Prioritization of enablers to assimilate sustainability in the supply chain for the Indian context

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Abstract

The changing economic policies and increasing environmental and social concerns have compelled business strategies to modify. In the present scenario of increasing environmental concerns and societal pressures, it has become imperative for industries to incorporate sustainability in their supply chain. Many researchers have prioritized the influencing factors of Sustainable Supply Chain Management (SSCM) using different multi-criteria decision-making (MCDM) techniques, but conventional MCDM techniques always raise concerns about results' reliability. The present study has employed Best Worst Method (BWM) to identify the influence of enablers, which is known for its applications in complex decision-making involving many influencing factors. The present study's findings argued that managerial and supplier collaborations with effective governmental policies and regulations would drive SSCM implementation in manufacturing industries. The researchers and practitioners would be benefited from the present study by understanding the influence of various enablers and planning business strategies accordingly.

Keywords: Best worst method; Sustainable supply chain management; Enablers; Developing nations

1. Introduction

Industrialization has contributed significantly to enhancing living standards and lessening poverty worldwide. However, the improvement achieved through industrialization has proven to be at the expense of degradation and exploitation of the environment [1]. There are strong opinions that industrialization is a prime reason for temperature rise, global warming, and environmental imbalance [2]. The manufacturing sector has been the pioneer in driving industrialization to meet the commodity demand of the globe. Manufacturing industries have been consuming a large number of non-renewable resources for energy generation, which has adversely created environmental and societal issues [3]. Manufacturing industries must evaluate their operations for negative environmental impacts throughout the supply chain of each product [4]. Sustainable supply chain management (SSCM) is one of the initiatives which assimilates supply chain operations and partners with common goals of environmental protection, societal benefits, and monetary gains [5,6]. SSCM has received substantial consideration from academicians and practitioners for maintaining sustainable operations throughout the supply chain [7,8]. The literature has explored the positive link between assimilating sustainability in the industry's supply chain and improved organizational performance [9,10]. Governmental pressures through strict regulations also significantly compel industries to adopt sustainability in regular supply chain operations [11].

The successful assimilation of sustainability at the intra and inter-level of the supply chain depends on consumers' awareness and willingness toward sustainable practices [12,13]. Due to extensive research works and the incredible benefits of SSCM, the wider population of the world has started realizing the need to assimilate sustainability into the supply chain [14]. However, most consumers' awareness regarding SSCM has been found in developed nations compared to developing nations [15]. Increased consumer awareness has assisted developing nations in adopting SSCM and answering the concerns of environmental and social protection with gaining economic soundness [16,17]. Most developing nations ignore environmental and social concerns in meeting the commodity demand of the increasing population [18,19]. Being the third-largest emitter of Greenhouse Gases (GHGs), Indian manufacturing industries must integrate sustainability across each product's supply chain operations [20]. The industries need to identify the influence of each stakeholder to integrate sustainability at each node of the supply chain. The interdependencies of stakeholders between the nodes across the supply chain are so complex that failure at one supply chain node can adversely disturb the entire chain and its operations [21]. Many manufacturing industries have started understanding the urgency of assimilating sustainability in the supply chain and have initiated implementing SSCM [22]. However, before implementing SSCM, manufacturing industries need to identify the motivating factors or enablers that can guide SSCM implementation. The implementation of SSCM in India involves the contribution of various stakeholders with their different influence power. Indian manufacturing industries must understand the enablers these stakeholders offer in implementing SSCM.

Identifying the influence power of different enablers is vital to understand the requisites of implementing SSCM in India. Multi-criteria decision-making (MCDM) techniques have been proven to be game-changers across various research fields in prioritizing complex systems with manyffecting factors [23]. Many attempts have been made in the literature to prioritize the influencing factors of SSCM through MCDM techniques. Khatri and Srivastava, (2016) applied an analytic hierarchy process (AHP) technique for sustainable technology selection of sustainable supply chains through model development. Gandhi et al., (2016) prioritized success factors of the green supply chain using the AHP technique to evaluate a case of Indian manufacturing industries. Bahinipati et al., (2018) proposed a framework for Indian small and medium enterprises (SMEs) to prioritize the impact of critical barriers to SSCM implementation using AHP. Narayanan et al., (2019) employed the fuzzy-AHP technique to prioritize and analyze interactions among the SSCM barriers. Balsara et al., (2019) utilized the AHP approach to evaluate climate change mitigation strategies of sustainable supply chain operations of the Indian cement manufacturing industry. Rajesh, (2020) applied the AHP technique to calculate the weightage of different factors in selecting SSCM strategies for implementation. Pandey et al., (2021) employed the AHP technique to analyze the critical success factors of SSCM for the Indian engine manufacturing industry. Menon and Ravi, (2021) analyzed the enablers of SSCM in electronics industries by combining the grey-DEMATEL technique. Most previous studies have prioritized the influencing factors of SSCM through traditional MCDM techniques, which raises the question of results' reliability and the need for large pairwise comparisons for complex systems like SSCM. AHP technique requires a large number of complex pairwise comparisons to calculate the weights of the factors. For complex systems where the decision-making involves a large number of factors, it is not recommended to utilize AHP as it will lead to inconsistent results [30]. DEMATEL also has some limitations, like experts' relative weights are not combined with individual decisions of experts in group calculation (Si et al. 2018; Malek and Desai 2019a). The present study believes that the results obtained from such traditional MCDM techniques raise a stern concern over their reliability. The literature suggests an urgent need to utilize some prominent MCDM techniques that can provide consistent and reliable results.

Based on the above discussion and gaps identified through an extensive literature review, the following objectives were framed to fill the gaps present in the SSCM field:

- To identify the significant SSCM enablers affecting its implementation in Indian manufacturing industries.
- To prioritize the selected enablers to identify the influence power of each enabler affecting the implementation of SSCM.
- To explore the implications and roles of different stakeholders in implementing SSCM in Indian manufacturing industries.

The present study has adopted a step-by-step methodology to achieve the aforementioned research objectives. The prime reason for not understanding the influence power of enablers in previous studies is the utilization of MCDM techniques that provide unreliable and inconsistent results. Best Worst Method (BWM) has been a proven MCDM technique that has gained attention across various research fields to attain consistent and reliable results for complex systems with many factors (Malek and Desai, 2019). BWM provides more consistent results for complex systems by reducing the required number of pairwise comparisons for the MCDM problem [33,34]. The present study has employed BWM to prioritize the enablers, a proven MCDM technique to get consistent and reliable results in complex systems with many factors.

The rest of the article is structured as follows: Section 2 represents the extensive literature review on SSCM, enablers, and justification for utilizing BWM. The methodology utilized for the present study is explained in Section 3. Section 4 describes the case of calculating the weights of enablers. The discussion on the results obtained from the ranking of enablers is carried out in Section 5. Section 6 highlights the implications for different stakeholders from the ranking of enablers. The conclusion is briefed in Section 7, with limitations and future research directions.

