 88.3% was obtained. In cases where a researcher could not readily discern that a relevant publication addresses collaboration theoretically, conceptually, or empirically, it proceeded to the full-text review stage for careful examination in accordance with the inclusion and exclusion criteria (Table 1).

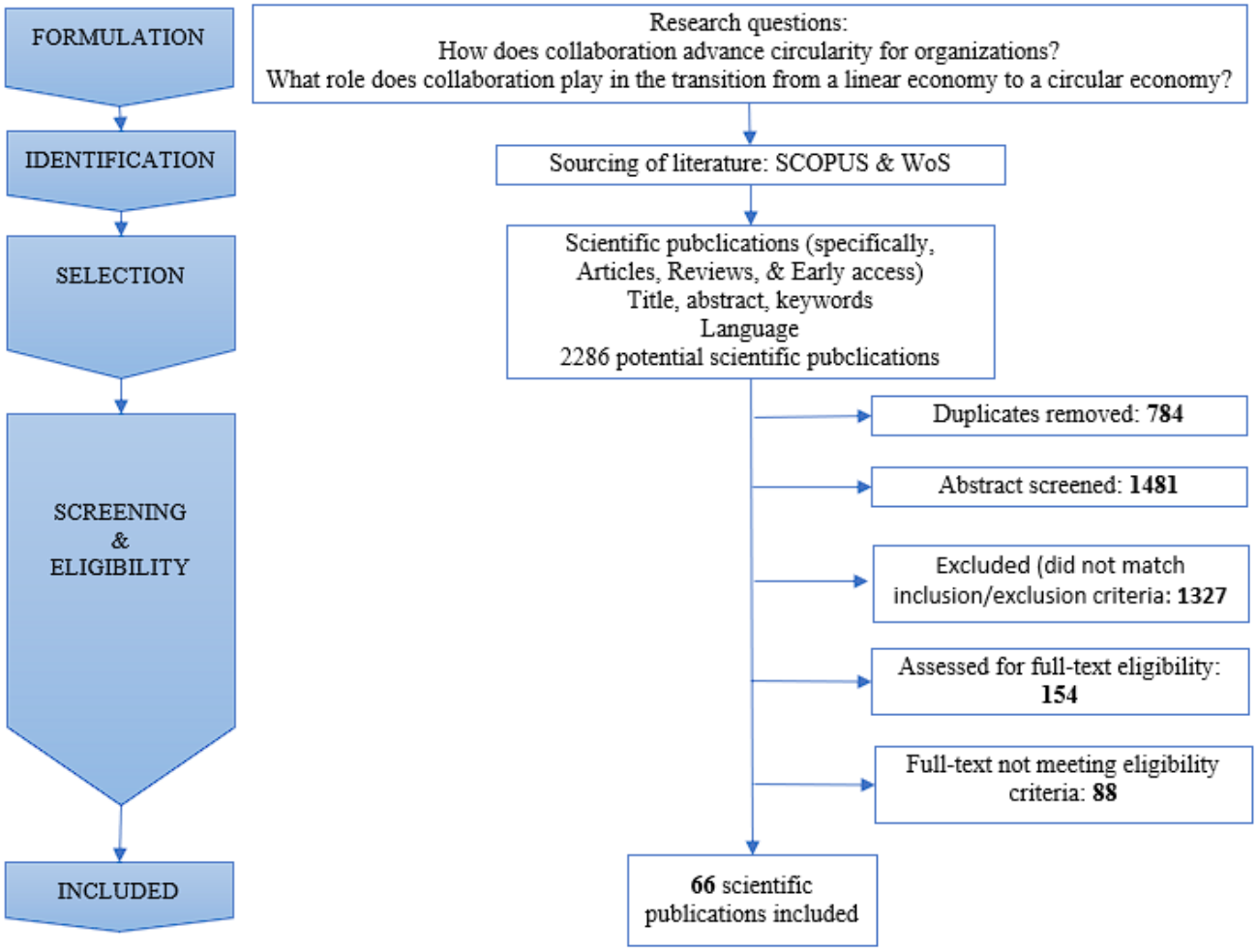

Figure 1. Publication search and screening process.

Table 1. Inclusion/Exclusion criteria.

Inclusion Criteria	Exclusion Criteria
Must explicitly address circular economy (e.g., circularity, circular business models, circular-oriented innovation, circular bioeconomy, circular design, circular supply chains, or circular networks, etc.)	Does not explicitly address circular economy (e.g., instead, only addresses CSR, sustainability, eco-innovation, industrial symbiosis, waste management, etc.)
Must explicitly address collaboration theoretically, conceptually, or empirically in the literature review, conceptual background, or methods sections.	Does not substantively address collaboration theoretically, conceptually, or empirically in the literature review, conceptual background, or methods sections (e.g., only in the introduction, findings, and/or in a normative way)

If a publication addressed strategies to slow or close resource loops, as both strategies broadly seek to extend resource utility and close resource loops, then the publication was included (see Table 1). If a publication only focussed on resource efficiency or eco-efficiency alone, this did not fit within the inclusion criteria and such publications were excluded [16].

The paper includes all publications discussing collaboration, including among organizations, between sectors, and with the government. This approach aligns with Geng and Doberstein's [30] classification of the micro (i.e., organizations), meso (i.e., eco-industrial parks), and macro levels (i.e., government), which are based on industrial ecology. The classification into these three levels has been carried forward conceptually by other researchers

such as Korhonen et al. [52], who also consider CE as a potential enabler of sustainable industrial transformations. Accordingly, publications that focused on one or multiple levels were included. This approach was undertaken as it will conceptualize in one place the relationship between collaboration and circularity.

Publications that theoretically, conceptually, or empirically addressed collaboration in accordance with Thomson's et al. [12] definition (see introduction) were also included. Those who mentioned collaboration as a recommendation or suggestion did not meet this criterion and hence were excluded. Those who focused on coordination or cooperation only were also excluded as these have been distinguished from collaboration [40]. This follows Matterssich's et al. [56] distinction, who defines collaboration as a relationship characterized as having integrative and formalized layers of shared governance and administration.

3. Descriptive Findings

3.1. Demographic Overview of the Publications

This section begins with a demographic overview of the 66 reviewed publications. The findings show that a large proportion is based in Europe. The European Commission's Circular Economy Action Plan places a strong emphasis on collaboration, potentially explaining the largest proportion of the literature involving two or more European countries (10). Many of these research collaborations explored large multinationals operating within the European Union, where regulatory frameworks, including the European Green Deal, have cross-national collaboration as foundational principles for their CE vision [57].

Far fewer publications looked at non-European developed economies such as the UK (3), Australia (2) US (1) and developing economies including Brazil (4), India (2), and African counties (3). These countries represent different institutional and economic contexts, and while European leadership is useful for examining best practices, context-based studies in other jurisdictions are needed to consider local conditions (Figure 2).

