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Factors affecting the Circular Supply Chain and Zero Waste: A Systematic Literature Review

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ABSTRACT

The current rate of resource consumption is alarming and if things proceed at the same level, we will soon be facing a global emergency. The circular supply chain has become quite relevant. However, the shift from a linear model to a circular one required organizational support at multiple levels. The CSC emphasizes the adoption of reuse, recycling, and remanufacturing. Incorporating circularity in the supply chain offers unique opportunities for making it possible to implement supply chain operations in the long run. Although the importance of this shift is huge, organizations are still facing trouble bringing about this change successfully because of the lack of knowledge about barriers to implementation, risks, and success factors. This research was carried out to identify barriers to circular supply chain implementation and factors in implementing circular supply chains. Identifications of these elements from a perspective that a generalized approach needs to be drawn to help organizations/industries of all types and sizes can help them develop the appropriate strategies for effectively handling circular supply chain practices. For the identification, PRISMA analysis was carried out. Primary relevant studies were selected through different sources of data including Google Scholar, Science Direct, JSTOR, Web of Science, Emerald Insights, and IEEE. Inclusion and exclusion criteria were then followed to filter the studies. Finally, 21 studies were made part of the final research. These studies provided insights into the barriers and success factors in implementing the CSC. 17 barriers that make it difficult to practice a circular supply chain and 9 factors to implement a circular supply chain were identified. More studies can be scrutinized to explore the ranking of these barriers and enablers to assist organizations in designing a reliable framework for change implementation. The findings can also help contribute towards transforming supply chains. They can be utilized to encourage economic well-being and minimize the issue of over-consumption of resources that industries are facing at a global level.

Keywords: *Circular supply chain, circular supply chain management, PRISMA*

1 | INTRODUCTION

The last decade has seen rapid growth in industrial activities. Consequently, the rate at which we have utilized natural resources and contributed to environmental degradation increased manifold. If we continue at the current level of consumption, without any consideration of how the items are sourced, produced, delivered, and utilized, we will consume most of its natural resources shortly (Hazen et al., 2017). The ongoing situation has provoked multiple discussions and debates in the academic literature that revolve around establishing and adopting a sustainable approach. Consequently, every organization now aims to have a supply chain that is that is more suitable keeping the economic and environmental perspectives in mind. Moreover, solid waste is of huge concern globally. Statistics show how serious the problem has become with multiple studies confirming that more than 1.47 billion tons of solid waste are annually generated worldwide (Zaman, 2015). However, so far, the production of such waste is an inevitable part of the process and the only approach to disposal incurred heavy costs making it undesirable, especially in developing or underdeveloped countries (Geng & Doberstein, 2008). Without a proper recycle/reuse strategy in place, most of the waste is managed inefficiently leading to premature disposal of many useful materials that can be repurposed and reused in a different setting (Wilson, 2012). Researchers have pointed out that although 84% of solid waste is generally collected from around the world, only 15% of it is recycled while the remaining is simply dumped into landfills. There is a pressing need for waste management and some researchers have put forward the concept of "Zero Waste", a wider concept as compared to the traditional "solid waste hierarchy". Zero Waste refers to a unifying concept that focuses on developing and implementing measures to eliminate waste (Curan & Williams, 2012). It recognized waste as a resource and its recyclability depending on the degree of the waste production. Zero Waste is relatively a new concept and is still in the stage of constant development. However, it is being implemented in close relationship with other relevant topics with the intention of developing circular supply chains and successfully implementing zero waste concept worldwide.

The Circular Supply Chain brings a new concept as compared to the conventional approach. The traditional supply chain focuses on converting natural resources into products and delivering them to the end consumers. In this linear approach, the waste products are dumped into landfills, which ultimately generates waste and contributes to ecological deterioration issues. On the other hand, a Circular supply chain is a regenerative and restorative approach that focuses on 6Rs: reuse, recycling, reduction, redesign, repair, and remanufacture. Recently a definition of circular supply chain management has surfaced in literature which states (Batista et al., 2018).

"*The coordinated forward and reverse supply chains via purposeful business ecosystem integration for value creation from products/ services, by-products, and useful waste flows through prolonged life cycles that improve the economic, social and environmental sustainability of organizations"*

The goal of CSC is to produce a "closed-loop system" that reduces resource input and waste (Bressanelli et al., 2020). It connects all stakeholders and paves the way for the exchange of knowledge and collaborations between different supply chains to achieve a common goal (Wieland, 2021). A circular Supply Chain can help organizations achieve resource efficiency and profitability while reducing negative impacts on the environment and the economy.

It is a crucial point in time when decision-makers need to take steps to rectify environmental problems for business supply chains (Alkhuzaim et al., 2020). Adopting a circular SC is a prospective sustainability approach that already promised more than 40% savings on energy and 30% on raw material usage as

compared to the linear supply chain model (Ansari et al., 2020). Currently, CSC practices are being implemented in developed countries like Germany, UK, and France (Yu et al., 2021). However, developing or underdeveloped countries are still behind in developing an understanding of circular supply chains and implementing it across different industries. In such countries, the implementation rates of circular supply chains are low since the associated risks have still not been calculated appropriately. Supply chains are generally considered vulnerable due to the complexity of the economic landscape in developing countries, material shortages, poor resource planning, supplier unavailability, and labour strikes. The barriers have also not been studied in a wide scope of research which presents another challenge. To ensure a smooth circular supply chain implementation, it is important to manage these risks and barriers, especially for companies that face more competition and deal with diverse risks. Correct identification of risks and barriers that hinder circular supply chain management may lead to improved supply chain resilience and better outcomes.

1.1 Research questions:

- What are the factors that play a pivotal role in implementing a CSC?
- What are the barriers associated with CSC implementation?

The academic contribution to the CSC and its adoption practices is limited (Nasir et al., 2017). The absence of literature and practical research that can enhance understanding of the barriers, risks, and factors associated with circular supply chains limits industries and businesses for circular supply chain initiatives. The systematic review aims to highlight the importance of practicing a circular supply chain, the factors that are required in its implementation, and the risks/barriers associated with a circular supply chain. The results can provide instructions to businesses in their efforts to minimize material use, remake, and reuse.

