



## CIRCULAR SUPPLY CHAIN: THE STATE OF THE ART ON ITS DEFINITIONS THROUGH A SYSTEMATIC BIBLIOGRAPHIC REVIEW

## CADEIA DE SUPRIMENTOS CIRCULAR: O ESTADO DA ARTE EM SUAS DEFINIÇÕES ATRAVÉS DE UMA REVISÃO BIBLIOGRÁFICA SISTEMÁTICA

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**Abstract:** This study addresses the diverse and fragmented interpretations of the Circular Supply Chain (CSC) concept and its management (CSCM) in academic literature, identifying a gap in understanding these interpretations. To address it, a Systematic Bibliographic Review was conducted, analyzing 91 articles, aiming to consolidate the perspectives and meanings of CSC. The results successfully delineated seven conceptual groups for CSC or CSCM. This categorization offers a concise overview of the state of the art on the topic, highlighting the originality of this approach, which is pioneering in academia. The research found a definition that represents the connection between Circular Economy, different kinds of Supply Chain and Ecosystem Management. In conclusion, the study not only fills the theoretical gap by structuring CSC definitions but also provides a meaningful conceptual framework to guide future practical applications and research in the field. It is also suggested that future work could associate existing CSCs with the concepts defined here.

**Keywords:** Circular Supply Chain. Circular Supply Chain Management. Circular Economy. Systematic Literature Review. Supply Chain Management.

**Resumo:** Este estudo aborda as diversas e diferentes interpretações do conceito de Cadeia de Suprimentos Circular e sua gestão na literatura acadêmica, identificando uma lacuna na compreensão dessas interpretações. Para abordá-la, foi realizada uma Revisão Bibliográfica Sistemática, analisando 91 artigos, com o objetivo de consolidar as perspectivas e os significados de CSC. Os resultados delinearão com sucesso sete grupos conceituais para CSC ou CSCM. Essa categorização oferece uma visão geral concisa do estado da arte sobre o tema, destacando a originalidade dessa abordagem, que é pioneira no meio acadêmico. A pesquisa encontrou uma definição que representa a conexão entre Economia Circular, diferentes tipos de Cadeia de Suprimentos e Gestão de Ecossistemas. Em conclusão, o estudo não apenas preenche a lacuna teórica ao estruturar as definições de CSC, mas também fornece uma estrutura conceitual significativa para orientar futuras aplicações práticas e pesquisas na área. Também é sugerido que trabalhos futuros possam associar Cadeias de Suprimentos Circulares existentes aos conceitos aqui definidos.

**Palavras-chave:** Cadeia de Suprimentos Circular. Gestão da Cadeia de Suprimentos Circular. Economia Circular. Revisão Sistemática da Literatura. Gestão da Cadeia de Suprimentos.

## 1 INTRODUCTION

Circular Supply Chain (CSC) or Circular Supply Chain Management (CSCM) remains relatively underexplored and is an increasingly relevant topic in both academic literature and corporate practice (Farooque *et al.*, 2019b; Hazen *et al.*, 2021). However, it yet remains relatively underexplored in its full complexity. Its significance is undeniable, as it represents a crucial facet of sustainability within Supply Chain (SC) frameworks, surpassing the scope of Green Supply Chain (GSC) and Sustainable Supply Chain (SSC) (Farooque, *et al.*, 2019a). The promising importance of CSC in the corporate landscapes underscores its role in increasing organizations sustainability efforts and strategic positioning (Husain *et al.*, 2021). Since 2017, there has been a notable surge in research efforts to elucidate the concept and definition of CSC. However, a significant research gap persists. To date, there has been no comprehensive endeavor to aggregate and structure the diverse and fragmented definitions dispersed throughout literature. This absence prevents a cohesive, unified understanding of CSC for both researchers and practitioners. In light of this, the research question guiding this study is: "Has there been any consolidation within academic literature regarding the concepts, meanings, and explanations surrounding CSC?".

The primary objective of this study is to address this gap by systematically synthesizing, consolidating and contextualizing the various perspectives on the concept and significance of CSC or CSCM through a comprehensive examination of definitions and interpretations obtained from academic literature.

The research methodology employed is a Systematic Bibliographic Review (SBR). By its very nature, this approach is designed to comprehensively map a specific subject discussed across academic literature from diverse perspectives and identify new avenues for future research. The remainder of this paper is structured to first detail the theoretical background, followed by a thorough explanation of the SBR methodology, and a presentation of results found, culminating in the consolidated conceptual framework for CSC.