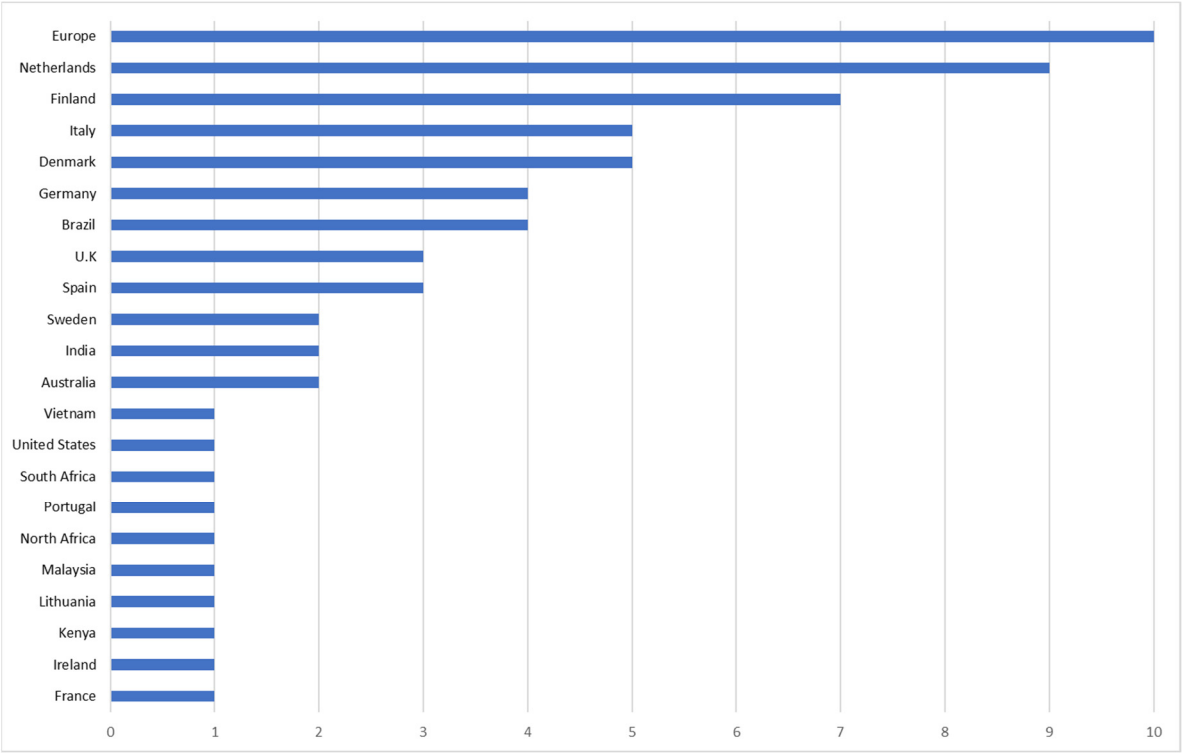

Figure 2. Leading countries publishing on circular economy and collaboration.

The starting point for publications devoted to CE collaborations is 2016, which coincides broadly with regulatory changes to accommodate CE principles such as the European Commission's "Towards a circular economy: A zero waste programme for Europe" pub-

lished in 2014. The UN-SDGs in 2015 may have also acted as an impetus for research into CE.

Since 2019, interest in CE and collaboration has jumped significantly (see Figure 3). The number of publications on CE and collaboration doubled in 2020 (10) and almost tripled in 2021. The interest has continued up until July 2022. The majority of publications are empirical, with forty-four qualitative papers, five quantitative, and four mixed methods. A total of thirteen conceptual publications (e.g., literature reviews) are also included.

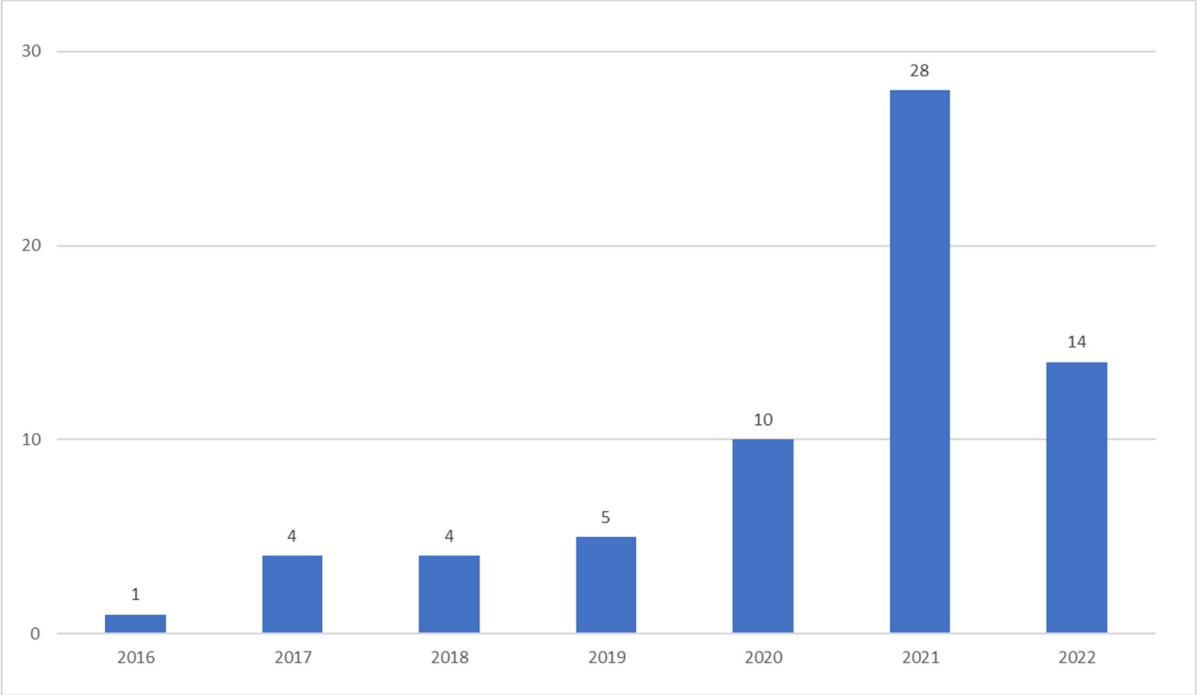

Figure 3. Publications on circular economy and collaboration by year.

However, the increase in interest in CE and collaboration has been focused disproportionately on the level of organizations. Following Geng and Doberstein's [30] classification levels of analysis, Figure 4 overviews the publications which examine slowing and/or closing resource loops at the micro (i.e., organizational), meso (i.e., eco-industrial parks), and macro (i.e., government) levels. If a publication included an analysis of both slowing and closing strategies, they were included for both categories. The majority focused on the micro level for both circular strategies with 29 for slowing loops and 33 for closing respectively. A far smaller proportion is devoted to the macro level with 11 and 12 respectively. An even smaller proportion looked at the meso level with eight and seven publications respectively.

3.2. VOSviewer Bibliometric Analysis of Publications

Keyword co-occurrence mapping assists in the identification and assessment of the most important words and phrases in an area of study. It clusters related keywords based on the strength of their co-occurrence between publications [58]. Keyword co-occurrence assists in the interpretation of important relationships between concepts and research topics, and hence, provides insights into the cognitive structure of a research field [59]. Based on two or more keyword co-occurrences between publications, four clusters are presented in Figure 5 for analysis. The size of labels represents their respective strengths in terms of their co-occurrence in the literature.