2. Literature review

2.1 Sustainable Supply Chain Management

The extent of the supply chain at the global level has increased the need to maintain efficient SCM. SCM provides industries with the most profitable, operational, and competitive business benefits in a globally competitive environment. Traditionally, SCM was considered a cost-effective, time-based, and quality-based practice to avail the goods and products in the system. With the increasing concern for environmental and societal protection, SCM has been assimilated with sustainability to balance economic, social, and environmental aspects (Dai et al., 2021). Sustainable supply chain management (SSCM) manages intel, goods, and materials with capital and cash flow [36]. It also considers the collaboration between businesses and industries a part of the supply chain. A sustainable supply chain considers the economic, ecological, and societal implicationshile implementing long-term decisions [37]. SSCM is the management of goods, supplies, data, and assets associated with purchasing, manufacturing, and distributing products or services to meet the stakeholder's demands and gain a competitive edge [38]. SSCM can be classified as a supply chain management (SCM) with its prime emphasis on maintaining societal, ecological, and economic balance in long-term sustainable growth [39]. After a thorough literature review, a comprehensive number of enablers that impact SSCM implementation have been identified that are discussed in the following section.

2.2 Enablers of SSCM

This section describes the different enablers that can assist industries in implementing SSCM and enhancing environmental and social performance. The enablers were identified through a widespread literature review, and later they were finalized by consulting the experts' in the SSCM field. A total of twenty-eight enablers were categorized under six major criteria. The enablers were categorized so that each category represents the substantial potential for incorporating SSCM practices for manufacturing industries. The enablers that can boost the implementation of SSCM are discussed as follows:

Kumar and Rahman, (2017) suggested that top management commitment is the most effective enabler in implementing SSCM by combining supply chain partners. Management should be constructive rather than reactive in implementing sustainable practices [41]. Nishat Faisal, (2010) suggested that management can commit to implement SSCM by formulating supply chain policies like providing sustainable knowledge to all the supply chain partners. Lin et al., (2013) found that organization's most significant encouraging activity is connected to top management’s commitment and the degree of engagement they would provide. Top management must devote sufficient financial aid for research and development efforts to encourage sustainable development in supply chain operations. Mani et al., (2015) pointed out that the capacity to invest is also one of the other main enablers. Nishat Faisal, (2010) noted that financial liquidity might also be needed to help supply chain partners who lack the financial strength to facilitate sustainability initiatives. Shibin et al., (2016) identified financial stability as one of the significant enablers for incorporating sustainability in different supply chain operations. Mathivathanan et al., (2019) revealed that despite industries’ continuous full measures, they cannot replace conventional practices with scientifically innovative practices due to financial constraints.

Previous studies have explored that government plays a significant role in encouraging or compelling industries by enforcing strict environmental regulations and zero-waste strategies in their legislation [3]. To comply with governmental legislation, the industries can also develop benchmarks for selecting suppliers with joint strategies to minimize energy waste and carbon emissions. Kumar and Rahman, (2017) further showed thabuyers and sellers lack understanding due to the differences in environmental and economic standards across the supply chain partners. As a result, supply chain partners must be mindful of sustainable practices to implement and maintain environmental standards in the supply chain. Mangla et al., (2018) also stated that eco-friendly standards would help audit the requisite product quality specifications and monitor sustainability goals in integrating sustainable policies. Environmental certification is one of the substantial ways to establish benchmarks for assuring organization’s operations so that adverse environmental effects are reduced to a minimum. Mangla et al., (2018) stated that the government plays a critical role in identifying economic sustainability goals. Infrastructure (e.g., transportation and stable energy) and cooperation between domestic and foreign governments need substantial government support and a regulatory framework. Mathivathanan et al., (2019) found that the government’s Make in India initiatives have revolutionized the entire marketplace for the technology industry. However, industries will be forced to compete with already-established global marketers. Industries must explicitly follow sustainability standards in their procurement, and implementing safety standards would boost environmental efficiency by setting uniform environmental standards [48].

The industries can initiate their sustainable operations by selecting suppliers based on sustainable criteria [49,50]. Supplier selection based on economic, environmental, and social aspects is vital for integrating sustainability in the supply chain [51]. Eco-friendly supplies are the product of sustainable buying. Nevertheless, since supply chains have become far more interconnected and reliant on partner capabilities, it is critical to consider sustainability from a supply chain perspective. Furthermore, the internet’s rapid proliferation and widespread acceptance have provided opportunities to choose suppliers without geographical boundaries. Mangla et al., (2018) referred to as a fundamental enabler for implementing sustainability using Information and Communication Technology (ICT), and sharing real-time information between climate change-related supply chain partners. Nishat Faisal, (2010) also noted the need for a thorough understanding of the dynamics for incorporating sustainability into a coherent supply chain. Supply chain partners can resist reform, but the most significant step towards sustainability is acknowledging supply chain partners’ concerns.

Traditional logistics coordinate forward distribution from supplier to customer, including transportation, warehousing, packaging, and inventory management. To assess the impacts of products on climate change, reverse logistics has been introduced, which involves the recycling and disposal of the products [52]. Parashar et al., (2020) enlisted that industries can build an excellent public image and corporate responsibility by introducing reverse logistics, which can assist in achieving a sustainable economy. Logistics optimization is otherwise known as optimizing various factors such as type of transport, the time taken, route, use of alternative fuels in place of fossil fuels, reverse logistics, etc. It greatly impacts the profit margin and reduces greenhouse emissions in companies and firms [54]. Sun, (2017) also highlighted the importance of adopting reverse logistics, saving time and energy to make the supply chain more sustainable and ultimately reduce the carbon footprint. Govindan and Bouzon, (2018) have put forward the need to conduct more research in reverse logistics and how it can be integrated with research to get more ideas on sustainable supply chain practices.

Green practices lead to the validation of environmental concerns and inspire different industries to shift their operations from a traditional system to a sustainable system. Mohanty, (2018) indicated that internal environmental sustainability, eco-sourcing, and eco-design, which are otherwise commonly seen to assess green practices, are the fundamental elements of green practices influencing the Green Supply Chain (GSC). Diabat et al., (2014) claimed that implementing any framework in the organization requires modifications in the current methodological activities. To adopt sustainable practices, industries must reconstruct their industrial practices with special attention to environmental concerns [3]. The previous studies suggested the need to design processes and products that are environmentally responsible for reducing negative impacts throughout their lifespan [59].

Kumar and Rahman, (2017) stressed that management relationships in the distribution chain improve sustainability efficiency in the long run. Long-term partnerships enhance supply chain partners' socialization. Understanding sustainability decreases supply chain partner resistance and fosters longterm relationship perspectives [37]. Supply chain stakeholders receive updated information on each other's processes which aids decision-making on sustainable practices by reducing complexities [60]. Deploying new environmental technologies, environmental innovation, improved environmental efficiency, energy savings, and minimizing the supply chain's collective impact on the environment and community are benefits of exercising in a long-term partnership. Mathivathanan et al., (2019) also highlighted that collaborative growth among industries would support them in improving long-term results and sustainable conditions for a competitive edge.

