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Review

The Circular Economy – A new sustainability paradigm?

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ABSTRACT

While the terms Circular Economy and sustainability are increasingly gaining traction with academia, industry, and policymakers, the similarities and differences between both concepts remain ambiguous. The relationship between the concepts is not made explicit in literature, which is blurring their conceptual contours and constrains the efficacy of using the approaches in research and practice. This research addresses this gap and aims to provide conceptual clarity by distinguishing the terms and synthesising the different types of relationships between them. We conducted an extensive literature review, employing bibliometric analysis and snowballing techniques to investigate the state of the art in the field and synthesise the similarities, differences and relationships between both terms. We identified eight different relationship types in the literature and illustrated the most evident similarities and differences between both concepts.

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1. Introduction

There is a pressing need to transition to more sustainable sociotechnical systems (Meadows et al., 2004; WBCSD, 2010; Seiffert and Loch, 2005; Markard et al., 2012). Environmental problems, such as biodiversity loss, water, air, and soil pollution, resource depletion, and excessive land use are increasingly jeopardising the earth's life-support systems (Rockström et al., 2009; Jackson, 2009; Meadows et al., 2004; WWF, 2014). Societal expectations are not met due to issues such as high unemployment, poor working conditions, social vulnerability, the poverty trap, inter- and intra-generational equity, and widening inequalities (Banerjee and Duflo, 2011; Sen, 2001; Prahalad, 2004). Economic challenges, such as supply risk, problematic ownership structures, deregulated markets, and flawed incentive structures lead to increasingly frequent financial and economic instabilities for individual companies and entire economies (Sachs, 2015; Jackson, 2009).

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To address these and other sustainability issues, the concept of the Circular Economy – while not entirely new – has recently gained importance on the agendas of policymakers (Brennan et al., 2015). This becomes evident, for instance, in the comprehensive European Circular Economy package (European Commission, 2015) and the Chinese Circular Economy Promotion Law (Lieder and Rashid, 2016). The Circular Economy has also become an important field of academic research with a steep increase in the number of articles and journals covering this topic during the last decade. Companies are also increasingly aware of the opportunities promised by the Circular Economy and have started to realise its value potential for themselves and their stakeholders (EMF, 2013b).

Despite the concept's importance for academia, policymakers, and companies, the conceptual relationship between the Circular Economy and sustainability is not clear. This has potential detrimental implications for the advancement of sustainability science and the diffusion of practices based on these concepts. Therefore, this research aims to contribute to conceptual clarity by investigating the similarities, differences, and relationships between both concepts in theory.

The paper is structured as follows. Section 2 covers a brief literature review that is introducing sustainability and the Circular Economy by presenting their origins, synthesising their conceptual definition, and illustrating their relevance for research and practice. The subsequent section describes the research design by presenting the research questions and the methods employed, including the implemented snowballing and the outcomes of a bibliometric research that helped to determine the sample of articles that would initially be investigated. Section 4 presents the results of the research, first illustrating the identified relationships between sustainability and the Circular Economy, before similarities and differences are contrasted. This is followed by a discussion of our findings. The paper concludes with final remarks on the contributions of this research, its limitations, and interesting fields for further research.

2. Background

This section provides a short introduction to the two main concepts addressed in this research, sustainability and the Circular Economy. Starting with the former and concluding with the latter, this chapter briefly introduces the historical origins of the concepts, compares and synthesises the selected definitions, and discusses the notions' relevance.

2.1. Sustainability

Sustainability concerns are increasingly incorporated into both the agendas of policymakers and the strategies of companies. The term *sustainability* itself originates in the French verb *soutenir*, "to hold up or support" (Brown et al., 1987) and its modern conception has its origins in forestry. It is based on the silvicultural principle that the amount of wood harvested should not exceed the volume that grows again. This conceptualisation was written down already in the early 18th century in "*Sylvicultura oeconomica*" (von Carlowitz, 1713), and there seem to be even older sources that follow the underlying principles in face of shortages in wood supply and the husbandry of cooperative systems (Mantel, 1990). Later, it was transferred to the context of ecology, as a principle of respecting the ability of nature to regenerate itself (Duden, 2015), from where the modern definition of being "able to be maintained at a certain rate or level" (Dictionary, 2010) developed.

Johnston et al. (2007) estimated that there are around 300 definitions of sustainability. To cite but a few, sustainability can be defined as a situation in which human activity is conducted in a way that conserves the functions of the earth's ecosystems (ISO 15392, 2008), a transformation of human lifestyle that optimises the likelihood that living conditions will continuously support security, well-being, and health, particularly by maintaining the supply of non-replaceable goods and services (McMichael et al., 2003), or an indefinite perpetuation of all life forms (Ehrenfeld, 2010).

The concept's uptake can be traced back to the increasing evidence on global-scale environmental risks, such as ozone depletion, climate change, biodiversity loss or the alteration of the nitrogen cycle. These risks have been systematically investigated since the 1960s, raising questions about whether present prosperity trends can be maintained in the future (Clark and Crutzen, 2005; Rockström et al., 2009) and, consequently, revealing many sources of tensions. This includes, for example, the limited store of resources, its uneven geographical distribution and appropriation (e.g. Georgescu-Roegen, 1977), and the implications of the assimilative capacities of ecosystems over economic growth (e.g. Daly and Townsend, 1993).

These sources of tensions were condensed by the environmentalists Ehrlich and Commoner in their equation "I = P x A x T". Environmental impact (I) is a function of three factors: population (P); affluence, which is a proxy to represent consumption (A); and technologies (T) (Chertow, 2001; Commoner, 1971; Holdren and Ehrlich, 1974). The emphasis given to population, consumption, and technologies, as well as the interrelation between these variables, has varied considerably among scholars. Some emphasise demographic control (e.g. Hardin, 1968), others would rather advocate for reduction in consumption levels (e.g. Woollard and Ostry, 2000), and an increasing number of scholars highlight the role of science, technology, and innovation in fuelling social inclusion and environmental resilience (e.g. Hart and Milstein, 2003; Kemp and Pearson, 2007; Cohen, 2006).

The emergence of such tensions fuelled a series of international discussions on the complex and dynamically interconnected nature of the environment, society and the economy (Kates et al., 2005). These discussions challenged oversimplified development frameworks and their assumptions about economic growth. The Stockholm Conference in 1972 and the report *Limits to Growth* had wide repercussions due to their interpretation of "development" and "environment" as contradictory elements of an intrinsic trade-off (Sachs, 2015; Jackson, 2009). Nevertheless, the most prominent understanding of sustainable development arose with the Brundtland Report (1987), which came not as a reformulation of the terms of such trade-offs, but rather as an answer to its apparent conflicts (Nobre and Amazonas, 2002): "The concept of sustainable development does imply limits – not absolute limits but limitations imposed by the present state of technology and social organization on environmental resources and by the ability of the biosphere to absorb the effects of human activities" (Brundtland, 1987:8).

