



## Different concepts of supply chain sustainability: an approach on circular supply chain

### Distintos conceptos de sostenibilidad de la cadena de suministro: una aproximación a la cadena de suministro circular

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#### ABSTRACT

There are many overlaps between sustainability concepts so they are sometimes used interchangeably. This study was aimed to provide a deep analysis of the sustainability concepts in the circular supply chain (CSC) field and to identify research gaps and paths for future research. We conducted a search using keywords including “sustainability” combined with at least one of the keywords sustainable supply chain, green supply chain, circular supply chain, and closed-loop supply chain in the Google Scholar, ScienceDirect, and Emerald as well as the Web of Science. Mind Map Software was used to identify the gaps in the use of the CSC. The comparative investigation of the different concepts of sustainability showed that the CSC encompasses all concepts of sustainability and has a comprehensive concept that goes beyond all concepts of sustainability.

**Keywords:** Supply chain, Sustainability, Green supply chain, Closed-loop supply chain, Circular supply chain, Circular economy.

#### RESUMEN

Hay muchas superposiciones entre los conceptos de sostenibilidad, por lo que a veces se usan indistintamente. Este estudio tuvo como objetivo proporcionar un análisis profundo de los conceptos de sostenibilidad en el campo de la cadena de suministro circular (CSC) e identificar brechas de investigación y caminos para futuras investigaciones. Realizamos una búsqueda utilizando palabras clave que incluían "sostenibilidad" combinadas con al menos una de las palabras clave cadena de suministro sostenible, cadena de suministro verde, cadena de suministro circular y cadena de suministro de circuito cerrado en Google Scholar, ScienceDirect y Emerald, así como en la Web de Ciencias. Se utilizó el software Mind Map para identificar las lagunas en el uso del CSC. La investigación comparativa de los diferentes conceptos de sostenibilidad mostró que el CSC abarca todos los conceptos de sostenibilidad y tiene un concepto integral que va más allá de todos los conceptos de sostenibilidad.

**Palabras clave:** Cadena de suministro, Sustentabilidad, Cadena de suministro verde, Cadena de suministro de circuito cerrado, Cadena de suministro circular, Economía circular.

## 1. INTRODUCTION

Nowadays, due to the growth of consumer societies and the dramatic development of industrial activities, the production of solid waste and landfill has increasingly intensified. In addition, due to the growth in world population, and especially the strong growth of the middle class, the demand for resources is expected to increase rapidly (Lieder and Rashid, 2016). Indeed, The global economy is growing by about three percent every year, indicating an increase in demand in the market as well as output to support this demand. On the other hand, by limiting the resources of the planet, the requirements of economic growth and population growth cannot be met. The importance of this issue, while a congestion of 9 billion in 2050 and 10.1 billion in 2100 has been predicted by global population experts (Bastein, 2013).

Given the current level of production and the expansion of production forecasts, many countries, such as China, face resource shortages (Su et al, 2013). Therefore, resource management needs to be improved in order to earn more money for individuals while maintaining sustainable practices (Shi et al., 2017). The concept of sustainability in supply chain operations has attracted the attention of many managers, professionals, and academics. Studies in this area include green supply chain (GSC), closed-loop supply chain (CLSC), and sustainable supply chain (SSC) (Gurtu et al, 2015).

Sustainability is the intergenerational philosophy to help advance the future. However, one way to reduce resource demand is a circular economy model that reduces the need for new and raw resources through resource reuse (Kok et al., 2013). Circular economy plays a main role in challenges such as resource scarcity, waste generation and the preservation of economic benefits. The importance of this issue refers to the extent that the European Commission has recently estimated that this modern economic transition could generate 600 billion euro in annual economic revenue for the EU's manufacturing sector (Korhonen et al, 2018). The circular economy is a universal implication supported by the many companies around the world, several national governments, and European Union. In addition, the circular economy is as an approach to tackle promote sustainable development and environmental challenges (Korhonen et al, 2018). In the past decades, circular economy has recognized as one of the economic models that can replace with the linear economy. At present, the circular economy with environmental issues, long-term economic growth, and social justice can be introduced as a tool for sustainable development (Millar et al, 2019). Given the increasing population and rising consumer in the global market, the circular economy approach alone is not enough for production, stakeholders, manufacturing, etc., but it is necessary to transform the supply chain from linear model to circular model (Batista et al, 2018). In fact, integrated supply chain models are needed for circular supply chain (CSC) in which products are returned to end-users through recovery operations including reuse, repair, rebuilding or recycling. Furthermore, the purpose of CSC management is to optimize resource consumption via the product life cycle using recycling (Mangla et al, 2018).