1.2 Theoretical Background

The sourcing of raw materials and the high level of waste generated as part of the process are only a few challenges that a linear supply chain presents. It is a threat to the environment given that most of the recycling programs have not yielded any evident results over the past few years (Khan & Haleem, 2020). Alternatively, issues encompassing the success of the linear supply chain system can be replaced with a circular approach which reduces the need for new, untouched raw materials by prioritizing those existing as by-products of other supply chains functioning in the system already. The circular supply chain considers factors that can help minimize waste and track product utilization more efficiently. The circular approach to the supply chain will systematically restore technical materials and provide enough time for biological material to regenerate ultimately paving the way to a zero-waste vision through innovating practices that can be implemented across all businesses and supply chain functions. A successful circular supply chain management process will oversee product/service processes to reuse and waste management, considering all stakeholders involved in every step of the product/service life cycle (Farooque et al., 2019). Subsequently, the implementation of CSC will improve the environmental conditions, minimize resource consumption and reduce the total amount of waste generated every year.

The circular supply chain system got prominent over the older approach in recent years, some studies have surfaced in the literature that explore different perspectives and discuss implementation challenges and barriers concerning different industries or regions. It is possible to identify some studies that explore circular supply chains from an implementation perspective. These typically shed light on practices and drivers of circular supply chain management (Batista et al. 2018). Undoubtedly, the studies have provided

useful insights into the supply chain landscape. Agyemang et al., (2019) have also discussed the success factors of circular supply chains in an economy and possible barrier that industries might face in coming years concerning this concept's implementation. Another example is that of detailed research published by Tura et al., (2019) that worked on devising a framework for limitations and factors in specific areas of an organization. It explored the barriers and success factors regarding environmental impact, social needs, technological landscape and political settings. (Bhatia et al. (2020) analyzed and discussed success factors for encouraging circular practices in the production business. Mangla et al., (2018) explored barriers to CSC management with a specific focus on developing the economy which qualifies as one of the most useful quantitative studies since most of the previously published work was qualitative only.

It is critical to investigate the CSC and zero waste approach from a perspective where previous studies have been limited. For example, several published studies have explored specific industries, and the results are thus limited to the specific business sector only. Where most of the studies have discussed barriers to circular supply chain success, they do not consider enablers that are equally important in making the implementation of the new concepts a reality. A research gap also exists with studies being conducted in a limited regional context. One must understand barriers/risks associated with circular supply chains in a comprehensive study that focuses on circular supply chain management and highlights important enablers across different industries and regions.

2. RESEARCH METHOD

For this systematic analysis, we adopted the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) guidelines. PRISMA helps to synthesize a collection of the most relevant studies and then analyze the presented information of the articles to develop a better understanding of circular supply chain concepts, barriers to its implementation, and success factors (Page et al., 2021). PRISMA analysis is often preferred for systematic reviews and bibliometric studies because it is a transparent approach. The step-by-step method makes it easy to identify, select, analyze, and synthesize relevant studies required to establish correct information regarding research questions, which in our case are relevant to barriers and success factors for circular supply chain. Following Tranfield et al., (2003) guidelines, our approach also adopted a structure, of transparent pathways to search, select, and then assess the evidence from relevant and reliable data sources. This review focused on gathering information for peer-reviewed articles and research reviews, excluding books, e-books, and chapters from such publications, conference proceedings, etc. The following sections further explain how the PRISMA analysis was carried out, the inclusion/exclusion criteria, the selection of studies, and data analysis.

2.1 Search Strategy

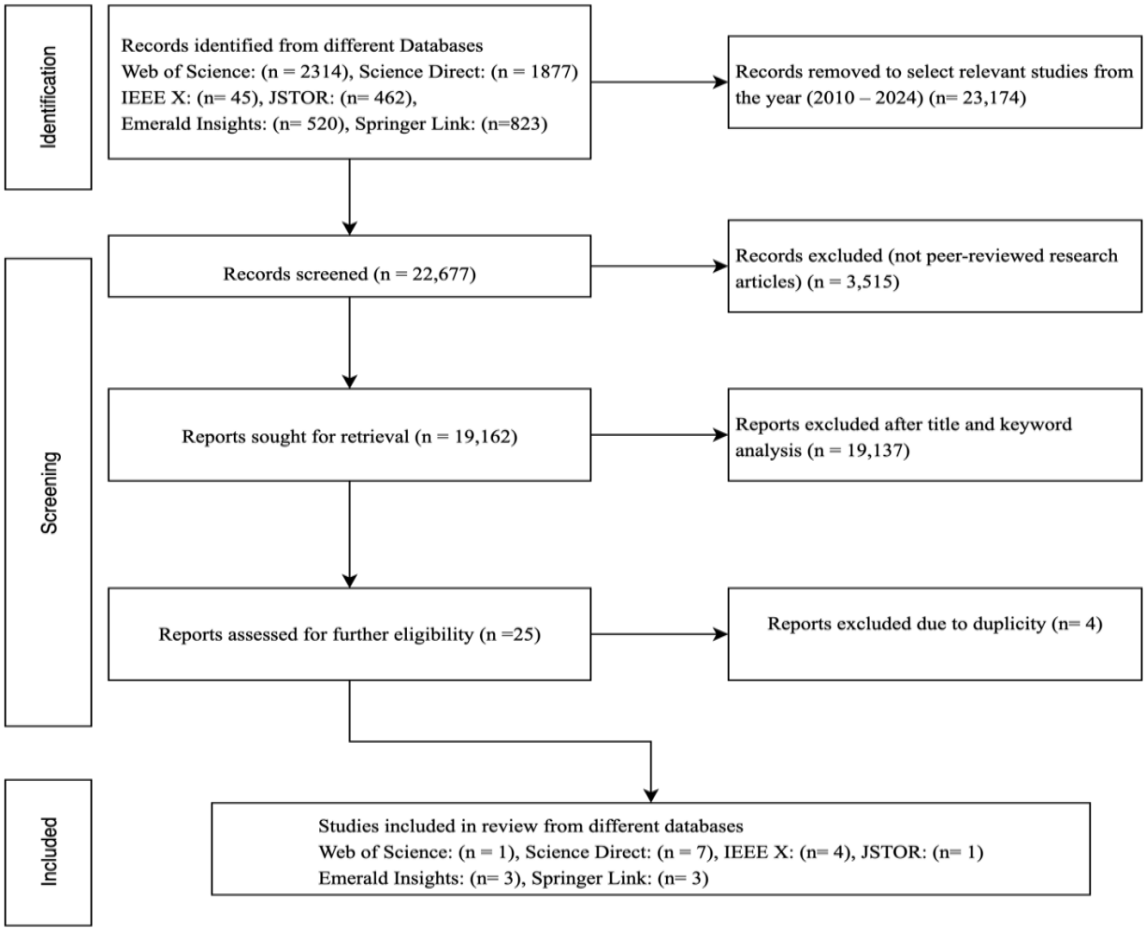
The Prisma technique was used to select evidence-based minimum sets of journals, articles, and published studies for reporting on a specific topic in the form of systematic reviews and analyses. The PRISMA technique involves the following steps:

1. **Identification:** Relevant studies will be identified through database searches (e.g., Scopus, Web of Science, Google Scholar) using keywords such as "circular supply chain," "zero waste," "Green supply chain", etc.
2. **Screening:** In-depth scrutiny of titles and abstracts will be performed to exclude irrelevant studies.

