RESEARCH ARTICLE

Business Strategy
and the Environment

WILEY

Evaluating barriers and strategies to sustainable supply chain risk management in the context of an emerging economy

Aquib Irteza Reshad[1] | Tasnia Biswas[1] | Renu Agarwal[2] | Sanjoy Kumar Paul[2] | Abdullahil Azeem[1]

[1]Department of Industrial and Production Engineering, Bangladesh University of Engineering and Technology, Dhaka, Bangladesh

[2]UTS Business School, University of Technology Sydney, Sydney, Australia

Correspondence
Sanjoy Kumar Paul, UTS Business School, University of Technology Sydney, Sydney, Australia.
Email: sanjoy.paul@uts.edu.au

Abstract

With increasing awareness about society and the environment, industries are urged to develop and implement sustainable supply chain (SSC) processes. However, the risk of non-compliance against these SSC processes to manage overall business risks, namely, avoiding reputational damage and managing financial losses, is increasingly receiving senior management attention. Given these shortcomings, the objective of this research is twofold, namely, (i) to identify and evaluate barriers adopting sustainable supply chain risk management (SSCRM) processes and (ii) to prioritize SSCRM strategies to overcome these barriers in an emerging economy, namely, Bangladesh. To achieve the objectives, this study develops a framework by integrating the *technique for order of preference by similarity to ideal solution* (TOPSIS) and *VIsekriterijumska optimizacija i KOmpromisno Resenje* (VIKOR). The results show that the "information-related barriers" are most prevalent among the categories of barriers, and "lack of coordination and collaboration" has been identified as the most significant barrier. Evaluating the strategies, "top management commitment" is the best strategy. These findings can help managers develop strategies to overcome the most significant barriers to adopting SSCRM. The proposed framework, which integrates quantitative and qualitative approaches, can be used by decision-makers to make accurate, prompt, and systematic decisions compliant with SSCRM business processes.

KEYWORDS
barriers, risk management, strategies, sustainable supply chain

1 | INTRODUCTION

Sustainability implies fulfilling the needs of today's world while simultaneously ensuring a better prospect for future generations. The prominence of sustainability globally has gradually increased as organizations have realized the importance of climate change, coupled with the social and environmental impacts on future generations and the environment (Badri Ahmadi et al., 2017). Sustainability in supply

---

chains (SC), referred as sustainable supply chains (SSC), ensures that firms are environmentally compliant, fulfill their social responsibilities, and adopt good economic practices in line with the triple bottom line (TBL) concept (Carter & Easton, 2011; Dawo et al., 2022). For example, Carter and Rogers (2008) developed a sustainable supply chain management (SSCM) framework for managing sustainability in an SC incorporating strategic business aspects, namely, a collaborative approach underpinned by culture, strategy, transparency, and risk management. The model refers to three performance measures—either in pairs or all three outcomes simultaneously—related to each aspect of sustainability: economic, environmental, and social. To achieve sustainability goals, the best situation is when all three sustainability aspects are achieved simultaneously.

Over the past few years, numerous cases have demonstrated poor sustainability in supply chain risk management (SCRM), putting pressure on businesses to manage and measure social and environmental issues. The focal firm's SC governance actions can positively and negatively impact SC stakeholders in various ways, such as selecting transportation mode and routing, packaging of goods, selection of suppliers, and logistics and distribution of products. For instance, suppliers can compel organizations to follow a sustainable business approach (Kumar & Garg, 2017). As such, organizations must engage in SSCM practices, which is not a discretionary requirement anymore, according to Carter and Rogers (2008). As SCs have been globalized and emerging economies have grown, SCs need to be more sustainable in managing the world's resources and the environment to support future growth. Mathivathanan et al. (2018) mentioned that transforming the SC into SSC helps reduce the industries' detrimental effects and enhance business profitability through friendly and socially beneficial environmental practices. Carter and Rogers (2008) also identified four enablers of SSCM: identifying SSCM actions aligning with the overall sustainability goals, management of risk for upstream and downstream SC processes, managing organizations from both inside and outside, and ensuring visibility and traceability of resources.

Added to sustainability goals and focusing on risk management (RM), such as avoiding reputational damage and managing financial losses, the aim is to conduct contingency planning to minimize SC disruptions. SC risk is related to unforeseen events that result in negative consequences (Hajmohammad & Vachon, 2016; Narasimhan & Talluri, 2009). On the other hand, SSCM risk is related to incidents that affect firms financially, socially, and environmentally (Blome & Schoenherr, 2011; Hofmann et al., 2014; Zarbakhshnia et al., 2022), subsequently creating challenges and opportunities that motivate SCs to become sustainable. Therefore, mitigating these risks, which may include supply disruption, supply delay, price fluctuations, demand fluctuations, exchange rate fluctuations, system risks such as information infrastructure breakdown, forecast risks due to inaccuracies, procurement and inventory risks, capacity risks, and intellectual property risks, is important (Chopra & Sodhi, 2004).

In emerging economies, strategies used for risk mitigation do not always decrease the actual supply chain risks (SCR), whereas sustainability efforts often help to reduce SCR (Cruz, 2013). As a result, SCRM strategies are most effective when implemented in conjunction with sustainability efforts in the SC. However, significant barriers are involved in adopting the RM process in SSCM. It is also important to understand the strategies to overcome the barriers to adopting the RM process in SSCM.

Some articles have used multi-criteria decision making (MCDM) methods to develop a framework aiming at evaluating SSCRM. For instance, Rostamzadeh et al. (2018), Zhang et al. (2020), and Abadi and Darestani (2021) introduced frameworks for SSCRM evaluation in Iran. Moreover, Abdel-Basset and Mohamed (2020) developed a model to rank the criterion for evaluating SSCRM. The risks of SSCM have also been ranked by ul Amin et al. (2022). Elmsalmi et al. (2021) classified and prioritized sustainable development practices (SDP) for effective risk management in SCM. However, in the literature, a few studies have developed a framework to evaluate the barriers and overcoming strategies for adopting SSCRM. For example, Hudin et al. (2019) analyzed barriers to SCRM adoption in automotive companies. Oelze (2017) explored the barriers and enablers of SSCM in the textile industry. Manuj and Mentzer (2008) worked on the strategies for SCRM from a global perspective. Faisal et al. (2007) analyzed the barriers to SCRM in SMEs. Table 1 summarizes closely related studies under SCRM, SSCM, and SSCRM. Compared with the closely related studies, this paper is unique as it evaluates both barriers and overcoming strategies in SSCRM in an emerging economy such as Bangladesh. This study aims to advance existing literature and contribute knowledge to the field of SSCRM by examining the following research questions (RQs):

RQ1: What barriers do Bangladeshi industries face to adopting SSCRM processes?

RQ2: What are organizations most critical barriers in adopting SSCRM processes?

RQ3: What strategies should be implemented to overcome those barriers?

RQ4: What are the most effective strategies to overcome barriers to adopting SSCRM processes?

Three steps are adopted to address the above research questions. First, the literature has been thoroughly explored, experts from different industries were consulted to identify barriers existing in Bangladesh, and probable strategies have been outlined to overcome these barriers through the qualitative part of this research. Second, the barriers were sequenced based on the effectiveness and dominance of the SSC using an MCDM method. Third, a quantitative analysis was conducted to analyze barriers and overcoming strategies. RM in SSC is an intricate task as numerous barriers are experienced by organizations in a developing country like Bangladesh. Therefore, the key contribution of this paper is to integrate both barriers and overcoming strategies for adopting SSCRM processes.

