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Review

Driving the Transition to a Circular Economic Model: A Systematic Review on Drivers and Critical Success Factors in Circular Economy

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Received: 16 October 2020; Accepted: 17 December 2020; Published: 21 December 2020

Abstract: The circular economy (CE) is arising as a novel economic system that is restorative by design. In light of its capability to boost sustainable economic development and to cope with environmental challenges, it has recently attracted increasing attention from academics, practitioners, policymakers, and intergovernmental organizations. Despite the wide speculation on this issue, the scientific literature lacks a wide-ranging, systematic, and updated identification and classification of the main drivers and Critical Success Factors of CE initiatives, which appears increasingly necessary to facilitate future scientific work, practical implementations, and policy guidelines. With this aim, this paper develops a systematic literature review by starting with over 400 manuscripts. A final set of 55 selected papers was selected for singling out and classifying drivers and Critical Success Factors in the CE context. The results may provide clear indications for further research, may help business organizations in evaluating CE initiatives, and may guide policy makers in developing and refining CE normative frameworks.

Keywords: circular economy; drivers; Critical Success Factors (CSFs); literature review; sustainability

1. Introduction

The circular economy (CE) is emerging as a novel approach to boost sustainable economic development and cope with environmental challenges and has recently attracted increasing consideration in discussions on industrial development [1–3].

The traditional and still dominant linear economic model based on extracting-producing-using-discarding materials and energies is unsustainable [1,4]. Although it has been followed throughout the history of humanity, the linear economic model started to assert itself strongly during the industrial revolution in the 18th century, which ignored the environmental limits and the long-term damages caused to the whole world. On the contrary, the CE represents a cyclical and regenerative economic model of production and consumption, which involves reusing, repairing, sharing, refurbishing and recycling existing materials and products for as long as possible [5–7].

Since the growing attention paid to the environmental problem and a more sustainable economic development, the CE concept and its application have attracted increasing attention from practitioners, academics, policymakers and intergovernmental organizations [1,6–10]. Accordingly, a significant number of studies have focused on the concepts defining the CE [11] and on explaining the relationship between sustainable development and CE [12].

In attempts to contribute to this change of model paradigm, a considerable number of scholars have started to explore which drivers may lead the implementations of CE initiatives by business organizations [13,14]. The improved awareness and understanding of CE drivers, in fact, may help business organizations in evaluating CE programs and governments/public authorities in providing the right incentives and legislation.

Similarly, numerous studies have been aimed at Critical Success Factors (CSFs), which may pave the way for the implementations of CE initiatives (e.g., Rizos et al., 2016; Sandvik et al., 2019) [15,16]. Such factors are the elements—e.g., company capabilities, legislation, financial funding, stakeholder awareness—which enable the implementation of CE business models and are critical in CE projects [17–21]. CSFs strongly influence the degree of initiation, continuation, and success of CE actions and their study may contribute a lot to the "CE transition", which is progressively undertaken by business organizations. This makes the investigation of CFSs a very relevant and current topic from both an academic and a practical perspective [22,23].

Recognizing the importance of both CSFs and drivers concerning the CE initiatives (e.g., Tura et al., 2019; Russel et al., 2020) [24,25], several researchers have begun their investigation. However, the literature in this field appears to be quite fragmented, with most contributions focusing on CSFs or drivers of CE in a particular economic sector and/or business function (e.g., Adams et al., 2017; Agyemang et al., 2019; Notteboom et al., 2020; Garmulewicz et al., 2018; Centobelli et al., 2020) [26–30] or from a specific perspective (e.g., Khan et al., 2020; Kumar and Putnam, 2008) [31,32]. Despite the high number of interesting studies, to the best of our knowledge, the literature lacks a wide-ranging, systematic, and updated identification and classification of the main drivers and CSFs, which appears increasingly necessary to facilitate future scientific works and their classification, to support practical implementations, and to drive policymakers in their CE agenda.