This present intention seeks to cater a comprehensive comparison between different concepts of sustainability. Therefore, in order to constitute theoretical frameworks and cater a basis for further researches in the field of sustainability, this contribution is a significant phase. Recently, Farooque et al (2019), classified the concepts of sustainability and defined the CSC through this classification but they did not examine the differentiation of sustainability concepts and compare each of the sustainability concepts with the CSC. So, we can position CSC among all sustainability concepts.

This review article was aimed to provide a systematic approach and a deep analysis of the sustainability concepts, determine CSC role and position and extract research gaps and paths for future research in the field of CSC.

## 2. RESEARCH METHODOLOGY

A systematic review is a regular research method for starting research that can be used as a research method for reviewing and reviewing studies (Burgers et al, 2019). With the help of a systematic review, researchers can carefully examine their areas of concern and obtain good results (Denyer and Tranfield, 2009). Focusing on one section can lead to a systematic study from a non-systematic study. Many authors have suggested frameworks for providing a well systematic review.

In addition, systematic reviews provide a unit methodology to identify, select and secondary data analysis. As shown in Figure 1, systematic reviews commonly consist the below steps.

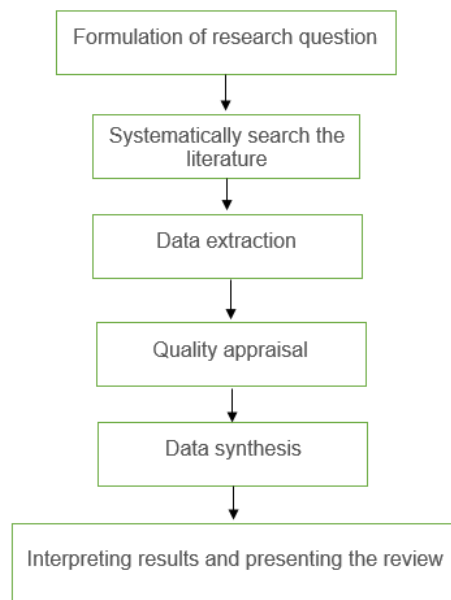


Figure 1. Research methodology of a systematic review

In this systematic review, we have used the steps according to figure 1 for identifying, data extraction, analyzing, interpreting and reporting the evidence from the different available sustainability concepts literature.

### 2.1. Question formulation

In this section, the study questions are necessary to be clearly defined in order to focus on them. In this regard, we created a comprehensive framework of sustainability concepts to explain and raise understanding of the CSC concepts. In fact, we aimed to answer three critical questions:

- 1- What is the difference between a GSC, CLSC, and SSC with the CSC?
- 2- Where is the position of CSC among the concepts of sustainability?
- 3-What are the research gaps in the CSC domain?

### 2.2. Systematically search of the literature

This step is to identify of the relevant studies. Therefore, different online databases including Google Scholar, Emerald and Science Direct, as well as Web of Science databases, were used.

Our review began with the definition of keywords based on our knowledge on the subject. Following the identification of a series of keywords, the set of keywords including “sustainability” combined with at least

one of the keywords green supply chain, closed-loop supply chain, and circular supply chain in the published articles was searched.

### 2.3. Study selection (Data extraction and Quality appraisal)

According to the criteria for entering and leaving articles, the articles that had used the sustainability term combined with at least one of the keywords CLSC, SSC, GSC, and CSC were selected. We limited the included papers for this review to papers that were published in the peer-review journals. Articles published at conferences were removed from our study. After these steps, the articles that had directly evaluated or debated the sustainability concepts in the supply chain field were only included in our data extraction (Table 1).

Table 1: Quantity of articles in sustainability with at least one of the sustainability concepts

Quantity of articles	Sustainability concepts
78	Sustainable supply chain
91	Green supply chain
7	Circular supply chain
25	Closed-loop supply chain

Table 2 shows the number of articles presented on different concepts of sustainability. However, 201 articles had directly studied the sustainability combined with at least one of the sustainability concepts.