Supplier collaboration empowers small suppliers in the supply chain to commercialize and ensure easy access to advanced technological innovations. The previous studies on the effects of environmental cooperation have mainly concentrated on its performance inferences [61]. Oelze, (2017) also noted that an efficient long-term SCM partnership develops a foundation in business planning that can be implemented for managerial and operational targets. The emergence of cross-functional partnerships among departments involved in supply chain operations makes it possible to impose policies effectively. A collaborative philosophy around SSCM can be built by cultivating strategies and approaches whereby employees can influence new ideas or innovations and discuss them with the top management.

Logistics integration involves suppliers, dealers, and third parties that share the inventory, manufacturing plans, product requirements, and allocation of resources. It also involves a mode of transport, logistical capability, and shipments powered by distribution, including sizes, locations, and destinations [63]. In logistics integration, if a problem occurs on the transporters' route, an automated module stimulates alternatives using real-time insight for the product lines. Rerouting directions thus allows equal use of driver time and satisfies the critical customer requirements. On the other hand, it contributes to long-term viability by preserving economic, societal, and ecological benefits. Logistics and technological integrations are ways of cooperation that increase sustainability efficiency [64].

Mohanty, (2018) clarified that integrated logistics minimize total supply chain costs, lessen lead times, and enhance reliability. With current technological advancements, environment-friendly and sustainable technologies are becoming increasingly popular and finding their place in most solutions. Sustainable technology means technologies that are easy to reconfigure and recycle and have no irreversible impact on the environment and society [65].

Mathivathanan et al., (2019) speculated on evaluating the environmental implications of their goods and strengthening the sustainability index by adopting life-cycle assessment methods. Life-cycle assessment methods provide significant technical assistance in assessing the efficient life of products at each level of their life cycle. The robust or versatile Supply Chain (SC) design effectively reduces market volatility, demand forecasting, custom product design, and distribution. To maintain a product's sustainability over time, Kausar et al., (2017) suggested the need for awareness of product's sustainability by which Indian industries can deliver cost-effective, eco-friendly, and social commodities. Indian manufacturing industries should seriously consider environmentally-conscious practices while implementing SSCM. The previous literature has understood the need to protect the environment and explored the extreme need to reduce the use of fossil fuels that can further reduce the carbon footprint. Most research papers have highlighted the need to incorporate an eco-friendlier approach to the supply chain by utilizing sustainable processes, technologies, and energy conservation [67,68]. The industries' proactive strategies to conserve the environment directly influence supply chains and viability [69].

Kausar et al., (2017) said that SSCM implementation requires interactions and coordination between employees to gather information on sustainable activities. Cross-functional engagement within the company helps to understand the strategic directions and priorities. Kumar and Rahman, (2017) also proposed open collaboration and information-sharing activities as encouraging practices that help the supply chain to be more sustainable. Mathivathanan et al., (2019) also stated that the Indian manufacturing sector can improve employee morale and confidence by allowing open communications within industries. The industries can boost the involvement and morale of the workers by providing them with healthy and safe working conditions. Diabat et al., (2014) discussed the rising work health and safety problems, discouraging workers' full involvement in organizational goals. Employees ' rights are healthy and safe working conditions, and each organization should comply with them. It is almost impossible for any organization to succeed without the full participation of employees. The industries can also increase employee involvement by providing financial benefits through community economic welfare.

Sánchez-Flores et al., (2020) explored the unawareness of sustainable processes' environmental and social benefits in developing countries. Kumar and Rahman, (2017) also highlighted sustainability profits like capacity building, growth, cost savings, and competitive advantage, which can justify supply chain partners' dedication to sustainability. Mani et al., (2015) stressed the importance of competitive rivalry in the supply chain to incorporate sustainability in the manufacturing industries. SSCM offers capabilities that are difficult to duplicate by competitors and are critical for long-term survival [71].

Andalib Ardakani and Soltanmohammadi, (2019) indicated that SSCM strategies could improve financial results and environmental benefits to provide a competitive market position. Furthermore, raising awareness of the benefits of sustainability, such as infrastructure development and growth, cost savings, promotion, and competitive advantage, will assist supply chain partners in justifying their dedication to sustainability [67].

Mohanty, (2018) believed that customers are becoming more mindful of sustainability and demanding environment-friendly green products. Understanding the diverse customer requirements and planning each product movement as per the requirements is vital in the supply chain. Kumar and Rahman, (2017) also stated that every organizational operation aims tcomply with its stakeholders' demands. The desire for sustainable products by society is the primary enabler for any organization willing to adopt SSCM. The demand for sustainable products from society would encourage the industries to provide sustainable products by enhancing consumer loyalty and prestige (Malek and Desai, 2019). Irfan et al., (2020) also indicated that the strategy for developing ecologically and economically sustainable goods that can be recycled is the prime design to be followed. Mani et al., (2015) suggested that customer and buyer specifications affect social sustainability. These conditions mandate the distributor to guarantee the supply chain’s long-term viability.

Mathivathanan et al., (2019) argued that developed countries have been eager to provide a healthier social position for their residents by introducing social sustainability practices, but developing countries such as India and China have been unable to do so due to their large populations. Developing countries have long been concerned about the social implications of globalization and industrialization [74]. Internal pressures are the organization’s pressures due to internal factors such as employees' behavior and dedication. Employees’ participation, role, and commitment to the organization contribute significantly to the smooth implementation of sustainable practices. Labor sustainability ensures safe and healthy working conditions for the workers to maintain the morale and honesty of the workforce. Several studies have shown the value of promoting socially-conscious suppliers and their positive effect on buyer companies’ reputations and financial results [75]. Tax moderations, incentives, and other rewards offered by the government, trade unions, and other social development help industries to ensure sustainability [23]. To ensure that environmental and social interventions happen at the convergence of the triple bottom line, industries must specifically tie ecological, societal, and financial priorities within a broader tactical perspective. To achieve a competitive edge in the marketplace, a supply chain must successfully implement appropriate strategies to incorporate sustainable practices across the supply chain [76].

Indian manufacturing industries have been using fossil fuels to boost production to meet the commodity and energy needs of the country's large population. Manufacturing industries satisfy these needs at the expense of environmental degradation and societal well-being. It is highly recommended for Indian manufacturing industries to incorporate sustainable practices in their operations. The present study has attempted to provide a roadmap for Indian manufacturing industries in implementing SSCM as their strategic policy. The present study has ranked significant SSCM enablers that can assist manufacturing industries in implementing SSCM through better understanding the enablers’ influence. The finalized SSCM enablers for the present study have been shown in Table 1 with their respective sources.

