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## Contrasting restorative economy and regenerative economy in circular economy context

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**Abstract:** A large part of the existing circular economy (CE) literature uses the definition of Ellen MacArthur Foundation (EMF) of the CE as restorative and regenerative by intent and design. This definition of CE has come into common use, but these concepts are rarely defined or explained.

This paper aims at understanding the current state of the art of regenerative economy in CE literature addressing the research question: "How is the concept of regenerative economy defined in the current CE literature?"

We conducted a systematic literature review of regenerative and restorative circular economy. In 52 reviewed articles, only one article defined the terms regeneration and restoration while many articles used these terms to define other concepts. Most reviewed articles simply repeated the definition provided by EMF. We argue that in the transformation towards regenerative economy and regenerative sustainability, it is important to distinguish regenerative economy strategies from restorative economy strategies.

**Keywords:** circular economy; regenerative economy, restorative economy; regenerative sustainability.

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### 1 Introduction

Sustainability and circular economy (CE) are of increasing interest for companies, governments, investors, and the civil society. Sustainable business models enabled by CE aim at a balanced integration of economic performance, social inclusiveness, and environmental resilience. This all has clear implications to innovative business models and their management in CE (Pieroni, McAloone and Pigosso, 2019). A large part of the existing CE literature uses the definition of Ellen MacArthur Foundation (2015, p. 2) for

CE: “A circular economy (CE) is one that is **restorative** and **regenerative** by design and aims to keep products, components, and materials at their highest utility and value at all times, distinguishing between technical and biological cycles”. This definition of the CE as restorative and regenerative has come into common use in the mainstream of the CE literature, but these concepts are rarely defined or explained in the CE literature.

The companies following the principles of regenerative economy face the challenge of redesigning the industrial system of production and consumption following regenerative patterns of resource and energy use. This requires holistic view to resources and energy use in production and consumption, yet there is confusion about what is regenerative and what kind of regenerative strategies can be used by regenerative economy companies. Therefore, it is necessary to identify and clarify the central attributes and strategies for restorative and regenerative economy and find more clear and distinct definitions for them (Morseletto, 2020).

Consequently, the case examples described in various studies fit to various degree to the definitions put out by the authors. Podsakoff et al. (2016) argue that concept definitions are essential building blocks of theory and moreover, it is essential to describe their fundamental attributes clearly. Therefore, this paper aims at understanding the current state of the art of regenerative economy in CE literature. Thus the goal of this study is to clarify the concept of regenerative economy, particularly from the viewpoint of CE business models by addressing the research question: *How is the concept of regenerative economy defined in the current CE literature?* The research question is addressed in terms of a literature review to examine circular economy by focusing on regenerative and restorative cycles.

## 2 Restorative and regenerative economy

Generally, restoration refers to a process that focuses on reversing damage caused by human intervention that requires returning to an unspecified origin condition (Morseletto, 2020). Regeneration, on the other hand, represents a form of upgrade from restoration, since it contributes positively to society and environment leaving the environment (and society) in a better state than before (Hahn and Tampe, 2021; Bocken, Niessen and Short, 2022). Thus, if restoration means “to make something well again,” regeneration means “to make it better” than the original condition (Morseletto, 2020).

It is quite usual that these terms are not distinguished in the literature. For instance, Hofstra and Huisigh (2014) summarize that regenerative means to restore, renew, revitalize and ensure rebirth to sources of energy and materials by taking into account future needs, wants and desire of society and nature. This makes it challenging to identify what actually are restorative and regenerative strategies used by the companies or other actors. For example, a solar panel can be considered a regenerative product if it produces more energy during its lifetime than is consumed during its life cycle from manufacturing until recycling (Rhodes, 2017), whereas some label regenerative products any products that maintain current state or aim to produce net positive outcomes (Hahn and Tampe, 2021).