Table 2: Quantity of articles in different sustainability concepts

Quantity of articles	Sustainability concepts
2310	Sustainable supply chain
3900	Green supply chain
58	Circular supply chain
2170	Closed-loop supply chain

### 2.4. Study Findings (Data synthesis and interpreting the results)

Our aim was to analyze the literature on SCS. Numerous studies had been presented in different areas of SCS. Most articles have been published in the field of GSC and sustainability. Although the issue of CSC encompasses all concepts of sustainability, few articles have addressed its sustainability. Given the similarity of some aspects of sustainability concepts, these concepts have been mistakenly used interchangeably. These concepts were also differentiated, despite the commonalities.

Since there were few articles on the difference between sustainability concepts, this section explores the differentiation and sharing of different concepts of sustainability.

## 3. LITRATURE REVIEW

### 3.1. The difference between a GSC, SSC and CLSC with CSC

In industry and other departments, responsibility and accountability to society and the environment are one of the most important issues for companies (Singh and Trivedi, 2016). For this purpose, companies should focus on sustainability in supply chain management. Supply chains need more attention to expand sustainability dimensions (Ashby et al, 2012). In fact, many scholars, managers, professionals, and academics have focused on the concepts of sustainability many. Studies in this area include GSC, SSC, and

CLSC (Gurtu et al, 2015). A new concept that has attracted the attention of many researchers is the CSC. In addition to the concepts of SCS, the CSC is also used as a concept of sustainability.

An important issue in the field of SCS is the lack of distinction between them. Because of the overlap, some researchers consider the green, closed-loop and reverse sights to be synonymous under a broader supply chain perspective (Walker and Jones, 2012; Batista et al, 2018; Carter and Rogers, 2008; Farooque et al, 2019). In this paper, we tried to examine the differentiation and sharing the concepts of sustainability combined with at least one of the sustainability concepts.

At first, each of the sustainability concepts are briefly defined and then compared to the circular supply.

### 3.2. Green supply chain

The issue of GSC management (GSCM) has emerged with increasing customer demands for green products as well as government legislation to consider environmental standards. GSCM involves examining the environmental factors involved in a supply chain to minimize its negative outcomes (Chin et al, 2015; Vanalle et al, 2017; Kaur et al, 2018; Cousins et al, 2019). Greening in the supply chain is the process of considerations throughout the supply chain or considering environmental criteria (Wang et al, 2016). GSCM, in order to maximize the efficiency of resources and energy consumption along with improving the supply chain performance, integrates environmental requirements with supply chain management at all stages of raw materials selection, product design, production and manufacturing, distribution and transfer processes, customer delivery and after use, recycling and reuse management (Sarkis et al, 2011; Uygun and Dede, 2016). In essence, the GSC combines the concept of supply chain management and the environment to manage and control environmental impacts. The sharing and coordination of information between all members of the chain is the basis of this control (Wong et al, 2015).

### 3.3. Sustainable supply chain

With the advent of sustainability and sustainable development emerged a new concept in the SC (Ahi et al, 2016). However, different dimensions and definitions of a SSC have been expressed. Today, SSCM encompasses widespread social responsibility management related to SC operations. The goal of SSC is to minimize the flow of materials in both production and consumption processes, reducing waste and pollution generation throughout the chain (Eskandarpour et al, 2015; Sarkis et al., 2011; Dong et al., 2016; Dubey et al, 2017; Genovese et al., 2017).

The benefits of a SSCM include customer satisfaction, quality, innovation, trust, resource speed, flexibility, optimal inventory, cost control and lead time. Four main dimensions of SSCM are: process design, sustainable product design, customers and as well as sustainable collaboration with suppliers (Paulraj et al, 2015). Stakeholders' awareness of social sustainability and environmental issues among universities and professionals is on the rise. The main interest for corporate intentions from stakeholder incentives and external pressures for the SCS at the enterprise level, usually in the process of tending to refine the SC concept, comes from the focal companies to their suppliers (Mani et al, 2018).

### 3.4. Closed-loop supply chain

Supply chains are divided into two categories of direct and reverse supply chains. These supply chains consist of successive levels that meet customer needs by adding value to the raw material and converting it into the final product (Baumgarten et al, 2003; Schultmann, et al, 2006; Govindan et al, 2015; Soleimani et al, 2015; Gao et al, 2016; Heydari et al, 2017). Reverse networks also contribute to collection of end-of-life products and their recycling in order to obtain raw materials, components and products for the direct grid, as well as to reduce the environmental effects of waste (Chahar Soghi et al, 2015). The main focus of the CLSC is on the flow of mainstream products rather than on the waste stream. In addition, Industrial parks

are a collection of companies located in one area and work together in a network designed to improve sustainability. (Bellantuono et al, 2017).