Table 1: List of SSCM Enablers

MAJOR CRITERIA	**SUB CRITERIA**	**REFERENCES**
Managerial Enablers	Top Management Commitment (ME1)	[42–44,46,53,77,78]
	Supply Chain Orientation (ME2)	[42–44,46,62,72,73]
	Reverse Logistics (ME3)	[2,46,53,72,73,79]
	Availability of Funds (ME4)	[42,44,45,53,58]
	Environmental Purchasing (SE1)	[42,45–47,53,57,58]

Supplier Enablers	Standards & Certifications (SE2)	[32,44,46,48,53,58,73,77,79]
	Auditing Suppliers (SE3)	[40,43,45,46,58,79,80]
	Green Packaging (SE4)	[40,43,45,46,58,79,81,82]
Collaborative Enablers	Long Term Relationship with SC Partners (CE1)	[40,43,46,62,80]
	Collaborating with SC Partners (CE2)	[42,57,58,66,72,73,79,83]
	Joint Development (CE3)	[42,57,58,66,72,73,79,84,85]
	SC Partner Development (CE4)	[40,42–44,46,57,62,72,73]
	Logistical Integration (CE5)	[42,57,58,66,72,73,79]
	Technical Integration (CE6)	[42,57,58,66,72,73,79]
Environmental Enablers	Design of Products to Reduce Waste & Costs (EE1)	[40,42–44,46,57,59,62,72,73]
	Design for Emissions Reduction (EE2)	[42,57,58,66,72,73,79,86]
	Innovation (EE3)	[43,46,57,58,73,84]
	Life Cycle Analysis (IE1)	[43,46]
	Effective Use of By Products (IE2)	[46,47,58,66,72,73,86,87]
Internal Enablers	Enhanced Communications (IE3)	[40,43,44,46,57,62,73]
	Adoption of Cleaner Process Technology (IE4)	[46,47,58,66,72,73]

	Competitive Advantage (IE5)	[40,43,45,46,58,71,76,79]
Societal Enablers	Involvement of Consumers (SOE1)	[42,46,57,58,62,66,72,73]
	Environmental Awareness & Training (SOE2)	[40,43,44,46,57,62,72,73,88]
	Measurement Systems & Rewads Linked to Sustainability (SOE3)	[40,43,45,46,58,79,89]
	Work Safety & Human Rights (SOE4)	[57,58,66,72,73,79,89]
	Government Rules & Regulations (SOE5)	[23,40,43,44,46,57,62,73]
	Pressure from Non-Government Bodies (SOE6)	[40,43,44,46,57,62,72,73]

3. Methodology

The present study has carried out an extensive literature review to identify the significant SSCM enablers. A decision panel of industry experts has also been formed to finalize SSCM enablers based on their inputs. A decision panel finalized twenty-eight enablers, also categorized under six major categories to represent their functional areas. To rank the finalized SSCM enablers, the Best Worst Method (BWM) was utilized by considering expert opinions at different stages. Each expert was asked to provide their input for each major criteria and sub-criteria. A detailed discussion based on the ranking of enablers was also carried out to explore the findings from the present study. Based on the findings, the present study has also explored various insights and implications for researchers and practitioners. A step-by-step methodology adopted for the present study is depicted in Figure 1.

3.1 Introduction to BWM

Since SSCM is an integration of sustainability in conventional SCM, it is tough for decision-makers to identify the priorities of different factors affecting the complex system. Managers must examine and analyze various factors to decide the priorities of factors for assigning resources in the right direction. MCDM techniques have been known to examine complex problems with high randomness, conflicting priorities, various perspectives, and different types of data [90,91]. SSCM implementation demands a robust MCDM technique that can prioritize many factors with different perspectives. A modern approach, BWM has been gaining attention worldwide for providing consistent and reliable results for complex systems like SSCM [92]. BWM reduces the inconsistencies in criteria weights by reducing the pairwise comparisons between criteria found in the Analytic Hierarchy Process (AHP) [34].