The Brundtland Commission also provided the most commonly accepted definition of sustainability as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland, 1987). Despite being initially driven by environmental concerns, the term *sustainable development* has since then accommodated a variety of expectations for desirable progress: "the concrete challenges of sustainable development are at least as heterogeneous and complex as the diversity of human societies and natural ecosystems around the world" (Kates et al., 2005:8). The broad colloquial meaning of the verb "to sustain" refers to maintaining unspecified features over time, while "development" can comprise multiple interpretations, varying according to values, interests and disciplinary conventions. Nevertheless, all perceptions of sustainable development seem to invoke feelings of desirability and goodness

(or avoidance and badness), nurturing reflexivity upon shared responsibilities and alternative directions of progress (Stirling, 2009).

Particularly relevant to the widespread diffusion of the term and its most contemporary understandings is the so-called triple bottom line (Elkington, 1997), the three pillars of sustainability: people, profit, and planet. After the World Summit in 2002, the triple bottom line has been referred to as the balanced integration of economic, environmental and social performance. The three spheres are systemically intertwined and continuously and cumulatively affect one another through mutual causality and positive feedbacks (Mckelvey, 2002). In other words, they act as "as interdependent and mutually reinforcing pillars" (UN General Assembly, 2005) that can be adapted to a broad range of different contexts and time horizons (Wise, 2016).

Based on this, and with regards to maintaining the holistic, adaptive, and flexible nature of sustainability, the term sustainability is framed in this article as *the balanced and systemic integration of intra and intergenerational economic, social, and environmental performance.*

Instead of merely setting common goals, sustainability opens up the scope for multiple expectations about, for example, what should be developed and what is to be sustained, for how long, and for the benefit of whom (Acero and Savaget, 2014). It has encouraged reflexivity on how to expand intragenerational prosperity while simultaneously preserving life-support systems needed to meet intergenerational needs.

Despite divergence in the perceived strengths and weaknesses of the term and its associated responses, sustainability has been institutionalised into the agendas of policymakers and strategies of large organizations, becoming cumulatively more embedded into the rules that structure social interventions and shape behaviour (Hodgson, 2005). While incorporating a broad range of contradictions and being ambiguously instrumentalised by diverse interest groups, the concept proves to be a "political concept as persistent as are democracy, justice and liberty" (O'Riordan, 1993:48).

2.2. Circular Economy

The concept of the Circular Economy has been gaining momentum since the late 1970s (EMF, 2013b). Several authors, like Andersen (2007), Ghisellini et al. (2016), and Su et al. (2013) attribute the introduction of the concept to Pearce and Turner (1989). By describing how natural resources influence the economy by providing inputs for production and consumption as well as serving as a sink for outputs in the form of waste, they investigate the linear and open-ended characteristics of contemporary economic systems. This is influenced by Boulding's (1966) work, which describes the earth as a closed and circular system with limited assimilative capacity, and inferred from this that the economy and the environment should coexist in equilibrium.

Stahel and Reday (1976) introduced certain features of the Circular Economy, with a focus on industrial economics. They conceptualised a loop economy to describe industrial strategies for waste prevention, regional job creation, resource efficiency, and dematerialisation of the industrial economy. Stahel (1982) also emphasised selling utilisation instead of ownership of goods as the most relevant sustainable business model for a loop economy, allowing industries to profit without externalising costs and risks associated with waste.

The contemporary understanding of the Circular Economy and its practical applications to economic systems and industrial processes has evolved to incorporate different features and contributions from a variety of concepts that share the idea of closed loops. Some of the most relevant theoretical influences are cradle-to-cradle (McDonough and Braungart, 2002), laws of ecology (Commoner, 1971), looped and performance economy (Stahel, 2010), regenerative design (Lyle, 1994), industrial ecology (Graedel and Allenby, 1995), biomimicry (Benyus, 2002), and the blue economy (Pauli, 2010).

The most renowned definition has been framed by the Ellen MacArthur Foundation, introducing the Circular Economy as "an industrial economy that is restorative or regenerative by intention and design" (2013b: 14). Similarly, Geng and Doberstein (2008: 231), focusing on the Chinese implementation of the concept, describe the Circular Economy as the "realization of [a] closed loop material flow in the whole economic system". Webster (2015: 16) adds that "a circular economy is one that is restorative by design, and which aims to keep products, components and materials at their highest utility and value, at all times". Accordingly, Yuan et al. (2008: 5) state that "the core of [the Circular Economy] is the circular (closed) flow of materials and the use of raw materials and energy through multiple phases". Bocken et al. (2016: 309) categorise the characteristics of the Circular Economy by defining it as "design and business model strategies [that are] slowing, closing, and narrowing resource loops".

Based on these different contributions, we define the Circular Economy as *a regenerative system in which resource input and waste, emission, and energy leakage are minimised by slowing, closing, and narrowing material and energy loops. This can be achieved through long-lasting design, maintenance, repair, reuse, remanufacturing, refurbishing, and recycling.*

The circular economy has received increased attention in academic research with a range of reviews on the topic by Andersen (2007), Ghisellini et al. (2016), Lieder and Rashid (2016), and Su et al. (2013). Specific areas of attention are closed loop value and supply chains (Guide and Van Wassenhove, 2009; Wells and Seitz, 2005; Govindan et al., 2015; Stindt and Sahamie, 2014), circular business models (Bocken et al., 2016) and circular product design (Bakker et al., 2014).

The work of the Ellen MacArthur Foundation is important in this context. The Foundation has published a range of publications on the topic, including a book by Webster (2015) and a series of reports (EMF, 2014, 2013a, 2013b). The Foundation also acts as a collaborative hub for businesses, policy makers, and academia. Various consultancies have now tapped into the opportunities of a Circular Economy (e.g. Lacey and Rutqvist, 2015 and McKinsey through the support of the Ellen MacArthur Foundation in EMF, 2013a, b, for example).