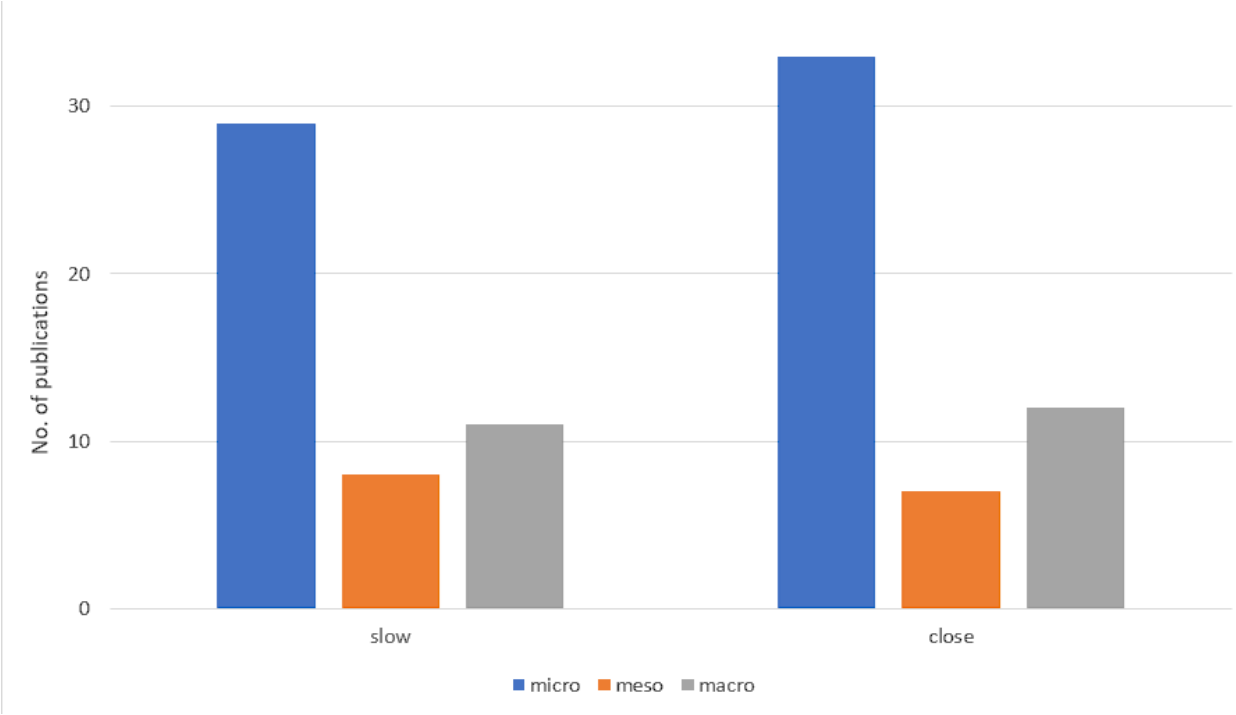

Figure 4. Slowing and closing resource loops by level of analysis.

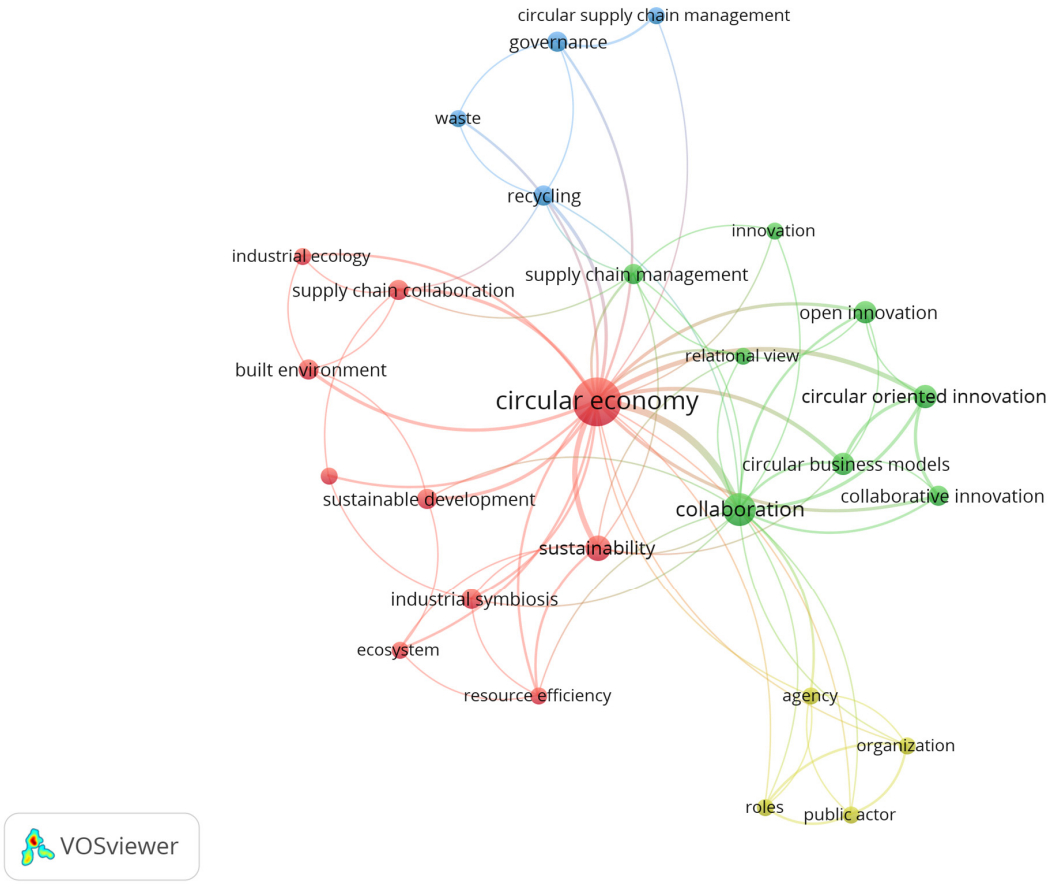

Figure 5. VOSviewer keyword co-occurrence map.

As expected, the red cluster shows that CE is studied in conjunction with its capacity for sustainability and sustainable development. Collaboration influences this relationship.

A relationship is also shown between CE and its parent constructs, such as industrial ecology and industrial symbiosis, which relate to inter-firm resource exchange arrangements in supply chains. For the blue cluster, CE collaboration is researched by looking at recycling processes. Governance is shown to play a role in circular supply chains, which manage waste as a resource.

Turning to the green cluster, a strong link is shown between collaboration and innovation. An emerging concept in the literature is 'circular oriented innovation', which relates to innovation to slow resource loops in circular products, services, and business models designed collaboratively to create and capture circular value [60,61]. Open Innovation [10] and Relational View [44] are examples of relevant theoretical frameworks used in the reviewed publications. Finally, the yellow cluster points to a relationship between the government (via public actors) and organizations. This cluster links roles and agencies with collaboration and CE.