2 | LITERATURE REVIEW

This section provides a literature review of barriers and overcoming strategies for SSCRM. Some barriers have been taken from the

TABLE 1 Summary of closely related studies to this research study

Author/year	Objectives and contributions	Findings	Context of the study	Methodology	Economy
Tobescu and Seuring (2015)	Identified factors that enable SSCRM	A total of four enablers were identified for SSCRM	Automotive industry	Semi-structured interviews	Germany (developed)
Hudin et al. (2019)	Analyzed the barriers to SCRM adoption	Adopting SCRM receives a negative viewpoint because of a challenging level of understanding.	Automobile companies	Thematic analysis	Malaysia (developing)
Oelze (2017)	Found the barriers and enablers of SSCM	An effective SSCM can be achieved. Specific modes of collaboration can also remove barriers to policy implementation.	Textile industry	Qualitative research approach	Germany, Sweden, USA, Canada, Norway (developed)
Vilko et al. (2012)	Demonstrated an information-exchange perspective on SCRM	One of the factors affecting information exchange was the lack of collaboration among the organizations in the SC	Existing literature and experts' opinion	Qualitative research approach	Baltic States and Finland (developed)
Manuj and Mentzer (2008)	Worked on global SCRM strategies	Six RM strategies that apply to all the environmental conditions	Manufacturing SC context	Qualitative research approach	USA (developed)
Faisal et al. (2007)	Found the barriers to SCRM in SMEs.	A very significant group of barriers.	SMEs	ISM	India (developing)

literature on SCRM and SSCM because if any barrier can hinder the SCRM or SSCM, it could also possibly be a barrier to SSCRM that affects the firm's financial, social, and environmental performance (Blome & Schoenherr, 2011; Hofmann et al., 2014; Zarbakhshnia et al., 2022). Moreover, to contextualize the barriers and their overcoming strategies, we have also taken statements from experts, as presented in Appendix C.

2.1 | Review of barriers to RM in SSCs

This section reviews existing scholarly articles to identify different barriers to SSCRM, categorizing barriers to SSCRM into four themes: managerial and organizational, financial, information-related, and socio-cultural.

2.1.1 | Managerial and organizational barriers

Companies do not engage in long-term commitments or agreements with their partners, instead frequently shifting from one partner to another whenever a better opportunity arrives; for example, an opportunity to increase profit. For instance, due to short-term business relationships, there is a lack of trust among SC members resulting in refraining from sharing business information on profits, budget, and sourcing, which hinders SSCRM activities and progress (Christopher & Lee, 2004; Finch, 2004; Sinha et al., 2004). Existing arm's-length

operations or adversarial relationships among partners of the SC create a competitive attitude towards each other, thus decreasing the sense of collaboration among partners, which becomes a barrier to SSCRM (Christopher & Lee, 2004; Finch, 2004; Sinha et al., 2004). A total of 14 barriers have been identified, as summarized in Table 2.

2.1.2 | Information-related barriers

Seuring and Müller (2008) narrated SSCM as the flow management of capital, raw materials, and information and the collaboration with stakeholders within the SC to achieve sustainability goals. Thus, visibility is needed for proper RM of the SC. For example, the lack of trust between partners hinders coordination and collaboration among stakeholders (Biswal et al., 2017; Sharma & Bhat, 2014), leading to minimal information sharing among SC partners. Thus, SCs mainly focus on local SC objectives, and risks are not understood in an SSC context. Table 3 summarizes five information-related barriers.

2.1.3 | Financial barriers

Implementing different RM techniques is costly (Christopher & Lee, 2004; Finch, 2004; Sinha et al., 2004). Preventive measures needed for SCRM begin with accumulating and analyzing immense data, which can be expensive. Significant amount of funds is also necessary for maintaining large infrastructure and manpower (Lee, 2008;

TABLE 2 List of barriers to SSCRM under the category of managerial and organizational barriers

Barrier category	Barriers to SSCRM	References
Managerial and organizational barriers	Unwillingness to share risks	(Faisal et al., 2007)
	Lack of trust among SC members	(Sinha et al., 2004) (Christopher & Lee, 2004) (Finch, 2004)
	Arm's-length or adversarial relationships	(Sinha et al., 2004) (Christopher & Lee, 2004) (Finch, 2004)
	Lack of strategic risk planning	(Sinha et al., 2004) (Christopher & Lee, 2004) (Finch, 2004)
	Inadequate ERM training	(Bashir & Long, 2015) (Moshesh et al., 2018)
	Lack of ERM understanding	(Chileshe & Kikwasi, 2013) (Rostami et al., 2015) (Moshesh et al., 2018)
	Complex structure of SC	(Isik, 2011) (Moshesh et al., 2018)
	Organizational complexity	(H. Liu et al., 2015) (Moshesh et al., 2018)
	Rigid ERM framework	(Rosman, 2011) (Moshesh et al., 2018)
	Lack of management buy-in for ERM	(Schlak, 2015) (Moshesh et al., 2018)
	Non-effective change management	(Kallenberg, 2009) (Moshesh et al., 2018)
	Goal misalignment	(Avelar-Sosa et al., 2014) (Moshesh et al., 2018)
	Managers cannot agree on quantification of uncertainty/subjective probability assessment	(Tummala et al., 1997)
	Lack of top managers/supervisors' support	(Sharma & Bhat, 2014) (Zhao et al., 2015) (Renault et al., 2016) (Moshesh et al., 2018)

TABLE 3 List of barriers to SSCRM under the category of information-related barriers

Barrier category	Barriers to SSCRM	References
Information-related barriers	Lack of coordination and collaboration	(Sharma & Bhat, 2014) (Biswal et al., 2017)
	Lack of loss assessment metrics due to risk for the SC	(Henriques & Sadorsky, 1996)
	Lack of information technology support for ERM	(Kerstin et al., 2014)
	Difficulty in understanding and interpreting outcomes of RM process	(Faisal et al., 2007)
	Difficulty in obtaining input estimates and assessment of risk probabilities	(Faisal et al., 2007) (Manuj & Mentzer, 2008)

Mudgal et al., 2010). For example, creating a budget to bear this huge cost is difficult for a developing nation such as Bangladesh, where budgeting for RM is not a priority for industries (Chileshe & Kikwasi, 2013; Faisal et al., 2007; Zhao et al., 2015). Other barriers identified from the review of extant literature result in five financial barriers, as summarized in Table 4.

2.1.4 | Socio-cultural barriers

The surroundings and the society to which an industry belongs play a vital role in the decision-making rules of that industry. There is insufficient pressure from government and environment-oriented groups, so social and environmental issues are mostly neglected (Biswal

TABLE 4 List of barriers to SSCRM under the category of financial barriers

Barrier category	Barriers to SSCRM	References
Financial barriers	Lack of budget for RM	(Faisal et al., 2007) (Chileshe & Kikwasi, 2013) (Zhao et al., 2015)
	High cost of RM process techniques	(Hudin et al., 2019)
	Expensive resources of ERM	(Chileshe & Kikwasi, 2013) (Zhao et al., 2015) (Hudin et al., 2019)
	Low-profit margin of sustainable activities	(Smith & Bohn, 1999) (Hwang et al., 2014)

TABLE 5 List of barriers to SSCRM under the category of socio-cultural barriers

Barrier category	Barriers to SSCRM	References
Socio-cultural barriers	Lack of corporate social responsibility practices	(Manuj & Mentzer, 2008)
	Insufficient application of government legislation	(Mitchell, 1995) (Biswal et al., 2017) (Henriques & Sadorsky, 1996)
	Insufficient societal pressure	(Muduli et al., 2013)

et al., 2017; Henriques & Sadorsky, 1996; Mitchell, 1995). For example, some managers do not find engaging in corporate social responsibilities profitable, creating a barrier to SSCRM (Manuj & Mentzer, 2008). Table 5 summarizes three socio-cultural barriers as identified from the extant literature.

2.2 | Review of strategies to overcome barriers to adopting SSCRM

This section describes the strategies that influence RM in SSCs by overcoming barriers such organizations face. A total of 13 strategies have been identified from the literature review, as summarized in Table 6.