CLSCs have a great effect on improving the overall efficiency of the SC by increasing profits, increasing production and increasing customer satisfaction by presenting diverse products at different quality levels (according to recycled products) (Farahani et al, 2014). The CLSC includes supplier, manufacturer, retailer and seller of recycled materials. The purpose of a CLSC is to maximize the total profit of the chain (Yang et al, 2009).

### 3.5. Circular supply chain

Numerous definitions have been proposed regarding the CSC. In this section, we discussed the concept of the SC from the perspective of various researchers (Table 3).

Table 3: Circular supply chain definitions in previous studies

<b>NO.</b>	<b>Circular supply chain (CSC) definitions</b>	<b>References</b>
1	A CSC merges forward and reverse aspects of supply chains	Thierry et al., 1995
2	CSCs have a much wider scope than linear production systems.	linton et al., 2007
3	CSCs allow companies to control their materials and products over a cycle.	Bocken et al., 2016
4	The CSC represents a system capable of being repaired in such a way that materials enter a chain without restriction of reuse, recycling and reproduction. The goal of this restorative chain is to maximize the use of resources. This means that at the end of the shelf life of the products there will be minimal waste	Genovese et al., 2017
5	CSC leads to supply chain transformation from linear model to circular model through reuse, recycling and reproduction	Mangla et al., 2018
6	CSCM creates new perspective on SCS by integrating SCM and circular thinking.	Farooque et al., 2019
7	CSCs encompass opened and closed supply chains. CSCs have a wider vision and scope than a stable supply chain and closed loop.	Batista et al., 2018

The CSC requires integrated SC models in which the products of the final consumers are returned through recovery, including reuse, repair, rebuild, or recycling into the chain. Maximizing and optimizing the use of chain resources with regard to the reuse of the purpose of the circular supply chain.

### 3.6. Difference between GSCM and CSCM

The GSC is used by organizations to minimize the environmental destructive impacts (Sarkis et al, 2010). Although, in the literature of SCM, the issue of GSCM and SSCM are commonly used interchangeably, two concepts are different. Ahi and Searcy (2013), in an article they contrast the two concepts of sustainability. To analyze and characterize the distinction between these two concepts, they identified a set of key features with respect to the literature. For example, the characteristics for green supply chain are flow, coordination, stakeholders, relationships, value, effectiveness and operational focus and characteristics for SSC are economic, social, environmental, voluntary, resilience, and long-term focus. The results indicated that the definitions of the green supply chain were more restrictive than the concepts of the sustainable supply chain. Although some features overlap, the SSC is the expanded GSC. If we consider the environmental, social and economic dimensions of the SSC in general (Hong et al, 2018; Ahi and Searcy, 2013; Beske et al. 2014;

Carter and Rogers, 2008; Seuring and Müller, 2008; Dubey et al, 2016b; Silvestre, 2015) and the environmental criteria of the GSC (Chin et al, 2015; Dubey et al, 2016; Zhu et al, 2017; Chan et al, 2012), the GSC will be a subset of the SSC (Figure 2).

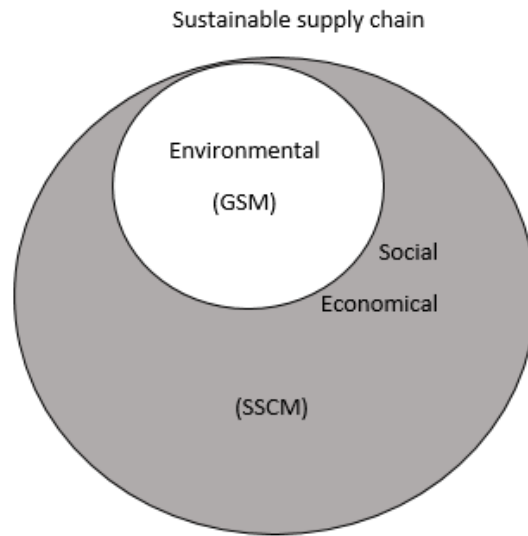


Figure 2. Difference between GSCM and SSCM

After comparing the SSC and GSC, we compare the circular and GSC dimensions. The dimensions of the CSC as described above, are the economic, social, environmental, circular thinking aspects of each sector of the chain, and the waste-free economy (Farooque et al, 2019). The essence of circular thinking is that we have to abandon the linear value chain based on the logic of "capture, build, and disposal" and create the circular chain instead, where materials are often used (Benton et al, 2017). In other words, circular economics expands the boundaries of GSCM by developing new methods to maintain resource sustainability (Nasir et al, 2016). Difference between GSC and CSC has been shown in Figure 3.