4. Discussion of the Findings

Based on Bocken's et al. [16] classification, namely slowing and closing resource loops, and Geng and Doberstein's [30] classification levels of analysis for CE, two relevant findings emerged from our qualitative analysis of the 66 publications. Firstly, based on these findings, we conceptualize how organizational-level collaborative processes and structures change for different CE strategies. Second, we argue that collaboration needs to occur between multiple levels (i.e., organizations, eco-industrial parks, and government) to facilitate a transition from a linear economy to a CE. The following subsections discuss these findings.

4.1. Conceptualizing How Collaboration Advances Circularity

Collaboration advances circularity in organizations through a variety of processes and structures at three stages of the product lifecycle. The product lifecycle for slowing and closing resource loops is discussed at the design, use, and end-of-life stages [16]. Slowing resource loops occurs at the design stage. It then moves to the use phase (i.e., while being used by the consumer), where slowing resource loops is enacted to extend product utility and performance. Finally, the end-of-life stage is where closing the resource loops is conducted by recovering and then reintegrating secondary resources. Figure 6 presents a conceptual framework of these three stages, which are denoted as (1) circular design, (2) circular products and services, and (3) circular resource recovery respectively.

Each stage of the product lifecycle is distinguished by different collaborative processes and structures. These collaborative processes and structures assist organizations in conceptualizing how collaboration changes at each stage. The next subsections discuss each of the processes and structures at each stage.

4.1.1. Circular Design

Circular design requires broadening collaboration scope to acquire knowledge. It involves being able to identify, co-create, and integrate diverse transdisciplinary knowledge sources for circular product design, including designing for remanufacture, refurbishment, and repair [62,63]. Circular design requires scoping across heterogeneous knowledge sources and with collaborators with circular know-how, including lifecycle thinking skills that factor in utility and performance considerations [64]. Brown et al. [61] emphasize the need to find the right people with the technical know-how of circular design principles. Eisenreich et al. [65] found that a network approach to collaboration and crowdsourcing helps to locate expertise and generate conditions for product innovation. This will likely require searching for innovation opportunities and the capacity to "utilize broad crowd wisdom" [65] (p. 17). An important note here is that collaboration for circular design starts with the development of an open innovation culture that values and systematizes collaboration routines geared towards finding new knowledge, co-creating it, and integrating it [66,67].

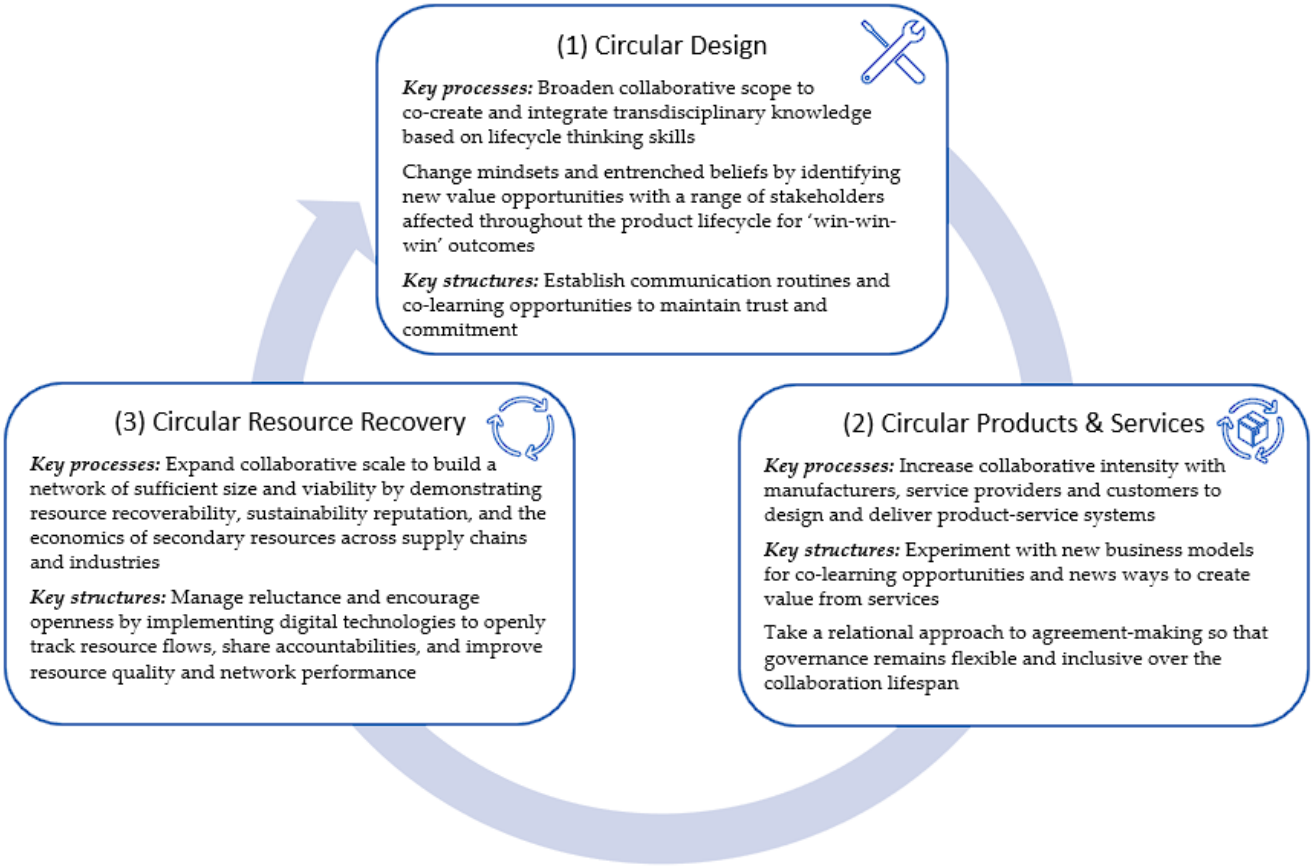

Figure 6. A conceptual framework of key collaborative processes and structures at different stages of the product lifecycle (Source: Authors).

Collaborative planning is important early on during formation [42]. During formation, a collaborative partnership needs to be based on sound economic fundamentals and a circularity strategy [60,68]. The Business Model Canvas [34] was often employed by scholars looking to demonstrate the economics of a proposed business model with a clear strategic argument for collaboration [69–74]. The first step is presenting a credible circular proposition. This is performed by first considering the product, business model, and network configuration required [60]. Brown et al. [75] developed a Circular Collaboration Canvas tool for such a purpose. The tool estimates the value and readies potential collaborators by identifying interdependencies between partners to fulfil specific collaborative circular objectives.