As an illustration, one of the most critical strategies has been the commitment of top management, which is a key success factor for an SC (Chuang & Shaw, 2000). An RM program and culture can be inculcated if the top management is committed to the organization, eventually leading to efficient RM (Hallowell et al., 2013). As the top management makes all organizational decisions, their decisions can significantly change the company's mindset, and committed management will surely take decisions to lower risks to make their institution successful and sustainable. Second, as any SSC considers the environmental, social, and economic effects, these three pillars of sustainability are not steady but changeable. To cope with these, the SC should also be proactive. Early identification is not the only task, as taking action regarding those changes is also a key issue for SSCRM. Being proactive can improve the outcomes and performance of an SC. It is one of the key factors behind successful RM in both an active and passive sense, as it enables organizations to make prompt decisions to mitigate risks (Hallowell et al., 2013).

TABLE 6 List of strategies to overcome barriers to adopt SSCRM from the literature review

Strategy to overcome barriers	References
Top management commitment	(Chuang & Shaw, 2000) (Hallowell et al., 2013)
Increasing the visibility of the information	(Guojun & Caihong, 2008) (Christopher & Lee, 2004)
Active and passive support from executives	(Hallowell et al., 2013)
Being proactive towards risks	(Hallowell et al., 2013) (Christopher & Lee, 2004)
Flexibility in SC	(Jüttner et al., 2003) (Manuj & Mentzer, 2008)
Provision of adequate training to staff	(Hallowell et al., 2013) (Cetinkaya, 2011)
Sharing risk with partners	(Manuj & Mentzer, 2008) (Jüttner et al., 2003)
Developing performance metrics for SC	(Manuj & Mentzer, 2008) (Hallowell et al., 2013)
Specifying sustainability goals in the SC strategy	(Cetinkaya, 2011)
Providing incentives and motivating people	(Cetinkaya, 2011)
Engaging in corporate social responsibility (CSR) activities	(Cruz, 2013)
Considering SSCRM as an industrial requirement as well as customer need	(Hasani et al., 2017)
Assuring governmental support	(Hasani et al., 2017)

In addition, key operational metrics and status reports of the SC, such as raw materials, work in process, demand, forecasts, production yields, finished goods, capacities, and shipment plans, must be visible

to the members of the SCM. This makes it easy to identify risks and take proper action. Visibility results in lesser risk in the SC. Best practice companies have transparent designing, planning, and implementation of sustainability practices, allowing them to better understand the market, customer needs, and changing environment of business (Cetinkaya, 2011). Further, the accuracy of this information should also be guaranteed.

Another example is flexibility, which is an RM strategy. Flexible firms outperform less flexible ones (Fawcett et al., 2008). Upton (1994) describes flexibility as "the ability to change or react with little penalty in time, effort, cost or performance." SCs that are flexible are responsive to a corrective action whenever a risk is seen or forecasted, and a volatile political phenomenon is common in emerging economies in case of any scenario, and agility or flexibility can help firms respond faster.

Table 6 presents 13 strategies to overcome barriers faced in SSCRM, as identified in the literature review.

2.3 | Research approaches for evaluating barriers and strategies

MCDM techniques have been used to evaluate several factors in the SC, including the evaluation of indicators of the SSCM applying fuzzy analytical hierarchy process (AHP) (Kumar & Garg, 2017); selection of the best supplier using fuzzy analytic network process (ANP) (Danai et al., 2019); evaluation of SC strategy for sustainable development using AHP, subjective and objective weight integrated approach (SOWIA), and TOPSIS (Sreekumar & Rajmohan, 2019); selection of critical factors of green business failure using grey decision making trial and evaluation laboratory (DEMATEL) (Cui et al., 2019); and selection of sustainable outsourcing partner using best-worst method (BWM) and VIKOR (Garg & Sharma, 2020). Table A1 in Appendix A summarizes different techniques used to identify and evaluate the SSCRM barriers and prioritizes strategies to overcome such barriers. It also lists different applications and how they have been applied across different contexts to address different research questions.

2.4 | Research gaps and contributions

As evident from Table 1, researchers have focused on the barriers and enablers of SSCM or only on the barriers of SCRM. Based on Sections 2.2 and 2.3 and Appendix A which detail different MCDM techniques, we found that few studies have integrated qualitative expert opinion and quantitative techniques into a decision-making framework for evaluating strategies to overcome barriers to adopting SSCRM in emerging economies, such as Bangladesh.

Bangladesh's industrial development needs to mitigate sustainability risks that can lead to negative social or environmental impacts. However, both barriers and overcoming strategies for adopting SSCRM have not yet been systematically analyzed for use as a

guideline for Bangladesh's industrial users. Henceforth, this research contributes to the literature by analyzing both key barriers and overcoming strategies that help lead to a successful implementation of SSCRM, which are summarized as follows:

i. Identifying and evaluating barriers to adopting SSCRM and evaluating overcoming strategies;
ii. Demonstrating a hybrid framework that integrates qualitative expert survey and quantitative TOPSIS for ranking and weighting the barriers; and
iii. Integrating the VIKOR method into a defined framework to evaluate strategies to overcome barriers to adopting SSCRM.

3 | RESEARCH FRAMEWORK

Both qualitative and quantitative methods have been used to design the research framework to increase the robustness of this study. The barriers to adopting SSCRM were initially identified from scholarly articles and a survey conducted with experts in phase 1. In phase 2, we evaluated barriers by applying the TOPSIS method and providing relative weights. In phase 3, evaluating different strategies using the VIKOR method helped calculate the weighted score for each strategy. The research framework is presented in Figure 1.

3.1 | Phase 1: Identifying barriers and strategies to adopting SSCRM

As shown in Figure 1, a survey was conducted in phase 1 to seek expert opinions and feedback based on barriers obtained from scholarly articles. Though we identified an initial list of barriers from the literature on SCRM and SSCM, the experts helped to contextualize the barriers for SSCRM and identified if there were any additional barriers. As respondents are experienced managers and chief executives of manufacturing businesses, they already apply different RM techniques in their SSC or aim to implement these RM strategies in the future. The literature review helped identify strategies in RM, which the experts verified. The questionnaire survey allowed for the provisioning of new barriers or strategies that were not included in the survey. For example, a new barrier identified from expert opinions included corruption in society, which implies that the government organizations aspiring for sustainability and saving the environment could not work transparently.