In an attempt to fill this gap, we developed a systematic literature review based on the review protocol by [33]. Starting from over 400 contributions, we selected a final set of 55 manuscripts. Drawing from their in-depth analysis, we singled out a list of CE drivers and CSFs, and we respectively classified them following specific dimensions. Our findings contribute to the scientific literature by providing indications for further research investigating drivers and CSFs in real CE initiatives and simplifying the classification of their results. From a practitioner's viewpoint, this study may also help companies and practitioners in evaluating CE interventions and guiding legislators in the law-making process on CE normative frameworks and the associated sustainability incentives.

The remainder of the paper is structured as follows: Section 2 describes the research design; Section 3 describes and discusses the findings from the literature review; finally, Section 4 depicts the potential directions for future research and concludes the paper.

2. Materials and Methods

This research was conducted through a systematic literature review re-adapting the methodology proposed by [33], which has largely been used by other academics (e.g., Savino et al., 2017; Kauppi et al., 2018) [34,35]. Table 1 details the steps followed for this review.

By using the proposed research string, we performed a query on Scopus, which is the largest database of peer-reviewed scientific literature. In addition, ISI Web of Science (WoS) was considered in this research for triangulating the results [36]. We obtained 406 contributions from Scopus and 232 from WoS. Both the Scopus dataset and the WoS dataset were initially refined in Phase 5 (first step) through inclusion/exclusion criteria, reducing the contributions respectively to 308 and 174. The exclusion of conference papers is due to their commonly lower scientific impact and lower robustness [37]. The two datasets (Scopus and WoS) were subsequently merged into one, considering only once the overlapping papers. The resulting dataset was composed of 316 contributions.

Afterwards, by examining the title, abstract, and keywords, we assessed the appropriateness of the 316 papers with our research objectives and we reduced the number of contributions to 90 (Phase 5, second step).

Table 1. Review protocol.

Review Phase	Detail	Outcome
1. Identification of the keywords	The keywords identification was driven by the research purpose and by the recent contributions in this sector. The most accepted keywords in the targeted field were selected.	*"circular economy"; "closed-loop supply chain"; "antecedent"; "determinant"; "success factor"; "enabling factor"; "driver"; "enabler"*
2. Query string development	*"Circular economy"* and *"closed-loop supply chain"* were combined through the *OR* logical operator for obtaining a broader overview, including also contributions who use the concept of closed-loop supply chain. For the same reason, the *OR* operator was used for the keywords *"antecedent"; "determinant", "success factor", "enabling factor", "driver", "enabler"*. The operator AND was necessary for isolating only the contributions that are in the CE field and treat the drivers and/or CSFs.	*("circular economy" OR "closed-loop supply chain") AND (antecedent OR determinant OR "success factor" OR "enabling factor" OR driver OR enabler)*
3. Potential additional keywords	A first search in the Scopus database in "Title, abstract, keywords" was conducted. The keywords in the contribution obtained were analyzed through Scopus analytics and VOSviewer software. Current keywords were sufficiently comprehensive, no further keywords are needed	Current keywords are satisfactory; no further keywords are needed
4. Search string and database identification	We selected Scopus as scientific database because it is the largest abstract and citation repository of peer-reviewed literature. To triangulate the results, ISI Web of Science (WoS) was also considered [36]. The search in "Title, abstract, keywords" assures a wide coverage (almost "the maximum" one) of the results.	Database: Scopus; ISI WoS The query in Scopus was carried out in "Title, abstract, keywords". The query in WoS was carried out in "Title", "Abstract", "Author Keywords"
5. Refinement of the articles identified	This phase consisted of two steps. In the first step, the papers from Phase 4 were refined based on the inclusion/exclusion criteria and, then, the two datasets were merged. Specifically, we posed the following inclusion/exclusion conditions: Source type = Journal OR Review; Language = English; Time window = 2005 – Today (June 2020). Afterwards, the two datasets (Scopus and WoS) were merged in one, considering only once the overlapping papers. To be noted that 8 papers were present in the WoS dataset while not included in the Scopus dataset. In the second step, title, abstract and keywords of the 316 papers (merged dataset) were carefully examined to assess if they fit our research topic and purpose.	Input first step: 406 papers Scopus; 232 papers WoS Output first step: 308 journal papers Scopus; 174 journal papers WoS Merged dataset: 316 journal papers Output second step: 90 journal papers
6. Quality appraisal of articles identified	The full body of the 90 papers was evaluated on the basis of quality criteria (*Theory Robustness, Methodology, Scientific Contribution, Generalizability*) adapted from [33] in line with our research objective. This method was preferred to bibliometric metrics, e.g., number of citations, because the novelty of the CE field. In this way, a final subset of 55 papers was obtained.	Input: 90 papers Final output: 55 papers
7. Articles evaluation	The selected 55 papers were reviewed to identify a list of CE drivers and CSFs and to understand their potential role.	Analysis of the articles