Planning also involves being inclusive. Chirumalla et al. [72] emphasize the need for early commitment towards multiple stakeholder involvement in strategic discussions and the importance of demonstrating shared value creation. Early discussions must acknowledge varying perspectives, values, and expectations and strive towards shared goals [72]. To assist in collaborative planning, numerous researchers have developed tools that could be deployed during strategic discussions [70,72,76]. Bertassini et al. [70] offer useful planning guidelines for identifying value opportunities (including value missed) according to a range of identified stakeholders. Tseng et al. [77] (p. 762) recommend presenting "clear objectives and convincing explanations", which set out strategic plans for shared learning processes to generate new ideas and a map guiding members towards mutually beneficial goals. Strategic discussions set the scene for establishing networks and communication norms between partners and are necessary for kickstarting ideation and getting initial commitment towards collective goals [61].

Many organizations lack the relational competencies necessary to build trust and commitment [23]. However, organizations must develop these competencies to confront mindsets that avoid sharing financial risk [61]. Trust is a crucial competence for developing CE collaborations. Köhler et al. [66] found that trust is built via regular and transparent communication based on established knowledge-sharing routines. This may occur formally or informally. For example, Hansen and Schmitt [62] found that the complexity of the CE requires a sense-making approach, which can be performed during lunch breaks and/or in seminars and ongoing learning activities.

Trust is also built through learning. Learning activities, such as events, are important for generating understanding, which importantly, helps to generate trust [62]. Mishra et al. [78] note that training opportunities established a shared understanding of the potential for circularity and a foundation for collaborative action. Leising, Quist, and Bocken [63] found that reaching a productive level of learning and collaboration was based on generating trust. The process starts by establishing milestones and transparent discussions about collaboration goals. Trust is further developed as rules and norms emerge during the formalization phase of a collaboration to ensure that knowledge-sharing routines are maintained and reciprocal actions between parties create collaborative actions towards these ends [79]. Learning about circular design principles can also build trust as found by Hornbuckle [80], who demonstrated that material samples enabled the flow of communication and co-learning, which went towards establishing relationships built on trust and familiarity.

Leadership is also a necessary relational skill required to manage collaborations. This is because CE requires radical changes across multiple interconnected systems [16]. Leadership is therefore required to drive change and overcome complexity. Consistent with this, Hansen and Schmidt [62] highlight the role of specific power promotors in firms that are able to cultivate top management commitment and also effectively champion CE to new and existing partners. Zucchella and Previtali [79] found that a leading firm acts as a network orchestrator whose rallying competencies relate to transformational leadership traits of communicating vision, generating trust through advanced interpersonal skills, and changing mindsets and entrenched beliefs. The orchestrator defines the roles and responsibilities of various actors, communicates effectively to quell resistance and generate context-specific learning opportunities, and skillfully frames the CE vision on sound entrepreneurial and economic terms based on tangible and openly negotiated terms [79,81].

4.1.2. Circular Products and Services

Circular products and services require increasing collaboration intensity in the use phase of the product lifecycle. It denotes more frequent and ongoing collaborations with producers, service providers, and customers to ensure service development, delivery, and sales functions [38]. The processes and structures of this collaboration are governed under a Product-service system (PSS) business model. PSS business models capture value by providing as many customers as possible access rather than ownership to a desirable product (e.g., via leasing terms), and hence require significant changes in collaborative business model design [16]. Importantly, the addition of services (such as repair and maintenance) is a deliberate design feature of circular product offerings, where the utility of the product is maintained for as long as possible.

Several key collaborative processes and structures define circular products and services. For example, formal negotiations should include an agreement to engage in early experimentation. Brown et al. [60] found that experimenting with newly created shared processes should be included during formal negotiations with the intention to share and co-create knowledge for mutual gain. Experimentation requires planned evaluations and processes to manage the learning process [82]. Köhler et al. [66] suggest that flexibility to reconfigure internal capabilities to cater to agreed changes is important for the development of collaborative business models. An ambidextrous approach ([83] to trialling new business models is likely to be even more important among incumbents pursuing ambitious business

models involving significant disruption to several interconnected systems and processes. The ambidextrous approach may also reveal gaps in collaboration capabilities and thus help organizations plan more effectively [61,66].

However, structures (i.e., agreed-to rules governing a collaborative relationship) may be complicated. This is because the nature of the CE may not always allow for the ability to explicitly predict outputs for each collaborator, complicating contract negotiation. For example, collaborations can contain unexpected contingencies, such as regulations or standards, which prevent circular flows, the need to reinvest in further product design, or unforeseen complications in orchestrating multisystem change [84]. Given the complexity, Fischer and Pascucci [84] recommend a relational approach to agreement-making, where the goals should be more qualitative than quantitative by design. Taking such an approach requires a collaborative mindset and a willingness to persevere during uncertainty. This exemplifies the key role that collaborative processes such as trust-building play in developing and maintaining structures.

Similar sentiments regarding the need for flexibility and perseverance are echoed by other authors. In fact, Beraldi and de Brito [23] note that CE collaboration evolves over time and can be dynamic in nature. As a collaboration evolves, it may confront significant changes to account for new ways of creating and capturing value [75]. Therefore, more flexibility in a firm's strategy is necessary to deal with collaborative dynamics as they may arise [61]. Projects for collaboration may benefit from 'flatter' governance architectures with built-in contingency measures created for existing and new members to remain confident in the capacity to suggest changes [61].

4.1.3. Circular Resource Recovery

Circular resource recovery requires expanding the collaboration scale to build a network of sufficient size and viability. Several authors emphasize that size determines an organization's capacity to access secondary resources to support viable circular material flows and hence to advance circularity [64,65,68,85–88]. The composition of the network is dependent on a range of factors, such as the geographic distribution of the collaborators involved [89], the sector and resources each creates and requires [90], respective members' level of commitment over time [91], and the capabilities of various participants to manage and process circular flows [68]. Clearly, building a functional network of sufficient size and viability is a complex undertaking. In fact, the complexities and composition of various materials and resources during recovery make processing circular flows even more complex.

Resource recoverability is a major hurdle to a viable network. It requires collaboration at the design stage. Bocken et al. [16] call this designing for technological cycles. In fact, Franco [68] found that finding a sufficient number of contributors to form an adequately sized network was only part of the problem. Collaborating throughout the network with manufacturers to improve the quality and composition of materials at the design stage with end-of-life recovery requirements was crucial for enabling adequate volume [68]. Resource recoverability may determine the speed and quantity of recycling, and hence the capacity for its network partners to support multi-loop cycling [85]. Producers need to be able to collaborate with network members for faster and more voluminous recovery, such as with upstream design processes, to reduce the complexity of basic materials, the architecture of its component parts, and their malleability to be deconstructed for effective recovery [68].

A major enabler for enhancing viability is the capacity to build and maintain trust. This may be founded upon previous sustainability reputation and perceived competence of, and between network members. Cantele et al. [73] showed that creating a network of organizations of sufficient size is a gradual process that may be based on leveraging a good reputation for collaboration and sustainability success. Leising, Quist, and Bocken [63] add that success can be demonstrated by showing the tangible financial benefits of collaborating. Yet, reaching a critical mass of collaborators may take time. Luthra et al. [92] argue that the foundations for building a network require patience before surrounding onlookers perceive

it to have legitimacy. A wider perception of a network being reliable can create further investment and widen its membership. Interestingly, as the network grows in size, issues such as mistrust and perceptions about power asymmetry may diminish [92].