3.2 | Phase 2: Evaluating barriers to adopting SSCRM

As shown in Figure 1, the TOPSIS method is applied in phase 2 to evaluate different barriers. Bai and Sarkis (2019) used TOPSIS to
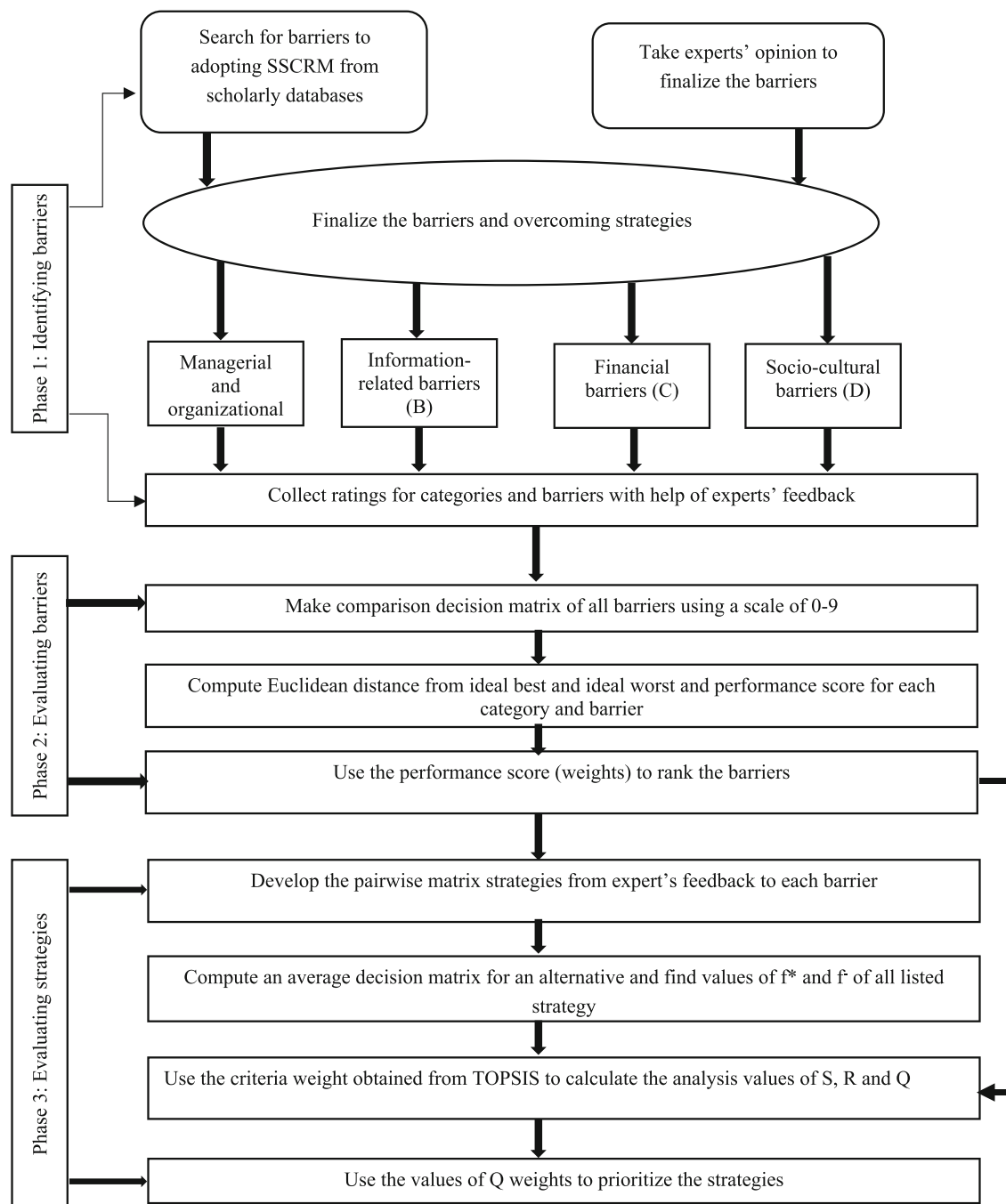
FIGURE 1 Research framework

select sustainable third-party reverse logistics providers; Ülengin et al. (2010) determined the best transportation policy utilizing TOPSIS; Liu et al. (2013) conducted a study to find the weights of the decision-makers by TOPSIS; and Kumar and Singh (2012) evaluated 3PL in an SC applying TOPSIS. In a similar vein, TOPSIS helps us identify the optimal solution alternative for SCCRM that is nearest to the positive-ideal solution (maximum normalized weight) and farthest from the negative ideal solution (minimum normalized weight) (Yoon & Hwang, 1995). A step-by-step procedure for using TOPSIS is described in Appendix B.

3.3 | Phase 3: Evaluating strategies to overcome the barriers

As shown in Figure 1, phase 3 evaluates strategies using the VIKOR method, and ideal solutions are determined through consensus leading to decision-making. The VIKOR method is well-renowned for ranking alternatives. For example, Zeng et al. (2013) used VIKOR to make decisions regarding service management in healthcare industries, and You et al. (2015) employed VIKOR to select suppliers. The stepwise procedure of VIKOR is based on Paul et al. (2020), described

in Appendix B. In step 4 (Appendix B), the weight of the barriers was used to connect barriers with strategies.

4 | RESULT ANALYSIS

In this section, we analyze the application of the developed framework for identifying barriers and overcoming strategies to adopt SSCRM, followed by their evaluation.

4.1 | Phase 1: Identifying barriers and strategies using the qualitative survey based on expert opinion

Based on the expert's feedback from the survey, the list of barriers from the literature review and survey is combined into four barrier categories, as demonstrated in Table 7. Totally, 17 experts participated in the survey, and their profiles are presented in Table C5 of Appendix C. Qualitative analysis facilitated the identification of 27 barriers and 13 strategies. The final list of strategies is presented in Table 6.

4.2 | Phase 2: Evaluating barriers using TOPSIS

After finalizing the barriers, we made a comprehensive list of the decision criteria to analyze them using the TOPSIS method. A second questionnaire survey helped select the most appropriate barrier categories. The questionnaire for evaluating barriers is presented in Appendix C. Experts were asked whether the indicators were suitable in the Bangladeshi context. We received feedback from 17 experts who participated in the survey.

Analyzing the feedback in phase 2 allowed decision-makers to rate barrier categories, which then facilitated the ranking of the

TABLE 7 Final list of barriers of SSCRM

Category	Barrier	Sources (LR = literature review)
Managerial and organizational barriers (A)	Unwillingness to share risks (A1)	LR + survey
	Lack of trust among SC members (A2)	LR
	Arm's-length or adversarial relationships (A3)	LR + survey
	Lack of strategic risk planning (A4)	LR + survey
	Inadequate ERM training (A5)	LR + survey
	Lack of ERM understanding (A6)	LR + survey
	Complex structure of SC (A7)	LR + survey
	Organizational complexity (A8)	LR + survey
	Rigid ERM framework (A9)	LR + survey
	Lack of ERM buy-in from top management (A10)	LR
	Non effective change management (A11)	LR + survey
	Goal misalignment (A12)	LR
	Managers cannot agree on quantification of uncertainty/subjective probability assessment (A13)	LR
	Lack of top managers/supervisors' support (A14)	LR + survey
Information-related barriers (B)	Lack of coordination and collaboration (B1)	LR + survey
	Lack of loss assessment metrics due to risk for the SC (B2)	LR
	Lack of information technology support for ERM (B3)	LR
	Difficulty in understanding and interpreting outcomes of the RM process (B4)	LR + survey
	Difficulty in obtaining input estimates to assess risk probabilities (B5)	LR + survey
Financial barriers (C)	Lack of budget for RM	LR + survey
	High cost of RM process techniques (C2)	LR + survey
	Expensive resources of ERM (C3)	LR + survey
	Low-profit margin of sustainable activities (C4)	LR
Socio-cultural barriers (D)	Lack of corporate social responsibility practices (D1)	LR + survey
	Insufficient application of government legislation (D2)	LR + survey
	Insufficient societal pressure (D3)	LR
	Corruption in the sustainability law enforcement process (D4)	Survey

—WILEY—

individual barriers. As an example of the calculations conducted using TOPSIS, Decision Maker-1 (DM1) identified "Managerial and organizational barriers (A)" as the most important barrier category and "Socio-cultural barriers (D)" as the least important barrier from the list of barrier categories. Similarly, DM1 identified "Arm's-length or adversarial relationships (A3)" as the most important barrier and "Complex structure of SC (A7)" as the least important barrier among other barriers. Using the TOPSIS method, the optimum weight of the main barrier categories and individual barriers was calculated. Table 8 shows the normalized weight of each barrier and the final importance ranking.