Subsequently, the 90 manuscripts were scrutinized (Phase 6) by means of quality criteria (*Theory Robustness*, *Methodology*, *Scientific Contribution*, and *Generalizability*), which we adapted to our research purpose from [33]. One out of the five criteria proposed by [33]—*"Implication for practice"*—was not applied in this review because we aimed to include purely theoretical contributions unlike them. The description of the evaluation rules for the quality criteria is reported in Appendix A.

The 55 papers selected as the final group were analyzed in depth to identify a list of CE drivers and CSFs and understand their potential role (Phase 7).

3. Results and Discussions

The 55 selected manuscripts were carefully analyzed, in terms of content and quality, to elicit the CE drivers and CSFs as highlighted by the scientific literature. Sections 3.1 and 3.2 present and discuss the most relevant evidence obtained, respectively, for drivers and for CSFs, and Section 3.3 suggests the managerial implications of this work.

In addition, VOSviewer software, a text-mining software for analyzing the content of titles, keywords, and abstracts, was exploited to identify the most used "keywords" in the field and the connections between them [38,39]. Figure 1 shows the identified keywords and their relationships. The higher the significance and popularity of an item with respect to the other ones, the bigger is the node representing it. The cluster colors of the items indicate clusters of closely associated items. This bibliometric mapping analysis may help researchers find their way around in the considered investigation area.