In the previous literature, regenerative economy has been discussed mostly in the context of agriculture (Rhodes, 2017) and built environment (Reed, 2007). In agriculture, regeneration aims at improving the soil to enhance the land productivity (Rhodes, 2017). Regenerative products in agriculture are 100% recyclable and in addition improve environmental conditions, for example, by water purification or by sequestering the carbon

into soil (Rhodes, 2017). In built environment integrative design and construction processes optimize each system and part in relation to health of the whole system, e.g., rainwater harvesting to creating more water than is used and using local renewable wood for construction material.

### 3 Methodology

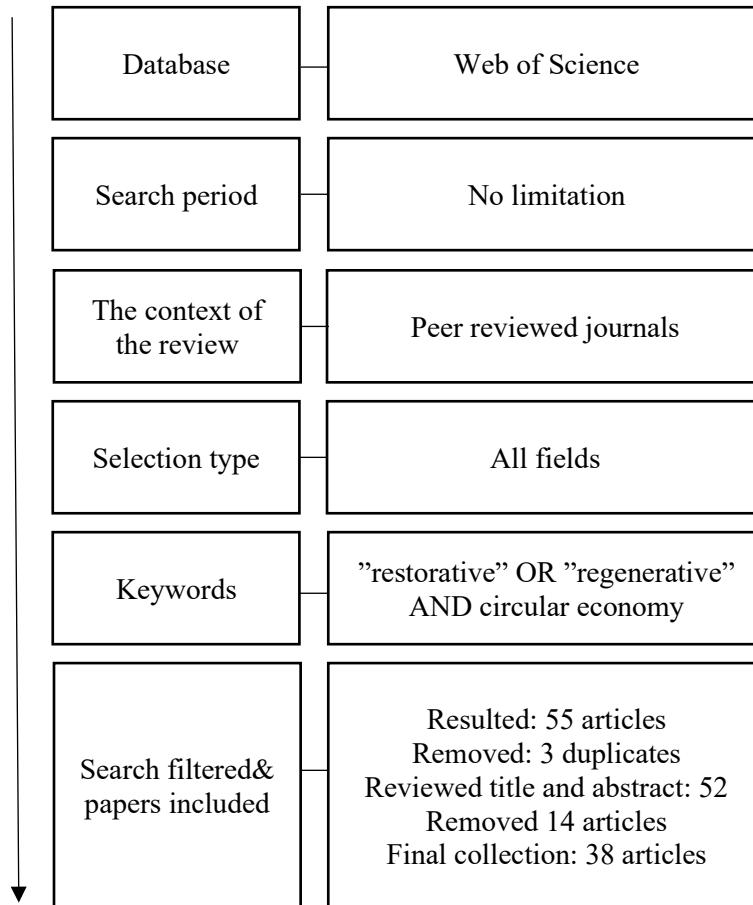
This research follows Podsakoff et al. (2016) recommendation for concept definition. As there is conceptual confusion on the regenerative economy concept, this research applies exploratory approach to uncover the compulsory attributes of the concept. We aim to define the concept of regenerative economy and its attributes by exploring literature. In this study, researcher, data and method triangulation is applied.

We used the systematic literature method to guide our literature review. Systematic reviews improve the quality and the outcome of the review process by carrying out a transparent and reproducible process (Tranfield, Denyer and Smart, 2003). The aim of a systematic review is a conceptual consolidation in a field of study that is fragmented. The goal for our literature review was to examine the concepts of regenerative and restorative circular economy and their use in the previous literature. Our goal in this review is thus a comprehensive overview and, additionally, *conceptual*, not empirical consolidation. Methodologically we use descriptive approach rather than meta-analytical statistical approach. We search for patterns and explanations (Yin, 2009). Furthermore, we used a data-driven principal search approach (Hiebl, 2021). Data-driven principal search approach starts with identification of key words for scoping the study and then the key words are used to in one, like in our study, or in multiple databases. Our review process consisted of three phases, which were data collection, data analysis, and data synthesis (Tranfield, Denyer and Smart, 2003). Next, we describe the phases and what we did in each phase.