3. **Eligibility:** All the selected articles will be checked for eligibility based on predefined inclusion and exclusion criteria.
4. **Inclusion:** Studies meeting the set criteria will be made part of the final analysis.

Current study employed bibliometric methods to quantify data obtained from research documents on circular supply chain management. The purpose of drawing a bibliometric review is to identify the strong patterns that exist across many documents available online that are relevant to the selected topic. Five search engines were used as a document source based on their wide coverage of social science and management literature. These included Science Direct, Web of Science, Emerald Insights, Springer Link, JSTOR, and IEEE. The aim was to select peer-reviewed journals as they have been critically examined by the experts and minimize errors or misinterpretations. The scope of the review was covered with the title "factors that impact the Circular Supply Chain and Zero Waste: A Systematic Literature Review" without regard to sector, industry, or geography. The procedure for data sources selection is shown in Figure 1 below.

Figure 1: Data sources Selection Criteria



PRISMA technique was used to select the studies. The details of search thread are demonstrated in table 1. Whereas the search was based on the following keywords:

- Supply chain
- Circular supply chain
- Zero waste

- Barriers to circular supply chain/zero waste

Table 1: Research Thread

Topic	Search Engine	Timeline	Area
(Factors) OR (Constraints) OR Limitations) AND (Circular Supply Chain) OR (Supply Chain Management) AND (Zero Waste)	**Web of Science**	2010-2024	Supply chain/Logistics Management
	Science Direct	2010-2024	Supply chain/Logistics Management
	IEEE X	2010-2024	Supply chain/Logistics Management
	JSTOR	2010-2024	Supply chain/Logistics Management
	Emerald Insights	2010-2024	Supply chain/Logistics Management
	Springer Link	2010-2024	Supply chain/Logistics Management

2.2 Study Selection Process

The criteria for searching for articles/reviews was followed until the most relevant studies were selected for analysis. Peer-reviewed articles, systematic literature reviews, bibliometric literature were selected for this study. The studies that did encompass the specific topics that we are discussing in our project were removed from the collection. Moreover, the search was carried out in a specific timeframe to ensure that only the latest statistics were made part of the analysis. This was also done because the concept of the circular supply chain is rather new, and most of the practical work and framework design has been done in the last decade. Determining a timeframe allowed us to focus on the newer, fresher studies. The search was also carried out keeping in mind that publications in English were included only. As it turns out, most of the journals adopt English for worldwide publication. The pre-determined search criteria were applied to the selected repositories (Science Direct, Google Scholar, Web of Science, Emerald Insights, IEEE, Springer Link and JSTOR). Using a combination of different repositories allowed us to achieve a more comprehensive search capacity for the identification of the relevant studies as compared to most of the other published work that included 2 or 3 data sources only. The details of inclusion/eclusion criteria are given in the table 2 which follows below.

Table 2: Inclusion/Exclusion Parameters

Inclusion Parameters	Exclusion Parameters
Published between 2010 to 2024.	Published before 2010.
Publication in English language.	Published in languages other than English.
Studies that carry our essential keywords in the title. (CSC, zero waste, and/or PRIMSA technique).	Studies that did not carry our essential keywords in the title. (Circular supply chain, zero waste, and/or PRIMSA technique).
Unique literature with no duplication.	Duplicated records and articles with unnecessary data.

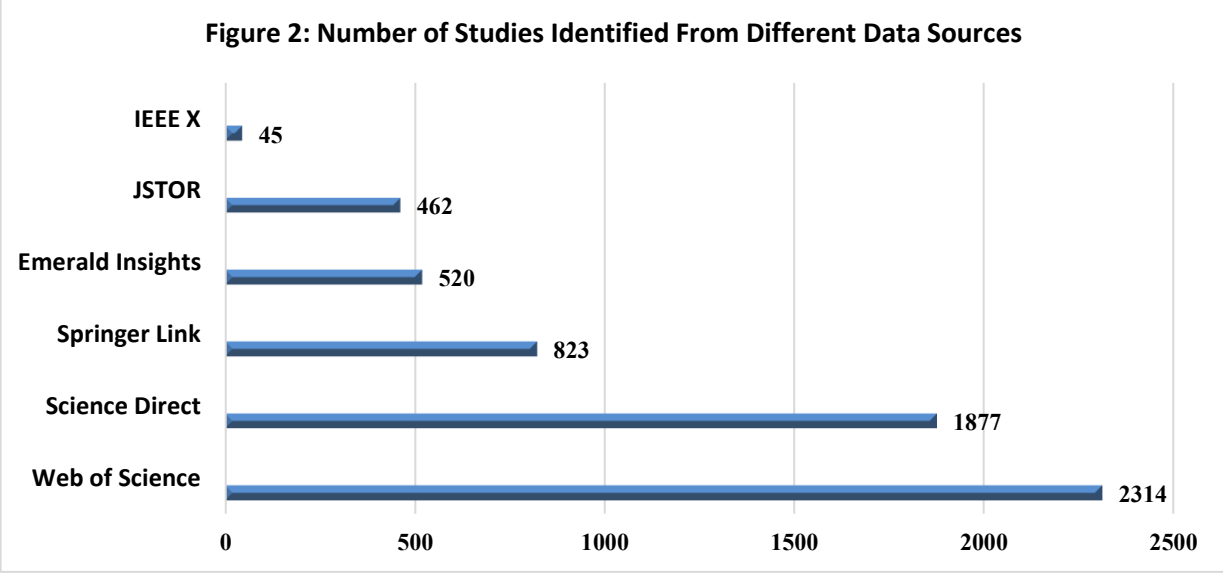
Generalized studies were included.	Studies that have been gender or industry-specific or focused on a particular age group only.
Only relevant studies were included leading toward project objectives.	Studies that do not discuss primary outcomes that relate to the research objectives of this project.

2.3 Identifying Sources

The search for the articles was carried out using PRISMA on 8th July 2024. The results were confirmed again with independent research carried out on 10th July 2024 following the same parameters. The intention of repeating the research is to ensure that there were no updates in the database and all recently published articles were included in the analysis. The primary keywords research was carried out using title input "Identification of The Factors That Impact the Circular Supply Chain and Zero Waste: A Systematic Literature Review" and yielded the following result in different databases.