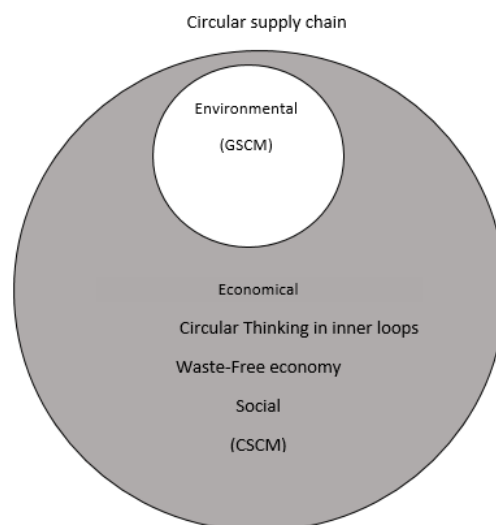


Figure 3. Difference between GSCM and CSCM

As figure 3 shows, the GSCM is a subset of the CSCM.

### 3.7. Difference between SSCM and CSCM

SSCM is defined as the inter-organizational interaction in a chain in which the social, economic and environmental benefits of the entire SC are achieved (Morali and Searcy, 2013; Paulraj et al, 2015). In other words, the purpose of SSCM is to minimize the flow of materials while reducing the negative consequences of inappropriate consumption and production patterns (Seuring and Müller, 2008). The frontiers of environmental sustainability are pushed through the circular economy by implementing manufacturing systems in which materials are reused. (Genovese et al, 2017). Given the dimensions of the SSC and the dimensions of the CCS described in the previous step, we can draw the distinction and overlap between these two concepts of sustainability as follows: (Figure 4).

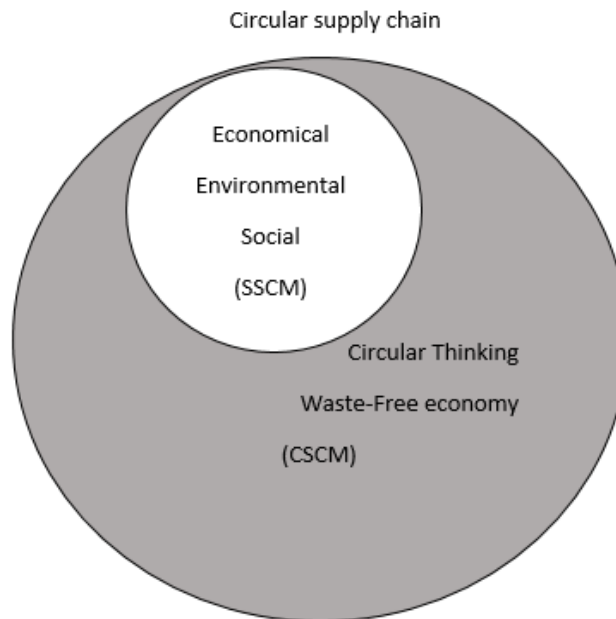


Figure 4. Difference between SSCM and CSCM

As figure 4 shows, the SSCM is a subset of the CSCM.

### 3.8. Difference between CLSC and CSC

According to the definition, CLSC attempts to recover the value added by reusing the entire product by taking the products from the consumers and coming back them to the main producer (French and LaForge, 2006). In this background, the issue of CLSC is expanded as a conformity of the principles of circular economics for SCM. In fact, the CLSC involves operations with product design, activities and life cycle management to maximize value throughout the whole cycle (Baruffaldi et al, 2019; Horton et al, 2018).

CSCs are the development of a CLSC philosophy based on the scope and focus on value chains that further circulate CLSC boundaries by considering post-production collaboration and cooperation (Batista et al, 2018) (Figure 5). They expand to transform forward-flowing materials into alternative supply chains. In the other words internal loops in the supply chain are used as repair processes to reduce the reuse of materials and resources (Batista et al, 2018). In the CLSC, there is a lot of losses due to the inability to reuse and recover all the unwanted items. Whereas in the CSC, the value of waste recycling is greater by working with different industrial sectors (Weetman, 2017). Closed-loop SCs take the linear model of supply chains and incorporate reverse logistics and supply chains (Sarkis, 2019).