#### *Data collection, data analysis and data synthesis*

Data collection was conducted rigorously using rigorous methodology, which meant documenting our steps of the data collection and each step of the review process (Tranfield, Denyer and Smart, 2003). We conducted the search for the literature in April 2023 on Web of Science database. We used keywords “regenerative” and “circular economy” and “restorative” and “circular economy”. We chose the concept of circular economy as a mass noun. This meant including both words in the search as a concept. The use of more than one database does not necessarily create better results (Harzing and Alakangas, 2016). The keywords were used as a search term in all fields not to miss any potential studies. We did not limit the span of the research. However, the research seemed to be conducted during 2016-2023 years. We decided to limit our search to English language texts in peer-reviewed journal articles only. Hence, we did not include book reviews, conference papers, books, book chapters etc. With this limitation we wanted to ensure peer review rigor of texts to be reviewed. Peer -reviewed articles were used as main source of the review, because of their potentially higher standards that result in articles with good quality, validated knowledge and higher impact (Light and Pillemer, 1984). We did not limit the

results to any subject areas such as “Business, management and accounting” or “Social Sciences” to get a comprehensive picture of the phenomenon.



**Figure 1** Sample selection.

Articles were then screened by each individual researcher, and we worked in parallel to one another. First, all the 55 articles were screened for the presence of all the search words in the title of the paper and the abstract. At this point we noticed that there were 3 duplicates. All the duplicates were removed. Thereafter, if all search words were present, the article was retained. If not, this article was removed and stored on an Excel sheet with, the name of the assessor, the date and why the article was removed. Next, the articles were thoroughly read. If all the key words were found, this paper was retained. This collection of articles served as the review collection. We also conducted constant verification of the 14 rejected articles. It was done by the other researchers in the team. Finally, we ended up with 38 articles.

## 4 Results

In 52 articles reviewed, only one (Morseletto, 2020) defined the terms regeneration and restoration (Table 1). In some articles, the word regener\* was found only from the reference list (Yang and Thoo, 2023), in the author information (e.g. Kolkwitz et al., 2022) or in the title (e.g. Mercader-Moyano & Ramos-Martín, 2020).

Many articles (37) define other circular concepts by using the terms regeneration and/or restoration. These circular concepts were supply chain management (2), regenerative design (2), urban development (5), other concepts (7) and circular economy (21). Other concepts included ecoinnovation, agriculture, ecological capacity, business model, renewable energy technologies, restorative systems, and industrial sustainability.

**Table 1** Definitions in reviewed articles.

<i>Definition</i>	<i>Number of articles</i>	<i>Article</i>
Regener*	1	(Morseletto, 2020)
Restor*	1	(Morseletto, 2020)
Supply chain management	2	(Batista <i>et al.</i> , 2018; Faisal, 2023)
Regenerative design	2	(Cerreta <i>et al.</i> , 2020; Bakos and Schiano-Phan, 2021)
Urban development	5	(Amenta and Qu, 2020; Newton and Frantzeskaki, 2021; Williams, 2021; Della Spina and Giorno, 2022; Nowysz <i>et al.</i> , 2022)
Other	7	(Smart <i>et al.</i> , 2017; Dewick, Maytorena-Sanchez and Winch, 2019; Böckin <i>et al.</i> , 2020; Salvador <i>et al.</i> , 2020; Williams, 2020; Novara <i>et al.</i> , 2022; Schoden <i>et al.</i> , 2022)
Circular economy	21	(Moreno <i>et al.</i> , 2016; Pollard <i>et al.</i> , 2016; Hobson, 2016; Bernon, Tjahjono and Ripanti, 2018; Kapsalis, Kyriakopoulos and Aravossis, 2019; Poponi <i>et al.</i> , 2019; Zucchella and Previtali, 2019; Aloini <i>et al.</i> , 2020; Avraamidou <i>et al.</i> , 2020; Ranta, Keränen and Aarikka-Stenroos, 2020; Donati <i>et al.</i> , 2020; Fulgenzi <i>et al.</i> , 2020; Manniche, Larsen and Broegaard, 2021; Rocchi <i>et al.</i> , 2021; Velasco-Muñoz <i>et al.</i> , 2021; Baratsas, Pistikopoulos and Avraamidou, 2021; Mboli, Thakker and Mishra, 2022; Chavez <i>et al.</i> , 2022; Dossa <i>et al.</i> , 2022; Whiting <i>et al.</i> , 2023; Coppola, Vollero and Siano, 2023)