## **2 CIRCULAR ECONOMY (CE)**

The academic literature has several definitions of CE. It can be a contemporary concept of economy or economic system that replaces the Linear Economy (LE) (Kazancoglu *et al.*, 2020; Husain *et al.*, 2021), a concept of using products sustainably and with no useful life deadline (Wang *et al.*, 2020), a new production model (Kazancoglu *et al.*, 2021), a new business model (Mboli *et al.*, 2022) or an economic model that brings environmental development closer to economic development (Liu *et al.*, 2022).

This work uses as a reference the concept given by the Ellen MacArthur Foundation: CE is a system in which materials never become waste and are always regenerated, that is, products and materials are kept in a circular system incessantly forever. be reused. The EMF also establishes 3 principles for the CE: This work draws upon the conceptual framework provided by the Ellen MacArthur Foundation. The CE is a system wherein materials are never discarded as waste; instead, they are always regenerated, ensuring that products and materials are consistently reused within a circular system. EMF further delineates three core principles underpinning the CE:

1. Eliminate waste and pollution: preventing the use or consumption of a certain product from generating waste is the essence of this principle.
2. Optimize the circulation of products and materials: This principle emphasizes not only reusing products but also maximizing their value while ensuring no adverse effects on the organization's operations or finances.
3. Regenerate nature: in other words, changing the linear system of extracting, producing and discarding to a circular system which supports the natural process of developing nature.

## **3 SUPPLY CHAIN MANAGEMENT**

Supply Chain Management (SCM) had already been considered by professionals and academics as an extension of the logistics concept or the same as logistics (Cooper *et al.*, 1997), however, over time SCM has been considered as a process that encompasses logistics (Lambert *et al.*, 1998). Simply put, SCM can be defined as the management of relationships between stakeholders (Lambert *et al.*,

1998), or a process of planning, implementing, and efficient control over the cost, flow, and storage of materials.

SCM can also be considered within the context of a company as the discipline of Demand Chain Management, through the combination of functions and obligations between the different areas of the company, especially those involved with the Sales & Operation and Planning process, Sales/Marketing, Product, Supplies, Manufacturing, Quality, HR and Finance (Klein and Cassel, 2021).

Another perspective on SCM is that it functions as a mapping tool for the network of suppliers and consumers within a company's ecosystem. Its aim is to optimize processes within the supply chain, facilitating more efficient operations. This optimization is achieved through eight key processes (Croxton *et al.*, 2001):

1. Customer relationship management: In this level, key customers must be identified to be targeted as part of the company's business mission. It is separated into two process, the Strategic Process that provides the framework for how customers are developed and maintained. And the operational process, which deals with the products and services negotiations and agreements.
2. Service management for consumers: everything that presents the company directly to consumers, for example, exchanging information about product availability and delivery times and possible agreements created for the delivery of purchased products and services. This key process means the relationship and retention of the customer after the agreement has been done.
3. Demand management involves considering the specifications and requirements of consumers to enable companies to adjust their production systems and procurement policies, ensuring they can meet these demands effectively. This key process coordinates all acts of the business to synchronize the supply capacity within the customer's demand.
4. Fulfillment of orders: uninterrupted fulfillment of orders placed by consumers, considering not only the required product or a similar product, but also meeting the delivery time expected by the consumer. In this case, it is up to

the company to form possible partnerships with other SC players to fully meet consumer requirements.

5. Manufacturing flow management: establishing and controlling the application of improvements throughout the entire production flow of a company, from the extraction and sale of possible raw material to product delivery to the final consumer. This management approach must consider in this flow flexible processes to serve different markets or adapt to changes occurring in the same market.
6. Supplier relationship management is the process that demonstrates how the company interacts with its suppliers. It points out that companies must maintain a very close relationship with some suppliers, while on the other hand, develop new suppliers. In one sentence this key process can be explained as: define and manage the products and services agreements between the company and the suppliers.
7. Product development and commercialization is a critical process to maintain the company's success, given that developing new products based on consumer demands is fundamental to maintaining sales and, therefore, the company's participation in the Marketplace. In this key process, SCM means integrating customers and suppliers into the product development process.
8. Returns management is reverse logistics, that is, the return of SC products and inputs to their origins or other stages where they can be reused. When this process is well implemented and executed, it allows the company to increase its competitiveness in the market through cost reduction. It is a very important process to assist the company in achieving sustainability.