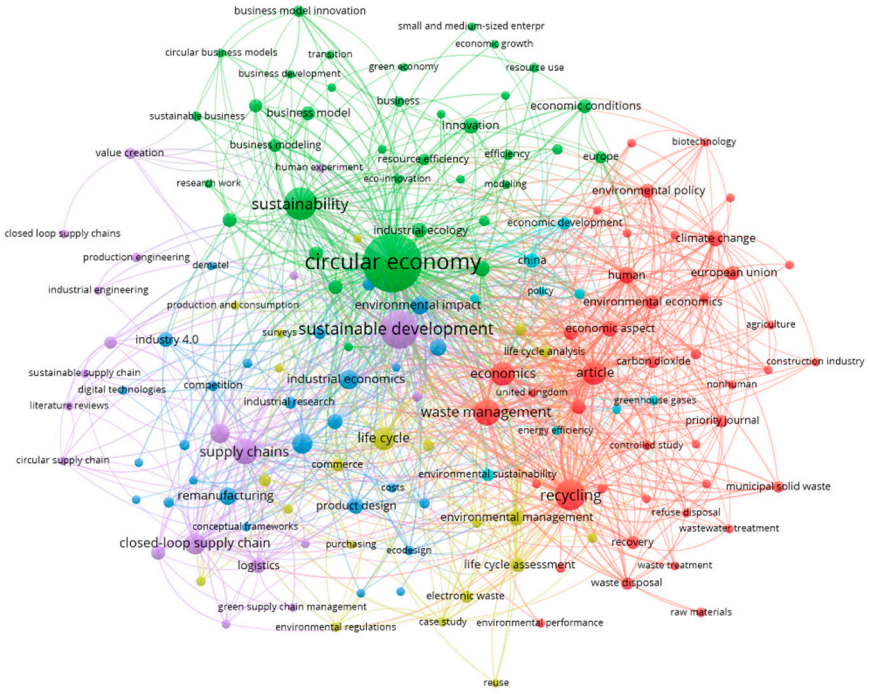

Figure 1. Map of keywords represented through the VOSviewer software.

As expected, the general words related to the research field, such as *Circular Economy*, *Sustainable development*, *Recycling* and *Sustainability*, are the most frequent keywords, with the term *Circular Economy* assuming the most preeminent role. It is noteworthy that *closed-loop supply chain*, although it is used by a specific stream of CE research, is less frequent in the scientific literature with respect to the terms previously reported. Thanks to this representation, scholars may define the most appropriate keywords for searching past research and/or for indexing their own.

3.1. Drivers

The analysis of the 55 journal papers enabled the identification of 14 drivers for CE initiatives (Table 2): Legal and regulatory environmental framework; Support; Potential for improving cost efficiency, profitability, revenue streams, and competitiveness; Potential for new business development and innovation; Environmental concerns; Strategical concerns; Skills and capabilities

for CE; Global pressure; Opportunity for job creation; Consumers' awareness; Communication and collaboration; Supply configuration; Technology for Rs; Information and Communication Technologies. Table 2 describes the drivers and reports the contributions that help to identify them.

Furthermore, to organize and cluster the CE drivers, they were classified in 7 dimensions: *Institutional*; *Economic*; *Environmental*; *Organizational*; *Social*; *Supply Chain*; *Technological*. These seven dimensions seem to be accepted in the literature, as reported by [24].

Table 2. The drivers of circular economy (CE) initiatives.

Dimension	Driver	Reference
Institutional	**Legal and regulatory environmental framework:** *policies, laws, directives, regulations, standard requirements set by institutions, including extra costs for environmental pollution and waste (inefficient consumption taxes), regulations on landfill and end-of-life.*	[5,14,23,24,27,40–44]
	Support: *tax cuts, refund policies, funding, low-interest loans, subsidies policies, incentives (e.g., for developing new solutions for waste collection, for cleaner production, for repairing or renovating products instead of purchasing new ones).*	[5,10,14,24,41–43,45]
Economic	**Potential for improving cost efficiency, profitability, revenue streams, and competitiveness:** *transportation cost savings, resources' efficient use and recover (Rs, rare materials included), rising resource demand, higher resources cost, cost reduction and higher profitability from circular use of resources, profitability / firm performance / competitiveness, access to funding, response to competition, reducing dependency from raw materials import, volatility of resources' price.*	[5,10,13,14,23,24,27,41,43–52]
	Potential for new business development and innovation: *new value creation, accessing green, niche or new markets.*	[13,14,24,27,28,46–49]
Environmental	**Environmental concerns:** *climate change and global warming, overconsumption of energy and resources, scarcity of resources, environmental safety, resource constraints.*	[10,13,23,24,27,43,45,46,52]
Organizational	**Strategical concerns:** *brand reputation and social responsibility, business resiliency, ISO 14001 certification, corporate strategy for CE and sustainability, change to a sustainable and competitive business model, quality of circular products, potential for differentiation and strengthening.*	[5,14,23,24,27,28,43,46,49,51,53]
	Skills and capabilities for CE: *training and education for CE, development of skills and capabilities for CE, employee involvement and motivation towards CE and sustainability.*	[14,24,45,46,53]
Social	**Global pressure:** *pressure towards greening and healthier practices from community, competitors, society.*	[10,14,23,24,27,28,45,52,54]
	Opportunity for job creation	[23,24,48,52,54]
	Consumers' awareness: *environmental awareness, shifting of consumer preferences (e.g., from ownership of assets to service models and to sustainable products).*	[5,10,14,23,28,43,45,52]
Supply Chain	**Communication and collaboration:** *environmental collaboration with customers / suppliers, collaboration or partnership with stakeholders (organizations, NGOs, government) within the SC, communication practices and knowledge sharing, potential for reducing supply dependence and avoiding high and volatile prices, interconnection capacity (geographical proximity, affinity of company management to work in an interconnected manner).*	[5,10,14,24,26,27,45–47,50]
	Supply configuration: *SC integration, management of reverse network, supply market structure.*	[5,13,14,24,26,46,47].
Technological	**Technology for Rs**	[5,13,14,24,27,43–45,50,54]
	Information and Communication Technologies	[13,24,44,54]

