

# Value Chain Models and Circular Economy: Exploratory Results of a Systematic Literature Review

Pedro Almeida<sup>1</sup> & Carlos Ferreira<sup>2</sup> & Irina Saur-Amaral<sup>3</sup>

<sup>1</sup> PCI – Creative Science Park Aveiro Region, University of Aveiro, [pma@ua.pt](mailto:pma@ua.pt)

<sup>2</sup> LASI/IEETA, DEGEIT, University of Aveiro, [carlosf@ua.pt](mailto:carlosf@ua.pt)

<sup>3</sup> ISCA, University of Aveiro, NECE-UBI, Universidade da Beira Interior, [isaur@ua.pt](mailto:isaur@ua.pt)

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## Abstract

The transition from the dominant value chain models based on "Take, Make, Use, and Dispose" to the Circular Economy (CE) is gaining global traction as a sustainable development approach. With a growing global population surpassing 7.7 billion people, the need for sustainable practices that safeguard resources and protect vulnerable communities is becoming increasingly urgent. This article presents a systematic literature review conducted to assess to which extent researchers are addressing the adaptation of value chain models to the emerging concepts of CE, using a structured methodology that involved three stages: definition of the research focus, search for relevant literature, and reporting the results, being the goal to provide a comprehensive and unbiased analysis. Based on a final working sample of 159 articles extracted from Scopus and Web of Science Core Collection, we discover there is a higher interest from the scientific community to analyze traditional value chain models and relate them with the new concepts introduced by circular economies, revealing an active engagement of the scientific community in addressing the challenges posed by consumers and policy regulators to promote a sustainable society. Furthermore, the results suggest a rising trend of the combination of traditional value chain models with strategies and objectives of the CE practices.

**Keywords:** Value Chain; Circular economy; Sustainability; Sustainable Development; Systematic Literature Review.

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## 1. INTRODUCTION

Circular Economy (CE) is becoming a worldwide concept and development model as it aims to provide a sustainable alternative to the so far dominant economic development model, the so called “Take, Make, Use and Dispose” model. According to this model, industry manufacturers source the raw materials, transform them into finished products and sell them in the market to end consumers, which afterwards use and dispose them at the end of their lifetime or when they are no longer required (Ghisellini et al., 2016; Patwa et al., 2021).

Nevertheless, as the Earth population grows to unprecedented levels, reaching more than 7.7 billion people, there is a global concern and a strong need for a sustainable development model that ensures the availability of resources without sacrificing the global environment and/or vulnerable communities from developing countries (Mhatre et al., 2021). In this vein, there is a growing concern from consumers and policy regulators to manage the adverse effects of the unsustainable and environmental consumption and production patterns, which is leading to a competitive business landscape where industry is required to make significant improvements in resource performance across the global economy. Because of these reasons, many business organisations are exploring new ways of reusing the materials or products’ components to be used for a longer period, leading to a new paradigm shift that promotes a sustainable society and improves the environmental and economic concerns, i.e., the Circular Economy (CE) (Rajput & Singh, 2019).

In this context, the question arises: is the academic community keeping up the pace with the policy makers, industry and consumers in terms of scientific publications that relate value chain models and circular economy? To answer this question, the current research aims to understand how far the scientific community is addressing the need to adapt traditional value chain models to the new concepts that are being introduced by the circular economies, as this is an important aspect to tackle the challenges that are being claimed by consumers and policy regulators that want to foster a sustainable society (Patwa et al., 2021).

The methodology used to implement this systematic literature review was structured in a linear process that combines three stages: the definition of the research focus, the search for relevant literature and the reporting of the results, being the goal of this systematic literature review to provide a comprehensive, unbiased, and replicable synthesis of the existing research on value chain models and circular economy.

The following sections describe the methodology and the analysis of the results of the systematic literature review, followed by the discussion of the results and the associated limitations, a description of future work relevant for this scientific analysis and the conclusions of this study.

## 2. METHODOLOGY

In this article it is presented a systematic literature review that is composed by a linear process that comprises the definition of the research focus, the search for relevant literature and associated selection of scientific articles that are related with the focus of this scientific work, and the reporting and analysis of the results. The next sections describe the methodology that was used to implement this study, which was based on the methodology proposed by Tranfield and colleagues (2003).