As the SC evolves together with discussions on sustainability, various forms of chains with environmental or socio-environmental aspects have emerged (Batista *et al.*, 2018): Sustainable Supply Chain, Green Supply Chain, Reverse Supply Chain and the Closed Loop Supply Chain, that in short explained below:

- **Sustainable Supply Chain (SSC):** can be viewed as a SC model that contributes to economic development, balancing environmental and social aspects (Kozancoglu *et al.*, 2020). It can also be explained as the

management of materials and equipment, financial management and the flow of information and cooperation between companies, to integrate the Triple Bottom Line variables (Gómez *et al.*, 2019; Bag and Rahman, 2021). Just like CE, SSC blends with the process of industrial symbiosis by engaging with different stakeholders within a SC (Wang *et al.*,2020). Also like the CE, the SSC can be viewed as a path to success in implementing the UN Sustainable Development Goals (SDGs) (Pohlmann *et al.*, 2020).

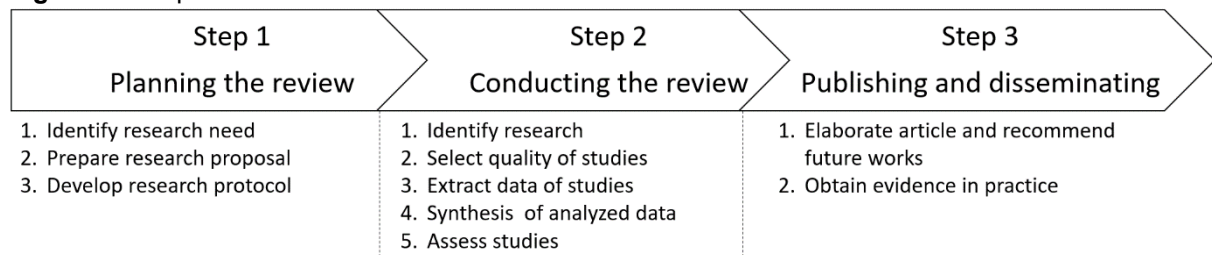
- **Green Supply Chain (GSC):** The definition of Green Supply Chain (GSC) closely aligns with that of Sustainable Supply Chain (SSC), as both aim to integrate environmental considerations throughout product development, raw material selection, and management of supply chain activities. (Torres-Carrión *et al.*,2018) and can be considered fundamental for the successful implementation of CE (Gupta *et al.*,2019; Nasir *et al.*, 2017).
- **Reverse Supply Chain (RSC):** RSC is defined as a new structure within the SC with challenges of managing the steps in which products are distributed to actors in the chain and how they are returned for reuse within the chain itself (Garrido-Hidalgo *et al.*,2019; Braz *et al.*, 2018; Isernia *et al.*, 2019).
- **Closed Loop Supply Chain (CLSC):** Among the SC analyzed so far, CLSC comes closest to the concept of CE, as it creates and recovers value throughout the useful life of products within the chain (Gupta *et al.*,2019) For the CLSC concept, it can be said that it incorporates the complete cycle of delivering products to consumers in the chain and then returning such products to the chain itself for reuse (Braz *et al.*, 2018).

## 4 METHODOLOGY

The research is conducted through a Systematic Bibliographic Review (SBR), a crucial research methodology that enables the researcher to thoroughly explore the subject under study. SBR assists in identifying research questions for further development and unveils new avenues for future research endeavors (Torres-Carrión *et al.*, 2018). Additionally, it seeks to identify and suggest new research avenues upon

the conclusion of the study (Seuring and Gold, 2011). Chronologically, SBR is structured into 3 stages, as shown in Figure 1.

**Figure 1 - Steps of a SBR**



**Source:** prepared by the authors based on Tranfield *et al.*, 2003.

In this work, SBR is chosen as a way to identify all possible definitions about CSC or CSCM and how the analyzed publications are related to the definitions found.

To guide the research, the following question was asked: Has there been any consolidation within academic literature regarding the concepts, meanings, and explanations surrounding CSC?

Having established the questions, the main objective of this work is outlined: Analyze the state of the art on CSC definitions and explanations and categorize them into groups of concepts for a unique understanding of the subject.

In addition, the preparation of this work is justified by the need to have a structural discussion about all CSCM or CSC concepts found in academic literature, to apply the results in future work.