The list of drivers here presented can answer the question "Which factors may encourage an organization to undertake CE actions?".

As demonstrated by the review results, many elements with different natures may push business organizations to embark on CE initiatives. The most important drivers appear to be the Institutional and the economic ones [14], although the social ones are growing in importance. In particular, consumers' awareness and global pressure seem to play a very important role in CE projects (e.g., Moktadir et al., 2018; Salim et al., 2019; Jia et al., 2020; Notteboom et al., 2020) [10,28,45,52]. For instance, [45] showed the high relevance of customer awareness for two leather-processing companies in Bangladesh. The study also discovered that this factor is more important for large-scale companies than smaller ones.

Institutional interventions from governments and other regulatory bodies heavily affect the economic choices of organizations and can really stimulate CE innovations, as well as other actions in the sustainable direction [24,42,55,56]. For this reason, institutional support and the legal and regulatory environmental framework may be the real keys to a strong future advancement of CE in the economic world, questioning the linear economic model. For example, [42] show the importance of a proper environmental legislation for municipal waste management companies, underlining how EU legislation —though appropriate public economic incentives—can be one of the major differences between the development level reached by companies in Slovenia and Serbia. While confirming the relevance of an adequate legislation, [10] remarked the preeminent importance of the institutional financial support for implementing a circular business model in the textile industry.

However, the effects of CE drivers can also highly depend on the specific context involved, e.g., the business sector, the country, and the type of organizations [23]. Although the scientific literature is quite rich, more in-depth investigations of the effects of CE drivers in different business environments are desirable. For example, different aspects can urge companies to apply CE logics in the commodity markets (e.g., paper, iron, and plastic) and in highly specialized markets (e.g., precision electronics, planes, and industrial machines). Likewise, the drivers pushing organizations toward CE initiatives may be very dissimilar between developed countries and underdeveloped ones.

For potential further research, the list of CE drivers detected in the literature may guide researchers in the study of CE business contexts and/or specific CE projects, preventing the neglect of any possible relevant driver. Moreover, suggestions for future research on CE drivers are reported in Section 4.

3.2. Critical Success Factors

The analysis of the 55 journal papers also allowed the identification 13 CSFs for CE initiatives (Table 3): *IS and ICT; Rs Technology; Financial support; Financial and economic sustainability; Legal and regulatory environmental framework; Public awareness; Support; CE-oriented business model; Company culture; CE-oriented knowledge and information management; CE-oriented environmental strategy; Coordination and collaboration; Consumer awareness*. Table 3 describes each CSF and reports the contributions that help to identify each of them.

To the best of our knowledge, dimensions which classify CSFs of CE had not been identified in the scientific literature. Thus, we elicited through this review the dimensions in which to classify CSFs. Five dimensions were established: *Technological*; *Economic and Financial*; *Institutional*; *Strategic*; *External*. The identification of CE dimensions for organizing the CSFs, as reported in Table 3, should be considered a contribution of this work.