The concept has also gained traction with policymakers, influencing governments and intergovernmental agencies at the local, regional, national, and international level. Germany was a pioneer in integrating the Circular Economy into national laws, as early as 1996, with the enactment of the "Closed Substance Cycle and Waste Management Act" (Su et al., 2013). This was followed by Japan's 2002 "Basic Law for Establishing a Recycling-Based Society" (METI, 2004), and China's 2009 "Circular Economy Promotion Law of the People's Republic of China" (Lieder and Rashid, 2016). Supranational bodies have also incorporated circular economy concerns – most notably the EU's 2015 Circular Economy Strategy (European Commission, 2015).

3. Research design

The previous sections summarised the history, definition, and relevance of sustainability and the Circular Economy. Both concepts are essentially global in their nature, sharing concerns with the current state of technology, industrial production, and consumption, which might not only jeopardise future generations, but also present sources of unexplored competitive advantage. They also stress the importance of better integrating environmental and

social aspects with economic progress, and set system-level changes at their very core.

Apart from these similarities, the concepts are notably used in different contexts and with different purposes. Sustainability, in particular in its early rooting of sustainable development (Brundtland, 1987), is more open-ended than the Circular Economy (Yuan et al., 2008) and used to justify a broader variety of institutional commitments and to signal a wider set of risks and opportunities. Although both concepts are being adopted by a growing number of academics and practitioners, the relationship between both notions has not been studied extensively, and the similarities and differences between them remain underexplored. Knowledge about their relationship, similarities, and differences is relevant for conceptual clarity, as well as to reveal the interests and goals behind the use of these terms by policymakers and companies. Therefore, this research can assist efforts aiming at integrating these concepts to better promote social inclusion, environmental resilience, and economic prosperity.

To investigate the research gap, the following two research questions were formulated:

RQ 1: What are the main conceptual similarities and differences between sustainability and the Circular Economy?
RQ 2: How is the Circular Economy conceptually related to sustainability?

To work towards answering these two research questions, we employed different methodological techniques.

First, we conducted a bibliometric research, a well-established form of meta-analytical research of literature (Kim and McMillan, 2008). This is a method that analyses published data, measuring texts and information such as authorship, affiliation, citations, and keywords (Bellis, 2009), unveiling articles and illustrating linkages between and among articles about a certain research topic (Fetscherin and Usunier, 2012). It can be used to describe, evaluate and monitor the state of a particular field over time, evaluating meta-analytically the development of a given research area to identify their key components and underlying theoretical frameworks (Fetscherin and Heinrich, 2015). A bibliometric review was thus conducted to identify the articles that describe both sustainability and the Circular Economy, while also revealing the most cited authors, keywords mentioned, and the journals in which they were published.

Data were collected from Web of Science in January 2016 by searching with the strings *"circular economy"*, *sustainability* and *"circular economy" AND sustainability*, as shown in Table 1. The search was applied to topics and for publications in English that were published after 1950. These searches helped identifying the initial sample of papers that would be investigated in depth through an extensive literature review. Furthermore, as the Circular Economy is a recent research topic, we observed the importance of analysing its emergence and progress before analysing its relationship with literature on sustainability. Therefore, for the 295 records on the Circular Economy, we used the open source software NAILS to carry out the statistical and network analysis functions (Knutas et al., 2015) needed to uncover and quantitatively describe our dataset. It is important to mention that all abstracts resulting from the searches were scanned to filter out irrelevant publications. The most relevant results are demonstrated below, in Figs. 1–4.

Fig. 1 shows a steep increase in the number of publications on the Circular Economy, reaching a more than tenfold growth in the last 10 years. Nevertheless, the absolute number of publications on the Circular Economy is small when compared to publications on sustainability (see Table 1). This finding suggests that research on the Circular Economy may be far from saturated, and there is great room for improvement in terms of conceptual development and cross-fertilisation from other research fields.

Figs. 2 and 3 show, respectively, the most common locations of authors and the most cited publications. Only one country (China) has more than 100 publications, presenting almost four times the number of the second in the ranking, England. The same applies to the most cited publications, as the first, Journal of Cleaner Production, has more than twice the number of publications than the second in the ranking. That indicates that a few players have taken the lead in the conceptual development of this emerging topic, with China as the top-ranking country, which is not surprising given its Circular Economy Promotion Law (Lieder and Rashid, 2016).

Fig. 4 presents the most popular keywords. Among them are subtopics of the Circular Economy, such as recycling, reuse, waste management, and eco-efficiency. It also incorporates other concepts and schools of thought that are cross-fertilised with the Circular Economy, such as industrial symbiosis and sustainable development. Interestingly, China, in addition to being the country of origin of most of the authors, is also one of the most popular keywords, reflecting the efforts the country has been taking since it began regulatory implementation in 2009 (Lieder and Rashid, 2016), inspiring not only new practices and evidences, but also authors covering the geographical contexts and jurisdictional performances.

These steps offered a better understanding of the coverage of our research topic and contributed to identifying the sample of articles that should be investigated in depth through an extensive review of the literature. This review started with a sample of relevant papers published by highly cited journals and academics, which was then followed by a semi-structured snowballing approach (Wohlin, 2014), to capture both established and emerging conceptual trends (see Fig. 5).

The snowballing started with the definition of an initial sample of relevant papers, which contained 295 documents arising from the search on "Circular Economy". As demonstrated in our bibliometric results, we included publications since 1950 into our sample, although most publications are dated since 2006 and the numbers of documents increased steeply in the last 4 years.

The authors first scanned the titles and abstracts of these papers, then focusing on examining the full content of the 67 articles stemming from the search on "Circular Economy" AND "Sustainability". It is important to stress that we concentrated on peer-reviewed scientific journal articles in English to ensure the quality of our sample, but we subsequently selected a limited number of influential publications from non-profits and international organizations (such as the OECD and the Ellen MacArthur Foundation). The inclusion of non peer-reviewed articles was appropriate since

Table 1
Number of articles and reviews resulting from search string.