The first bibliographic survey was carried out by the authors on July 19, 2022 and in 4 different sources: Web of Science, Scopus, Engineering Village and Science Direct. No restriction on the year of publication was determined on the topic and the following filters were applied:

1. Filter 1: Search in title: "CIRCULAR ECONOMY" AND "SUPPLY CHAIN MANAGEMENT" OR Search in summary: "CIRCULAR ECONOMY" AND "SUPPLY CHAIN MANAGEMENT" OR Search in Keywords: "CIRCULAR ECONOMY" AND "SUPPLY CHAIN MANAGEMENT"
2. Filter 2: Exclusion of articles not published in English
3. Filter 3: Exclusion of repeated articles

4. Filter 4: Refinement of the strings, in which only those articles that actually have the concept of CSC were considered.

A second bibliographic search was carried out, also by the authors, on October 2, 2023, restricting the publication period only to the years 2022 and 2023, however, maintaining the same filters as the previous search to select the final articles for detailed analysis.

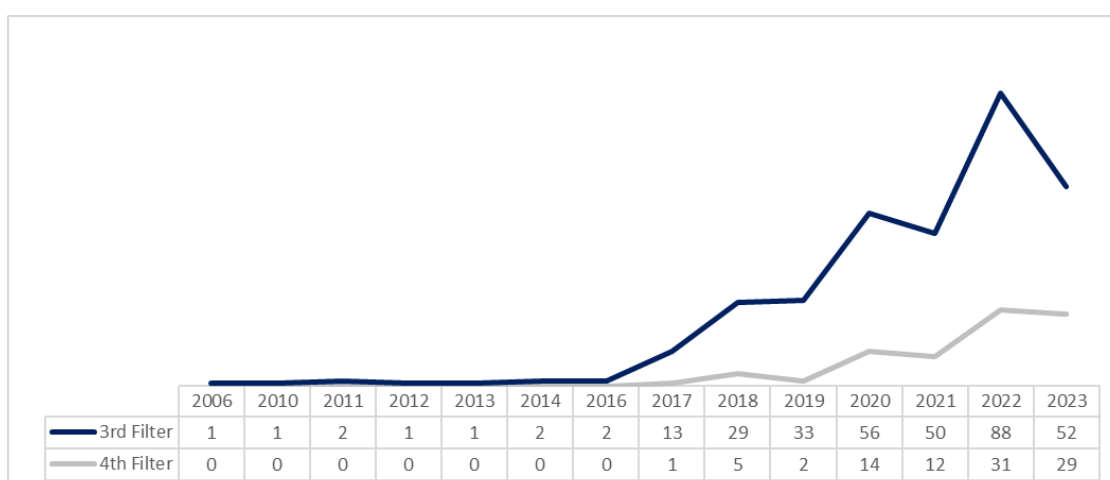
After conducting the searches, it identified the following distribution of publications presented in Table 1.

**Table 1** - quantitative results of articles found

Search carried out	Articles
1 <sup>st</sup> Filter	1.196
2 <sup>nd</sup> Filter	906
3 <sup>rd</sup> Filter	331
4 <sup>th</sup> Filter	91

Regarding the years of publication, the chart in Figure 2 made by the authors shows a comparison between the 3rd and 4th filters. While the second considers articles with content about CSC or CSCM, the first is limited to publications involving the CS and CE theme.

**Figure 2** - chart with evolution of publications



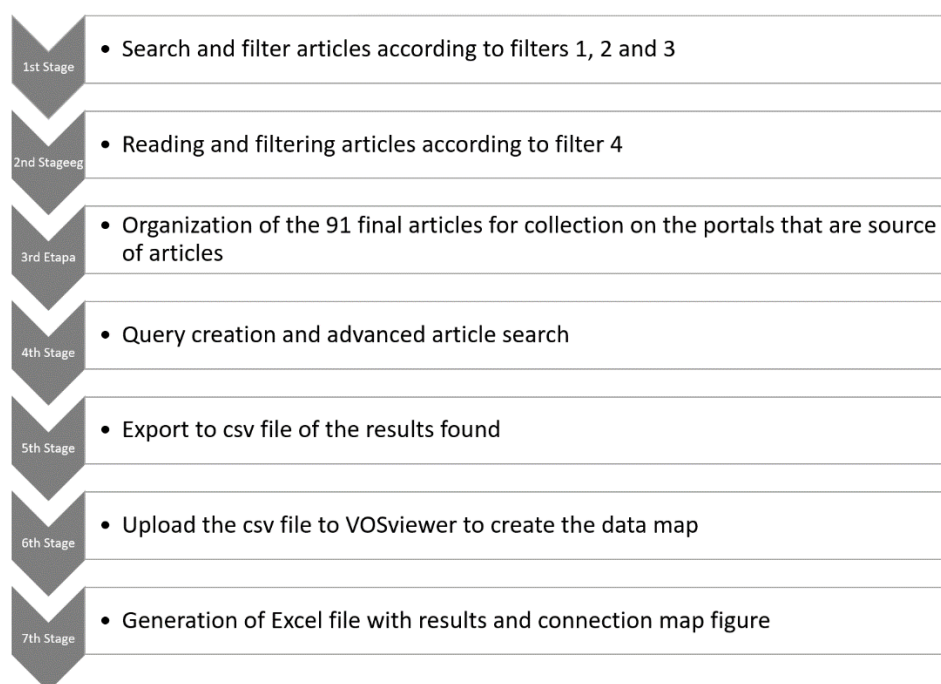
The chart shows that, although articles on CE have been published since 2006, it is from 2017 onwards that this topic gained more prominence in academia. Also in