The structure of the review process is depicted in Figure 1 and it is comprised by three different stages: the definition of the research focus, the search for relevant literature and the reporting of the results, which are detailed in the next sections.



Figure 1- Structure of the review process

### 3. RESEARCH FOCUS DEFINITION

The research focus of this study is to understand, through a systematic literature review, the relation between value chain models and circular economy and to what extent these topics have been combined and detailed in scientific literature. Two main categories have been identified, “value chain” and “circular economy” and these were the selected search expressions to retrieve scientific publications that combine both terms. Aligned with the research focus, the type of publications that was selected for this systematic literature review only includes peer reviewed journal articles and review articles to ensure the scientific value of the information being collected.

The term Circular Economy (CE) was first devised in 1990 in a study entitled ‘Sustainable Economic Development’ of Pearce & Turner. This study emphasized the interlinkages between the economy and environment and was based on a utilitarian benefit-cost principle instead of the conventional economic paradigm of take-make-use-dispose utility (Pearce & Turner, 1990).

By definition, “A circular economy is an economic system that is based on business models which replace the ‘end-of-life’ concept with reducing, alternatively reusing, recycling and recovering materials in production/distribution and consumption processes, thus operating at micro level (products, companies, consumers), meso level (eco-industrial parks) and macro level (city, region, nation and beyond), with the aim to accomplish sustainable development, which implies creating environmental quality, economic prosperity and social equity, to the benefit of current and future generations” (Kirchherr et al., 2017, p. 229).

The concept of CE is therefore characterized by a closed loop model that focuses on regenerative aspects, being grounded on an approach that is based on the make-use-reuse-remake-recycle model, having as foundation the principles of sustainability and a recurring usage of resources. Its main purpose is to enhance resource efficiency and the environmental performance of industrial processes and systems, enabling them to adapt to new concepts based on ‘end-of-life’ with restoration and elimination or reduction of waste. This involves the explicit implementation of new design models, product systems and materials that might have impact at the different nodes of traditional value chain models (Mhatre et al., 2021; Rajput & Singh, 2019).

Management literature describes various frameworks to reflect a company’s business activities, e.g., its value chains and supply chains, intending mainly to improve corporate performance. Some frameworks aim to analyse business activities from a strategic and conceptual point of view, e.g., the business model canvas of Alexander Osterwalder and Yves Pigneur (Osterwalder & Pigneur, 2010), whereas others have a more operational and processual perspective, e.g. Porter’s value chain framework (Porter, 1985). Within the scope of this article, the value chain model that is adopted by industry is not relevant, although it will be an important factor to further extend the analysis of this systematic literature review in the future.

Therefore, we expect that this study can contribute to understand to which extent circular economy and industry value chain processes are being used in peer reviewed scientific publications and therefore assess the novelty and relevance of this scientific work.

#### 4. RELEVANT LITERATURE SEARCH

To perform the relevant literature search, two scientific databases were selected: Scopus and Web of Science Core Collection, which have a significant coverage of the topics that have been selected during the research focus definition (Zhu & Liu, 2020). The search was conducted on April 12<sup>th</sup>, 2023, and no initial date was defined in the search query, so the full database was queried without a specific date-time filter. As we considered that potential early access articles could be available with relevant information, we also selected the possibility to include early access articles in the literature search. Based on these assumptions, both searches were conducted according with the following variables:

**Databases:** Scopus & Web of Science Core Collection

**Search Strings:** “value chain” AND “circular economy”

**Search Fields:** Title, keywords, abstracts

**Time Frame:** scientific articles published until 2023, including early access articles

**Language:** English

**Publication Types:** Peer-reviewed journal articles and literature reviews

**Execution Date:** April 12, 2023

In terms of the methodology and results of the relevant literature search, Figure 2 depicts the linear process that was conducted, and the results attained at each step of this process.