Search term	Number of articles and reviews found in Web of Science
"Circular economy"	295
Sustainability	59,464
"Circular economy" AND sustainability	67

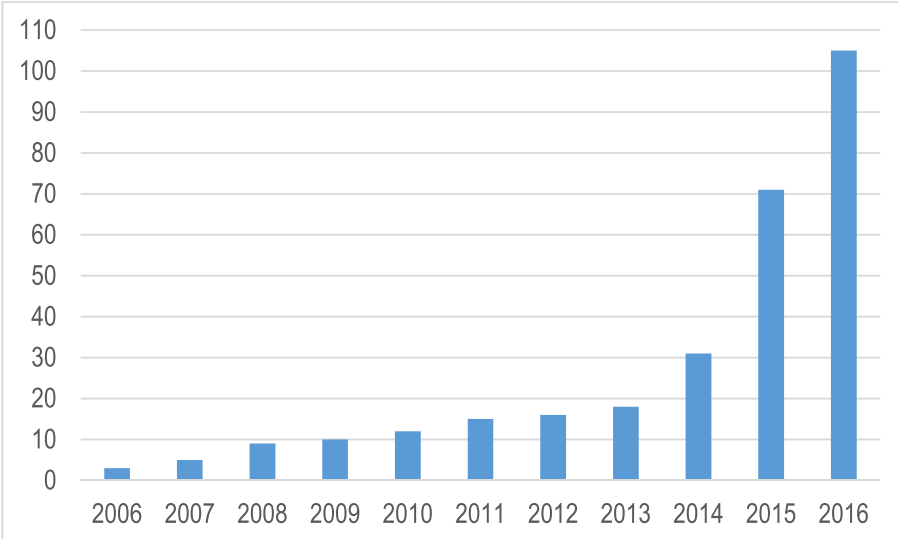

Fig. 1. Number of reviews and articles per year with the topic circular economy on Web-of-Science.

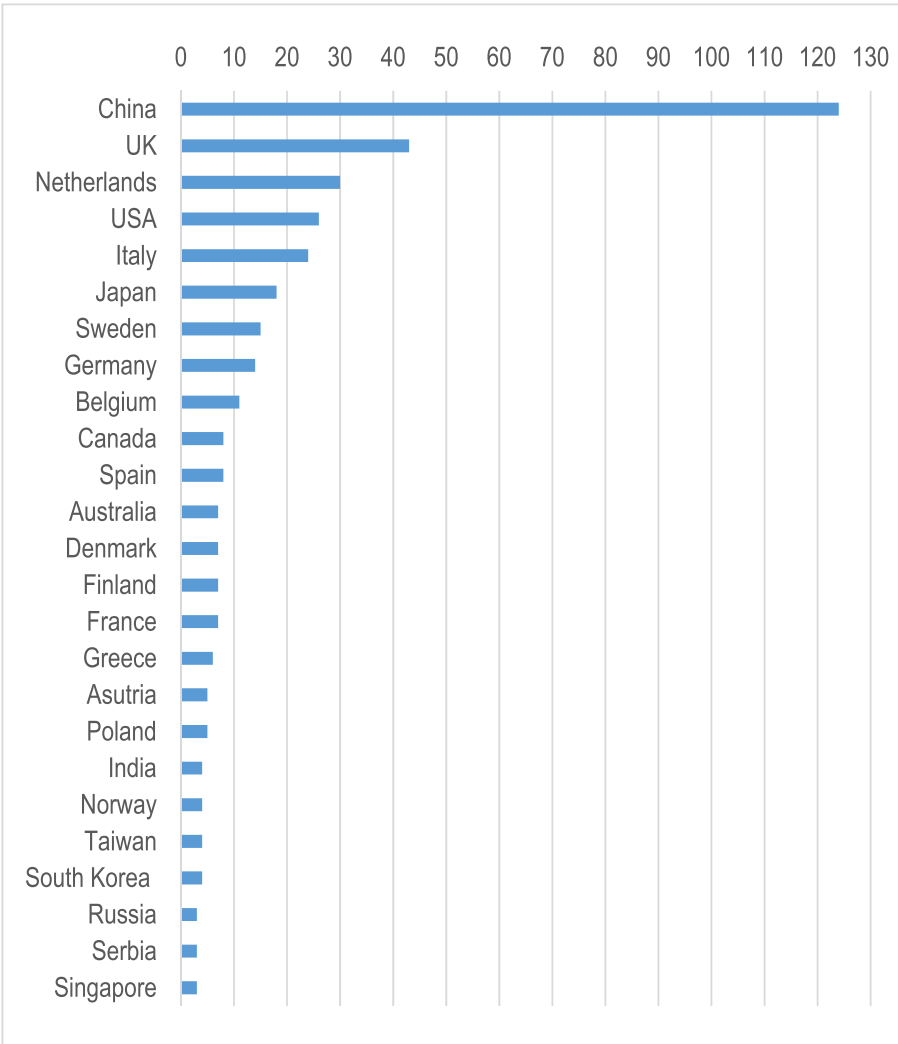

Fig. 2. Most common geographical locations of authors of reviews and articles with the topic circular economy that have more than three publications.

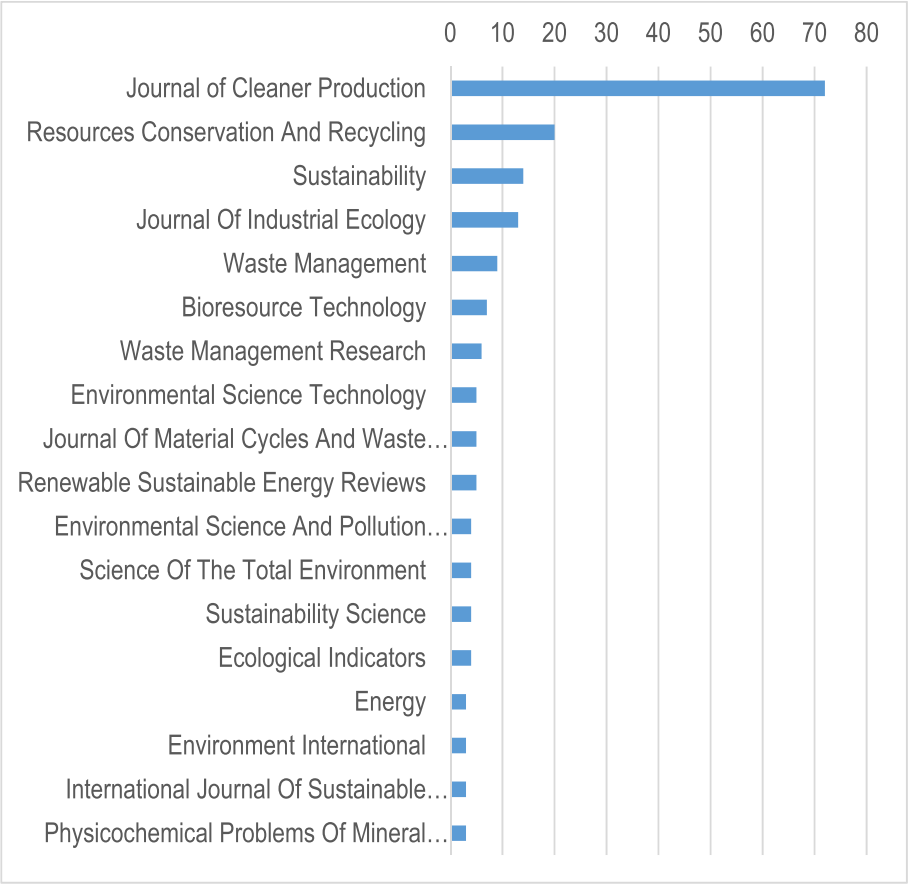

Fig. 3. Publications per journal of reviews and articles with the topic circular economy that have more than three publications.