2017, CSC publications began to appear, however, with a significant increase since 2020.

The subsequent step of the analysis and development of the work was based on the 91 articles published on CSC and CSCM, with these articles an analysis carried out using the VOSviewer software. According to its own manual, VOSviewer is a tool for creating maps of many different types of data, facilitating their analysis. A specific functionality of the software is the construction of relationship networks of different scientific publications, considering journals, research authors, institutions that support published research, countries, keywords or terms (VAN ECK and WALTMAN, 2013). These analysis variables are connected through some variables of the article, including the citation of articles, which is used in the analysis framework of this work.

To obtain the results from VOSviewer, the steps described in Figure 3 were followed.

**Figure 3** - Micro action steps for extracting the data connection map



The data map obtained as a result of Step 7 is generated through a figure with a network of connections, shown in Figure 4, and an Excel table, Table 2.



The analysis sequence follows the structure outlined in Table 2, organized in descending order based on the degree of intensity of connections for each article within the sampled dataset. Links are connections and similarities that exist between the documents in the studied sample and will never have a negative value (CWTS, 2023).

**Table 2** - articles published and classified according to the connection strength in each one

Item	Document	Links	Citations
1	Farooque (2019b)	56	362
2	Genovese (2017)	43	818
3	Batista (2018)	28	207
4	De Angelis (2018)	26	319
5	Geissdoerfer (2018)	24	596
6	Farooque (2019a)	17	151
7	Jain (2018)	10	68
8	Del Giudice (2020)	8	150
9	Sudusinghe (2022)	8	71
10	De Lima (2022)	7	32
11	Le (2023)	7	2
12	Braz (2023a)	7	0
13	Varma (2023)	7	0
14	Khandelwal (2020)	6	32
15	Lahane (2022)	6	30
16	Saroha (2022)	6	29
17	Alavi (2021)	5	89
18	Kazancoglu (2020)	5	81
19	Roy (2022)	5	15
20	Agarwal (2021)	5	14
21	De Lima (2023)	5	8
22	Fobbe (2023)	5	5
23	Çikmak (2023)	5	3
24	Chikwava (2022)	5	0
25	Hussain (2020)	4	134
26	Maranesi (2020)	4	53
27	Khan (2022)	4	26
28	Schultz (2021)	4	26
29	Burke (2021)	4	19
30	Aarikka-Stenroos (2022)	4	18
31	Saraji (2022)	4	16
32	Münch (2022)	4	16
33	Amiri (2022)	4	11
34	Chen (2021)	4	9

35	Ahmad (2023)	4	9
36	Zhang (2021b)	4	8
37	Yousaf (2023)	4	3
38	Braz (2023b)	4	3
39	Carissimi (2023)	4	1
40	Lahane (2020)	3	171
41	Julianelli (2020)	3	137
42	Hazen (2020)	3	83
43	Wang (2022b)	3	43
44	Farooque (2022)	3	42
45	Calzolari (2022)	3	39
46	Kayikci (2022)	3	36
47	Kazancoglu (2021)	3	33
48	Mondal (2023)	3	18
49	Hettiarachchi (2022)	3	17
50	Formentini (2022)	3	13
51	Vegter (2023)	3	4
52	Faisal (2023)	3	3
53	Zhang (2022b)	3	3
54	Batista (2023)	3	2
55	Viscardi (2022)	3	2
56	Kirbac (2023)	3	1
57	Betts (2022)	3	0
58	Wang (2020)	2	120
59	Zhang (2021a)	2	77
60	Gebhardt (2022b)	2	45
61	Mboli (2022)	2	43
62	Gebhardt (2022a)	2	27
63	Romagnoli (2023)	2	12
64	Kaya (2023)	2	8
65	Momeni (2022)	2	5
66	Goli (2023)	2	1
67	Santiago (2023)	2	0
68	Avikal (2023)	2	0
69	Jia (2020)	1	272
70	Centobelli (2022)	1	168
71	Mastos (2021)	1	91
72	Madau (2020)	1	61
73	Paul (2022)	1	35
74	Mańkowska (2020)	1	29
75	Van Capelleveen (2021)	1	25
76	Wang (2022a)	1	9
77	Agnusdei (2023)	1	9