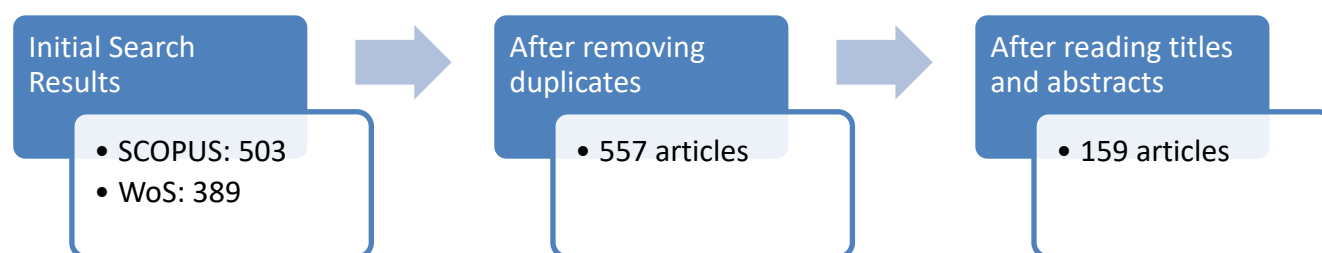


Figure 2 – Results of relevant literature search

Based on this process, the initial search results included 892 scientific articles that fulfilled the search criteria, being 503 articles associated with the Scopus database, and 389 articles with the Web of Science Core Collection database. These results were exported to the EndNote software and a semi-automatic process was performed to remove the duplicates from the search results, resulting in a total of 557 distinct articles. The semi-automatic process was necessary because after importing all the result to EndNote it was not possible to automatically remove the duplicates from the bibliographic database. It was not clear which were the reasons behind this limitation of EndNote but it led to a time-consuming task of removing duplicate entries. The next step in the review process was to read the titles and abstracts of the scientific articles and exclude articles that were highly technical or specialized in topics that don't address value chain models associated to industry, e.g., chemistry, forestry, or biomass. After completing the review process, a final sample of 159 was reached, which was the corpus selected to assess the review process.

Besides the limitation mentioned previously, some other limitations were detected at this stage that required the post processing and manual retrieval of information associated to the search results to improve the accuracy and value of this scientific work. One of the limitations faced was the fact that the name of the publications was not normalized. As an example, the publication “Sustainability” in the WoS database had an equivalent name of “Sustainability (Switzerland)” in the SCOPUS database. Consequently, the name of the publications had to be reviewed manually to normalize the publication's name.

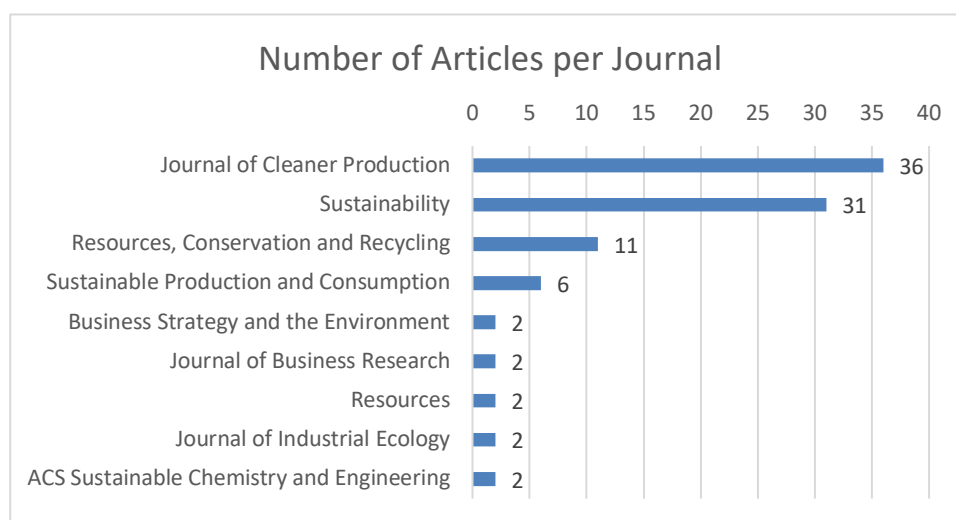
Another limitation was the fact that some records from the WoS did not include the Keywords when the export process was executed. As we planned to analyse the relevance of the articles and its content, we had to manually import the keywords of several articles to ensure that the relative weight of the keywords was properly assessed. Furthermore, as some articles had keywords in singular and others had the same keywords in plural we performed another manual time-consuming revision of the keywords associated to the scientific articles.