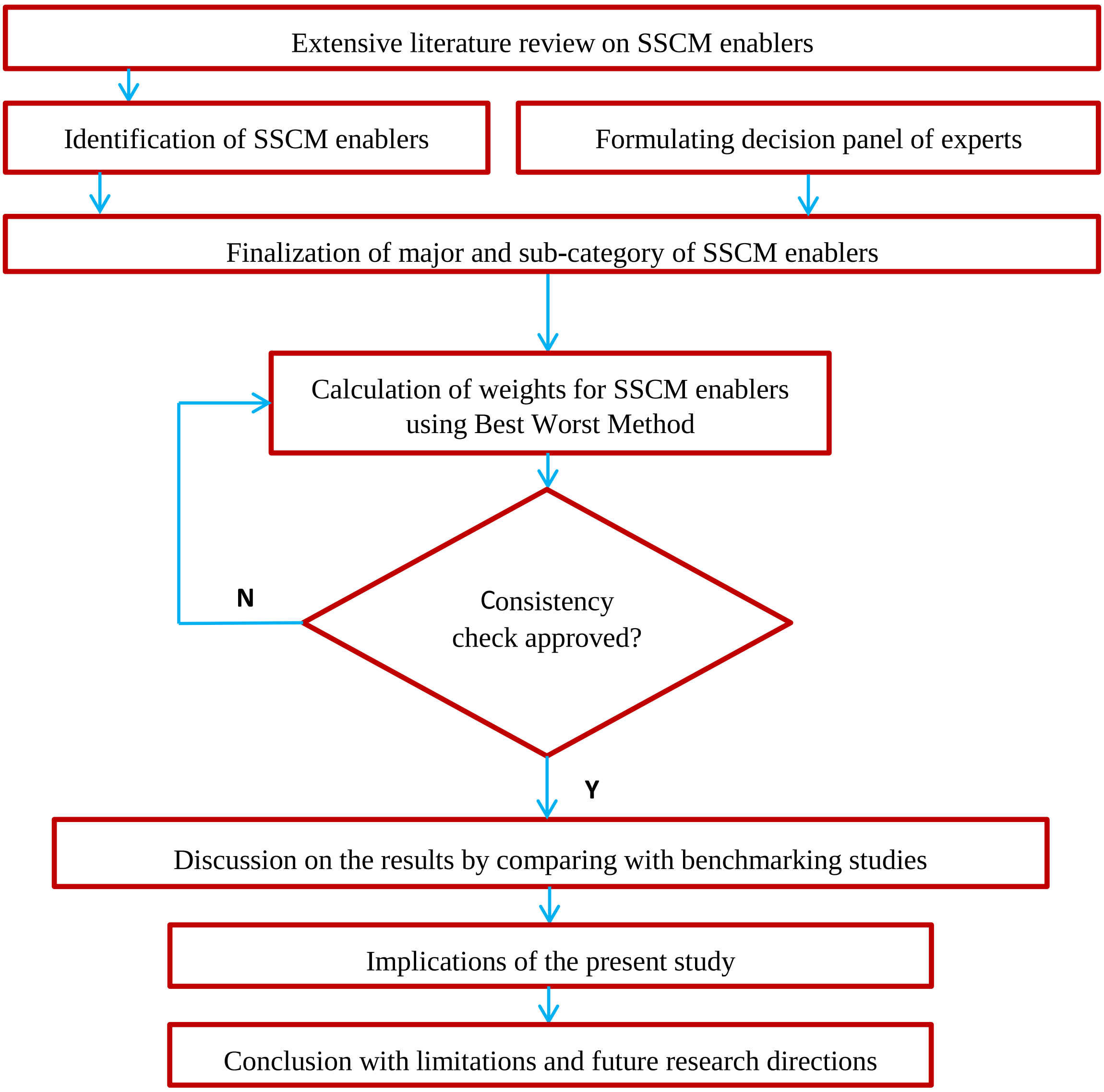

Figure 1: Methodology of the present study

BWM involves solving a Linear Model (LM) to calculate criteria weights from comparisons. BWM provides more consistent results and requires fewer pairwise comparisons than other MCDM methods [33]. BWM has gained tremendous applications in different fields where prioritization was carried out in complex systems with many influencing factors (Malek and Desai, 2019). Some of the applications of BWM in SSCM have also been found in previous literature. Nurul et al., (2017) evaluated the external factors disturbing the sustainability of the supply chain in the oil and gas industry. The social sustainability of the supply chain was also assessed using BWM for manufacturing industries of developing countries [94]. Rezaei et al., (2019) prioritized the alternatives of sustainable productpackage design using BWM for the supply chain of the food-packaging industry. Munny et al., (2019) employed BWM for integrating social sustainability in the supply chains of the footwear industry of Bangladesh by prioritizing its enablers. Kusi-Sarpong et al., (2019) prioritized the sustainable innovation management criteria using BWM to implement sustainable supply chains in manufacturing companies. Suhi et al., (2019) assessed the environmental sustainability of developing countries by prioritizing environmental factors using BWM. BWM has also been utilized to prioritize the barriers to sustainable supply chain innovation in a manufacturing organization [98]. Since the present study prioritizes twenty-eight enablers of SSCM, the use of BWM is justifiable due to the need for large pairwise comparisons. The methodological steps involved in applying BWM for the prioritization of SSCM enablers have been explained in Appendix A.

4. Case explanation

As stated earlier, BWM requires preferences from experts for pairwise comparisons. The present study has also formed a decision panel of nine proficient experts in the field to acquire their preferences for prioritization. In BWM, each expert must identify the best and worst factors from the factors that must be prioritized. After identifying the best and worst factors, each expert needs to provide their preferences by using a scale of 1 to 9 for major criteria and sub-criteria amongst the major criteria. The best factor's comparison with the rest of the factors forms the Best-to-Others vector, and the comparison of the rest of the factors with the worst factor forms the Others-to-Worst vector. For calculating the weights for major criteria of the present study, each expert was asked to identify the best and worst major criteria enabler. Comparing the best major criteria enabler with the rest of the major criteria enabler formed the Best-to-Others vector (Table 2), and comparing the rest of the major criteria enabler with the worst major criteria enabler formed the Others-to-Worst vector (Table 3). The weights of the major criteria enablers have been calculated using steps summarized in Appendix A. Each expert has calculated weights as per their two vectors. An average of nine experts was taken to reach the combined final weights of the major criteria enablers (Table 4). The consistency of the results was also checked by calculating the consistency index for each expert. An average consistency index for the major criteria enablers was 0.07329335 (close to zero), showing consistent pairwise comparisons and reliable results. Due to space constraints, the calculations for each sub-criteria enabler of major criteria enablers have not been included.

The weights calculated in Table 4 are the average major weights for each category under which twentyeight enablers have been categorized. The local weights of each sub-criteria enabler were also calculated using the procedure mentioned for major criteria enablers. To calculate the global weights of twentyeight enablers, the weights of each sub-criteria enabler were multiplied by the average major weights of respective major criteria enablers. The final ranking of the enablers based on the global weights is shown in Table 5.

Table 2: Best to Others Vector for Major Criteria

BEST						
	ME	**SE**	**CE**	**EE**	**IE**	**SOE**
Expert 1	1	2	3	6	5	7
Expert 2	1	3	9	4	5	2
Expert 3	3	7	1	4	2	6
Expert 4	1	2	3	5	4	6
Expert 5	2	4	1	7	3	5
Expert 6	2	2	4	2	2	1
Expert 7	1	3	2	2	5	4
Expert 8	1	2	8	4	9	4
Expert 9	1	4	7	2	4	3

Table 3: Other to Worst Vector for Major Criteria

WORST						
	ME	**SE**	**CE**	**EE**	**IE**	**SOE**

Expert 1	7	6	4	3	2	1
Expert 2	9	4	1	3	2	5
Expert 3	5	1	7	2	6	3
Expert 4	6	4	5	3	2	1
Expert 5	5	3	7	1	4	2
Expert 6	7	7	1	7	7	9
Expert 7	5	3	4	4	1	2
Expert 8	9	8	2	4	1	4
Expert 9	7	5	1	6	5	6

Table 4: Major Criteria Weights

	ME	SE	CE	EE	IE	SOE	Ksi
Expert 1	0.39739027	0.23131673	0.15421115	0.07710558	0.09252669	0.04744958	0.06524318
Expert 2	0.42763158	0.15350877	0.04385965	0.09868421	0.07894737	0.19736842	0.03289474
Expert 3	0.15212528	0.04474273	0.38478747	0.11409396	0.22818792	0.07606264	0.07158837
Expert 4	0.36931818	0.22727273	0.15151515	0.09090909	0.11363636	0.04734848	0.08522727
Expert 5	0.2189781	0.10948905	0.3892944	0.0486618	0.1459854	0.08759124	0.0486618
Expert 6	0.17647059	0.17647059	0.03921569	0.17647059	0.17647059	0.25490196	0.09803922
Expert 7	0.42162162	0.10810811	0.16216216	0.16216216	0.06486486	0.08108108	0.0972973
Expert 8	0.45502646	0.26455026	0.04761905	0.0952381	0.04232804	0.0952381	0.07407407
Expert 9	0.1509434	0.11220472	0.03937008	0.22440945	0.11220472	0.1496063	0.08661417
Average	0.30772283	0.1586293	0.15689276	0.12085944	0.11723911	0.11518309	0.07329335

Table 5: Final Ranking of Enablers

Major Criteria	Major Weight	Factor Code	Local Weight	Global Weight	Ranking
Managerial Enablers	0.307722831	ME1	0.400099193	0.123119656	1
		ME2	0.261127286	0.080354828	2
		ME3	0.151336301	0.046569635	7
		ME4	0.18743722	0.057678712	3
Supplier Enablers	0.158629299	SE1	0.31768708	0.050394479	5
		SE2	0.300855145	0.047724441	6
		SE3	0.195228774	0.030969004	12
		SE4	0.186229001	0.029541376	13
		CE1	0.25432484	0.039901725	8
		CE2	0.240642471	0.03775506	10
		CE3	0.108128406	0.016964564	25