78	Godinho (2022)	1	9
79	Van Capelleveen (2023)	1	6
80	Haber (2022)	1	3
81	Soleimani (2023)	1	1
82	Sahabuddin (2023)	1	0
83	Ozkan-Ozen (2020)	0	148
84	Mishra (2018)	0	116
85	Choi (2021)	0	37
86	Kazancoglu (2022)	0	9
87	Meier (2023)	0	8
88	Van Engelenhoven (2021)	0	4
89	Alamelu (2023)	0	3
90	Zhang (2022a)	0	3
91	Saide (2023)	0	1

## 5 RESULTS

Based on all the bibliographic analysis carried out and presented using the VOSviewer software, the main works on the topic can be outlined, which are represented in Table 2. And it is based on this table that the work of classifying and grouping the concepts about CSC begins, explained by the main authors of the topic.

There is no exact agreement on the meaning of CSC or CSCM, however, there are authors who converge with the same explanation or explain them similarly, which allows such concepts to be organized into groupings. In other words, of the 91 articles read and analyzed in detail, 7 different conceptual groups of CSC are identified, here called “Concepts.”

Based on the analysis of 91 articles, Concepts 1, 2, and 5 are the most representative, with a total of 72 occurrences, and are detailed in Table 3. Concept 1 stands out with the highest intensity and frequency, while Concept 2 has the second-highest intensity and the highest average intensity, as show in Table 4. Concept 5 serves as a key intersection between the other two, ranking third in intensity and second in frequency (see Table 4). In contrast, Concepts 3, 4, and 6 are the least representative in the literature, with only 18 total occurrences, none of them ranking among the top two in any variable, suggesting that researchers should exercise caution when using them to define or explain the concepts of Circular Supply Chain (CSC) and Circular Supply Chain Management (CSCM).

**Table 3** - groups of concepts about CSC or CSCM

Concepts and description	References
<p><b>CONCEPT 1:</b> entails the integration of the CE philosophy within the SCM, offering a new perspective for sustainability within the SC, by integrating the “zero waste” strategy and maximum use of the value of each product and input, when these are transformed into waste (Farooque <i>et al.</i>, 2019a; Farooque <i>et al.</i>, 2019b).</p>	<p>Farooque <i>et al.</i> (2019b); De Angelis (2018); Farooque (2019a); Chen <i>et al.</i>, 2021; Giudice <i>et al.</i>, 2020; Jain (2018); Mishra <i>et al.</i> (2018); Amiri <i>et al.</i>, 2022; Khan (2022); Paul (2022); Ozkan-ozen (2020); Maranesi (2020); Khandelwal (2020); Kazancoglu (2021); Wang (2022a); Godinho <i>et al.</i>, (2022); Centobelli <i>et al.</i>, (2021); Gebhardt <i>et al.</i> (2022); Capelleveen <i>et al.</i>, (2021); Alavi <i>et al.</i>,2021; Kazancoglu (2022); Engelenhoven <i>et al.</i> (2021); Jia <i>et al.</i>, 2020; Varma <i>et al.</i>, 2023; Lahane e Kant, 2022; Saroha <i>et al.</i>, 2022; Münch <i>et al.</i>, 2022; Yousaf <i>et al.</i>, 2023; Calzolari <i>et al.</i>, 2022; Mondal <i>et al.</i>, 2023; Formentini <i>et al.</i>, 2022; Zhang <i>et al.</i>, 2022; Viscardi <i>et al.</i>, 2022; Kirbac <i>et al.</i>, 2023; Momeni <i>et al.</i>, 2022; Santiago <i>et al.</i>, 2023; Avikal <i>et al.</i>, 2023; Van Capelleveen <i>et al.</i>, 2023; Haber e Fagnoli, 2022; Soleimani <i>et al.</i>, 2023; Sahabuddin <i>et al.</i>, 2023; Alamelu <i>et al.</i>, 2023; Saide e Sheng, 2023</p>
<p><b>CONCEPT 2:</b> involves the integration of two types of SC by transitioning from the conventional linear flow of resources and information to a circular model. This shift introduces the key features of a non-linear SC, fostering collaborative action among partners through reverse logistics (Genovese, 2017). In Concept 2, it can be said that CSC encompasses Linear, Reverse, Green, Sustainable, or Closed Loop SC, coordinated through business integration and value creation from products/services, by-products, and waste, which flow constantly along the chains (Batista <i>et al.</i>, 2018).</p>	<p>Genovese (2017); Batista <i>et al.</i>, 2018; Sudusinghe (2022); Hazen (2020); Mbolli (2022); Ahmad <i>et al.</i>, 2023; Agnusdei, <i>et al.</i>, 2023</p>
<p><b>CONCEPT 3:</b> defines the CSC as the collaboration between external partners to close resource loops, eliminate waste, and increase efficiency. The most representative work, by Geissdoerfer <i>et al.</i> (2018), emphasizes this coordination, while others like Choi and Chen (2021) and Aarikka-Stenroos (2022) stress the vital role of external agents from other sectors.</p>	<p>Geissdoerfer <i>et al.</i>,2018; Aarikka-Stenroos (2022); Burke (2021); Choi e Chen, (2021); Madau (2020)</p>
<p><b>CONCEPT 4:</b> merges the application of circular economy principles with the connection between supply chains. This concept, led by Wang (2020), focuses on involving stakeholders both inside and outside the chain to reuse inputs and resources. It emphasizes a dynamic system where different chains form industrial ecosystems, facilitating a fluid exchange of materials to extend their lifecycle.</p>	<p>Schultz (2021); Wang <i>et al.</i>,2020; Kazancoglu (2020); Mastos (2021); Le <i>et al.</i>, 2023; Çikmak e Kesici, 2023; Carissimi <i>et al.</i>, 2023; Gebhardt (2022); Kaya, 2023; Goli <i>et al.</i>, 2023</p>