An additional relevant comment worth mentioning is the fact that we used four different software tools. The first one was EndNote, as the software that was selected to aggregate the results of the initial search in the SCOPUS and WoS database. Afterwards, we used VosViewer as the software platform to create a set of maps based on the bibliographic data in order to analyse the co-authorship and keyword co-occurrences. As we planned to evaluate the novelty of this thematic and to identify the most representative publications, we installed a plugin in EndNote to export the aggregated bibliographic data to the Excel format and afterwards build the pivot tables that would allow to create the graphical representations with the information that was intended to be interpreted. Finally, the WebQDA web platform was used to create a Word Cloud of the terms that were associated to the bibliographic records. After this process, we performed a qualitative analysis to deepen the understanding of our results, which are described the next section.

## 5. RESULTS

After reading the titles and abstracts and defining the final selection of relevant scientific articles, a series of analysis were performed to assess the results from this systematic literature review. The following subsections describe the results attained and detail important aspects that are relevant to reach some of the conclusions attained within this study.

### 5.1. QUANTITATIVE ANALYSIS

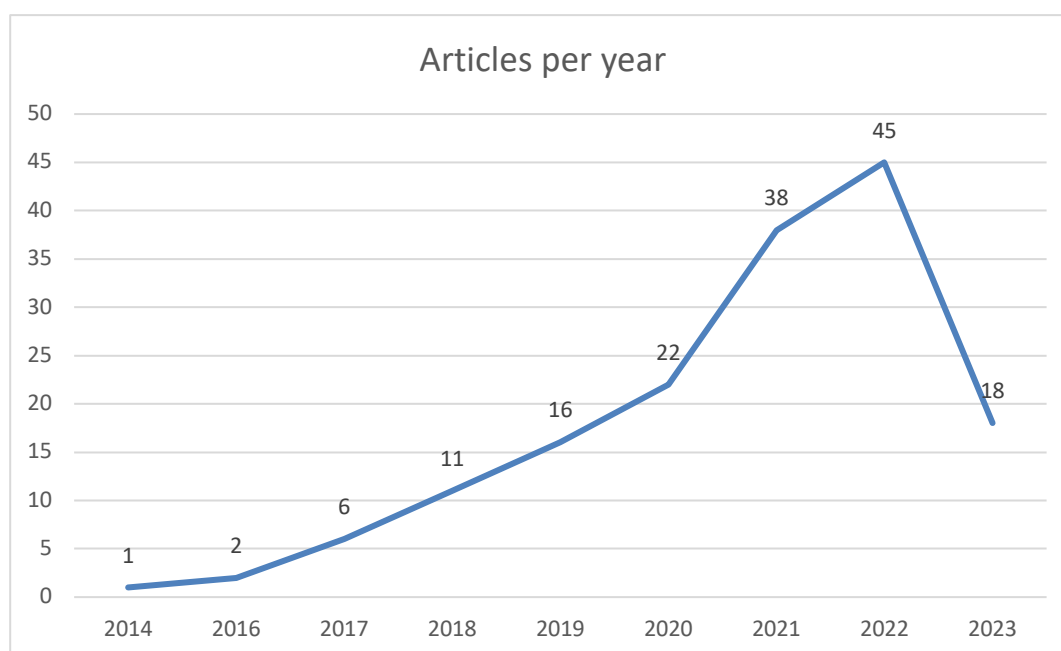


**Figure 3 - Number of Articles per Journal**

One of the dimensions that was intended to be analysed was to understand which were the publications that had a higher relevance when assessing the relation between circular economy and value chain models. As it is depicted in Figure 3, the four scientific journals that have a higher weight in this systematic literature review are: Journal of Cleaner Production (36 publications) and Sustainability (31 publications), followed at quite some distance by Resources, Conservation and Recycling (11 publications) and Sustainable Production and Consumption (6 publications). The other five scientific journals depicted in Figure 3 had only two scientific articles associated to each journal, which may be considered as a marginal contribution. All combined, the

total number of articles identified in Figure 3, 94, represent ~59% of the total number of selected articles, which is considered representative based on the dimension of the analysed universe.

By assessing the scope and focus of the four more representative scientific journals, there is a match between the focus of this systematic literature review and the resulting scientific journals, validating therefore at this stage the selected methodology.