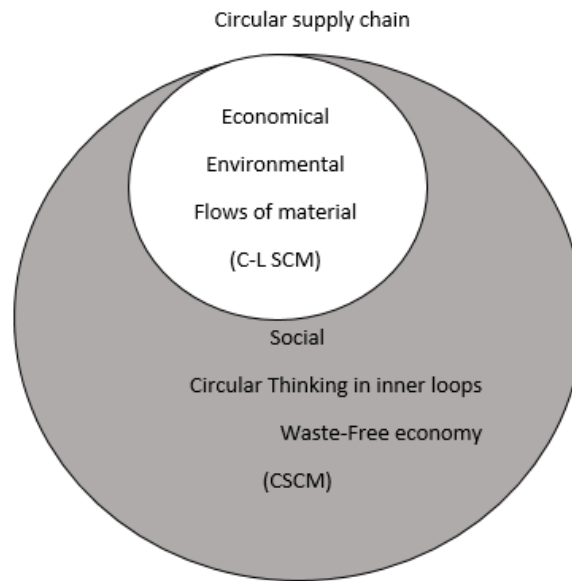


Figure 5. Difference between closed-loop SCM and CSCM

As figure 5 shows, the closed-loop SCM is a subset of the CSCM.

### 3.9. The role of circular supply chain among the concepts of sustainability

A CSC requires integrated SC models in which products are returned to end-users through recovery operations including reuse, repair, rebuilding or recycling (Mangla et al, 2018). It can therefore be concluded that the integration of renewable supply chains that support the implementation of material recovery processes with the SC constitutes the concept of a CSC (Batista et al, 2018). In fact, some problems such as production patterns, pollution, consumption, resource scarcity and climate change can be solved by using CSCM. This is because changing in some circular models of products, materials and waste streams, organizations will be able to reduce adverse environmental impacts and waste (Nasir et al, 2017; Genovese et al, 2017).

But then, the CSC has an overarching purpose beyond the traditional GSC and removes the shortcomings of the linear SC (Genovese et al, 2017). The concepts of the GSC and the SSC are developed in one direction and in parallel in discussions of ecosystem and industrial environments. (Nasir et al., 2017). The CSC has an overarching purpose beyond the traditional GSC and removes the shortcomings of the linear SC (Genovese et al, 2017). The essence of circular thinking is that we have to abandon the linear value chain based on the logic of "capture, build, and disposal", and instead create the circular chain, in which materials are repeatedly used. Thierry et al (1995) who designed the model where the product reaches the end consumer (such as reuse, repair, rebuild or recycle); products are linked to the supply chain ahead. The circular economy is pushing the borders of environmental sustainability by focusing on the idea of converting products as soon as they are manufactured. The basis for the paradigm shift in redesigning the material flow is long-term economic growth (Murray et al, 2017).

In the studies on SCM in the field of sustainability, a various concept such as SSC, GSC, CLSC has been introduced (Gurtu et al, 2015). As the concepts presented attempt to combine circular thinking in the supply chain, there is no definition to consider circular thinking. There is limited scope for integrating the two concepts of SCM and circular economy (Govindan and Hasanagic, 2018; Batista et al., 2018).