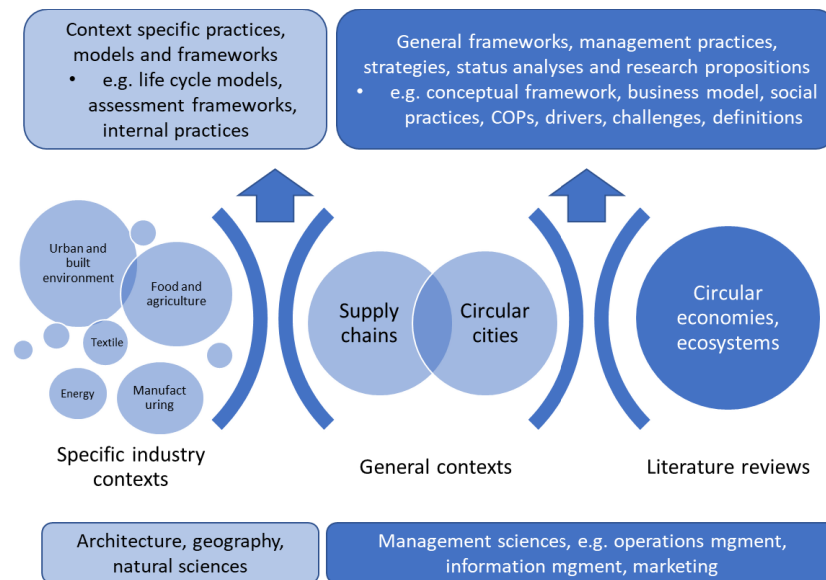
Morseletto (Morseletto, 2020) defined restoration as “the return to a previous stage” and regeneration as “the promotion of self-renewal capacity of natural systems with the aim of reactivating ecological processes damaged or over-exploited by human action”. This

was the only definition for these terms. In circular economy context, reviewed articles often referred to Ellen MacArthur Foundations definition that states that circular economy is restorative or regenerative by intention and design (Ellen MacArthur Foundation, 2013).

We found studies, where regenerative was not defined as a concept, but regeneration was used to define something else such as circular supply chain management, urban design and regenerative design. These definitions indicate ecosystem-related development, that are not visible in definitions in dictionaries. For example, in supply chain management context, Faisal et al. (2023) distinguish the concepts of restoration for technical materials and regeneration for biological materials. Faisal et al. (2023) defines that circular supply chain management “restores technical materials and regenerates biological material” with the help of innovation and stakeholder involvement, where Industry 4.0 can increase the efficiency of supply chain operations. Similar distinction has been made by Morsetto (2020) in the circular economy context. Restorative and regenerative capabilities in circular supply chain refer to an expansion from closed-loop material cycles to extended boundaries including material flows forward, the industrial symbiosis synergies of by-products and waste flows as well as reduced material processing (Batista *et al.*, 2018). According to Batista et al. (2018) circular supply chain is “designed to maximize restorative and regenerative processes downstream”, meaning towards a customer.

Regenerative urban development has risen alongside the reduction of carbon dioxide emissions, adaptation to the climate and the green transition (Newton and Frantzeskaki, 2021). The citizens' environmental awareness increases in regenerative urban ecosystems with local circular systems (as circular food system) and regenerative actions in community (as urban farming) (Williams, 2021). The development strategy in urban development should include the ecological, economic and social point of view to maximize the synergies (Cerreta *et al.*, 2020; Williams, 2021) and social practices for innovation activities in urban regeneration processes (Della Spina and Giorno, 2022). Regenerative urban development sees the green areas in the city as an opportunity to produce food and to support biodiversity (Nowysz *et al.*, 2022) and the regenerative city is able to adjust quickly to achieve the balance after facing challenges or risks realized (Amenta and Qu, 2020). Regenerative design in the urban environment is referred as renewing the energy and material sources (Bakos and Schiano-Phan, 2021) and on a wider perspective, integrating the fundamental human needs, ecosystem services and landscape to enable an ecosystem to produce goods and services to fulfil the human needs (Cerreta *et al.*, 2020).