Circular Economy is a new area of research, and its relationship with Sustainability has not been extensively addressed by peer-reviewed articles.

After reviewing our initial sample, we conducted a process of identifying and scanning articles referenced by the ones we reviewed, including the relevant ones into our sample. The inclusion/exclusion process depended on whether publications can provide new insights on the phenomena investigated, and this decision was reached after analysing their titles, contents and abstracts. In other words, relevant papers were defined as the ones capable of contributing with novel insight on similarities, differences or relationship types between the studied concepts. Furthermore, if a new paper was included in the sample, we would also analyse its references, in search for new inputs – and these iterations would occur until new papers were not contributing significantly to answer to our research questions.

Finally, all papers within our sample were thoroughly examined and contrasted, by using techniques for content analysis. This was used as a method of analysing written communication (Elo and Kyngäs, 2008), with the purpose of providing a condensed description by examining text to reveal patterns. This was a rather exploratory process, as the categories of similarities, differences and relationship types were not pre-defined, neither were the relationship types explicitly defined by the reviewed literature. Therefore, patterns emerged throughout the content analysis and were subsequently validated through the triangulation (Creswell, 1998) of the research outputs between the authors of this article, aiming at ensuring robustness and comprehensiveness of its conclusions.

4. Results

The following two subsections first summarise the identified relationship types between the Circular Economy and sustainability, and then, the main similarities and differences between both concepts in literature.

4.1. Similarities and differences

Table 2 provides an overview of the most relevant similarities between sustainability and the Circular Economy. Both notions emphasise intra- and intergenerational commitments motivated by environmental hazards and signal the importance of increasing agency and public deliberation upon the multiple and coexisting pathways for development. They also share an essentially global perspective, emphasising problems on a planetary scale that lead to shared responsibilities and to the relevance of coordination between multiple agents.

Both concepts frequently employ multi- or interdisciplinary approaches to better integrate non-economic aspects into development, which often conclude that system design and innovations are the main drivers for reaching their ambitions. They also describe not only potential costs and risks, but also the importance of diversification in taking advantage of distinct opportunities for value creation. Both concepts view cooperation between stakeholders not only as desirable, but as imperative to reach their expectations.

To guide and align stakeholder behaviour, both concepts rely heavily on regulation and increasingly on the deliberate design of

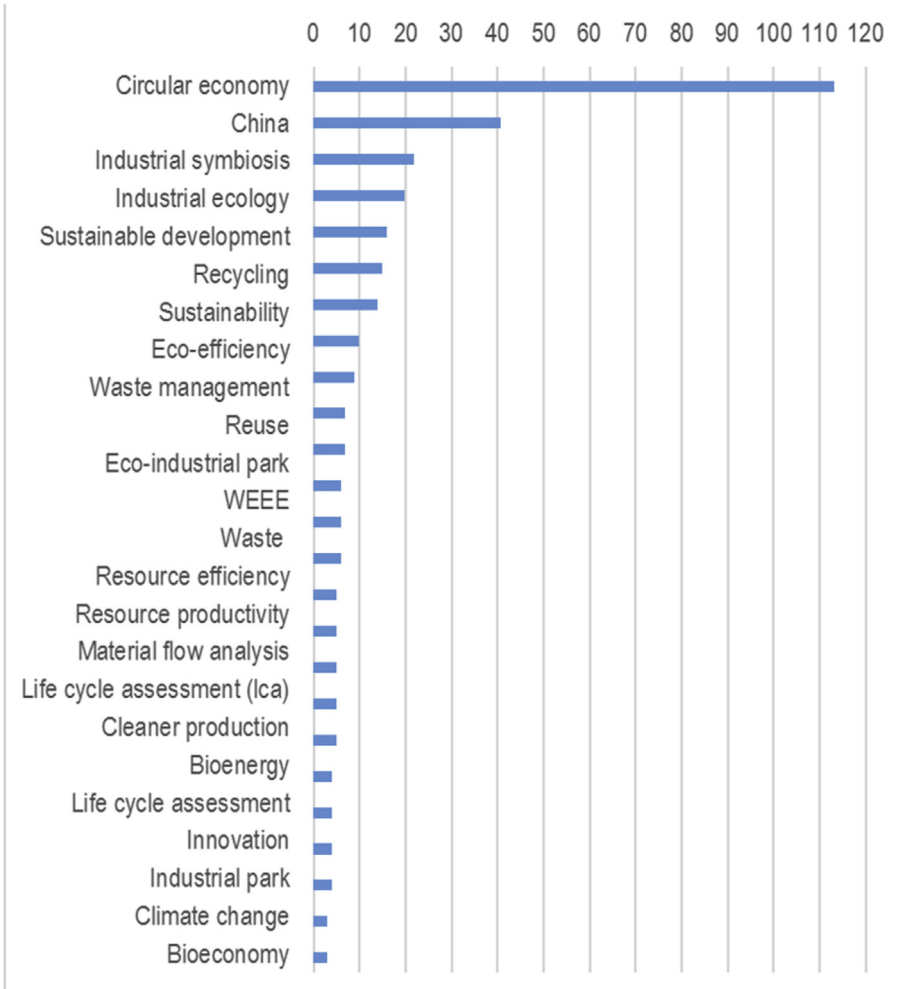

Fig. 4. Number of occurrences of most important keywords of reviews and articles with the topic circular economy.