Building leadership is also important to scale networks and improve viability. Some private firms take on a leadership role in the initial stages of collaboration, for example by uniting stakeholders around the intrinsic importance of sustainable business management or the strategic importance of advancing the Environmental, Social, and Governance (ESG) goals [82]. Shared values and visions based on the principles of circularity such as the need to divert waste from landfill, reduce emissions (including embedded emissions), and lower virgin resource use helped to create early commitment [68,73,78,93]. Leadership can also be demonstrated by a hub organization managing reluctance to collaborate. Reluctance is born out of legitimate concerns about losing autonomy and becoming overly dependent on partners or when resource exchanges are not at the quality required for viable reintegration [81,94]. According to Rincon-Moreno et al. [94], reluctance to share resources and information is a common issue between organizations collaborating in eco-industrial parks.

However, a strategy to manage reluctance to share resources and information is to develop digital capabilities. These capabilities can be deployed to measure and improve network performance over time, enforce the responsibilities of various partners, and hence help to meet the shared targets [95]. Importantly, CE collaboration requires the capture and exploitation of numerous data points to describe the quality and predict volume [96]. For example, Brown and Bajada [97] used accounting measurement tools to calculate recycling activity and velocity rates. The tools helped measure outcomes and hence strengthened monitoring and management processes among contributing collaborators.

Digital technologies may work as collaborative structures and processes which reinforce each other. For example, data sharing via digital platforms with open access improves transparency and accountabilities, which in turn, improve administration and build trust [98–100]. Tracking capabilities using sensors attached to mobile resources even improved collaboration as decision-making, forecasting of customer returns, and predictive maintenance opportunities were created [98]. For industrial symbiosis within eco-industrial parks, Rincon-Moreno et al. [94] showed that a program called iNex enabled the mapping of potential physical material flows with significant detail around key inputs, outputs, and other characteristics. The process improves traceability and hence the ability to plan and improve the quality of circular flows [101]. Overall, digital capabilities espouse important collaborative processes and structures.

The above analysis shows that there has been some success in advancing circularity for organizations. However, success in terms of the proportion of the global economy becoming circular is still limited. In fact, the global economy remains predominantly linear [7]. Therefore, to explain how collaboration facilitates a transition to a CE, it is necessary to consider the ways that diverse actors collaborate to drive systems-level change at different levels [8,30,52]. The findings of this paper show that collaboration needs to occur between the organizational, eco-industrial park, and government levels to facilitate a transition from a linear economy to a CE.

4.2. The Role of Collaboration in Transitioning from a Linear Economy to a Circular Economy

The transition from a linear economy to a CE involves multiple levels including between organizations, eco-industrial parks, and government at three stages of the product lifecycle. Figure 7 conceptualizes the role of collaboration in this transition. The next subsections discuss each level according to the three identified stages of the product lifecycle.

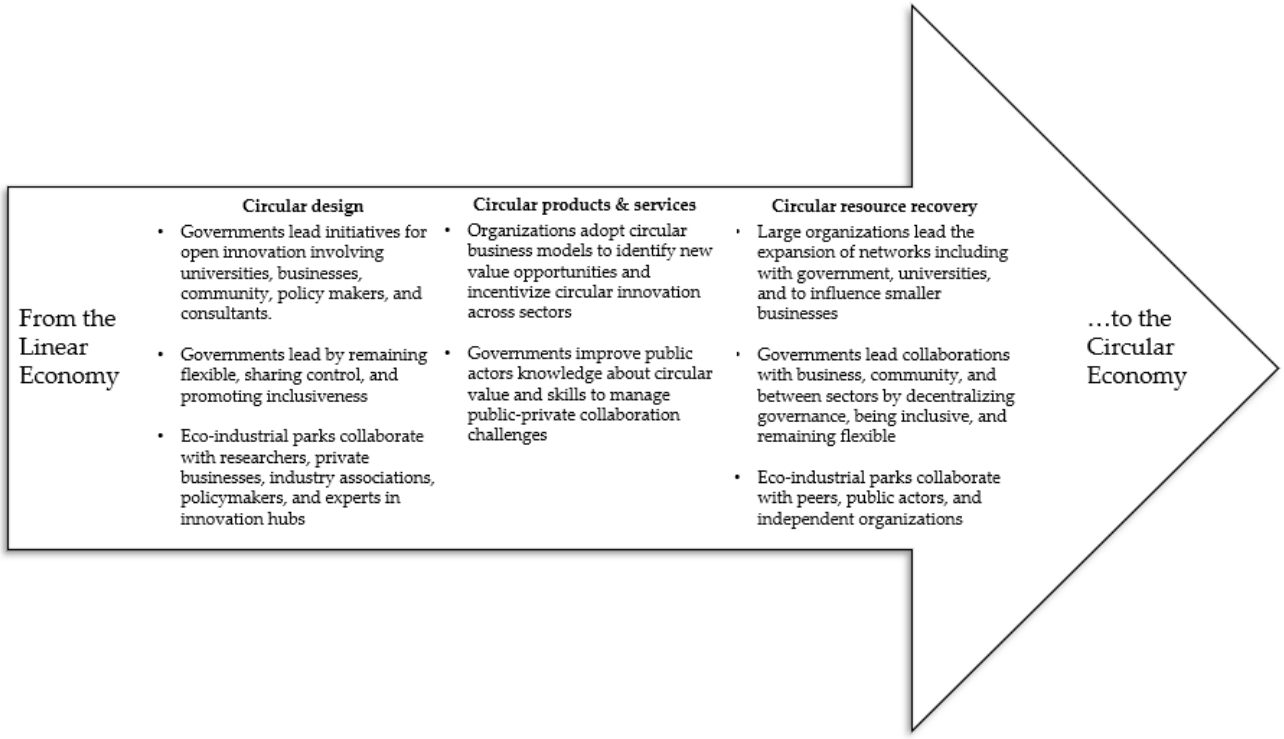

Figure 7. Multilevel collaboration for the transition to the circular economy (Source: Authors).

4.2.1. Multilevel Collaboration for Circular Design

The government has an important role to play in promoting circular design between multiple levels. For example, Martina and Oskam [86] found that government-led initiatives, such as programs and events to disseminate university and research institute contributions to product innovations, are powerful ways to form important networks. Others suggest that such initiatives should include university and industry collaborators. University-industry collaborations combine the conceptual expertise of universities with the market and process expertise of industry members [76,102]. The government can facilitate this collaboration and promote important circular design outcomes for wider collaboration.

The government can also create multilevel collaboration by facilitating Urban Living Labs (ULL). ULLs present new opportunities for multilevel collaborative exchanges and create important structures for knowledge sharing and co-creation in multidisciplinary engagement and real-life piloting with authentic users [103]. The ULL concept of open innovation and public-private-people-centric control represents a novel governance predisposition, unburdened by centralized control, and hence may hold important socio-economic transformational potential [103]. Similarly, a collaborative governance architecture was found to promote cooperation and experimentation to co-produce circular design knowledge for urban waste and resource problems [104]. Public-funded and administered, the knowledge and innovation created under these real-life conditions require an administrator to ensure learnings are captured, lived experiences are debriefed, and adjustments can be recast to formulate public processes collectively. Cerreta et al. [105] noted that monitoring and creating learnings based on co-evaluation is important for success.