4.3 | Phase 3: Evaluating strategies using VIKOR

We used the VIKOR method to rank strategies. The questionnaire for evaluating strategies is presented in Appendix D. Using the VIKOR method, the final average relation matrix is constructed for alternative

TABLE 8 Ranking based on the global weight of each barrier

Category name	Category weights	Barrier	Local weights of barriers	Global weights of barriers	Importance ranking
Managerial and organizational barriers (A)	0.64265876	Unwillingness to share risks (A1)	0.31193601	0.20046841	18
		Lack of trust among SC members (A2)	0.25177717	0.1618068	21
		Arm's-length or adversarial relationships (A3)	0.18898476	0.12145271	23
		Lack of strategic risk planning (A4)	0.45269774	0.29093017	12
		Inadequate ERM training (A5)	0.51309293	0.32974366	8
		Lack of ERM understanding (A6)	0.42110274	0.27062536	13
		Complex structure of SC (A7)	0.24147014	0.1551829	22
		Organizational complexity (A8)	0.38297042	0.24611929	14
		ERM rigidity (A9)	0.35796855	0.23005163	15
		Lack of ERM buy-in from top management (A10)	0.32660828	0.20989767	17
		Non effective change management (A11)	0.35613956	0.22887621	16
		Goal misalignment (A12)	0.45614718	0.29314698	10
		Managers cannot agree on quantification of uncertainty/subjective probability assessment (A13)	0.27862808	0.17906278	20
		Lack of top managers/supervisors' support (A14)	0.54767593	0.35196873	6
Information-related barriers (B)	0.68713026	Lack of coordination and collaboration (B1)	0.62512125	0.42953973	1
		Lack of loss assessment metrics due to risk for the SC (B2)	0.51005358	0.35047325	7
		Lack of information technology support for ERM (B3)	0.28206981	0.1938187	19
		Difficulty in understanding and interpreting outcomes of the RM process (B4)	0.53611734	0.36838245	3
		Difficulty in obtaining input estimates to assess risk probabilities (B5)	0.42649371	0.29305673	11
Financial barriers (C)	0.49886556	Lack of budget for RM (C1)	0.7296845	0.36401447	4
		High cost of RM process techniques (C2)	0.71892423	0.35864654	5
		Expensive resources of ERM (C3)	0.15236197	0.07600814	24
		Low-profit margin of sustainable activities (C4)	0.13901682	0.0693507	25
Socio-cultural barriers (D)	0.50030452	Lack of corporate social responsibility (CSR) practices (D1)	0.80867373	0.40458313	2
		Insufficient application of government legislation (D2)	0.64153799	0.32096436	9
		Insufficient societal pressure (D3)	0.00952149	0.00476364	27
		Corruption in the sustainability law enforcement process (D4)	0.12810326	0.06409064	26

solutions for each criterion. The final ranking of overcoming strategies is presented in Table 9.

4.4 | Discussion

In the TOPSIS analysis, "Information-related barriers (B)" is given the highest priority compared to other barrier categories, which mainly comprise five barriers: *lack of coordination and collaboration (B1), lack of loss assessment metrics due to risk for SC (B2), lack of information technology support for ERM (B3), difficulty in understanding and interpreting outcomes of RM process (B4), and difficulty in obtaining input estimates and assessment of risk probabilities (B5).*

Experts have placed particular importance on the *lack of coordination and collaboration* (B1). This information-related barrier has the highest weight in the final ranking. This evidence is also backed by a recent Bangladeshi article published in The Daily Star, which stated that the lack of freedom of association poses further hurdles to the implementation of sustainable compliance across the SC of the Bangladeshi textile and apparel manufacturing industry (The Daily Star, November 22, 2019). This shows that decision-makers prioritize sufficient coordination and collaboration among the SC members when sustainably implementing RM. Another barrier, *difficulty in understanding and interpreting outcomes of the RM process* (B4), was ranked third, indicating that decision-makers are concerned about the outcomes of the RM process and hence aim to have a clear and proactive understanding of the underlying RM processes.

Similarly, based on TOPSIS analysis, "Managerial and organizational barriers (A)" was ranked second among the barrier categories, which comprise 14 barriers (see Table 8). As evident from Table 8, experts prioritized "lack of top managers'/supervisors' support (A14)" under the managerial and organizational barriers, and it has the sixth highest weight in the final importance ranking, which indicates that

support from top management is critically essential for decision-makers. The published Bangladeshi newspaper states that "if there is a presence of strong support from the top management and if there are backup plans for their operations, then the companies will do better in managing SSC risk than those companies that are underprepared for facing risks" (The Daily Star, May 05, 2020).

Among the barrier categories, "Socio-cultural barriers (D)" was the third most important barrier category. This category includes four barriers (see Table 8). *Lack of corporate social responsibility practices (D1)* has the highest priority among these four barriers and is ranked second based on importance, while all the other barriers received noteworthy attention from the experts.

Lastly, "financial barriers (C)" was ranked last in the ranking barrier categories. In the TOPSIS analysis, most of the barriers under this category were given the least importance. The decision-making process for financial barriers cannot be neglected because these financial concerns are a priority daily.

Based on the results of global weights, "Lack of coordination and collaboration (B1)" is the most important barrier. It is followed by "Lack of corporate social responsibility practices (D1)," "Difficulty in understanding and interpreting outcomes of the RM process (B4)," and "Lack of budget for RM (C1)." The ranking of the rest of the barriers based on the global weight is in the following order:

C2 > A14 > B2 > A5 > D2 > A12 > B5 > A4 > A6 > A8 > A9 > A11 > A10 > A1 > B3 > A13 > A2 > A7 > A3 > C3 > C4 > D4 > D3.

The analysis based on the VIKOR method was used to establish a decision to select strategies to overcome the barriers. The importance of ranking is made using the values of the weights obtained. As shown in Table 9, "Top Management Commitment (S1)" is ranked highest in the VIKOR analysis, showing that "Top Management Commitment (S1)" presents the best strategy to overcome the barriers. This is

TABLE 9 Ranking of strategies

Strategies	S_a	Rank	R_a	Rank	Q_a	Rank
S1	1.247172868	1	0.243154818	1	0	1
S2	3.926278791	6	0.404583125	11	1.196934853	11
S3	3.669910956	4	0.279022845	2	0.491615726	2
S4	4.227778608	8	0.295905145	3	0.651082385	4
S5	3.462883177	3	0.313900701	5	0.653178729	5
S6	3.968824999	7	0.372267763	10	1.028809016	8
S7	5.296203031	13	0.357273458	8	1.112274033	9
S8	4.37818355	9	0.4199944	12	1.335424131	12
S9	3.683319459	5	0.3149958	6	0.686275074	6
S10	5.124654728	12	0.429539727	13	1.478816124	13
S11	5.091892072	11	0.368382447	9	1.14664682	10
S12	4.543940408	10	0.350473248	7	0.982895093	7
S13	3.459714873	2	0.308416458	4	0.623363204	3
S*	1.247172868	R*	0.243154818			
S⁻	5.296203031	R⁻	0.429539727			

followed by "Active and passive support from executives (S3)" as there can be no change without support from the executives. "Being proactive towards risks (S4)" is in the third position, followed by "Assuring governmental support (S13)," which can impose some strict rules to implement sustainability. The remaining prioritization from the largest to the lowest weight is in the following order: S5 > S9 > S7 > S6 > S7 > S11 > S2 > S8 > S10.

5 | MANAGERIAL IMPLICATIONS

For the first time, this study has helped identify barriers and strategies to overcome the barriers to adopting SSCRM in Bangladeshi industries. Furthermore, this study prioritized individual barriers and barrier categories using an integrated approach. If practitioners cannot focus on all barriers and their overcoming strategies, this research study can help them understand the priority of the barriers and strategies. The implications for managers who are willing to manage the risks in their organization's SC while maintaining sustainability are as follows:

1. According to this study, the most significant and effective strategy is "Top Management Commitment." For a successful RM, a strong commitment from the top management is paramount. Moreover, the top managers should also collaborate with their stakeholders and be proactive while deciding to improve RM outcomes in SSCM.

2. "Active and passive support from executives" strategy, which expresses the importance of the role of the executives, is key for SSCRM. The executives should provide active support (i.e., get involved in RM) and passive support (i.e., involve others in the organization and encourage knowledge sharing between employees to their staff). RM is a key strategic plan and awareness about this can be spread throughout the organization by facilitating various policies for training, workshops, and formal policy documents illustrating successful RM implementation. These require endorsement, assistance, and ongoing commitment from executives and top-level managers (Hallowell et al., 2013).