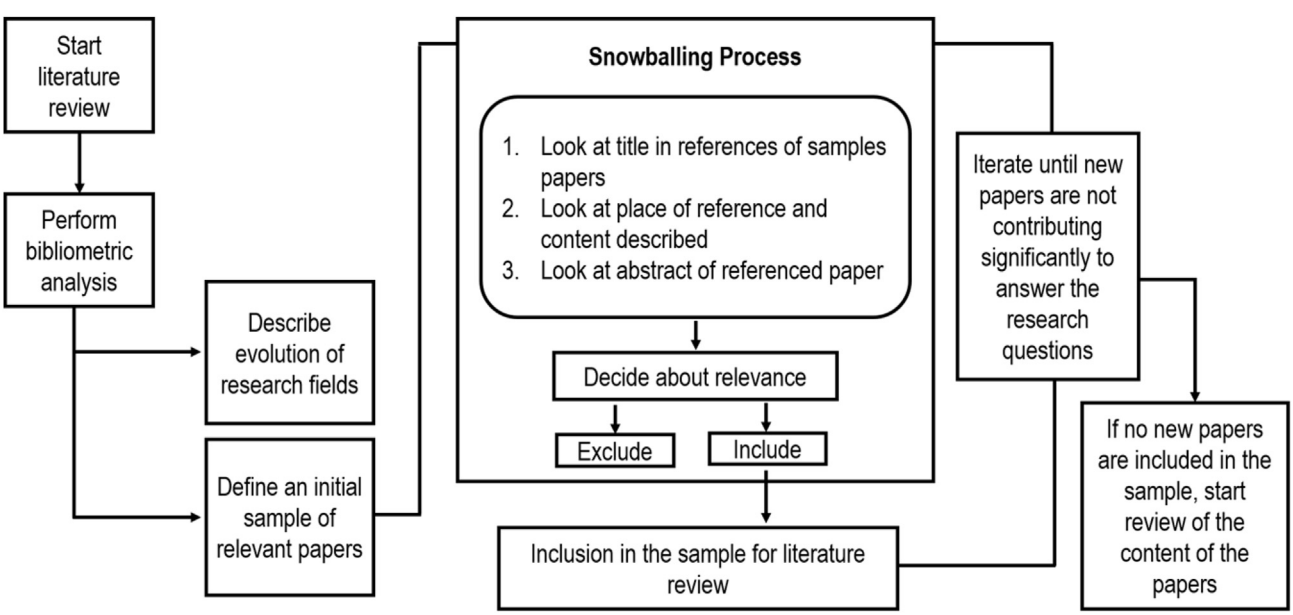

Fig. 5. Literature review process.

Table 2
Selected similarities between sustainability and the Circular Economy.

Similarities between sustainability and the Circular Economy
• Intra and intergenerational commitments
• More agency for the multiple and coexisting pathways of development
• Global models
• Integrating non-economic aspects into development
• System change/design and innovation at the core
• Multi-/interdisciplinary research field
• Potential cost, risk, diversification, value co-creation opportunities
• Cooperation of different stakeholders necessary
• Regulation and incentives as core implementation tools
• Central role of private business, due to resources and capabilities
• Business model innovation as a key for industry transformation
• Technological solutions are important but often pose implementation problems

incentive structures. Private business plays a central role among relevant stakeholders because it commands more capabilities and resources than any other actor. Since the implementation of more sustainable solutions seems to lag behind expectations and technological capabilities and advances in material and production technology are becoming ever more incremental, authors increasingly see business model innovation as the key pathway to the necessary socio-technical transitions (see also Geissdoerfer et al., 2016b).

The literature review also reveals a range of differences between the two concepts. For example, the concepts have different origins, goals, motivations, system prioritisations, institutionalisations, beneficiaries, timeframes, and perceptions of responsibilities.

The modern understanding of the term Circular Economy seems to have emerged more recently than that of sustainability. While the Circular Economy is traced back by EMF (2013b) to different schools of thought like cradle-to-cradle and industrial ecology, the concept of sustainability is considerably older (Mantel, 1990) and was institutionalised by environmental movements and supranational bodies, especially after the publication of the Brundtland report in 1987.

Furthermore, there are different goals associated with the Circular Economy and sustainability in the literature. While it seems clear to most authors that the Circular Economy is aiming at a closed loop, eliminating all resource inputs and waste and emission leakages of the system, the goals of sustainability are open-ended and different authors address a considerable multitude of goals, which also shift depending on the considered agents and their interests.

This is also reflected in the main motivation underlying each concept. The motives behind sustainability are based on past trajectories, are diffused and diverse, and often embrace reflexivity and adaptivity to different contexts. In contrast, the Circular Economy is mainly motivated by the observation that resources could be better used and waste and emissions reduced with circular rather than linear make-use-dispose systems.

In fact, sustainability aims at benefiting the environment, the economy, and society at large (e.g. Elkington, 1997), while the main beneficiaries of the Circular Economy appear to be the economic actors that implement the system. The environment is also seen to benefit through less resource depletion and pollution, and society benefits from the environmental improvements and certain add-ons and assumptions, like more manual labour or fairer taxation (e.g. Webster, 2015).

Different underlying motivations also lead to different systems being prioritised in the literature. The Circular Economy clearly seems to prioritise the economic systems with primary benefits for the environment, and only implicit gains for social aspects. Sustainability was originally conceptualised as holistically treating all three dimensions as equal and balanced, although portfolios of interventions should be prioritised according to contextual differences. For instance, it is conceptually plausible to design policies and industrial interventions with more environmental emphasis in rich countries like Sweden, and more social emphasis in developing countries like Zambia.

The literature also assumes differences in the way both concepts became institutionalised. While sustainability provides a broader framing (e.g. Brundtland, 1987), which can be adapted to different contexts and aspirations, the Circular Economy emphasises economic and environmental benefits compared to a linear system (e.g. Rashid et al., 2013).

There is also a difference in agency, influencing the understanding of the agents that should influence system changes. While agency is diffused in the case of sustainability (e.g. Bocken et al., 2015), as the priorities should be defined by all stakeholders, the Circular Economy has a clear emphasis on governments and companies (e.g. Webster, 2015).

Furthermore, the timeframes for the required changes differ for both concepts. The temporal dimension for sustainability is open-ended, as goals can be constantly adapted or reframed over time. In contrast, there are theoretical limits to optimisation and practical ones to implementation that could set the thresholds for the successful conclusion of the implementation of a Circular Economy within a geographical unit (EMF, 2013b).

Finally, the perception of responsibilities is also clearly distinct between both concepts. In the sustainability debate, responsibilities are shared, but not clearly defined, while the literature considers that the responsibility for the transition to a circular system lies primarily with private business, regulators, and policymakers. Moreover, the commitments, goals, and interests behind the use of the terms differ greatly. The focus seems to be on interest alignment between stakeholders for sustainability, whereas the Circular Economy prioritises financial advantages for companies, and less resource consumption and pollution for the environment.

Table 3 summarises the identified differences between the concepts that are discussed in this paper.

4.2. Relationship types

Rashid et al. (2013) describe circularity in business models and supply chains as a precondition for sustainable manufacturing, which in turn is necessary for the improved economic and environmental performance of industrialised and developing countries. Similarly, Läpple (2007) describes a circular economy as an important element of sustainable development.