Eco-industrial parks can collaborate between levels via innovation hubs for circular design. Meath et al. [106] studied a 'co-lab' innovation hub that involved university researchers, private businesses, industry associations, and a governance expert. This multilevel platform created a co-design approach. The innovation hub connected the top and the bottom (i.e., policymakers and individual firms). The deliberate inclusion of multiple parties at multiple levels provided valuable learnings about the technical and non-technical barriers preventing industry transition.

4.2.2. Multilevel Collaboration for Circular Products and Services

Organizations have a central role in expanding circular products and services in the transition towards a CE. A key driver identified in the literature is circular business models. Circular business models have the capacity for bottom-up change from the organizational level [39,107,108]. Their potential for driving change is demonstrated by organizations employing "economically viable ways to continually reuse products and materials" [16] (p. 308). This is achieved by identifying shared value opportunities, including missed value or under-utilized value streams [109–111]. The bottom-up forces created by circular business models have been noted by scholars. For example, Zucchella and Previtali [79] highlight that the use of circular business models enables economic incentives for wider adoption across sectors, where economic value opportunities can be identified and strategized more widely. Circular business models also enable the conditions necessary for circular innovation across industries. Cricelli et al. [69] showed that suppliers and manufacturers adopted innovations to accommodate the circular markets created by desirable partners.

Transitioning to a CE means that organizations and governments will need to overcome conceptual barriers. Fischer and Pascucci [84] stress the constraints on creating value in an institutional system entrenched by linear economy value capture logic. Kristensen, Mosgaard, and Remmen [112] found that circular public procurement officers in local government lacked crucial knowledge and practical guidelines when negotiating contract forms to generate value from circular products and services. A lack of widespread understanding and experience about circular principles is not surprising. In fact, even financial institutions still fail to fully validate circular value-generating potentials [84]. Witjes and Lozano [108] argue that the difficulty may be due to an inability to shift consciousness away from product unit price rationalities towards price per-service value creation architectures. Indeed, learning about the opportunities for circular value is likely to take time. Yet, given that public procurement represents significant spending, and therefore economic influence, the expansion of circular public procurement is important for driving CE transitions [112]. Furthermore, Fischer and Pascucci [84] point out that frontrunner organizations with the ability to demonstrate new ways of creating and capturing circular value can lead the transition. Therefore, combining the efforts of both top-down and bottom-up efforts towards the development of circular products and services is a powerful strategy for CE transitions.

However, the collaboration between the government and organizations presents other challenges. Hirvensalo et al. [113] argue that expanding CE is constrained by competitive logic which fails to recognize shared opportunities. This means that managing public-private collaborations requires public actors to develop new skills including the ability to acknowledge differences and find plausible solutions [114].

4.2.3. Multilevel Collaboration for Circular Resource Recovery

For circular resource recovery, organizations can play a leading role in multilevel collaboration. For example, large organizations with significant influence in supply chains need to collaborate to expand their networks. Large organizations' tendency to focus on in-house, supply chain-focused, recycling initiatives fail to incorporate the participation of diverse actors whose contributions may serve to strengthen it [68,84,88]. The inclusion of stakeholders such as local government, research institutes, and communities reflects the need to confront social, economic, and technical barriers collaboratively as networks mature [98]. For example, collaborating to gain access to local government assets (e.g., recycling infrastructure), favourable policy or government grants, community involvement, and technical support from research institutes are important aspects of network development. Large organizations may also influence small and medium enterprises (SMEs) which lack the capacity to manage complex networks. SMEs' involvement in network expansion, therefore, may be influenced by larger partners initiating and managing CE across supply chains.

The government also plays a crucial role in enabling the expansion of circular resource recovery initiatives. The literature shows that successful public-led collaborations for

circular resource recovery require flexibility, inclusiveness, and decentralized governance arrangements [115,116]. For example, in a study conducted by Oliveira Silva and Morais in Brazil [87], legislation to reduce solid waste created important incentives for shared responsibility, and importantly, shared power arrangements between local government, businesses, and informal recyclers, known as waste pickers. Sharing power is also important for the promotion of cross-sector collaboration. For example, Christensen [117] showed that municipalities in Denmark can exploit multiple modes of governance, such as using public waste management assets or creating incentives, to encourage collaboration between the construction and automotive industries.

Eco-industrial parks are often confined by logistical and spatial limitations, which reinforce isolation. Collaboration with multiple actors across multiple levels, therefore, is important for CE transitions. Uusikartano, Väyrynen, and Aarikka-Stenroos [118,119] showed that expansion is possible by including peers, public actors, and independent businesses sitting outside of the boundaries of conventional eco-industrial parks. This is important as it implies a range of actors, including government and private business, can create collaborative conditions for CE transitions.

4.3. Intermediaries to Accelerate CE Transitions

In addition to multilevel collaboration, the literature shows that intermediaries are important accelerators for CE transitions with the capabilities to collaborate with diverse stakeholders across multiple levels. This is because they are instrumental in bridging technology, cultural, institutional, attitudinal, and knowledge barriers for greater collaboration at all levels [62,90,93,120]. For example, intermediaries can help find technical experts with engineering and scientific knowledge to advise on product specifications [93]. Hansen and Schmidt [62] found that intermediaries were important in helping various organizations by diffusing specialized, complex, diverse, and dispersed pockets of crucial knowledge and mobilizing it effectively for other organizations.

Intermediaries have important network effects. They facilitate relationships with third parties and strengthen member participation [62,78,93]. Berlin, Feldmann, and Nuur [121] describe intermediary functions as crucial for changing rules and standards. In fact, intermediaries can influence uniform pricing conditions and supply chain reliability, and advocate for improvements in safety and shared protocols [121]. Hansen and Schmidt [62] agree that intermediaries are important consultants for disseminating knowledge about standards including certification standards.

Intermediaries are successful when they employ relational competencies such as the ability to build trust. They build trust by offering and facilitating the delivery of attractive opportunities and outcomes. Patala et al. [120] found that intermediaries employed relational competencies to maintain the openness of data sharing among multiple collaborators of different sectors. However, trust was only possible when intermediaries were able to deliver on their promises.

5. Conclusions

This paper sought to address two research questions. The first is how collaboration advances circularity in organizations. A conceptual framework (see Figure 6) was developed to differentiate collaborative processes and structures at three stages of the product lifecycle. The second research question sought to explain how collaboration might facilitate a transition from a linear economy to a CE. The discussion highlighted the important role of collaboration in CE transitions (see also Figure 7). The paper addresses an important gap in the literature by providing a comprehensive examination of collaboration and circularity in organizations and between stakeholders at different levels. Based on the findings, two key contributions are made about collaboration and circularity.