Collaborative Enablers	0.156892756	CE4	0.164240431	0.025768134	17
		CE5	0.117779253	0.018478712	22
		CE6	0.114884598	0.018024561	23
Environmental	0.117239107	EE1	0.433203294	0.050788367	4
		EE2	0.232660472	0.027276906	14
Enablers		EE3	0.334136234	0.039173834	9
Internal Enablers	0.117868405	IE1	0.266261552	0.031383824	11
		IE2	0.202685584	0.023890226	19
		IE3	0.163837789	0.019311299	21
		IE4	0.227595883	0.026826364	15
		IE5	0.139619192	0.016456691	27
Societal Enablers	0.11518309	SOE1	0.232765386	0.026810636	16
		SOE2	0.208740507	0.024043377	18
		SOE3	0.145335553	0.016740198	26
		SOE4	0.150165885	0.017296571	24
		SOE5	0.182952584	0.021073044	20
		SOE6	0.080040085	0.009219264	28

5. Results and discussion

The average major weights of major criteria enablers suggested managerial enablers as the most significant major criteria (0.307722831), followed by supplier enablers (0.1586293), collaborative enablers (0.15689276), design enablers (0.12085944), internal enablers (0.11723911), and societal enablers (0.11518309). The ranking of major criteria enablers explored the areas which encourage SSCM and the areas which need more effort to align toward SSCM. The manufacturing industries would be able to understand their priorities to incline their resources and efforts in the right direction of SSCM implementation. The present study has ranked the managerial enablers as the most significant major criteria enablers which explored that without efficient managerial decisions, the implementation of SSCM is impossible. The second most significant major criteria enabler is supplier enablers as it assists the industries in managing sustainability by adopting standardized methods like green packaging and environmentally conscious purchasing. The manufacturing industries need to give prior attention to managerial and supplier enablers for elevating their traditional supply chain to SSCM. The implementation of SSCM involves various stakeholders, and their collaborative effort is the prime requisite for the successful implementation of SSCM. The present study has ranked collaborative enablers as the third most significant major criteria enablers. Collaborative enablers help strengthen the partnerships between suppliers and management, which translates to reliability and transparency between industries. Effective collaboration between various stakeholders would assist in planning strategies to improve sustainable operations throughout the supply chain. Design Enablers are ranked the fourth most significant major criteria enablers. One of the vital options to incorporate sustainability in supply chain operations is to design the products in such a way that it maintains the sustainability criteria throughout their product life cycle. Industries must enrich their research and development (R&D) departments to design such products. Constant support from the R&D department will help the organization introduce sustainable operations throughout the supply chain. The present study has ranked internal enablers as the fifth most significant major criteria enablers. Improving in-bound and out-bound supply chain operations would be easier if the industries could improve their sustainable performance. The least significant major criteria enabler in the present study is societal enablers, including the wellbeing of stakeholders involved in the supply chain. The organization's efforts toward providing employee and customer benefits would improve their morale for sustainable activities and fulfill its corporate social responsibility.

Amongst the major criteria of managerial enablers, top management commitment (ME1) is the most significant sub-enabler with the highest weight. Top management commitment also guides the decisions at different levels to streamline the efforts toward SSCM [77]. A transition from a conventional supply chain to SSCM demands a change in the pre-existing work culture in the organization, which can only be possible by top management commitment [46]. Supply chain operation (ME2) is ranked as the second most important managerial enabler. Supply chain operations can facilitate sustainability in industries, which doubles profits and is both societal and environment-friendly. Availability of funds (ME4) is ranked as the third most significant sub-enabler among the major criteria of managerial enablers. The industries need to invest funds at different stages of projects which can only be managed when they have enough funds available [44]. Reverse logistics (ME3) is ranked as the fourth most significant sub-enabler among the major criteria of managerial enablers. To assess the impacts of products on climate change, reverse logistics has been introduced, which involves the recycling and disposal of the products [2]. Parashar et al., (2020) enlisted that industries can build an excellent public image and corporate responsibility by introducing reverse logistics, which can assist in achieving a sustainable economy.

Environmental purchasing (SE1) is the most significant sub-enabler with the highest weight among the major supplier enablers criteria. Environmental purchasing ensures that every part or product coming to the organization conforms to minimum environmental standards. By environmental purchasing, the industries can also ensure that each supplier must provide greener raw materials [46]. Standards and certification (SE2) is ranked as the second most important supplier enabler. International certification and government-implemented standards enable suppliers to a healthy competition that is useful for the social and environmental implications [44]. By adopting such standards and certifications, the industries can establish themselves as a “green company” which can further assist in maintaining a persistent market position (Malek and Desai, 2019). Auditing suppliers (SE3) is ranked as the third most significant sub-enabler among the major criteria of supplier enablers. Auditing suppliers is a vital initiative to ensure the purchase of the products with required sustainability standards [80]. The industries can guarantee sustainability and better environmental performance by regularly auditing vendors and suppliers to reduce excess wastage [46]. Green Packaging (SE4) is ranked as the fourth most significant sub-enabler among the major criteria of supplier enablers. Green packaging uses decomposable and recycled material, which further supports the industries in diminishing the negative environmental impact of the manufacturing processes by reducing different wastes [82].

Amongst the major criteria of collaborative enablers, a long-term relationship with SC partners (CE1) is the most significant sub-enabler with the highest weight. The organization aiming to maintain longterm relationships with supply chain vendors leads to a healthier partnership between them, ultimately generating transparency and a sustainable competitive advantage [80]. Collaboration with SC Partners (CE2) and supply chain partner development (CE4) are the second and third most significant collaborative enablers. If products are developed with the collaboration of supply chain partners, the industries can acquire green raw materials and deliver sustainable products to the customers [83]. Such collaboration would improve the sustainable performance of the industries and extend sustainability throughout the supply chain [46]. Both the enablers strengthen supplier-manufacturer relations, which aid in adopting new and innovative technology that improves sustainable development [42]. Logistical integration (CE5) and technical integrations (CE6) are ranked fourth and fifth. These enablers improve the industries' long-term feasibility by preserving economic, societal, and environmental benefits. Logistics and technological integrations are ways of cooperation that increase sustainability efficiency [64]. Mohanty, (2018) clarified that integrated logistics try to minimize total supply chain costs, lessen lead times, and enhance reliability. Mathivathanan et al., (2019) believed that both the enablers contribute significantly toward enhancing organizational performance and sustainability. Joint Development (CE3) is ranked as the sixth most crucial collaborative enabler. Joint development is one of the strategies to streamline the efforts toward successfully adopting sustainability throughout the supply chain [84]. Kumar and Rahman, (2017) explored that a lack of understanding among buyers and sellers is due to the differences in environmental and economic standards across the supply chain partners. Joint development ensures supply chain partners' full involvement in sustainable practices to maintain environmental standards in the supply chain [85].