As restorative and regenerative strategies usually require cooperation over organization and industry sector boundaries, it is not a surprise that many of the analyzed publications also represented cross-sectional studies and were carried out by researchers representing various disciplines. In Figure 2 these varying background disciplines are illustrated in the boxes in the bottom of the figure. In the middle layer of the figure the research contexts of the articles are illustrated and the upper most layer brings out the key findings of the articles.



**Figure 2** Key findings and contexts of the analysed articles.

When looking more carefully at the articles and the links between the background discipline, the context of the study and the key findings of the studies, management science researchers were the ones that produced most of the general and cross-sectoral studies focusing on such contexts as circular economies, ecosystems, circular cities, and supply chains. It is noteworthy that many of the CE and ecosystem studies were, however, literature reviews resulting in more on the identification of the drivers and challenges of restoration and regeneration than providing actual practices or models. Those articles that focused on supply chains or circular cities as general contexts provided more actual management practices and models, as well as created general level frameworks.

Among the analyzed articles there were also a group of specific context studies, which mostly focused on urban development and built environment or agriculture, but there were also some sporadic articles focusing on energy sector or textile industry. These studies focusing on specific context mainly provided very context specific, but at the same time also highly detailed level practices, models, and frameworks. For example, detailed level assessment frameworks and life cycle models were produced in these articles. This is of course natural, as many of these studies were provided by such researchers that are highly competent in the specific questions of these industries, like architects on buildings or chemists on cell energy issues. From these contexts specific studies there could be, however, identified such frameworks and models that might be applicable in other contexts, too. Thus, there is great potential to learn from the restorative and regenerative practices from one industry sector to another.



## 5 Discussion

In the transformation towards regenerative economy and regenerative sustainability, it is important to distinguish regenerative economy strategies from restorative economy strategies. This is significant for supporting innovation management to focus the perspective on enabling social and ecological systems to maintain a healthy state and evolve rather than limit the destruction we do to the nature or arrive at state, where we do not make things worse than before. The framework based on the existing CE literature is an opening towards discovering regenerative economy strategies. This is able to open up further research avenues and other studies to extend the possible ways regenerative economy companies can move ahead in this transformation.

Originally Ellen MacArthur Foundation (EMF) introduced the concept of CE as “an industrial economy that is restorative or regenerative by intention and design” (Ellen MacArthur Foundation, 2013). Most reviewed articles simply repeat this definition, without specifying whether their article follows restorative or regenerative approach. Furthermore, the detail of “by intention and design” is overlooked and is simply understood as either restorative or regenerative by intention.

Morseletto (2020) questions the elements of CE definition described by the EMF (2013) as an industrial economy that is restorative and regenerative, stating that it remains a question whether or not regeneration is a central principle of a CE. Based on the literature review presented in this paper, it seems that vast majority of the studies in the area of CE do not present application areas or case examples that are regenerative in nature. Instead, the mainstream of them focuses on restorative processes. However, literature review also reveals that regeneration in the context of CE is not limited to agriculture, but is discussed also in supply chain management, urban development and regenerative design. One example of this is the regeneration in urban development making use natural systems, such as, rainwater management through green infrastructure, edible and non-edible gardens (Nogueira & Wallig 2022).

Clear concept definition is the basis for all the research. This study represents the first results of the literature review aiming at understanding the current research in restorative and regenerative economy in the area of CE. The outcomes of the study are expected to benefit academics doing research, lecturers teaching various sustainable development and regenerative design methods and techniques, and also practitioners in current and future regenerative economy companies. Further research aims at giving a holistic picture of restorative and regenerative economy in CE as well as clear concept definition and central attributes that make it easier to apply regenerative economy strategies.

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