A much stronger conditional relationship is assumed by the Ellen MacArthur Foundation (2013b) and Webster (2015). Maybe even more pronounced, at least in the environmental dimension, are Bakker et al. (2014), who consider circularity as absolutely necessary for sustaining economic output. A similar approach is also held by the United Nations Environment Programme (2006), which presents the Circular Economy as a necessary condition for maintaining economic growth in a sustainable way, but here other pathways for establishing this condition are not excluded.

A third type of conditional relation is identified by Nakajima (2000), who describes circularity and service-based systems as a necessary but not sufficient condition for a sustainable system. Other conditions, like a change of lifestyle, must accompany a closed loop system to pursue long-term sustainability.

A similar view is held by the European Commission (2014), which presents circular economic systems as beneficial for different sustainability dimensions like resource productivity, job creation and GDP growth, but does not elaborate on whether this is a

Table 3
Selected differences between sustainability and the Circular Economy.

	Sustainability	Circular Economy
Origins of the term	Environmental movements, NGOs, non-profit and intergovernmental agencies, principles in silviculture and cooperative systems	Different schools of thought like cradle-to-cradle, regulatory implementation by governments, lobbying by NGOs like the EMF, inclusion in political agendas, e.g. European Horizon 2020
Goals	Open-ended, multitude of goals depending on the considered agent and her interests	Closed loop, ideally eliminating all resource input into and leakage out of the system
Main motivation	Diffused and diverse reflexivity and adaptive→ past trajectories	Better use of resources, waste, leakage (from linear to circular)
What system is prioritised?	Triple bottom line (horizontal)	The economic system (hierarchical)
To whose benefit?	The environment, the economy, and society at large.	Economic actors are at the core, benefitting the economy and the environment. Society benefits from environmental improvements and certain add-ons and assumptions, like more manual labour or fairer taxation
How did they institutionalise (wide diffusion)?	Providing vague framing that can be adapted to different contexts and aspirations.	Emphasising economic and environmental benefits
Agency (Who influences? Who should influence?)	Diffused (priorities should be defined by all stakeholders)	Governments, companies, NGOs
Timeframe of changes	Open-ended, sustain current status "indefinitely"	Theoretical limits to optimisation and practical ones to implementation could set input and leakage thresholds for the successful conclusion of the implementation of a Circular Economy
Perceptions of responsibilities	Responsibilities are shared, but not clearly defined	Private business and regulators/policymakers
Commitments, goals, and interests behind the use of the term	Interest alignment between stakeholders, e.g. less waste is good for the environment, organisational profits, and consumer prices	Economic/financial advantages for companies, and less resource consumption and pollution for the environment

necessary or sufficient condition or how it relates to other concepts that could foster sustainability.

Differently, Bocken et al. (2014) identified circularity as one archetype of sustainable business models among others. Circularity is seen as one of several options to foster the sustainability of the system. These options are all seen as beneficial in principle and can also be combined to add up gains or achieve synergies. Similarly, Evans et al. (2009) and Weissbrod and Bocken (2017) describe circular strategies as one option among others, like increasing efficiency or dematerialisation. This is a view that is also shared by other manufacturing scholars like Allwood et al. (2012), Garetti and Taisch (2012), and Seliger (2007), who do not explicitly group and highlight circular strategies, such as reuse and remanufacturing, among other manufacturing and societal changes that benefit sustainability, like energy efficiency or consumer sufficiency.

The OECD (2009) holds a hierarchical view and considers closed loop manufacturing systems to be more sustainable than most other manufacturing concepts because they comprise more eco-innovation targets and mechanisms. The only exception in this prioritisation is the industrial ecology framework, which is seen as even more sustainable.

Negative relationships between circularity and sustainability are also highlighted. Andersen (2007), for example, describes not only the potential benefits but also the costs of circular systems that must be balanced to avoid the creation of negative value. A similar view is held by Allwood (2014), who suggests a range of problems that the circular economy brings with it, such as the technical impossibility of a closed circle in combination with growing demand or problems with the energy required to recycle materials. This energy and its impact may be higher for many materials than the overall environmental effect of acquiring the material from conventional sources like mining. Thus, the circular economy might worsen the emission of greenhouse gasses and, as a result, accelerate global warming. Therefore, a more pragmatic approach is necessary, where material efficiency and other forms of reducing inputs should have higher priority than the circular economy.

Similarly, Murray et al. (2015) argue that while circularity has a positive influence on certain aspects of sustainability, it does not integrate other dimensions, especially the social one. These missing dimensions could be added to the concept of the Circular Economy.

Table 4 provides an overview of the different types of relationships between sustainability and the Circular Economy that were identified in the research. These categories aim at stressing the most evident differences identified within our sample. It is nonetheless important to stress that this table does not aim to be exhaustive, as each type of relationship could be further subcategorized and consequently be investigated in more depth.

5. Discussion

Our research shows that most authors (e.g. Bakker et al., 2014; Bocken et al., 2016; EMF, 2013b; Rashid et al., 2013) focus on the environmental performance improvements of the Circular Economy rather than taking a holistic view on all three dimensions of sustainability, although this is also true for a range of authors in the latter field (e.g. Muniz and Cruz, 2015; Shiva, 1992). While the environmental perspective taken by sustainability can vary from explicitly and implicitly holistic to the investigation of a specific set of issues, most authors conceptually simplify the Circular Economy to resource input, waste and emission output. Other issues like land use or biodiversity loss are only implicitly addressed by the latter authors (see e.g. Bakker et al., 2014; EMF, 2013b).

This more limited focus comprises a narrow coverage of social wellbeing by most Circular Economy authors. If social aspects are mentioned, the reference is mostly to job creation, as there seems to be no clear understanding of the extent to which the circular economy could contribute to subjective well-being (Frey and Stutzer, 2001). Some authors, like Webster (2015) try to construct other elements of a social dimension of the Circular Economy by adding a more just and efficient tax system and changing lifestyles through the shared economy. However, the conceptual integration is unclear in the work of most authors, and the increasingly apparent negative effects of the shared economy, like the deterioration of secure employment that is subject to social insurance contributions and the elimination of affordable housing in cities and tourist destinations (Malhotra and Van Alstyne, 2014), in fact imply detrimental effects on social inclusion and wellbeing.

The Circular Economy also refers mostly to individual economic

Table 4
Relationship types between the Circular Economy and sustainability.