**Figure 4 - Number of scientific articles published per year**

After identifying the most relevant scientific journals, we analysed the time span and distribution of the scientific articles over the time. As mentioned, during the selection process no date limit was defined, so all the publications that fulfilled the search criteria were retrieved independently of their publication date. After building the graphic representation of the number of scientific articles published per year, depicted in Figure 4, it is evident that the research focus of this systematic literature review, namely the relation between value chain models and circular economy, is a topic that was initially addressed in 2014 but only started to have a more significant relevance after 2018, having a significant relative growth from 2019 to 2022. Considering that our research only covered approximately 25% of the year of 2023, and assuming that the number of publications would be at least equivalent in the next three quarters, it can be expected that the total number of scientific articles published in 2023 may surpass the value attained in 2022.

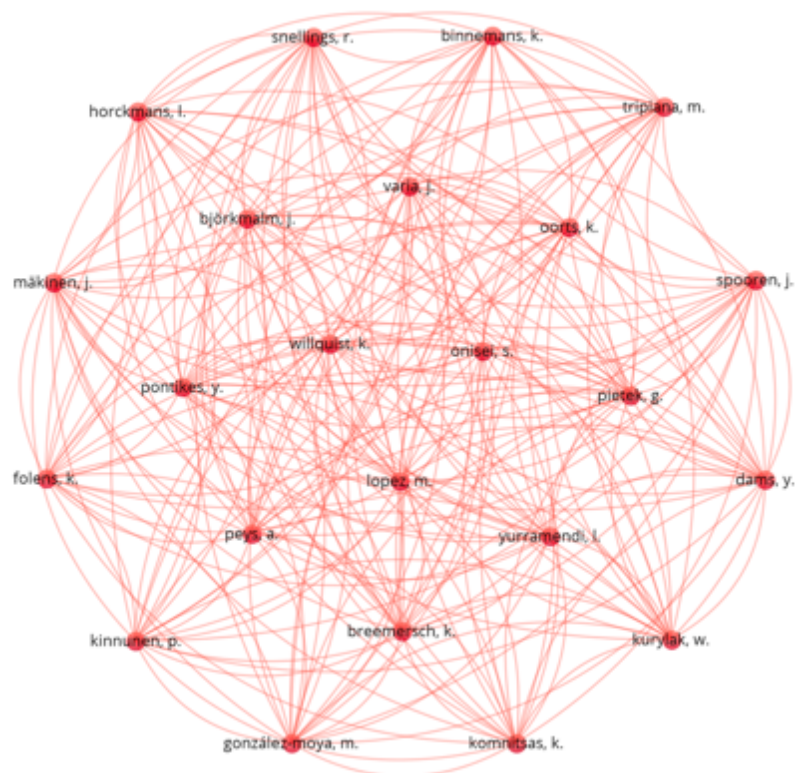
Based on this result, we may argue that there is a higher concern from the scientific community to address this research topic, which reinforces the novelty and relevance of this systematic literature review.

## 5.2. CO-AUTHORSHIP MAP ANALYSIS

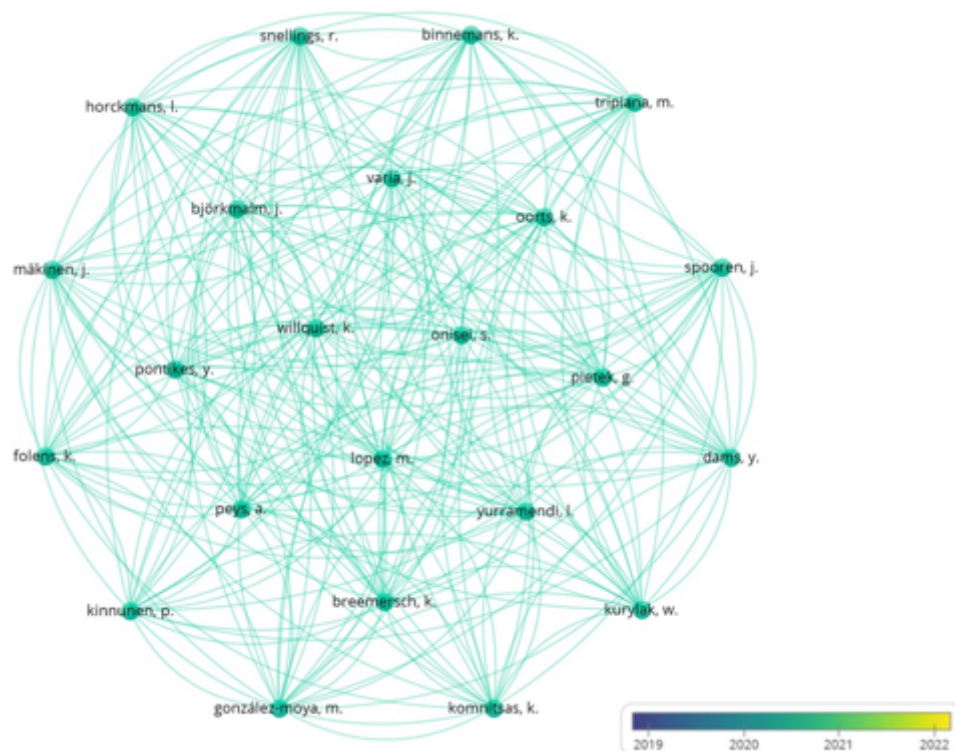
After the quantitative analyses, we analysed the co-authorship associated to the scientific articles that were selected during the initial process. We started with author network visualization, as depicted in Figure 5.