Once the main pool of results has been identified without any refinement or limitations, inclusion/exclusion parameters were implemented to filter down the results. In the first step, a timeframe was introduced to limit the results to those published between 2010 and 2024. All the repositories gave a direct filter option from where we could set a custom range for the displayed results. In the second step, articles were excluded that were not peer-reviewed research or review articles. Most of the results filtered in this step were either book chapters, e-books, or encyclopedia content. In the third step, a set of keywords were searched in the title of the available publications. The majority of this was carried out manually by going through the list of titles retrieved after the first two steps and determining whether they correspond directly to our keyword search or not. In the fourth step, we worked to identify duplicates in the chosen studies to ensure that the same study was not included from two different data sources. After removing the duplicates, we moved to the final step of study selection i.e., analysis of the abstract to re-confirm that the study indeed gave valuable insights relevant to our research questions and research objectives. The table below demonstrates the number of studies retrieved from different databases (Figure 2)

Figure 2: Result retrieved



3. ANALYZING COLLECTED DATA

In total, 7 different databases were used to extract research and review articles for the study. We included multiple databases so that a wider scope of research can be covered. Other search tools like Science Direct and Web of Science have broader coverage, and they also provide access to older data sets. This may not be fruitful as we are focusing on retrieving information from recent publications only, but it ensures that all types of studies are included, nonetheless. It was observed that each source gave us a different set of articles. Only a few studies had to be removed from the analysis because of duplication. All the articles published up to 2024 starting from 2010 were included.

The initial research step using 7 different sources of data retrieval yielded a total of 45,841 studies. Following this, inclusion/exclusion criteria were implemented in which studies were shortlisted by only including those that fall within the 2010-2024 year of publication. This left us with a total of 22,677 studies. As per our PRISMA criteria, only peer-reviewed articles and research reviews were to be made part of the study. This was done to maintain the quality of the content and to restrict the number of studies to a manageable count. Only English sources were made part of the review given the language limitation of thesis requirements. Further exclusion of studies based on this criterion gave us 19,162 studies eligible for the review. Then applying thorough keyword analysis for our chosen target keywords “circular supply chain”, “zero waste”, sustainable supply chain”, “CSC PRISMA analysis”, and “barriers to CSC” only left us with 25 focused studies that discussed in detail the information which we may need to explore answers to the research questions mentioned above. Next, it was important to identify if there were any duplicates in the data set, i.e. to confirm that all the data sources have yielded different studies, and the same study is not included from two or more two sources. This step results in the further removal of 4 research articles. The 21 remaining articles were analyzed by going through their abstracts and examining research objectives. Finally, 21 articles were retrieved from the data sources for observing barriers and success factors for circular supply chains and zero waste implementation. This data has been tabulated in the Figure above. The set criteria for inclusion and exclusion ensure that all articles specifically discussing barriers or success factors for circular supply chain implementation were retained and that all the studies that did not yield any conclusive decisions or findings were eliminated. The findings of each article were analyzed and compared to identify a unique set of barriers and factors related to circular supply chain and zero waste.

4. FINDING FROM SYSTEMATIC REVIEW OF LITERATURE

The systematic review of literature has led to understanding findings regarding there critical components. First component highlights the success factors that contribute towards CSC and zero wastage in supply chain management of an organization. Secondly, the studies have been listed on the basis of identification of barriers and the third category is based on success factors and barriers both. The categorization of studies in three different subsets are demonstrated in table 3, that enlists the details including source, methods, key findings and description of each study.

Table 3: PRISMA flow sheet & Key Findings

	Title	Date	Authors	Source	Methods	Key Findings	Description
Identification of success factors							
1	A grey-based framework for circular supply chain management: a forward step towards sustainability	2022	Shabaz Khan, Abid Haleem, Mohd Imran Khan	Google Scholar	Literature review and grey-Delphi approach. It was then coupled with an integrated grey-based Technique for Order of Preference by Similarity	The proposed framework was used to identify significant enablers for CSC	long-term planning and alignment of CE goals with strategic objectives can be fruitful in implementing CSC successfully
2	Sustainable supply chain management in a circular economy: A bibliometric review	2022	Monrudee Theeraworawit, Suparak Suriyankietkaew, Philip Hallinger	Springer Link	A systematic review conducted on 709 Scopus-indexed documents	Supply chain management in the context of redesign, reuse, and product transformation.	Reverse cycles are crucial in the supply chain.
Identification of barriers							
3	Barriers to effective circular supply chain management in a developing country context	2018	Sachin Kumar Mangla, Sunil Luthra, Nishikant Mishra, Akshit Singh, Nripendra P. Rana, Manoj Dora, & Yogesh Dwivedi	Springer Link	literature review and feedback from experts	Barriers to circular supply chain implementation	Government and legal regulations Infrastructure inefficiency Lack in IT system and technology Lack of environmental awareness
4	Benefits, challenges, and critical factors of success for Zero Waste: a systematic literature review	2017	Natalie Pietcxch, Jose Luis Duarte Ribeiro, Janine Fleith de Medeiros	Science Direct	a systematic literature review employing 102 published articles	Barriers were identified both in political and cultural settings.	Lack of customer awareness Lack of market regulations Lack of incentives and rewards
5	Towards a circular supply chain: Understanding barriers from the perspective of recovery approaches	2022	Sayed Mohammad Ayati, Ehsan Shekarian, Jukka Majava, & Brian Vejrum	Google Scholar	systematic literature review	There are frequent barriers in different categories that can impact how well CSC practices can be adopted.	Categorization of multiple barriers into sets and subsets fir better understanding
6	Barriers to dematerialize supply chains to reach circularity	2023	Amanda Helgostam & Sara Lindh	JSTOR	Literature review and feedback received from experts	important barriers were identified	Lack of customer awareness Lack of market regulations Lack of incentives and rewards Government and legal regulations Infrastructure inefficiency