**CONCEPT 5:** is the result of merging Concept 1 and Concept 2. It describes how CE principles are incorporated into supply chains that already have sustainability aspects. This means applying the circularity of products and materials within models like CLSC, GSC, SSC, or RSC.

Lahane *et al.*,2020; Hussain and Malik, 2020; Agarwal (2021); Zhang (2021b); Wang (2022b); Julianelli (2020); Saraji (2022); Farooque (2022); Roy (2022); Hettiarachchi (2022); De Lima *et al.*, 2022; De Lima and Seuring, 2023; Fobbe and Hilletoth, 2023; Chikwava and Shee, 2022; Mańkowska *et al.*, 2020; Kayikci, *et al.*, 2022; Vegter *et al.*, 2023; Faisal, 2023; Batista *et al.*, 2023; Betts *et al.*, 2022; Meier *et al.*, 2023; Braz and Mello, 2023 A; Walker, 2020; Agyabeng *et al.*, 2023

**CONCEPT 6:** describe the CSC as a merger of Reverse and Closed-Loop or Open Supply Chains. This is driven by collaboration and industrial symbiosis among various stakeholders to minimize environmental impact.

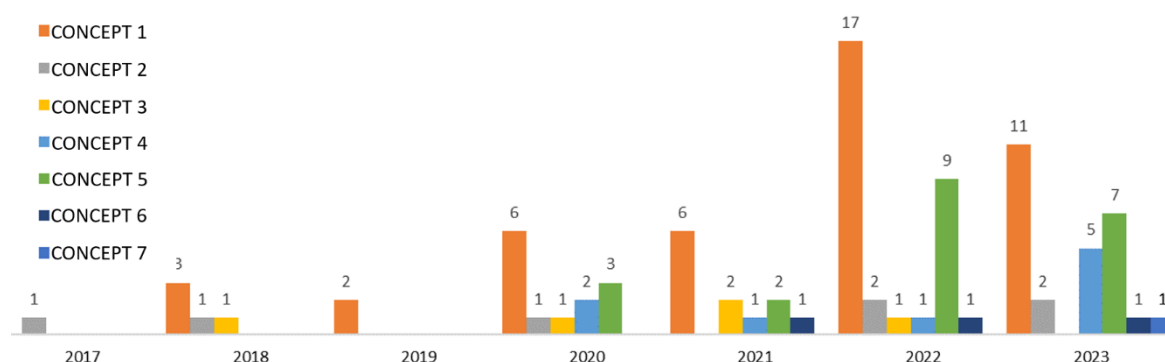
Zhang (2021a); Zhang (2022a); Romagnoli *et al.*, 2023

**CONCEPT 7:** serves as a foundational element in any discussion regarding CSC. Despite its singular occurrence, it serves as the linchpin connecting all other concepts discussed. Furthermore, Braz and Mello (2023b) provided a thorough and coherent explanation of this concept, drawing from articles included in the sample of 91 articles considered in their study.