The list of CSFs here presented can answer the questions *"Which are the enabling factors of CE initiatives?"* and *"Which capabilities/conditions may support the implementation of CE business models?"*.

Table 3. The critical success factors (CSFs) of CE initiatives.

Dimension	Critical Success Factor	Reference
Technological	**IS and ICT:** *includes all digital ICT technologies, digital intelligence, networks, etc.*	[20,22,25,40,48,57–62]
	Rs Technology: *technological product and process innovations to enable and/or improve the Rs.*	[16,26,29,31,32,49,52,60–65]
Economic and financial	**Financial support:** *possibility to access (internal or external) funding sources.*	[25,31,49,66–68]
	Financial and economic sustainability: *consistency between revenue gains/cost savings and necessary investments.*	[15,18,20,25–27,31,67]
Institutional	**Legal and regulatory environmental framework:** *national policies; laws and regulations; administrative enforcement and supervision capacity; other environmental limits (e.g., landfill practices).*	[18,24,25,31,32,48,52,54,63,65,67–69]
	Public awareness: *increased public awareness about CE, sustainability paradigm, and the risk of pollution for environment (safety and health risks).*	[20,25,26,31,40,41,49,52,63,67,69]
	Support: *economic support (e.g., loans, subsidies, tax cuts, incentives), legislative support from public institutions and other bureaucratic bodies.*	[18,25,26,40,49,52,61,65,66,68]
Strategic	**CE-oriented business model:** *includes standardization and warranties for recycled products; greater marketing of upcycled products; development of higher value secondary market; redistributed manufacturing; green purchasing; environmental management system; best practice case studies.*	[22,26,32,52,61–63,65,66,68,70–73]
	Company culture: *includes trust and openness, sustainability awareness, environmental culture.*	[15,18,20,24,59,74–76]
	CE-oriented knowledge and information management: *four phases of Knowledge Management, individual and organizational know how, education, skills, knowledge on environmental consequences, knowledge on Rs, internal coordination and collaboration, information on other industries, feasibility studies to analyze potential synergies, market knowledge, know how on sustainable technologies.*	[15,18,24,25,40,49,65–69,71,74,75,77,78]
	CE-oriented environmental strategy: *corporate social responsibility; CE-oriented vision; policies for CE practices; commitment and support; green image.*	[15,18,24,27,31,32,52,61,65,67,71,76]
External	**Coordination and collaboration:** *collaboration and coordination with external stakeholders (e.g., suppliers, customers, NGOs, regulators, producers, dismantlers, recyclers, and so on) by networking, information and knowledge sharing (e.g., on components and disassembly procedures), conjoint development of products and capabilities, collaboration on CE targets for Rs, SC redesign, distributed responsibility for CE implementation across SC.*	[15,16,18,20,25,32,40,49,52,60–62,65,67,71,74,76,78–81]
	Consumer awareness: *awareness of the consumers on CE and sustainability, including their perception towards CE and used products.*	[31,32,65,66,76]

This review confirms that many factors with different natures may enable business organizations to succeed in CE initiatives. The most important aspect seems to be the strategic one, as CE interventions usually require a strong and long-term strategy for completing the CE transition [15,18,71,82]. For example, the investigation of 61 shows the importance of a long-term strategies, in particular a CE-oriented business model, for the French companies in the electric vehicle battery field. Based on the role in the supply chain, companies should apply different business models, which determine

their development and market success. In parallel to a strong long-term strategy adopted by the company managers, the awareness of consumers may also play a fundamental role in the success of CE implementations. [65], for example, showed this element, alongside others, in the wood cascading market.