The first contribution is the novel conceptualization of the differences in the nature and purpose of collaboration for different CE strategies at three different stages of the product lifecycle. At the circular design stage, the nature of collaboration is about broadening

the scope to source new, transdisciplinary knowledge. For circular products and services, the purpose changes towards intensifying collaboration with new partners to create and capture circular value. With circular resource recovery, the nature of collaboration changes again towards increasing scale to build a network of sufficient size. There are several implications of these changes for organizations. First, in terms of managerial processes in organizations, collaboration managers need to instigate purposeful interactions with new and existing actors to acquire and assimilate new knowledge and learning [49]. This requires establishing effective knowledge-sharing routines with collaborators and developing the capacity to effectively integrate and reconfigure systems and processes [44]. Second, organizations may need to develop more flexible business models to support collaborative structures and processes [35]. For example, capturing value from circular products and services may require collaboration between organizations that specialize in circular products and services, and those that specialize in circular resource recovery (i.e., the reuse of materials). The intensity of the collaborations between partners can increase their interdependencies. Interdependencies enable collaborating organizations to devote greater resources to collaboration-specific routines to manage interdependencies for shared benefit. Relational competencies are necessary to facilitate collaboration including the capacity to build and maintain trust. Third, the implication of collaboration for circular resource recovery is that organizations develop collaborative processes and structures which expand the number of (and the relationships between) resource exchange partners. The larger the network of resource exchange partners, the larger the volume of resources available to be returned to an increasingly circular economic system. Managers will need to coordinate multiple interfaces for multiple purposes, including distribution from different locations and the reprocessing of secondary materials at the same or better quality as virgin resource inputs.

The second contribution of this paper to the CE literature is the examination of the role multilevel collaboration plays in the transition from a linear economy to a CE. The paper argues that collaboration needs to occur between multiple levels. For example, innovation hubs and urban living labs provide opportunities for new collaborations to form, facilitating knowledge sharing including with government, academia, and industry.

The implication for eco-industrial parks is that collaboration managers need to seek new collaboration opportunities with peers, businesses, and the government. The importance of this cannot be understated since eco-industrial parks typically pursue resource recovery strategies exclusively. Broadening the scope to include new expertise and knowledge sources from new business partners, for example, may offer possibilities for the adoption of new circular business practices. Therefore, a collaboration involving more scope may serve to strengthen the depth and impact of circularity in highly collaborative eco-industrial parks.

There are several key implications for the government. The government has an important convening role in promoting and facilitating collaborations. For example, policy settings incentivizing circular economics, circular public procurement standards for circular products and services, and government assets for resource recovery may create the conditions for multilevel collaborations. Collaborative processes are required to promote collaboration opportunities, namely in the power-sharing, flexibility, and inclusiveness they inculcate when administering collaborative projects. However, managing collaboration depends on public actors' capacity to overcome conceptual barriers to circularity, learn about circular value opportunities, and develop the skills to manage divergent perspectives. The governments will need to invest in strategies to promote these competencies. Intermediaries may have an important accelerator role to play. The capacity of intermediaries to bridge collaborations and aid in knowledge sharing and transfer at multiple levels should be harnessed by both the government and industry.

6. Limitations

This conceptual paper is not without limitations. Firstly, the inclusion of a wider (albeit, less targeted) string of search terms with related concepts such as governance, cooperation, and supply chain management might have brought greater insight into collaborative processes and structures. Secondly, the inclusion of grey literature (e.g., websites, reports, etc.) could have also strengthened these insights. Thirdly, including non-English literature may have provided insights into CE-related publications in regional languages in other parts of the world.

7. Future Research

Based on the aforementioned discussion above, future research should investigate the role of collaboration and circularity, for example, by considering the ways that recycling networks are formed and expanded, the identification of network characteristics such as size, partner characteristics, dynamic behaviour, or how long it takes to reach critical mass in various sectors [52,122]. This is important in understanding the constraints in various sectors preventing widespread collaboration to strive towards adopting CE initiatives.

In terms of collaborative processes, future research needs to understand the competencies required to set up and maintain networks. Network relationships become more complicated as additional stakeholders are included in the network, including, for instance, government and communities. Expansive collaborative activity can add complexity and become counter-productive when the size and capacity of the multiple partner interfaces supersede the managerial resources capable of effectively managing them [123]. The latter was highlighted by Cricelli et al. [69] (p. 1) who stated that "collaboration breadth has a negative impact on reverse logistics, an unexpected and surprising result for the innovation management literature." Therefore, future research should investigate the strategies that organizations with large networks can use to manage and maintain them. Future research could also consider the influence of larger players on smaller players and the ways that each collaborates to expand secondary resource markets.

Future research is also needed to understand how collaboration might facilitate the adoption of higher levels of circularity, and ultimately, the factors driving widespread collaboration for circular production and consumption. For example, in line with prior research on PSS business models, such as by Kristensen and Remmen [39], future research should look at how collaboration drives widespread economic, social, and cultural outcomes for CE transitions.

Following the work conducted by Uusikartano, Väyrynen, and Aarikka-Stenroos [118,119], future research should investigate the strategies to encourage eco-industrial parks to collaborate more widely. In addition, how eco-industrial parks can collaborate to include circular products and services has yet to be explored.

The crucial role of government as a facilitator of CE transitions is clear. Collaborative processes such as sharing power arrangements, providing incentives, and promoting inclusiveness allow for large collaborations involving multiple levels and multiple actors. Future research should carry these findings further to determine the specific individuals involved in various contexts, their competencies, and the policies employed to encourage widespread collaboration. This includes policies to facilitate bottom-up drives (such as circular business models) and top-down drivers (such as circular public procurement).

Furthermore, future research on the capacity of public-funded initiatives for collaboration, such as urban living labs for the transition to a CE, is needed. In particular, the ways that urban living labs might create new and valuable circular innovations are important areas of inquiry as too are the governance mechanisms required to sustain them and generate expansive processes for widespread collaboration.

Future research can also investigate how public actors (e.g., local government representatives) overcome conceptual, technical, market, and institutional barriers when collaborating with organizations and communities. In addition, future research should examine how government more generally can incentivize standardized circular product

design via both policy and internally via public actors and how such incentives can drive a transition towards circular production and consumption.

The significant role played by intermediaries in providing impetus to accelerate a transition to a CE cannot be overlooked. In particular, the ways that intermediaries bridge dispersed actors, including the local government, requires more attention. This includes new jurisdictions and economies where the CE is at different stages of development. The roles and functions of various kinds of intermediaries at different stages of organizations' CE transition lifecycle also require research. In addition, the relational competencies employed by various intermediaries at different stages and with different organizations are also important for future research. Finally, the collaboration competencies required between intermediaries, organizations, and the government respectively to work together represent areas of important future research.

Author Contributions: Conceptualization, S.D., A.Z. and J.R.; methodology, S.D., A.Z. and J.R.; formal analysis, S.D.; writing—original draft preparation, S.D.; writing—review and editing, A.Z., J.R. and S.D.; visualization, S.D. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: No new data were created for this study.

Conflicts of Interest: The authors declare no conflict of interest.

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