The minimum number of documents defined to build the map analysis was '1' resulting in set of connected items of 23, as depicted in Figure 5. Despite there is a relative dense network of co-authoring, the result of this analysis evidenced that only a rather low number of authors (30) had two or three publications.

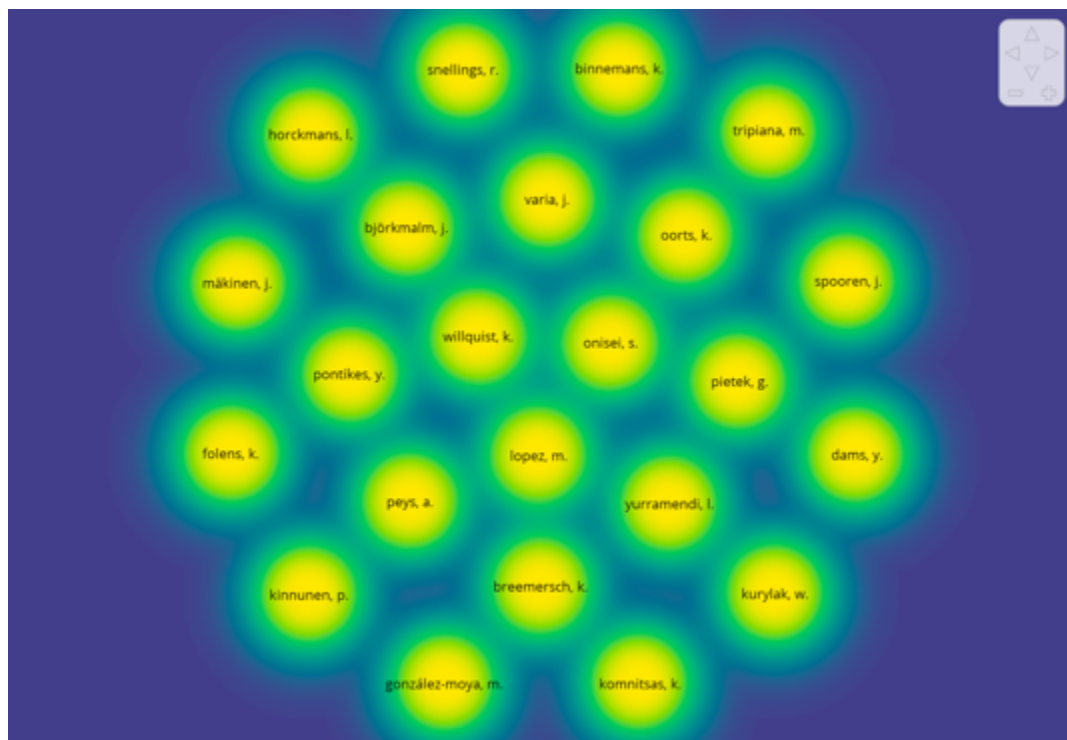




**Figure 5 - Author Network Visualization**



**Figure 6 - Author Network Overlay Visualization**



**Figure 7 - Author Density Visualization**

To further assess the co-authorship analysis, we built a map with the author network overlay, as depicted in Figure 6. This map corroborated the previous analysis of the time span of the scientific articles, as all these authors are associated to publication in a time span between 2020 and 2021. No author appears to have a significant higher weight compared with to total list of authors identified in the map analysis.