The empirical case studies examined in this work also underline the very significant role played by public institutions in the CE implementations (e.g., Bathia and Kumar Srivastava, 2019; Yu et al., 2014) [14,63]. In particular, two aspect were highly relevant: the economic support—e.g., public subsided loans, non-repayable subsidies, tax cuts, and economic incentives—which public institutions may provide, and the national/regional laws and administrative authorizations, which sometimes can make the implementations of CE initiatives very tricky. Proper institutional interventions, through laws and funds, may create the conditions suitable for enabling numerous CE initiatives, increasing their percentage of success. Without this group of factors, it is difficult for business organizations to succeed in CE action, though some positive experiences are reported [83]. For instance, [63] displayed the importance of institutional support for the development of CE initiatives in North American manufacturing organizations, revealing also the very relevant effects of different state legislations/support in the USA.

As well as for the CE drivers, the CSFs are contingent to the specific context involved, such as the business sector, the country, and the type of organizations [73]. Therefore, a more in-depth examination of CSFs in different business settings is desirable, paying particular attention to the differences between developed and developing countries, given the importance of institutional backing. The products and materials involved also play a very significant role in determining which CSFs have the most impact on the CE initiatives.

Understand better the dynamics behind the CSFs identified and how they can enable the success of CE interventions in different business environment constitutes an important further development of the scientific literature. In Section 4, suggestions for further research on CSFs are presented.

In addition, thanks to this list of CSFs currently identified by the literature, researchers can explore the potential presence of further enabling factors, maybe some context-specific ones, which have remained neglected until now.

3.3. Managerial Implications

The findings of this study also provide interesting managerial implications. The opportunities for business organization to transform their linear economic model into a more circular one are very relevant. However, understanding which CE interventions may or may not be convenient remains a challenging task. The list of drivers here reported may enable companies and practitioners to focus on the most important aspects in the evaluation of potential CE initiatives, supporting the elaboration of the economic feasibility plan of such interventions [84].

The growing pressure from public opinion on the sustainability issue is urging policymakers and intergovernmental organizations to pay more attention to CE drivers, in particular the institutional one, for favoring a wider application of the CE paradigm [6–8]. With this aim, the comprehension of CE drivers, provided by this paper, may help policymakers to introduce legislation supporting CE practices.

The review also singled out the enablers of CE initiatives through a list of CSFs identified by the scientific literature. In this way, this paper may help organizations in appraising the feasibility of concurrent hypothesized CE actions.

The list of CSFs may also assist business organizations and practitioners in the planning of CE interventions helping to focalize the attention on the most critical factors, which can strongly affect the likelihood of success of such interventions.

Finally, the identification of CSFs may also help policymakers and public institutions in discerning which factors can enable or hinder the implementations of CE paradigms in different business environments and then, it may promote a more encouraging CE legislation.

4. Conclusions and Indications for Further Research

CE is emerging as a novel approach in the broad context of sustainability. As a more sustainable economy is becoming a priority for the whole world, the transition from a linear to a circular economic model is in the spotlight. In this context, this paper investigates the drivers and CSFs of CE initiatives by developing a systematic literature review. Drawing from a critical analysis of 55 papers, a list of drivers and a list of CSFs was elaborated, following specific dimensions identifiable from past research for their classification.

The literature analysis reveals that more context-specific research evaluating drivers and CSFs in numerous business sector is needed. Our findings also provide researchers with indications for further research on drivers and CSFs in real CE initiatives. Specifically, Tables 4 and 5 present suggestions for future research on drivers and CSFs, respectively.

Relevant managerial directions (Section 3.3) are also pinpointed to support and encourage business organizations toward CE initiatives and toe guide legislators in law-making processes on the CE issue and the linked sustainability incentives.

Table 4. Suggestions for further research on CE drivers.