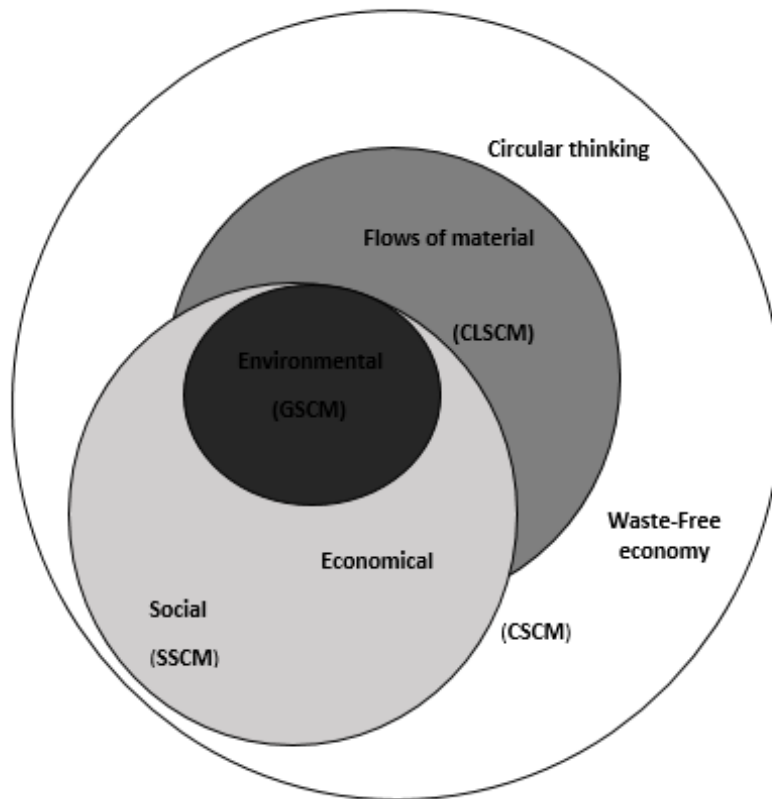


Figure 6. The domain of circular supply chain

According to the figure 6, two unique aspects of CSCM are: 1- The prospect of a waste-free economy; 2- Circular thinking which is the basis of the design of the repair cycle (Farooque et al, 2019).

#### 4. CONCLUSION

This study followed a systematic review methodology to ensure strong evidentiary value. In relevance with the first question, the emphasis of GSC is on reducing environmental effects. In essence, the green chain is based on the integration of the SC and environmental management. The scope of this chain is less than other concepts of supply chain sustainability and is used as a subset of all sustainability concepts. In the sustainable supply chain, some aspects of sustainability are considered, such as social, economic, and environmental.

The scope of the SCS is broader than the GSC but smaller than the CLSC. In the CLSC, the emphasis is on reuse and resource recovery through the integration of forward and reverse flows. However, the sustainable supply chain and closed loop are, like other concepts of sustainability, a subset of the CSC. Compared to all sustainability concepts with a CSC, this chain covers all sustainability concepts and has a broader scope and scope than other sustainability concepts that can serve as a viable management solution.

According to the second question regarding the explanation of the differentiation between different concepts of sustainability, the findings indicate that the CSC has a more comprehensive purpose than other sustainability concepts. This concept has a wider scope and also encompasses all sustainability concepts and removes the shortcomings of other sustainability concepts. In addition to being able to tackle problems such as inappropriate patterns of consumption and production, climate change, pollution, and resource

shortages, the supply chain integrates supply chain models, resources and products through reuse, restructuring or recycling to end consumer delivers.

In addition, there is no waste produced in this chain. In other words, the CSC refers to the regenerative processes in open looped and closed chains. In the CSC, resources enter into an unlimited process through recycling, repair or reuse and are used over and over again. In fact, in the supply chain, recycled materials are used as raw materials for the production of secondary products. In this chain, different surfaces serve as regenerative loops that are capable of resource efficiency and improve product life.

## 5. PATHS FOR FURTHER INVESTIGATION

Another aim of this review was to provide research gaps and paths for future research in the SCS field. The findings indicated that there are great potentials for more research in this field.

According to the review of all articles presented in the SC, the research gaps in this area have been presented in Figure 7.