As a final assessment of the co-authorship analysis, we built an author density visualization map, as depicted in Figure 7.

By looking at the result of this map, we observe that there are several authors starting to research the topic, yet there is no dominant author, or group of authors, that has a higher relevance when compared with the total universe of authors in our sample. This result reinforces the novelty of the research focus of this scientific publication.

### 5.3. KEYWORD CO-OCCURRENCE MAP ANALYSIS

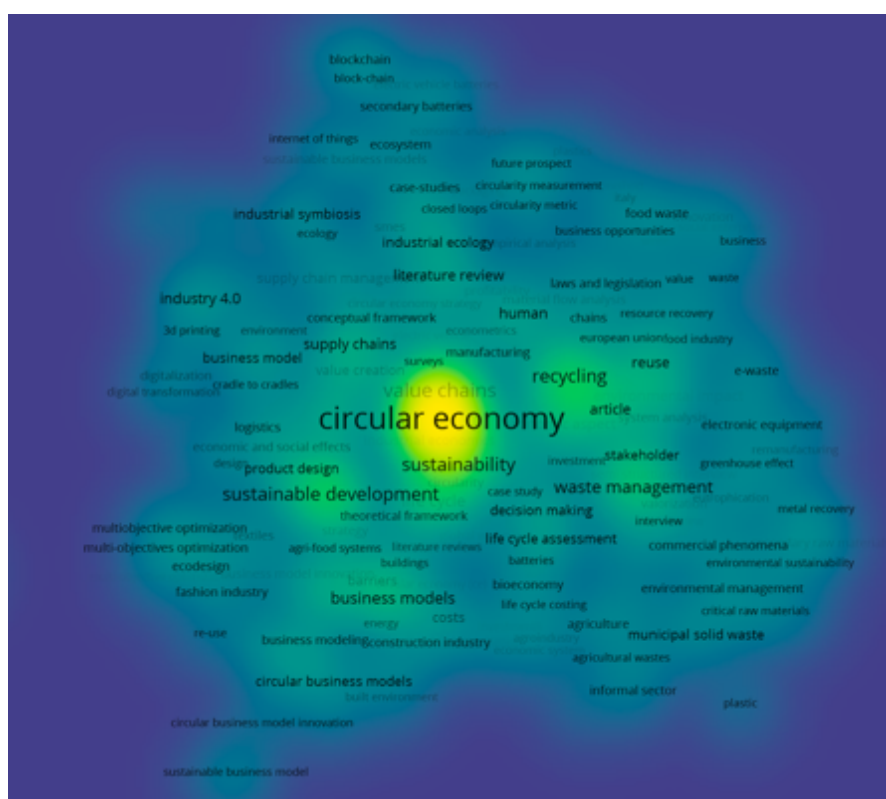
The next step in this systematic literature review was to analyse the occurrence of keywords in the final selection of scientific articles. Figure 8 depicts the keyword network where the keyword “Circular Economy” reveals a higher relevance when compared with the other keywords. The next four keywords with a higher relevance are “value chains”, “sustainability”, “sustainable development” and “recycling”, in line with the topic we addressed in this research.





To complement the keywords network visualization map, we extracted a keyword overlay visualization map to analyse the time span of the association of keywords to the scientific articles that were selected for this scientific literature review.

As it can be observed in Figure 9, the main keywords previously identified have a prevalence of dates between 2020 and 2021. We may also observe that the colours that have a higher prevalence are green and light green, which means that most of these keywords are comprised in a period around 2021. Based on this observation, we may conclude that the topics which have a strong focus on this scientific literature review, namely “circular economy” and “value chains” are, from a scientific publishing point of view, recent, therefore corroborating the novelty of this thematic as far as the involvement of the scientific community is concerned.



### Figure 10 - Keywords Density Map

In terms of the Keywords density map, which is depicted in Figure 10, we observe that the keyword “Circular Economy” has a higher relevance when compared with the remaining keywords, being followed by keywords as “value chains”, “sustainability”, “sustainable development”, “recycling” and “waste management”.