Driver	Suggestions for Further Research
Institutional	How may institutional regulations and policies facilitate industrial symbiosis? How may CE institutional support differ between commodity and non-commodity products? Which is the actual effectiveness of the different forms of economic-financial incentives in driving the CE transition?
Economic	To which extent may cost savings, higher firm profitability, and better competitiveness be enabled by CE practices? How may the potential economic benefit be affected by the market characteristics? Which new niches or markets may CE enable to develop?
Environmental	To which extent may CE practices reduce the exploitation of new resources? Are environmental concerns an actual priority driver in the firms' agendas?
Organizational	How may CE strategies affect product differentiation? Does the market reward the production of circular products? How may a firm choose the most appropriate CE practices to pursue its circular strategy? What are the new professional figures needed in circular markets? And which skills should they possess?
Social	Which may be the impact of the CE transition on job turnover and on the creation of new job roles? Which are the most effective means for a firm to communicate its CE values? How much are the new servitization business models adopted by the firms and appreciated by the customers?
Supply Chain	Which is the actual impact of the new CE actors (e.g., CE service brokers, decomposers, scavengers) on firms SC performances? How may forward SC issues (e.g., demand forecasting, bullwhip effect) affect reverse SCs? And how to cope with them?
Technological	How may collaborative technologies support the development of a CE strategy [85]? How may data integrity be granted in circular ecosystems?

Table 5. Suggestions for further research on CE CSFs.

CSF	Suggestions for Further Research
Technological	Which role may Distributed Ledger Technologies play in circular ecosystems? How may Enterprise Systems embed CE management processes? Which may be the most effective and innovative ICT to leverage in CE ecosystems? To which extent may technology-enabled process innovations contribute to the success of a CE strategy?
Economic and Financial	Which founding sources should be more accessible to stimulate the transition towards CE? How may Closed-Loop Supply Chains benefit from collective funding initiatives, such as crowdfunding?
Institutional	How may institutions support the regulation of new actors, such as scavengers, decomposers, and dismantlers? Which may be the most effective channels to raise public awareness concerning CE? Which may be the main legislative voids to fill for facilitating the implementation of CE strategies?
Strategic	Which may be the most effective and efficient strategies to enhance competitiveness in the secondary raw materials market? What may be the most relevant hurdles to CE-oriented change management activities? How should firms educate, train, and empower their human resources to catalyze the sustainable circular transition? Should the organizational structure be redesigned to spread CE-oriented commitment across all the firm's levels?
External	Which are the main CE collaborative patterns in Closed-Loop Supply Chains? And how do they differ among different markets? What may be the risks associated with the distributed responsibility for CE implementation across the SC? Which may be the benefits and drawbacks of integrating dismantlers and recyclers into a firm's own business? Which may be the most effective and efficient knowledge sharing practices in CE ecosystems?

Author Contributions: Conceptualization, D.A., R.D., V.M., A.S. and P.Z.; Methodology, D.A., R.D., V.M., A.S. and P.Z.; Formal Analysis, D.A., R.D., V.M., A.S. and P.Z.; Investigation, D.A., R.D., V.M., A.S. and P.Z.; Writing—Original Draft Preparation, D.A., R.D., V.M., A.S. and P.Z.; Writing—Review and Editing, D.A., R.D., V.M., A.S. and P.Z.; Supervision, D.A., R.D., V.M., A.S. and P.Z. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

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

Appendix A

All the 90 papers were evaluated based on four quality criteria adapted to our research purpose from [33]: *Theory Robustness, Methodology, Scientific Contribution,* and *Generalizability*. Each paper obtained a score from 0 to 3 for each criterion as proposed by [33]. Afterwards, the papers were selected through specific rules, as reported by Table A1. Following these rules, a final subset of 55 papers was obtained.

Table A1. Rules for selecting the papers based on the quality criteria.

Rule	Description	Justification
Rule *1*	*Scientific contribution*, *Theory robustness* ≥ 2	Selection of papers with a strong contribution and with sound foundations
Rule *2*	*Generalizability* and *Methodology* ≥ 1	The generalizability of several research in the field are low because numerous CE drivers and CSFs tend to be context-specific; since the fragmentation of the CE research field, research design turn to be very specific;
Rule *3*	Total evaluation ≥ 8	To guarantee a sufficient overall quality for the selected papers

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