Amongst the major criteria of design enablers, the design of products to reduce waste & costs (EE1) is the most significant sub-enabler with the highest weight. Mathivathanan et al., (2019) emphasized designing products in such a way that it performs their intended functions throughout the life cycle and ensures efficient reuse and recycling. Innovation (EE3) is ranked as the second most important design enabler. Innovation generally intends to generate something new, providing breakthrough improvement backed by research and development [84]. Mohanty, (2018) believed that industries could only maintain their sustainable growth in the competitive market if they were inclined toward innovation. Design for emissions reduction (EE2) is ranked as the third most significant sub-enabler among the major criteria of design enablers. Shibin et al., (2016) expressed that products should adhere to eco-designs to ensure the least emission levels. Design for emissions reduction is also one of the design aspects that ensures the product's design so that it performs its proposed functions without any harmful emissions [86].

Life cycle analysis (IE1) is the most significant sub-enabler with the highest weight among the major internal enablers criteria. Life cycle analysis empowers industries to improve their sustainability index by assessing the environmental effects of the products during the life cycle [46]. Adopting cleaner process technology (IE4) is ranked the second most important internal enabler. Biswal et al., (2019) suggested an innovation of cleaner processes and technologies as a vital SSCM enabler due to industries' usual attempt to portray themselves as technologically advanced to gain consumers' interest. Effective use of by-products (IE2) is ranked as the third most significant sub-enabler among the major criteria of internal enablers. The effective use of the by-products needs systemic modification in the supply chain to ensure continued recovery and distribution of resources [86]. Keeping track of the product's life cycle would assist the organization in acquiring information such as by-products produced during the entire life cycle of the products. By acquiring such information, the organization can reduce its manufacturing and waste disposal costs by reusing and recycling products [87]. Enhanced communications (IE3) is ranked as the fourth internal enabler. Kumar and Rahman, (2017) emphasized that exchanging feelings, ideas, and feedback among various organizational departments, investors, and supply chain partners reduces the resistance to implement SSCM. Competitive Advantage (IE5) is ranked as the fifth most significant internal enabler. SSCM ensures operational excellence across the supply chain and maintains a persistent competitive position in the global market [67]. Industries can gain a competitive advantage through SSCM because it ensures cost reduction, improved operational performance, increased quality, new market opportunities, premium pricing, improved corporate image, and customer satisfaction [71].

Amongst the major criteria of societal enablers, cooperation with consumers (SOE1) is the most significant sub-enabler with the highest weight. The most vital factor for any organization is delivering the productper the consumers' demand and maintaining their market position [18]. Shibin et al., (2016) believed that consumers' environmental consciousness is a vital driving factor that compels the industries toward a customer-focused corporate strategic vision for sustainable products and processes. Environmental awareness & training (SOE2) is ranked the second most vital societal enabler. The stakeholders of SSCM must gain awareness by acquiring appropriate awareness programs and training to streamline the implementation of SSCM and reduce the resistance from the stakeholders [88]. Mangla et al., (2018) stated that periodic workforce training and stakeholders' awareness are also crucial for enhancing industry's sustainability practices. Government rules & regulations (SOE5) is ranked as the third most significant sub-enabler among the major criteria of societal enablers. Mangla et al., (2018) stated that regulatory framework and governmental support are crucial to solve the infrastructure issues and coordination among local and foreign governments. Government's environmental supportive policies can restrict industries from adopting pollution-prone processes and encouraging them to sustainable practices [23]. Work safety & human rights (SOE4) is ranked as the fourth societal enabler. Chacón Vargas et al., (2018) cited that when a focal firm improves the working conditions of its employees, other companies in its supply chain perceive the focal firm positively. Organizations must provide appropriate working conditions and safety to their employees as it is their human right and vital for improving working morale. Measurement systems & rewards linked to sustainability (SOE3) is ranked as the fifth most significant societal enablers. Any organization needs to adopt innovative strategies to discover the unpredictable challenges associated with the supply chain. The organization needs to establish a performance measurement system that can assist in attaining supply chain goals by evaluating its innovative strategies [99]. Chacón Vargas et al., (2018) illustrated that industries could drive their sustainability by rewarding their employees. Government can also boost the drive for sustainability by offering tax benefits or other incentives like extending property rights. Pressure from non-government bodies (SOE6) is ranked as the sixth most significant societal enabler. Kumar and Rahman, (2017) suggested that external pressures (from trade unions, human rights industries, communities, NGOs, competitors' pressure, and civil society) on the organization play a significant role in initiating sustainability practices in the supply chain. Malek and Desai, (2021) also considered pressures from NGOs and other institutes as a significant solution to lift the adoption of sustainable practices.

6. Implications of the study

The present study has provided the needed priorities of different stakeholders involved in the supply chain to adopt SSCM effectively. The present study has provided a framework for manufacturing industries to identify their priorities and areas needing improvement. Categorizing enablers into logical groups would also assist the practitioners in understanding the requisites of different organizational functions to align efforts toward SSCM implementation. By understanding the requisites, the managers and practitioners would be able to plan their strategies effectively for SSCM implementation.

The present study has also provided a roadmap for manufacturing industries to incorporate sustainability in the supply chain by understanding the need to maintain relationships with supply chain partners. The present study believes that maintaining long-term supplier relationships leads to a healthier partnership, ultimately generating transparency and a sustainable competitive advantage. If products are developed with the collaboration of supply chain partners, then the industries can acquire green raw materials and deliver sustainable products to the customers. Such collaboration would improve the sustainable performance of the industries and extend sustainability throughout the supply chain.

The previous studies have utilized conventional MCDM techniques to prioritize different SSCM factors, which questions the reliability of the results explored in those studies. The present study has utilized one of the modern MCDM techniques, BWM, to prioritize SSCM enablers, which has provided consistent pairwise comparisons and reliable results. The successful application of SSCM in the present study would also encourage and provide a roadmap for the other manufacturing industries to adopt SSCM in their industries. One of the primary benefits of BWM is the need for fewer pairwise comparisons and consistently reliable results compared to other MCDM techniques. These benefits give practitioners an edge over their competitors and inspire them to implement sustainable practices in their supply chain. The present study has also provided a roadmap for practitioners and academicians to deal with many factors for complex systems like SSCM.

The present study has explored managerial, supplier, and collaborative enablers as the most significant enablers that assist practitioners in providing the needed roadmap for manufacturing industries to effectively implement sustainability in supply chains. The present study expressed top management's commitment toward SSCM as the most significant enabler for effective, sustainable operations across the supply chain. Top management commitment ensures effective policy generation for SSCM implementation led by aligning required resources for the project. If top management is committed to SSCM, it will streamline upstream and downstream supply chain efforts. Top management commitment to sustainable practices in the supply chain would also compel their suppliers and vendors for the same, resulting in sustainable operations throughout the supply chain. The implementation of sustainability practices across various levels of the organization is fuelled by top management's constructive views toward sustainable initiatives. Suppliers are the literal backbone of every business, from retaining customer loyalty to meeting consumer needs. Hence, top management's position in collaboration with critical suppliers and maintaining a clearer corporate vision is critical for effective SSCM implementation.