3. Third, "Assuring Governmental support" is an environmental characteristic that can significantly affect the implementation of social customer relationship management, and that government can be instrumental in bringing change. For instance, the Eastern and Central European governments funded a new era of privatization of businesses. Similarly, the Indonesian government supported and facilitated the implementation of e-commerce solutions among some small manufacturing enterprises (Rahayu & Day, 2015). Thus, for the smooth implementation of SSCRM, managers and executives should persuade their government to craft environmental and financial assistance policies.

4. Lastly, other top-ranked strategies include "Being proactive towards risks." This means that the need for proper RM in SSCM can be recognized, thus allowing the design of a flexible SC for implementing any changes for an efficient RM program. This also supports specifying sustainability goals in the SC strategy to simplify RM planning. Organizations' executives and managers should follow the identified key SSCRM strategies for productive SSCRM, thus eliminating or even minimizing barriers.

6 | CONCLUSIONS

This research has identified 27 barriers and 13 overcoming strategies for adopting SSCRM, as taken from literature and SC experts working in different industries while integrating qualitative and quantitative methods. The barriers were ranked using TOPSIS, and the overcoming strategies were evaluated using the VIKOR method. This research expands the knowledge base of RM in SSC and applies MCDM approaches in a more complex setting. The framework developed can be used to evaluate suppliers, organizational performance, employee performance, or other evaluation and assessment problems within the SSCRM setting as well as decision-making for accurate and prompt decision-making when managing risks across an SSC.

The success rate of implementing SSCRM in Bangladesh is relatively low, primarily attributed to several barriers. Therefore, the key contributions of this paper have been to identify and evaluate these barriers and prioritize the strategies to overcome most of the barriers so that Bangladeshi managers can concentrate on high-rank solutions to get desired outcomes. The results show that information-related barriers are most vital. Top management commitment ensures that the managers will proactively maintain an RM culture and will strongly commit to upholding sustainability in the SC. Appropriate government and top management assistance and support can significantly encourage the proper adoption of SSCRM. Similarly, active and passive support from executives is also significant in solving most of the barriers. As a result, ranking strategies help companies decide their strategic implementation priorities to overcome the barriers and increase the efficacy of RM in an SSC. As demonstrated, ranking these strategies using the proposed research framework is a robust approach that helps overcome most barriers, which is our main contribution to this research study.

This study has some limitations. For instance, 17 experts participated in the survey, and the number is not significantly high. More numbers would result in more precise results. The research represented only one emerging economy, and a future study could compare and analyze barriers and strategies across different economies/countries. Developed economies might have different sets of barriers, and the high-ranked strategies found in this study might not be effective in those types of economic conditions. For future research, other MCDM techniques, such as fuzzy ANP, fuzzy MACBETH, fuzzy VIKOR, fuzzy ELECTRE, and fuzzy PROMETHEE, can be applied to compare results with that of this paper. Using other MCDM techniques to evaluate the barriers and strategies of this research will help validate the results and fuzzy MCDM techniques aid in obtaining more realistic solutions. A sensitivity analysis can be conducted to demonstrate further robustness of the findings. Moreover, research can target specific industries, such as ready-made garments,

pharmaceuticals, and food, instead of selecting a diverse set of firms from different industries. An empirical case study can be undertaken using the proposed framework to validate and test the results.

ACKNOWLEDGEMENTS

CONFLICT OF INTEREST

The authors confirm that there is no potential conflict of interest.

ORCID

Sanjoy Kumar Paul 🄳 https://orcid.org/0000-0001-9523-179X

REFERENCES

Abadi, Y. T. H., & Darestani, S. A. (2021). Evaluation of sustainable supply chain risk: Evidence from the Iranian food industry. *Journal of Science and Technology Policy Management*. https://doi.org/10.1108/JSTPM-08-2020-0121

Abdel-Basset, M., & Mohamed, R. (2020). A novel plithogenic TOPSIS-CRITIC model for sustainable supply chain risk management. *Journal of Cleaner Production*, 247, 119586. https://doi.org/10.1016/j.jclepro.2019.119586

Avelar-Sosa, L., García-Alcaraz, J. L., & Castrellón-Torres, J. P. (2014). The effects of some risk factors in the supply chains performance: A case of study. *Journal of Applied Research and Technology*, 12(5), 958–968. https://doi.org/10.1016/S1665-6423(14)70602-9

Awasthi, A., Govindan, K., & Gold, S. (2018). Multi-tier sustainable global supplier selection using a fuzzy AHP-VIKOR based approach. *International Journal of Production Economics*, 195, 106–117. https://doi.org/10.1016/j.ijpe.2017.10.013

Badri Ahmadi, H., Kusi-Sarpong, S., & Rezaei, J. (2017). Assessing the social sustainability of supply chains using best worst method. *Resources, Conservation and Recycling*, 126, 99–106. https://doi.org/10.1016/j.resconrec.2017.07.020

Bai, C., & Sarkis, J. (2019). Integrating and extending data and decision tools for sustainable third-party reverse logistics provider selection. *Computers and Operations Research*, 110, 188–207. https://doi.org/10.1016/j.cor.2018.06.005

Bashir, N., & Long, C. S. (2015). The relationship between training and organizational commitment among academicians in Malaysia. *Journal of Management Development*, 34(10), 1227–1245. https://doi.org/10.1108/JMD-01-2015-0008

Biswal, J. N., Muduli, K., & Satapathy, S. (2017). Critical analysis of drivers and barriers of sustainable supply chain management in Indian thermal sector. *International Journal of Procurement Management*, 10(4), 411–430. https://doi.org/10.1504/IJPM.2017.085033

Blome, C., & Schoenherr, T. (2011). Supply chain risk management in financial crises—A multiple case-study approach. *International Journal of Production Economics*, 134(1), 43–57. https://doi.org/10.1016/j.ijpe.2011.01.002

Carter, C. R., & Easton, P. L. (2011). Sustainable supply chain management: Evolution and future directions. *International Journal of Physical Distribution and Logistics Management*, 41(1), 46–62. https://doi.org/10.1108/09600031111101420

Carter, C. R., & Rogers, D. S. (2008). A framework of sustainable supply chain management: Moving toward new theory. *International Journal of Physical Distribution and Logistics Management*, 38(5), 360–387. https://doi.org/10.1108/09600030810882816

Cetinkaya, B. (2011). Developing a sustainable supply chain strategy. In *Sustainable supply chain management: Practical ideas for moving towards best practice* (pp. 17–55). Springer. https://doi.org/10.1007/978-3-642-12023-7_2

Chen, C. C., Shih, H. S., Shyur, H. J., & Wu, K. S. (2012). A business strategy selection of green supply chain management via an analytic network process. *Computers and Mathematics with Applications*, 64(8), 2544–2557. https://doi.org/10.1016/j.camwa.2012.06.013

Chileshe, N., & Kikwasi, G. J. (2013). Perception of barriers to implementing risk assessment and management practices by construction professionals in Tanzania. *Management*, 1137, 1146.

Chopra, S., & Sodhi, M. M. S. (2004). Managing risk to avoid: Supply-chain breakdown. *MIT Sloan Management Review*, 46(1), 53–61.