							Reverse logistic issues
7	Barriers to effective circular supply chain management in a developing country content	2024	Mangla S, Luthra S, Mishra N, Singh A	Google Scholar	literature review and feedback received from experts. Interpretive Structural Modelling - MICMAC approach	Important barriers were identified	Poor financial planning Poor organization structure Lack of financial planning Lack of coordination and collaboration
8	Barriers and enablers of circular economy: A systematic literature review	2023	Ervisa Ndoka	IEEE X	Systematic literature review and bibliometric analytical procedures	Important barriers were highlighted by researchers	Top management commitment Consumers lack knowledge
9	Enablers to implement circular initiatives in the supply chain: A grey DEMATEL method	2020	Shabaz Khan, Abid Haleem, Mohd Imran	Springer Link	grey DEMATE	Factors vital for the implementation of circular initiatives.	There are many crucial factors that can drive success of initiatives in this field.
10	Evaluating and ranking the circular supply chain implementation enablers	2021	Ameer Al Haddad	Emerald Insights	Pythagorean fuzzy analytic hierarchy process (PF-AHP) technique	Circular supply chain enablers were identified	Involvement of top management Awareness program for buyers Appropriate performance markers Government and legal regulations
11	Towards the circular supply chain: a literature review of challenges	2019	Bressanelli, Gianmarco, Persona, Saccani,	Emerald Insights	Literature review	Challenges were identified and classified by literature	reverse logistics legislation or digital 4.0 technologies.
12	The role of technology in enabling circular supply chain management	2022	Lujie Chen, Fua Jia, Michelle D. Steward, Tobias Schoenhee	Science Direct	Systematic review	Issue companies face when implementing circular supply chain management	lack of efficient information systems
Identification of success factors + barriers							
13	Looking into literature in the field of circular supply chain and the subtopic from a customer's perspective: A	2023	Eduardo Sanchez, Javier Martinez, Bartlome Marco, Luis Antonio	Web of Science	Data were extracted from the Web of Science database and analyzed using bibliometric techniques,	Analyzed prominent contributions made in the field CSC from a customer's perspective and through literature.	The field has gained considerably more importance in the last 7 years

	bibliometric approach						
14	Industry 4.0 technologies as enablers of collaboration in circular supply chains: a systematic literature review	2021	Lujie Chen, Fua Jia, Michelle D. Steward, Tobias Schoenhee	IEEE X	systematic literature review	Technologies to enable circular supply chain implementation mechanisms.	Internet of Things, Blockchain, Cloud Systems
15	Strengthening supply chain visibility with blockchain: A PRISMA-based review	2018	Saumyaranjan Sahoo, Ashwani Kumar, Ruchi Mishra, Prasoon Tripathi	IEEE X	Bibliometric algorithms conducted on 308 SCOPUS-based articles	5 identified knowledge clusters	Blockchain for food SC transparency Distributed ledger for sustainable practices Traceability features using smart contracts IoT for logistics The emergence of Ethereum and hyperledger
16	Supply chain network, complexity, and optimization in developing economies: A systematic literature review and meta-analysis	2022	Neelam Baloch	Google Scholar	Journals from renowned publishers	The supply chain has grown considerably over the last few years	The popularity of the supply chain concepts is partly because of developing countries are more accepting towards it knowing its applicability across different industries
17	Strategic framework towards measuring a circular supply chain	2018	Sourabh Jain, Nikunj Jumar Jain, Bhimaraya Metri	Emerald Insights	A grounded theory approach has been used to develop the strategic framework	An integrative framework for studying, designing and evaluating circular supply chain	Reverse supply chain mechanisms through efficiency and effectiveness
18	Circular supply chains in the era of industry 4.0: a systematic literature review	2022	Emilia Taddei, Claudio Sassanelli, Paola Rosa, Sergio Terzi	Science Direct	Systematic literature review	Prevalent topics related to circular supply chain	Reuse-recycle-remanufacturing Waste management Material efficiency and energy consumption
19	Business models and supply chains for the circular economy	2018	Martin Geissdoerfer, Sandra Naomi, Marly Monteiro, Steve Evans	Science Direct	Literature analysis and four case studies.		Circular supply chain can help in achieving the sustainability goals at a global level

20	Towards circular economy: A guiding framework for circular supply chain implementation	2022	Saman Amir, Niloufer Salehi, Malvini Roci, Susanne Sweet, Amir Rashid	Google Scholar	Cross-functional perspective	Divides the CSC into four building blocks	Main drivers, Levels of decision making Mechanisms to manage the uncertainties of a complex system.
21	Evaluation and ranking of solutions to mitigate circular supply chain risks	2021	Swapnil Lahane & Ravi Kant	Science Direct	Pythagorean fuzzy analytic hierarchy process (PF-AHP) and Pythagorean fuzzy VIKOR (PF-VIKOR	Support factors for all types of stakeholders who can contribute towards effective circular supply chain implementation	Structural guidelines for product recovery Contingency plans Economic pricing for recovered products

4.1 Themes and Sub-themes

The table below further explains the themes and sub-themes for the selected studies which are listed in the above table. It further helps in synthesizing the findings based on 10 critical components that are crucial in CSC and zero

Table 4: Themes of findings

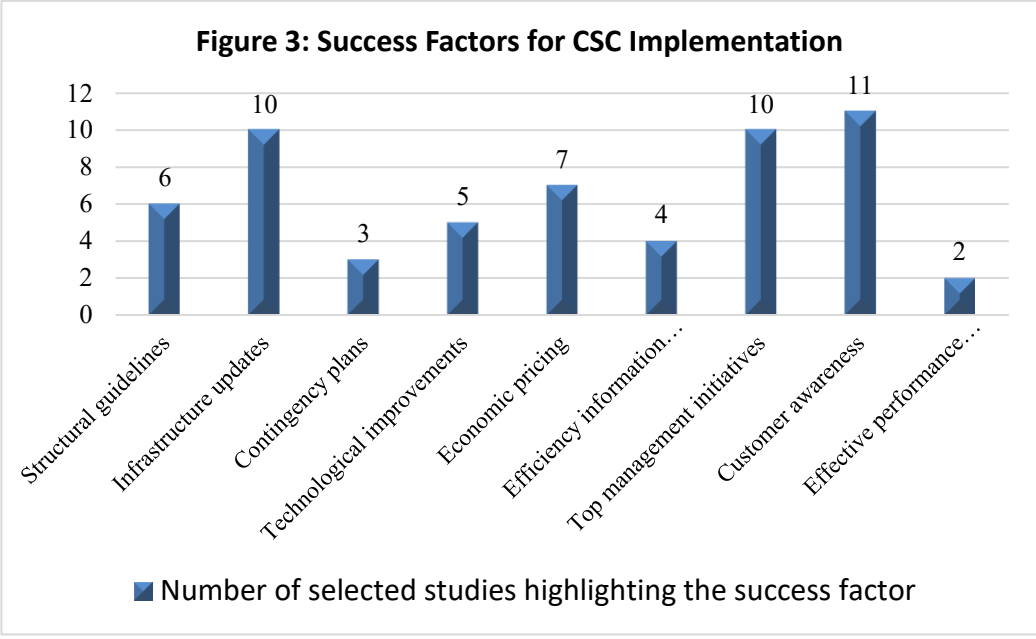
No.	Theme	Sub-theme
1	There are significant enablers for CSC success	• Long-term planning is the most significant enabler. • Coordination among the partners and strengthening of supplier-buyer relationship. • A circular economy enables a circular supply chain and vice versa.. • The product design also needs to be reconsidered so that it supports a longer shelf-life and extended usability.
2	The Success of CSC implementation depends on a better understanding of how a product can be recycled, reused, and repurposed	• Subject areas such as circular economy, waste management, decision making, environmental sciences, business management and accounting highlight the critical role of a CSC and circular economy in supply chain management. • The above-mentioned fields provide valuable perspectives on how product reuse and recycling can be effectively carried out. • The Circular Economy school, enlist contributions from 42 authors, that offers a pathway for CSC.
3	There are multi-faceted barriers to the implementation of CSC. The study divided these barriers into 8 levels.	• The barriers can be classified into level numbers based on importance: • Level 1 included a lack of economic benefits. And lack of coordination among different partners in the SC landscape. • Level 3 included lack of awareness, poor demand in marker, lack of technology, inadequate understanding of organizational structure in CSC practices and lack of support from different types of stakeholders.