Braz and Mello (2023b)

The name of each concept group above helps to chronologically identify the mentions in academic works of each of the 7 Concepts, which is demonstrated in the chart in figure 5, which was made by the authors.

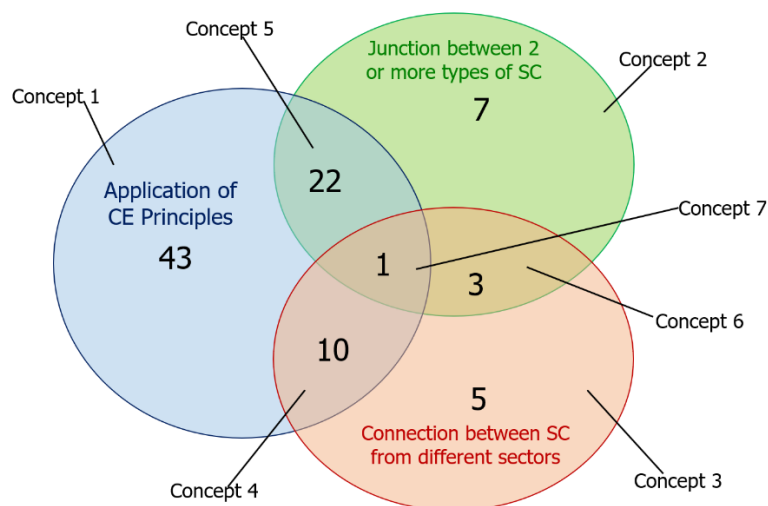
**Figure 5 -** distribution of recurrences of each concept in the works analyzed



Clearly, Concept 1 is the one that stands out the most, not only because it appears more times than the other concepts, but also because its appearance increases over the years analyzed, in total, within the analyzed sample, Concept 1 appears in 43 publications.

Given the explanations about each Concept, Figure 6, made by the authors, shows an interconnection between them.

**Figure 6** - interconnection between CSC concepts



Finally, based on data obtained through analysis in Vos Viewer and shown in Table 2, was created the Table 4, which presents the total sum of the article's importance indicator for each Concept, the occurrences of citations in the sample studied, also for each Concept, and, finally, the simple average between Total Intensity and Occurrences and calculated by the authors for each Concept. For better comparison and clearer visualization, a heat map with conditional formatting is used for each column. Optimal values are represented in green, while suboptimal values are highlighted in red, and intermediate values are shown in yellow. The average intensity formula of the last column is the simple average calculation between Total Intensity values and Occurrences values.

**Table 4** - Values in each Concept with heat chart

Group of concepts	Total intensity	Occurrences	Average intensity
CONCEPT 1	210	43	4,9
CONCEPT 2	89	7	12,7
CONCEPT 3	33	5	6,6
CONCEPT 4	34	10	3,4
CONCEPT 5	82	22	3,7
CONCEPT 6	4	3	1,3
CONCEPT 7	7	1	7,0

## 6 CONCLUSION

This research successfully achieved its objective: to consolidate the diverse perspectives on the concept of CSC or its management (CSCM) from academic literature. By addressing the identified research gap — the absence of a unified framework for CSC definitions — this study demonstrates that, although there is no single consensual definition, it is possible to outline a structured understanding of the topic.

Through an extensive Systematic Bibliographic Review, which analyzed 91 articles, it was possible to identify and categorize seven distinct conceptual groups for CSC. These "Concepts" therefore represent the consolidation of explanations scattered throughout the literature and directly answer our research question. This unprecedented categorization in the academic field not only offers a concise and pedagogical overview of the state of the art but also establishes a solid conceptual framework to guide future research and practical applications.

For corporate management, this work is a valuable resource. It allows managers to contextualize their companies SC within the seven identified conceptual groups, providing the assurance that their initiatives, even if they don't align with a singular definition, can be classified within one of the Concepts outlined.

Based on the results, we suggest three avenues for future work:

1. Develop research that associates existing CSC in the market with the Concepts defined here. And keep the CSC concepts found here up to date.
2. Conduct a new systematic review focused on case studies to categorize them based on the Concepts presented.
3. Deepen the study of the structural differences between CSC and other models such as SSC, GSC, SSC, CLSC and RSC, a topic that current literature still superficially explores.

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