Manufacturing industries of developing nations generally do not possess adequate funds for sustainable practices as most of the funds remain trapped in maintaining day-to-day production. They cannot formulate strategies to adopt all the enablers simultaneously in such a scenario. If the industries are aware of the significance of their enablers, then strategies for those enablers can be prepared successfully by focusing on a few key enablers. The prioritization of enablers also offers the possibility that some of the enablers may lie beneath the solutions of implemented selected enablers.

The present study has also offered different research directions that researchers worldwide can attain. The present study has explored the use of BWM in prioritizing SSCM enablers in developing nations' manufacturing industries. The present study would provide a roadmap for other developing nations to initiate the same study in their nations by considering their industrial environment. The present study has also facilitated the researchers to understand the requirements of implementing SSCM in manufacturing industries.

7. Conclusion

The poor organizational position of developing nations in adopting sustainable practices is the prime concern for environmental degradation around the globe. Manufacturing industries have been meeting the need of increasing population by increasing their production with the utilization of conventional practices, which are pollution-prone and harmful to the environment. In such a scenario, manufacturing industries need to incorporate sustainability in their supply chain operations throughout the supply chain. The present study has provided a roadmap for the manufacturing industries to assimilate sustainability in their supply chain operations through understanding the priorities of significant enablers of SSCM. The present study has identified twenty-eight enablers through an extensive literature review and experts’ opinions. The finalized enablers have been prioritized using the BWM technique, which has facilitated the present study to sustain consistent and reliable results by reducing the number of pairwise comparisons. The present study has categorized the finalized enablers into six major criteria of enablers as per their functions in the supply chain operations. The decision panel of nine experts provided their preferences for the enablers based on the methodological steps of the BWM. Based on the experts' inputs, the significance of each enabler was carried out through weight calculation. The present study has prioritized the SSCM enablers, which explores the priorities of focal manufacturing industries and other stakeholders involved in the supply chain.

The present study will facilitate the focal organization in understanding the role of different stakeholders involved in the supply chain operations. By understanding the role of different stakeholders, the focal organization can highlight the performance of different suppliers involved in the supply chain. It can also take corrective actions to remove the weak links in the supply chain. The present study has also explored that the focal organization can also improve the performance of different suppliers by helping them through proper training. By developing suppliers, the industries can also plan the effective joint development of the products, ensuring sustainability and developing long-term supplier-buyer relationships in the supply chain. The present study will let the practitioners understand the impact of enablers on the supply chain and will support them in adopting sustainable practices in the future. The present study's findings argued that adopting SSCM in manufacturing industries would be driven by managerial and supplier enablers with effective governmental policies and regulations. The present study also assisted the manufacturing industries in deciding the priorities for resource allocation as per the significance of their enablers. The present study will help practitioners understand which enablers are more important to their needs and neglect the ones with lesser importance.

7.1 Limitations and future scope

The present study has considered twenty-eight SSCM enablers to understand the requisites of integrating sustainability in the supply chain. However, it cannot be concluded that these are the only enablers that affect the SSCM. The present study can be extended by increasing the enablers and categorizing them into other logical groups. The same analysis can be expanded using BWM with a different set of enablers to investigate further interrelationships of the SSCM enablers. Experts' perspectives and viewpoints heavily influence the present study's conclusions, so scrutiny of expert feedback is needed. The present study is carried out in one of the manufacturing industries, but the findings cannot be generalized to the infrastructure, service, and textiles industries. The present study can be extended to other developing nations like China, Thailand, Indonesia, etc., by altering the country-specific enablers. A comparative analysis of the manufacturing sector for different developing nations may be conducted to provide more reliable data by comparing the results with the current findings. The present study has utilized BWM based on its proficient benefits of less pairwise comparisons and reliable results. The present study can be extended by prioritizing the same enablers with other MCDM techniques and then comparing those results with the current findings. The present study has offered a roadmap for manufacturing industries in developing nations by exploring implications for practitioners and academicians. The practitioners of the manufacturing industries would greatly understand the needed priorities of their stakeholders to integrate sustainability in the supply chain.

Statements and Declarations: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A (Steps of BWM)

1. Selection of a set of decision factors

This step includes the selection of factors for which weights are needed to be calculated. Let C_1, C_2, …, C_n be the factors for which weights are needed to be calculated. In the present study, these are the enablers of SSCM.

2. Selection of the best and the worst factors

In this step, decision panel will individually select the best factors and the worst factors from the available factors. This step only consists of selecting the factors and no further calculation of weights. If more than one best or worst criteria need to be selected then selection should be made randomly. *3. Assign the preference of the best factor over all the other factors*

In this step, decision panel will assign the preference of the best factor over all other factors by utilising a number 1 to 9. It would result into Best-to-Others vector, which is denoted as A_B:

$$A_B = (a_{B1}, a_{B2}, \ldots, a_{Bn}),$$

In this vector, a_{Bj} specifies the preference of the best factor B over factor j. It should be clear that in this case $a_{BB} = 1$.

4. *Assign the preference of all the other factors over the worst factor*

In this step, decision panel will assign the preference of all the other factors over the worst factor by utilizing a number from 1 to 9. It would result into Others-to-Worst vector, which is denoted as A_W :

$$A_W = (a_{1W}, a_{2W}, \ldots, a_{nW})_T,$$

In this vector, a_{jW} specifies the preference of the factor j over the worst factor W. It should be clear that in this case $a_{WW} = 1$. 5. *Calculate the final weights*

To calculate the final weights of the factors, the maximum absolute differences $\{|w_B - a_{Bj}w_j|, |w_j - a_{jw}w_w|\}$ for all j should be minimized. This condition can be formulated as below [92]:

$$\text{Min } \max_j \{|w_B - a_{Bj}w_j|, |w_j - a_{jw}w_w|\}$$

Subject to

$$\sum_j wj = 1$$

$$w_j \geq 0, \text{ for all j.}$$

The same equation can be solved by converting it into linear programming problem as:

$$\text{Min } \xi$$

Subject to

$$|w_B - a_{Bj}w_j| \leq \xi, \text{ for all j}$$

$$|w_j - a_{jw}w_w| \leq \xi, \text{ for all j}$$

$$\sum_j wj = 1$$

$$w_j \geq 0, \text{ for all j.}$$

The solution to the above problem is the final weights of the factors and value of ξ^L. For linear model like the present study of prioritizing the enablers, the value of ξ^L can be directly considered as a gauge for consistency check of the calculated weights. A value of ξ^L close to zero is considered as a high level of consistency.

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