		• Level 4 included the lack of a systematic information system. • Level 5 included a lack of support by managers and inadequate planning. • Level 6 included management commitment to bring out the desired changes. • Level 7 included a lack of supporting initiatives and an absence of environmental management certifications. • Level 8 included a lack of environmental laws, regulations, and financial planning.
4	Political and cultural barriers play a significant role in hindering the success of CSC implementation	Some of the identified barriers were: • Lack of solutions for dealing with waste generation. • The absence of appropriate technologies that can enhance productive processes • Absence of technologies for recycling the products.
5	There are frequent barriers in different categories that can impact how well CSC practices can be adopted.	• Technological barriers included designing new products, take-back processes, sorting and collecting of products, methods to integrate data, adopting recovery approaches, training workforces, and obtaining reliable feedback. • Economic and financial barriers included incentives to invest, low profits, complexities around circulatory costs, pricing of circular products, and low-cost penalties. • Market barriers included competitors, standards of recovered products, price gaps, unpredictable supply and demand, location of markets, and issues with brand positioning and reputation. • Organizational barriers included leadership issues, reluctance to change, recourse capacity, and unreliability along the new supply chain model. • Government regulation barriers included lack of support, legislation issues, lack of adopting circulatory, and policies to drive relationships in a circular model.
6	There are multi-faceted barriers to the implementation of CSC	• Traditional mindsets make it difficult to adopt change. • Different forms of ownership get in the way of proper task execution • Collaboration is not easy and straightforward in such models. There are risks associated with sharing information amongst different stakeholders. • The external situation in the market and customer demand trends do not support circularity.
7	There are multi-faceted barriers to the implementation of CSC	• The barriers can be classified into level numbers which show how crucial they are for the success of CSC. • Level 1 included a lack of economic benefits. • Level 2 included a lack of training and programs, as well as a lack of coordination among different partners in the SC landscape. • Level 3 included lack of awareness, poor demand in marker, lack of technology, inadequate understanding of organizational structure that supports CSC practices and lack of support from different types of stakeholders. • Level 4 included the lack of a systematic information system. • Level 5 included a lack of support by managers and inadequate planning. • Level 6 included management commitment to bring out the desired changes. • Level 7 included a lack of supporting initiatives and an absence of environmental management certifications. • Level 8 included a lack of environmental laws, regulations, and financial planning.

8	There are multi-faceted barriers to the implementation of CSC	• Regulatory barriers included a lack of government support, legislation, administrative processes, lack of environmental laws, limited protocols and the absence of state-of-the-art facilities. • Financial limitations included high costs, lack of high profit, requirements of high investments, high-cost production, cost of delivering high-quality circular products safely, and lack of funds for the industries. • Barriers related to knowledge and experience included lack of customer awareness, insufficient awareness programs, less publicity, lack of information about the design stage, and lack of effective guidance. • Technological barriers include infrastructure inefficiency, logistic issues, lack of adequate innovation, and lack of support from relevant departments. • Market barriers included pressures and demands, low customer interest, and unwillingness to take part in trade-offs.
9	Multiple factors need to be explored for a better understanding of the type of initiatives that can support circular objectives	• There are many crucial factors that can drive success of initiatives in this field. • Consumer attitude towards the purchase of new products. • Top management commitment to the change. • Economic incentives. • Legal policies/framework that support the cause.
10	Circular supply chain enablers identified in the study play an important role in driving the success of CSC across various industries. The enablers were ranked according to their global weightage.	• The first category of sub-enablers included employee engagement, training, proper incentives, and coordination. • The second category of sub-enablers included product recovery methods, monitoring, demand network design, and design for circularity approach. • The third category of sub-enablers included management support, strategic alliance, public procurement, industrial symbiosis, and standardization. • The fourth category of sub-enablers included government support, take-back policies, waste handling, and support by environmental management sectors.

4.2 Identified Factors for CSC Implementation

The factors were identified through a thorough literature review and keen study selection to highlight the specific ones that can be adopted across all industries without size and geographic limitations. In total, 21 articles are studies, and 9 common success factors were identified that are presented in the table above. The selection of the factors was made in accordance to the proposed framework The list of successful factors in implementing CSC is also demonstrated in figure 3 with number of studies that listed those factors among selected studies in PRISMA.



4.3 Structural guidelines

Structural guidelines in context of CSC & Zero waste refers to designing a product and process that enhance the efficiency and effectiveness of a business without causing any harm to the nature and human beings. There is a need to develop effective relationships with logistics partners and suppliers, which can make the change practical and long-lasting (Yadav et al., 2020). The organizations need to step up and foster effective relationships with logistic partners. The relationships are helpful because the circular supply chain objective will be met when the changes are introduced at the basic supply chain level. This demands contribution from all stakeholders. Customers, service provides, and supply chain members must come together for this cause.

4.4 Infrastructure improvements

The success of the circular supply chain approach also widely depends on how well the products are designed and developed for extended use. Again, this emphasizes polishing management practices with service providers and supply chain partners (Farooque et al., 2019). It is advised that product repurposing be done on the component level. Once the goals are aligned and relevant policies are put in place, it becomes relatively easier to train the stakeholders to achieve the strategic objectives.

4.5 Contingency plans

The contingency plan should encompass fund allocation through financial institutions to organizations that are willing to adopt the change to implement change-related practices (Tura et al., 2019). How customers' interest depends on government efforts and how that links to efficient managerial involvement shows that it is indeed a chain process to introduce and implement circularity. As per Schultz et al., (2021), the circular supply chain performs well in circularly enabled environments. As organizational operations begin to change, there is a possibility that unsupportive legal systems will intervene. Since the circular supply chain is still a new concept, there is confusion surrounding the company laws, products, manufacturing activities, and adoption (Prajapati et al., 2019).