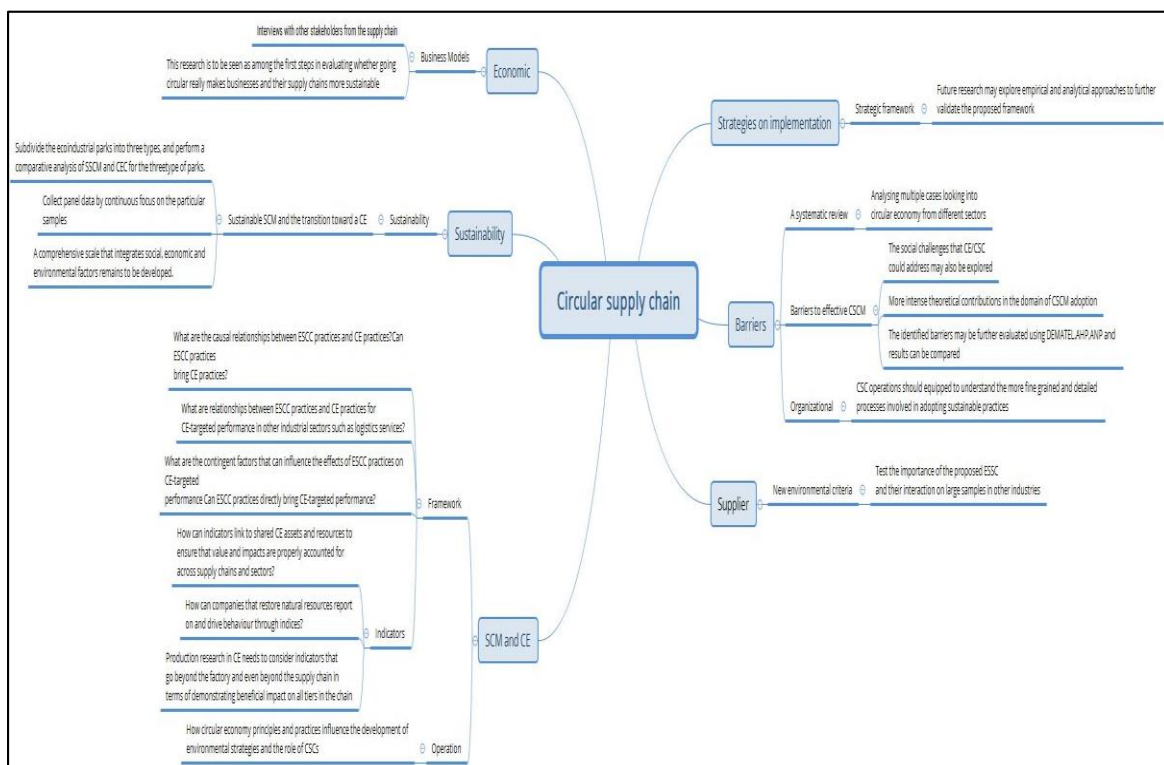


Figure 7. Further investigation on circular supply chain by using mind map software

Given the above form and output of the software, the various topics presented in the circular supply chain are first categorized, and their related gaps are briefly described (Table 4).

Table 4. Future research of circular supply chain in different fields

Fields	Further research	Authors (Year)
Economic	Interviewing with other stakeholders	Geissdoerfer et al(2018)
Sustainability	<ol style="list-style-type: none"> <li>1. Performing a comparative analysis of sustainability supply chain management and CEC, and subdividing the Eco industrial parks.</li> <li>2. A comprehensive scale that can integrate environmental, economic and social factors.</li> <li>3. Focusing on the particular samples and collecting panel data</li> </ol>	Zeng et al(2016)
Supplier	Testing the importance of the proposed ESSC	Prosman and Sacchi. (2017)
Strategy	Validating the proposed frameworks by exploring analytical and empirical approaches to further	Jain et al. (2018)
Barriers	<ol style="list-style-type: none"> <li>1. Looking into circular economy from different sectors by analyzing multiple cases.</li> <li>2. Exploring the social challenges addressed by CE/ circular supply chain</li> <li>3. More intense theoretical contributions in the section of circular supply chain management adoption</li> <li>4. Evaluating the identified barriers using ANP, AHP, and DEMATEL and comparison the results</li> <li>5. Equipping CSC operations for understanding the finer detailed and grained processes involved in adopted sustainable practices</li> </ol>	Mangla et al. (2018)
Framework	<ol style="list-style-type: none"> <li>1. Identifying the relationship between CE and ESCC practices.</li> <li>2. Considering indicators beyond the supply chain and the factory.</li> <li>3. Identifying a method for reporting the restore natural resources by companies</li> <li>4. Determining a relationship between indicators and shared CE resources and assets.</li> <li>5. Identifying the effective contingent factors on ESCC practices.</li> <li>6. Determining the causal relationships between CE and ESCC practices.</li> </ol>	<p>Zhu et al. (2010)</p> <p>Howard et al. (2018)</p> <p>Howard et al. (2018)</p> <p>Howard et al. (2018)</p> <p>Zhu et al. (2010)</p> <p>Zhu et al(2010)</p>
Operation	Identifying the effects of circular economy principles and practices on development of environmental strategies.	Batista et al(2018)

By examining all the circular supply chain articles, the different areas were identified. These areas were economic, sustainability, supplier, strategy, barriers, framework and operation. After identifying and categorizing different domains, gaps in each domain were identified in the context of the CSC. Given the number of gaps in different domains, there is a need for further consideration in the area of providing a framework for the CSC and barriers to the implementation of the CSC. Based on the research gaps for each area, we propose to carry out further investigations on the insights of CSCM framework.

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