#### 5.4. WORD CLOUD ANALYSIS

As a final analysis of this scientific literature review, a word cloud analysis was performed to assess the words that were most commonly used among the full text abstracts of the scientific articles. Based on the results of this analysis, it can be observed that the words with that have a higher number of occurrences are “circular”, “economy”, “value”, “chain”, “waste”, “recycling”, “sustainable”, “production”, “environmental”, and “business”, among other words, as illustrated in Figure 11.



### Figure 11 - Word Cloud

## 6. DISCUSSION

After evaluating the results described in the previous section, it is plausible to conclude that the relation between value chain models and circular economy is a thematic that only recently started to be scientifically addressed. This conclusion is grounded on several facts previously revealed, namely the facts that only after 2018 it can be observed an higher volume of peer reviewed scientific articles and that the number of published articles is increasing along the years, specially between 2020 and 2022, with an high probability to continue to increase in the upcoming years, that there is no significant high prevalence of author, or group of authors, that is specialized in this thematic, and that the prevalence of keywords as “circular economy” and “value chain” are consistent with the scientific focus of this systematic literature review.

Despite these results, the adopted methodology has some limitations that might potentially lead to biased results, although it is considered that this risk is moderate or low. One of the limitations is the fact that only two scientific databases were selected to perform the search, although, from a scientific point of view, these are the two most representative scientific databases that aggregate scientific articles related with the research focus. Another limitation is the fact that the selected keywords to perform the queries were limited to “value chain” and “circular economy”, although it was evident that these keywords had a high relevance within the keyword map analysis and the word cloud analysis.

Finally, a more detailed assessment based on a qualitative analysis could also contribute to the improvement of this systematic literature review. We may seek to understand to which extent the existing value chain models incorporate characteristics that are being introduced by the circular economy context. Some examples of the traditional value chain models that could be used withing the codification process include Porter's (1985) and Osterwalder and Pigneur's (2010) value chain models, which are grounded on a linear economic model based on "Take, Make, Use, and Dispose".

The classification process could eventually be further detailed to comprise a holistic view that includes both primary activities, such as logistics or production, and support activities, such as human resources (HR) management or accounting (Eisenreich et al., 2022).

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Finally, it would also be relevant and important to assess if the CE strategies are being addressed in scientific publications that directly reference value chain models and its adaptation to the closed loop model associated to CE, namely the make-use-reuse-remake-recycle model.

## 7. CONCLUSIONS

The purpose of this research was to understand if the academic community was keeping up the pace with the policy makers, industry and consumers in terms of scientific publications that relate value chain models and circular economy and assess the novelty and relevance of this research to eventually structure and implement a complete systematic literature review. Based on these exploratory results, it can be concluded that the goals defined for this research were accomplished, being sustained that there is a new trend in the scientific community, especially after 2018-2019, to publish articles that address the combination of these two topics, “value chain” and “circular economy”, as it is supported by the results and discussion presented in the previous sections.

One of the conclusions that can be drawn from this research is that the relevance and novelty of the research focus are supported by the lack of dominant author, or group of authors, and the continuous increase of scientific publications in the last years, revealing that there is an increased interest from the scientific community to address the need of adapting traditional value chain models to the new concepts that are being introduced by the circular economies.

While not yet representing a very high participation in the topics, the increase in publications number is encouraging and further effort should be made to develop scientific knowledge to tackle the challenges that are being claimed by consumers and policy regulators to foster a sustainable society as well as prepare for environmental and climate changes. Hopefully, the emergent trend of combining the traditional value chain models with the strategies and objectives of the circular economy approach may be followed by future scholars.

Finally, with the further development of this systematic literature review, there can be a direct contribution to better define how to integrate traditional business models with the strategies and focus of Circular Economy approaches.

## ACKNOWLEDGMENTS

This work was financially supported by PRR - Plano de Recuperação e Resiliência, funded by the European Funds NextGeneration EU, by NECE-UBI, Research Centre for Business Sciences, funded by FCT – Fundação para a Ciência e a Tecnologia, IP, project UIDB/04630/2020, and by IEETA, funded through FCT in the context of the project [UIDB/00127/2020].

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