4.6 Economic pricing

Moreover, buyers have to be guaranteed quality (Ansari et al., 2020). Customers liking circular products have to be supported through standardization, assurance measures, and appropriate certifications that can prove how safe recycled/remanufactured products are.

Pricing is a tool that can be used to create demand for the product. Economical pricing is set keeping the refurbishing of the products and components in mind (Abbey et al., 2016). For a circular product to have a useful design, it is important for the manufacturer to focus on creating a high-functioning life cycle and integrate a scope for improvement and self-maintenance.

4.7 Efficient information system

Circularity in the supply chain is not a stand-alone concept. Business needs to revolutionize their network to bring about this change (Yadav et al., 2020). Implementing well-designed reverse logistics and adopting an advanced IT system that could track end-products in one supply chain and direct their integration in another is needed to optimize the product return rate and reuse (Prajapati et al., 2019). The information technology process can be enhanced through the adoption of latest technology (Khan et al., 2021) and pairing it with developing reverse logistics infrastructure coupled with an efficient tracking system. Information technology can also be improved adopting to new innovative recycling processes, improved waste recovery techniques and efficient resource tracking system.

4.8 The role of top management

One of the studies has highlighted that the primary reason that industry is able to implement circular supply chain in developed countries is that they are extremely organized with respect to devised frameworks, laws, and guidelines (Lahane et al., 2020). A structured approach is necessary for mitigating financial sourcing and constraint-related risks. It becomes a worthy job for senior management to establish a contingency plan for effective adoption. It requires the involvement of top to middle-level managers.

4.9 Awareness and incentives

Identification of barriers also highlighted how a lack of public awareness is creating a hurdle for circular supply chain practices. To motivate customers to adapt to the change, different bodies have to invest in creating awareness and building demand for such products. Therefore, conducting seminars to educate not only the customers but all stakeholders should be beneficial (Ansari et al., 2020). This needs to be supported with appropriate incentives and rewards that can trigger customer's interest in buying circular products.

4.10 Effective performance markers and government regulations

This is where the need for reformulation of government policies becomes crucial. Governmental officials should work to impose stringent laws and policies that promote/enhance circular supply chain practices. With a lack of supportive legislation and regulations at national and international levels, the goals become even more difficult to achieve (Khan et al., 2021). Transparency within the supply chain fosters trust among different stakeholders which paves the way for long-term relationships.

4.11 Identified Barriers to CSC and Zero waste

The study has highlighted a total of 17 barriers that apply to industries of all types and sizes, quoted by multiple researchers in the literature. Barriers associated with circular supply chains are internal and external in nature (Ansari et al., 2020). Execution of internal operations often is the obstacle that hinders a business from adapting to circular supply chain practices. Internal barriers include inefficient IT systems, machinery malfunction, and internal problems for the organization (Munir et al., 2020). External barriers to circular supply chains refer to activities exterior to the organizations, such as logistics, unstable government policies, etc. (Tura et al., 2019). The list of barriers that hinders the process of CSC are demonstrated in the table 5 below.

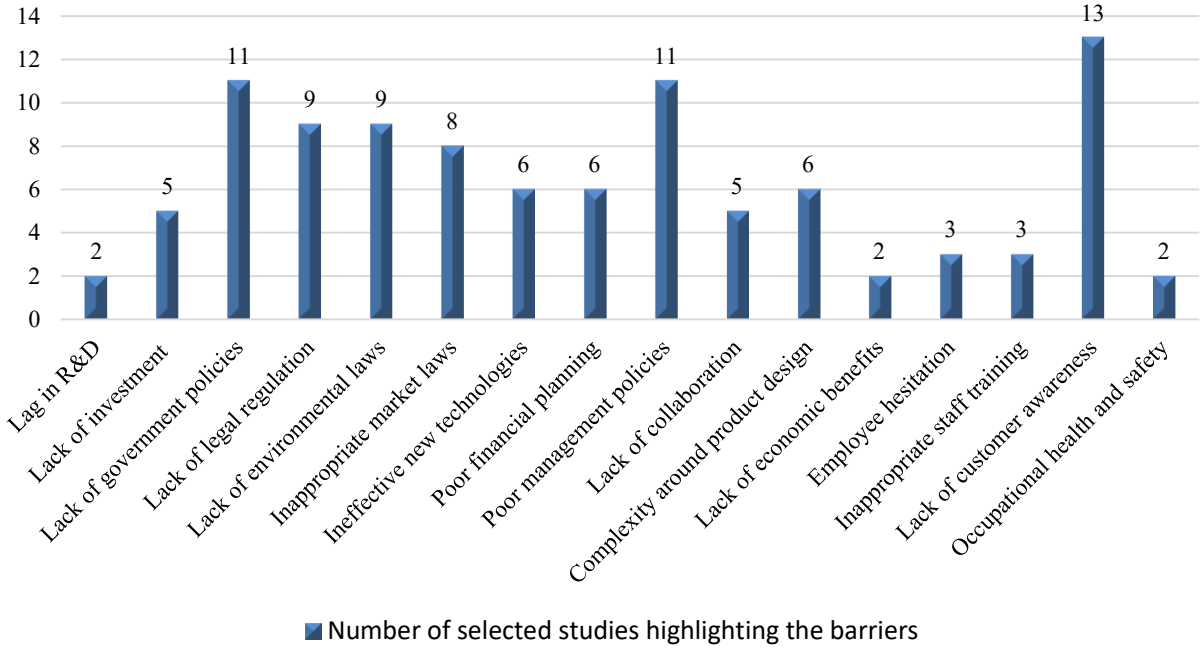
Table 5: Barriers to implementation of circular supply chain