General direction	Type of relationship	Short description Circularity/closed loop systems are seen as …	Examples in literature	Graphical representation
Conditional	Conditional relation	One of the conditions for a sustainable system	Läpple, 2007 Rashid et al., 2013	A→B
	Strong conditional relation	The main solution for a transformation to a sustainable system	Bakker et al., 2014 EMF, 2013b UNEP, 2006	A➡B
	Necessary but not sufficient conditional relation	A necessary but not sufficient condition for a sustainable system	Nakajima, 2000	
Beneficial	Beneficial relationship	Beneficial in terms of sustainability, without referring to condition-ality or alternative approaches	European Commission, 2014	+A→+B
	Subset relation (structured and unstructured)	One among several solutions for fostering a sustainable system	Allwood et al., 2012 Bocken et al., 2014 Evans et al., 2009 Garetti and Taisch, 2012 Seliger, 2007 Weissbrod and Bocken, 2017	
	Degree relation	Yielding a degree of sustainability with other concepts being more and/or less sustainable	OECD, 2009	
Trade-off	Cost-benefit/trade-off relation	Having costs and benefits in regard to sustainability, which can also lead to negative outcomes	Allwood, 2014 Andersen, 2007	
	Selective relation	Fostering certain aspects of sustainability but lacking others	Murray et al., 2015	

benefits through input reduction, efficiency gains, and waste avoidance with relatively immediate results compared to sustainability (e.g. EMF, 2013b; Elkington, 1997). Differently from sustainability, long-term viability seems to be excluded from most discussions (e.g. EMF, 2013b; Brundtland, 1987). Furthermore, the behaviour of organisational actors and consumers should be nudged with incentives in the Circular Economy, while many sustainability approaches favour behaviour change through engagement and education, although incentives also play an increasing role in the literature (e.g. Webster, 2015; Jackson, 2009).

While some authors consider the interpretive flexibility of the sustainability paradigm as a strength, that allows its adaptation to different contexts and wide institutionalisation (e.g. Leach et al., 2007), others argue that it is too vague and, consequently, hinders operationalisation (e.g. Middleton and O'Keefe, 1993). The concept of Circular Economy, on the other hand, is often seen as more narrowly framed by these authors, which would provide clearer directions for its implementation. This is sometimes accompanied by a – seemingly unrealistically promising – business case for the private sector (e.g. EMF, 2013b).

Also because many conceptualisations of the Circular Economy (e.g. Allwood et al., 2012; Bakker et al., 2014) appear to exclude large parts of the social dimension, emphasise economic benefits, and simplify the environmental perspective, the concept might be more attractive for policy makers and private business than competing approaches. This can be problematic for the transition to a more sustainable economic system because attention and resources are diverted from more comprehensive and holistic approaches.

To address this issue, we consider the identified subset relation to be adequate. It not only enhances diversity and adapts to different contexts but also allows the combination of circular with complementary strategies, because it does not prescribe an intrinsic hierarchy between the Circular Economy and other sustainability strategies. An example for this are the sustainable business model archetypes of Bocken et al. (2014). Therefore, we would propose this, as well as other work exploring the multiple dimensions of sustainable business models (e.g., Boons et al., 2013; Geissdoerfer et al., 2016a) as a good base for future research and practice. In this way, environmentally focused approaches to CE, like the work by Allwood et al. (2012) and Bakker et al. (2014), can be complemented with concepts that take a more holistic stakeholder view – and especially social considerations – into account.

6. Conclusions

First, based on key literature, *we define the Circular Economy as a regenerative system in which resource input and waste, emission, and energy leakage are minimised by slowing, closing, and narrowing material and energy loops. This can be achieved through long-lasting design, maintenance, repair, reuse, remanufacturing, refurbishing, and recycling*. Second, *we define sustainability as the balanced integration of economic performance, social inclusiveness, and environmental resilience, to the benefit of current and future generations.*

We found that the Circular Economy is an emerging topic that has attracted increasing research interest. While the roots of the topic are European, much of this recent surge started with Chinese authors after the implementation of regulatory controls in this country. Chinese and European scholars have in particular have taken up this topic and there is an exponential growth in publications. This could reflect the increased interest from companies and policymakers in these regions.

To answer the first research question - *What are the main conceptual similarities and differences between sustainability and the Circular Economy?* - this paper summarises the main similarities and differences between sustainability and the circular economy. Despite often being used in similar contexts, the similarities and differences between these concepts have not been made explicit in the literature, therefore blurring their conceptual contours and constraining the efficacy of their use. We believe that by shedding light on their differences, this paper contributes not only to conceptual development, but also serves to better reveal the interests,

motivations and practical implications of their use in the public and private sectors.

Furthermore, the paper addressed the second research question - *How is the Circular Economy conceptually related to sustainability?* We found that the Circular Economy is viewed as a condition for sustainability, a beneficial relation, or a trade-off in literature. This can be broken down into eight different relationships. Based on the investigated literature, this paper argues that the subset relationship seems to be appropriate to maintain diversity while, concomitantly, shedding light on the wide range of complementary strategies that managers and policymakers can adopt.

The most relevant limitations of this work derive from the methodologies employed for our literature review. Bibliometric analysis assumes that researchers publish their most important findings in journals and base their research on previously published articles (Fetscherin and Usunier, 2012). This paper used bibliometric tools for meta-analysis to cover the differences, similarities and interrelationship of the Circular Economy and sustainability by unravelling the evolution of these fields and the most relevant academic sources of research that would be initially sampled for literature review. However, contributions might arise from unpublished documents, as well as reports and other documents that are not published in academic journals. Moreover, bibliometric analysis was followed by semi-structured snowballing to capture emerging conceptual trends. The central limitation of this methodological step consists of the lack of randomised representativeness, resulting in selection bias. These limitations can be overcome by further research, using different methodological techniques to not only test the validity of these results, but also to clarify the contexts in which they might not be applicable.

Finally, there is a wide range of opportunities for future research in this area, of which we believe two are particularly critical to the advancement of literature. We would first encourage research about how the investigated relationship is seen by a wider range of companies and by policy makers, which can then be contrasted with the results presented in this article. Moreover, the linkage between Circular Economy and emerging concepts such as the Performance Economy (Stahel, 2010), Sharing Economy, and new business forms such as benefit corporations could be investigated (Bocken et al., 2014). Importantly, the actual impacts of Circular Economy initiatives need to be analysed – how do these perform against the triple bottom line (Elkington, 1997) and contribute to 'strong sustainability' and slower forms of consumption, i.e., closing as well as slowing resource loops (Bocken et al., 2016)? Lastly, it is critical to investigate the influence of a better understanding of the relationship between the Circular Economy and sustainability and their influences over the performance of supply chains, business models, and innovation systems.

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