Christopher, M., & Lee, H. (2004). Mitigating supply chain risk through improved confidence. *International Journal of Physical Distribution and Logistics Management*, 34(5), 388–396. https://doi.org/10.1108/09600030410545436

Chuang, M. L., & Shaw, W. H. (2000). Distinguishing the critical success factors between e-commerce, enterprise resource planning, and supply chain management. *Proceedings of the 2000 IEEE Engineering Management Society*, EMS 2000, 596–601. https://doi.org/10.1109/EMS.2000.872572

Cruz, J. M. (2013). Mitigating global supply chain risks through corporate social responsibility. *International Journal of Production Research*, 51(13), 3995–4010. https://doi.org/10.1080/00207543.2012.762134

Cui, L., Chan, H. K., Zhou, Y., Dai, J., & Lim, J. J. (2019). Exploring critical factors of green business failure based on Grey-Decision Making Trial and Evaluation Laboratory (DEMATEL). *Journal of Business Research*, 98, 450–461. https://doi.org/10.1016/j.jbusres.2018.03.031

Danai, H., Hashemnia, S., Ahmadi, R., & Bazazzadeh, S. H. (2019). Application of fuzzy ANP method to select the best supplier in the supply chain. *International Journal of Operational Research*, 35(1), 1–19. https://doi.org/10.1504/IJOR.2019.099540

Dawo, H. L. A., Long, T. B., & de Jong, G. (2022). Sustainable entrepreneurship and legitimacy building in protected areas: Overcoming distinctive barriers through activism. *Business Strategy and the Environment*. https://doi.org/10.1002/bse.3118

Elmsalmi, M., Hachicha, W., & Aljuaid, A. M. (2021). Prioritization of the best sustainable supply chain risk management practices using a structural analysis based-approach. *Sustainability*, 13(9), 4608.

Faisal, M. N., Banwet, D. K., & Shankar, R. (2007). Supply chain risk management in SMEs: Analysing the barriers. *International Journal of Management and Enterprise Development*, 4(5), 588–607. https://doi.org/10.1504/IJMED.2007.013460

Fawcett, S. E., Magnan, G. M., & McCarter, M. W. (2008). Benefits, barriers, and bridges to effective supply chain management. *Supply Chain Management*, 13(1), 35–48. https://doi.org/10.1108/13598540810850300

Finch, P. (2004). Supply chain risk management. *Supply Chain Management: An International Journal*, 9(2), 183–196. https://doi.org/10.1108/13598540410527079

Gandhi, S., Mangla, S. K., Kumar, P., & Kumar, D. (2016). A combined approach using AHP and DEMATEL for evaluating success factors in implementation of green supply chain management in Indian manufacturing industries. *International Journal of Logistics Research and Applications*, 19(6), 537–561. https://doi.org/10.1080/13675567.2016.1164126

Garg, C. P., & Sharma, A. (2020). Sustainable outsourcing partner selection and evaluation using an integrated BWM–VIKOR framework. *Environment, Development and Sustainability*, 22(2), 1529–1557. https://doi.org/10.1007/s10668-018-0261-5

Guojun, J., & Caihong, Z. (2008). Study on supply chain disruption risk management strategies and model. *International Conference on Service*

Systems and Service Management. 30 June 2008–02 July 2008, Melbourne, Australia. https://doi.org/10.1109/ICSSSM.2008. 4598472

Hajmohammad, S., & Vachon, S. (2016). Mitigation, avoidance, or acceptance? Managing supplier sustainability risk. *Journal of Supply Chain Management*, *52*(2), 48–65. https://doi.org/10.1111/jscm.12099

Hallowell, M. R., Molenaar, K. R., & Fortunato, B. R. (2013). Enterprise risk management strategies for state departments of transportation. *Journal of Management in Engineering*, *29*(2), 114–121. https://doi.org/10. 1061/(ASCE)ME.1943-5479.0000136

Hasani, T., Bojei, J., & Dehghantanha, A. (2017). Investigating the antecedents to the adoption of SCRM technologies by start-up companies. *Telematics and Informatics*, *34*(5), 655–675. https://doi.org/10.1016/j. tele.2016.12.004

Henriques, I., & Sadorsky, P. (1996). The determinants of an environmentally responsive firm: An empirical approach. *Journal of Environmental Economics and Management*, *30*(3), 381–395. https://doi.org/10.1006/ jeem.1996.0026

Hofmann, H., Busse, C., Bode, C., & Henke, M. (2014). Sustainability-related supply chain risks: Conceptualization and management. *Business Strategy and the Environment*, *23*(3), 160–172. https://doi.org/10. 1002/bse.1778

Hudin, N. S., Hamid, A. B. A., Habidin, N. F., & Mustaffa, W. S. W. (2019). Barrier analysis of supply chain risk management adoption in automotive companies. *International Journal of Academic Research in Accounting, Finance and Management Sciences*, *9*(3), 295–299. https://doi.org/ 10.6007/ijarafms/v9-i3/6521

Hwang, B. G., Zhao, X., & Toh, L. P. (2014). Risk management in small construction projects in Singapore: Status, barriers and impact. *International Journal of Project Management*, *32*(1), 116–124. https://doi.org/ 10.1016/j.ijproman.2013.01.007

Isik, F. (2011). Complexity in supply chains: A new approach to quantitative measurement of the supply-chain-complexity. *Supply Chain Management*, *21*(4), 417–432. https://doi.org/10.5772/15005

Jüttner, U., Peck, H., & Christopher, M. (2003). Supply chain risk management: Outlining an agenda for future research. *International Journal of Logistics Research and Applications*, *6*(4), 197–210. https://doi.org/10. 1080/13675560310001627016

Kallenberg, K. (2009). Operational risk management in Swedish industry: Emergence of a new risk paradigm. *Risk Management*, *11*(2), 90–110. https://doi.org/10.1057/rm.2009.6

Kerstin, D., Simone, O., Nicole, Z., & Lehner, O. M. (2014). Challenges in implementing enterprise risk management. *ACRN Journal of Finance and Risk Perspectives*, *3*(3), 1–14.

Kumar, A., Mangla, S. K., Luthra, S., & Ishizaka, A. (2019). Evaluating the human resource related soft dimensions in green supply chain management implementation. *Production Planning and Control*, *30*(9), 699–715. https://doi.org/10.1080/09537287.2018.1555342

Kumar, D., & Garg, C. P. (2017). Evaluating sustainable supply chain indicators using fuzzy AHP: Case of Indian automotive industry. *Benchmarking*, *24*(6), 1742–1766. https://doi.org/10.1108/BIJ-11-2015-0111

Kumar, P., & Singh, R. K. (2012). A fuzzy AHP and TOPSIS methodology to evaluate 3PL in a supply chain. *Journal of Modelling in Management*, *7*(3), 287–303. https://doi.org/10.1108/ 17465661211283287

Lee, S. Y. (2008). Drivers for the participation of small and medium-sized suppliers in green supply chain initiatives. *Supply Chain Management*, *13*(3), 185–198. https://doi.org/10.1108/13598540810871235

Lin, R. J. (2013). Using fuzzy DEMATEL to evaluate the green supply chain management practices. *Journal of Cleaner Production*, *40*, 32–39. https://doi.org/10.1016/j.jclepro.2011.06.010

Liou, J. J. H., Tamošaitiene, J., Zavadskas, E. K., & Tzeng, G. H. (2016). New hybrid COPRAS-G MADM model for improving and selecting suppliers in green supply chain management. *International Journal of Production Research*, *54*(1), 114–134. https://doi.org/10.1080/00207543.2015. 1010747

Liu, H., Ma, L., & Huang, P. (2015). When organizational complexity helps corporation improve its performance. *Journal of Management Development*, *34*(3), 340–351. https://doi.org/10.1108/JMD-05-2013-0071

Liu, S., Chan, F. T. S., & Ran, W. (2013). Multi-attribute group decision-making with multi-granularity linguistic assessment information: An improved approach based on deviation and TOPSIS. *Applied Mathematical Modelling*, *37*(24), 10129–10140. https://doi.org/10.1016/j. apm.2013.05.051

Malviya, R. K., & Kant, R. (2018). Prioritising the solutions to overcome the barriers of green supply chain management implementation: A hybrid fuzzy AHP- VIKOR framework approach. *Journal of Decision Systems*, *27*(4), 275–320. https://doi.org/10.1080/12460125.2019. 1603597

Mangla, S., Kumar, P., & Barua, M. K. (2014). An evaluation of attribute for improving the green supply chain performance via DEMATEL method. *International Journal of Mechanical Engineering & Robotics Research*, *1*(1), 30–35.