#	Barriers	References
1	Lack of investment in the development and expansion of practical research to encourage circular supply chain and zero waste adoption	Geng & Doberstein (2008); Su et al., (2013); Li et al., (2015)
2	Limited investment in redesigning circular products, purchase of necessary machine and equipment	Ethirajan et al., (2020); Ansari et al., (2020); Bressanelli et al., (2019)
3	Lack of government policies and support	Caldera et al., (2019); Su et al., (2013); Werning & Spinler (2019); Whalen et al., (2018); Yuan (2017)
4	Lack of regulation in the legal system	Ansari et al., (2020); Ethirajan et al., (2020); Tura et al., (2019); Oliveira et al., (2016)
5	Absence of environmental laws and regulations	Goyal et al., (2016); Venkatesh & Luthra (2016); Zhu et al., (2017)
6	Absence of appropriate laws in the market for sell/purchase of recycled products	Chang et al., (2013); Lehmann (2011)
7	Ineffective measures for the adoption of new technologies or technological measures	Geng & Doberstein (2008); Kaushik et al., (2014)
8	Poor financial planning and organizational structure that inhibits circular supply chain adoption	Ansari et al., (2020); Tura et al., (2019); Mangla et al., (2015a);
9	Failed management policies that can encourage adoption circular supply chain practices	Zhu et al., (2008); Kumar & Chandrakar (2012)
10	Lack of coordination/collaboration	Defee et al., (2009); Zhu & Geng (2013)
11	Complexity around product pricing policies, taxation, and inflation	Dev et al., (2020); Ansari et al., (2020); Harczeg et al., (2018); Tura et al., (2019); Ethirajan et al., (2020); Pinto & Diemer (2020)
12	Lack of economic benefits in the short run	Park et al., (2010); Zhu & Geng (2013)
13	Skilled labor availability for implementing circular practices	Ansari et al., (2020); Ethirajan et al., (2020);
14	Employee hesitation in adopting new practices in place of traditional ones	Benton et al., (2015); Lieder & Rashid (2016); Gallaud & Laperche (2016)

15	Inappropriate training and development programs for supply chain members	Zhu & Geng (2013); Lacy & Rutqvist (2015)
16	Lack of customer knowledge about the ecological benefits of circular supply chain and the acceptability rates for recycled products	Ansari et al., (2020); Ethirajan et al., (2020); Zhu et al., (2010); Fischer & Pascucci (2017); Herczeg et al., (2018); Pan et al., (2015)
17	Occupational health and safety	Ansari et al., (2020); de Oliveira et al., (2019)

The studies have critically valuated the implementation barriers that hinders the process and adoption of circular supply chain within different model. To further demonstrate the importance of these barriers a chart has been formed to represent the importance based on number of studies. For this purpose, figure 4 demonstrates the barriers that have been identified in table 5 to illustrate and synthesize the barriers in CSC implementation.

Figur 4: Barriers To CSC Implementation



4.12 Lack of investment in research and redesign

The literature has identified a lack of research, skills, and gap in information system implementation as few of the prominent barriers (Koutamanis et al., 2018). However, there are things to be explored deeper than the surface level.

4.13 Lack of government policies and support

Barriers at the government regulation level involve how policies set by the official encourage or support parties to move towards adopting circularity. If the rules do not support such growth, it is highly unlikely that customers, enterprises and supply chain partners can effectively accommodate any change.

It is also worth noting that the “least important” barrier that these studies highlighted was market reluctance to change in the supply chain (Caldera et al., 2019). This was mostly categorized as a sub-barrier to the lack of regulations and lack of government policies.

4.14 Lack of legal regulations

There are no legal regulations to monitor how recycled, circular products are manufactured and utilized. The government bodies have not put forward any framework for the legal system to work on which results in reluctance in the market (Geng & Doberstein, 2008).

4.15 Absence of environmental laws

With the increasing pressure of environmental concern and mass-level waste generation, it is only a matter of time before the demand for circular/repurposed products significantly influences organizations. This makes it crucial to identify the barriers in supply chains (Goyal et al., 2016).

4.16 Ineffective adoption measures and incentives

Since the organizations and the consumers are not incentivized enough to shift to circular products, they do not feel inclined to focus on using new resources and lowering energy costs. This explains why enterprises dominated by linear supply chain are hesitant to change their business model (Caldera et al., 2019). There is greater acceptance from startups that have been found and launched integrated with a circular approach from the start. However, large-scale organizations for which the cost of implementing circular strategies can be massive, it becomes a risky move.

4.17 Inadequate financial planning

Moving towards a circular model from a linear approach imposes a serious burden on the financial resources of any organization. Most of the literature recognized low investments and insufficient financial resources as a significant barrier to circularity.

All types of financial strains such as the cost of take-back processes and lower price of produce manufactured from fresh raw materials add to the concern (Liu and Bai, 2014).

4.18 Failed management policies

Change implementation requires efforts from the top management. The success factors discussed above highlight how important it is for the management to take the lead in educating the workers and implementing a system that could encourage the growth and adoption of a circular supply chain (Zhu & Geng, 2013). Unfortunately, so far, the management policies are inadequate to support such a change.

4.19 Lack of coordination and collaboration

Operational and technological barriers directly impact an organization’s capability of adopting a circular supply chain hamper its growth. Organizational structure and change implementation strategies are also affected by leadership, corporate operations, asset management, and organizational harmonization with other stakeholders (Zhu & Geng, 2013).

4.20 Lack of economic benefits

Moreover, there are economic barriers that may result in a business facing significant financial loss. These include inflation exchange rates, new organizational/governmental policies, etc. Economic and financial restrain identifies as one of the crucial limitations of adopting or continuing circularity in supply chains (Ansari et al., 2020). These factors can hinder organizational adaptation even if reliable government policies and stakeholder collaboration is established.

4.21 Employee hesitation and inappropriate training

There are barriers whose nature concerning internal or external placement is difficult to determine. For example, a lack of information, knowledge, employee skills, and technology can hinder an organization's adoption of circular supply chain practices and also impact the surrounding environment making it more unfavorable.

4.22 Lack of customer knowledge

Another prominent barrier is the lack of awareness regarding the importance of recovered products and inadequate information about quality-level maintenance for repurposed or reused products. With a huge educational gap, consumers show no interest in substituting their life choices for practices that support circular supply chains. Lack of public education and consumer unwillingness marks one of the most prominent barriers to circularity (Gåvertsson et al., 2020). How well the barriers are dealt with directly impacts the durability and effectiveness of a supply chain (Ethirajan et al., 2020). In a nutshell, the challenge begins as businesses face substantial investment lag to implement circular supply chain concepts. With a lack of regulations and incentives, it becomes difficult for suppliers and retailers to collaborate to make the framework a reality (Dora et al., 2016). On top of that, consumers also face the challenge of adopting the shift in model. Lack of knowledge around circularity, economic constraints, and management issues are all prominent hurdles in CSC implementation.

5. Discussion

This research was able to make valuable contributions to the knowledge and understanding of circular supply chain concepts and zero waste. Business demands constantly changing in today's landscape. Therefore, researchers have identified circular supply chain implementation strategies, risks, barriers, and enablers in specific industrial environments or specific areas. Most of the studies highlight how developed countries adopted circularity in supply chain, while some shed light on the challenges developing countries face when trying to make circular supply chain practices work out in their businesses

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