Manuj, I., & Mentzer, J. T. (2008). Global supply chain risk management strategies. *International Journal of Physical Distribution and Logistics Management*, *38*(3), 192–223. https://doi.org/10.1108/ 09600030810866986

Mathivathanan, D., Kannan, D., & Haq, A. N. (2018). Sustainable supply chain management practices in Indian automotive industry: A multi-stakeholder view. *Resources, Conservation and Recycling*, *128*, 284–305. https://doi.org/10.1016/j.resconrec.2017.01.003

Memari, A., Dargi, A., Akbari Jokar, M. R., Ahmad, R., & Abdul Rahim, A. R. (2019). Sustainable supplier selection: A multi-criteria intuitionistic fuzzy TOPSIS method. *Journal of Manufacturing Systems*, *50*, 9–24. https://doi.org/10.1016/j.jmsy.2018.11.002

Mirhedayatian, S. M., Azadi, M., & Farzipoor Saen, R. (2014). A novel network data envelopment analysis model for evaluating green supply chain management. *International Journal of Production Economics*, *147* (PART B), 544–554. https://doi.org/10.1016/j.ijpe.2013.02.009

Mitchell, V. -W. (1995). Organizational risk perception and reduction: A literature review. *British Journal of Management*, *6*(2), 115–133. https:// doi.org/10.1111/j.1467-8551.1995.tb00089.x

Moshesh, R., Kotzé, T., & Niemann, W. (2018). Enterprise risk management implementation challenges: A case study in a petrochemical supply chain. *South African Journal of Industrial Engineering*, *29*(4), 230–244.

Mudgal, R. K., Shankar, R., Talib, P., & Raj, T. (2010). Modelling the barriers of green supply chain practices: An Indian perspective. *International Journal of Logistics Systems and Management*, *7*(1), 81–107. https://doi. org/10.1504/IJLSM.2010.033891

Muduli, K., Govindan, K., Barve, A., & Geng, Y. (2013). Barriers to green supply chain management in Indian mining industries: A graph theoretic approach. *Journal of Cleaner Production*, *47*, 335–344. https://doi. org/10.1016/j.jclepro.2012.10.030

Narasimhan, R., & Talluri, S. (2009). Perspectives on risk management in supply chains. *Journal of Operations Management*, *27*(2), 114–118. https://doi.org/10.1016/j.jom.2009.02.001

Nazam, M., Yao, L., Hashim, M., Baig, S. A., & Khan, M. K. (2020). The application of a multi-attribute group decision making model based on linguistic extended VIKOR for quantifying risks in a supply chain under a fuzzy environment. *International Journal of Information Systems and Supply Chain Management*, *13*(2), 27–46. https://doi.org/10.4018/ IJISSCM.2020040102

Oelze, N. (2017). Sustainable supply chain management implementation-enablers and barriers in the textile industry. *Sustainability (Switzerland)*, *9*(8), 1435. https://doi.org/10.3390/su9081435

Paul, A., Moktadir, M. A., & Paul, S. K. (2020). An innovative decision-making framework for evaluating transportation service providers based on sustainable criteria. *International Journal of Production*

Research, *58*(24), 7334–7352. https://doi.org/10.1080/00207543.2019.1652779

Polat, G. (2016). Subcontractor selection using the integration of the AHP and PROMETHEE methods. *Journal of Civil Engineering and Management*, *22*(8), 1042–1054. https://doi.org/10.3846/13923730.2014.948910

Rahayu, R., & Day, J. (2015). Determinant factors of e-commerce adoption by SMEs in developing country: evidence from Indonesia. *Procedia-social and behavioral sciences*, *195*, 142–150.

Renault, B. Y., Agumba, J. N., & Balogun, O. A. (2016). Drivers for and obstacles to Enterprise risk Management in construction firms: A literature review. *Procedia Engineering*, *164*, 402–408. https://doi.org/10.1016/j.proeng.2016.11.637

Rosman, A. J. (2011). Auditors' going-concern judgments: Rigid, adaptive, or both? *Review of Accounting and Finance*, *10*(1), 30–45. https://doi.org/10.1108/14757701111113802

Rostami, A., Sommerville, J., Wong, I. L., & Lee, C. (2015). Risk management implementation in small and medium enterprises in the UK construction industry. *Engineering Construction and Architectural Management*, *22*(1), 91–107. https://doi.org/10.1108/ECAM-04-2014-0057

Rostamzadeh, R., Ghorabaee, M. K., Govindan, K., Esmaeili, A., & Nobar, H. B. K. (2018). Evaluation of sustainable supply chain risk management using an integrated fuzzy TOPSIS-CRITIC approach. *Journal of Cleaner Production*, *175*, 651–669. https://doi.org/10.1016/j.jclepro.2017.12.071

Schlak, T. M. (2015). Social capital and leadership in academic libraries: The broader exchange around "buy in". *Library Management*, *36*(6–7), 394–407. https://doi.org/10.1108/LM-11-2014-0133

Seuring, S., & Müller, M. (2008). From a literature review to a conceptual framework for sustainable supply chain management. *Journal of Cleaner Production*, *16*(15), 1699–1710. https://doi.org/10.1016/j.jclepro.2008.04.020

Sharma, S. K., & Bhat, A. (2014). Supply chain risk management dimensions in Indian automobile industry: A cluster analysis approach. *Benchmarking*, *21*(6), 1023–1040. https://doi.org/10.1108/BIJ-02-2013-0023

Sharma, V. K., Chandna, P., & Bhardwaj, A. (2017). Green supply chain management related performance indicators in agro industry: A review. *Journal of Cleaner Production*, *141*, 1194–1208. https://doi.org/10.1016/j.jclepro.2016.09.103

Sinha, P. R., Whitman, L. E., & Malzahn, D. (2004). Methodology to mitigate supplier risk in an aerospace supply chain. *Supply Chain Management*, *9*(2), 154–168. https://doi.org/10.1108/13598540410527051

Sirisawat, P., & Kiatcharoenpol, T. (2018). Fuzzy AHP-TOPSIS approaches to prioritizing solutions for reverse logistics barriers. *Computers and Industrial Engineering*, *117*, 303–318. https://doi.org/10.1016/j.cie.2018.01.015

Smith, G. R., & Bohn, C. M. (1999). Small to medium contractor contingency and assumption of risk. *Journal of Construction Engineering and Management*, *125*(2), 101–108. https://doi.org/10.1061/(ASCE)0733-9364(1999)125:2(101)

Sreekumar, V., & Rajmohan, M. (2019). Supply chain strategy decisions for sustainable development using an integrated multi-criteria decision-making approach. *Sustainable Development*, *27*(1), 50–60. https://doi.org/10.1002/sd.1861

Tobescu, C., & Seuring, S. (2015). Internal enablers for the implementation of sustainable supply chain risk management systems. In *Logistics management* (pp. 17–26). Springer. https://doi.org/10.1007/978-3-319-13177-1_2

Tummala, V. M. R., Leung, H. M., Mok, C. K., Burchett, J. F., & Leung, Y. H. (1997). Practices, barriers and benefits of using risk management approaches in selected Hong Kong industries. *International Journal of Project Management*, *15*(5), 297–312. https://doi.org/10.1016/s0263-7863(96)00082-8

ul Amin, F., Qian-Li, D., Grzybowska, K., Ahmed, Z., & Bo-Rui, Y. (2022). A novel fuzzy-based VIKOR–CRITIC soft computing method for evaluation of sustainable supply chain risk management. *Sustainability*, *14*(5), 2827. https://doi.org/10.3390/su14052827

Ülengin, F., Kabak, Ö., Önsel, Ş., Ülengin, B., & Aktaş, E. (2010). A problem-structuring model for analyzing transportation-environment relationships. *European Journal of Operational Research*, *200*(3), 844–859. https://doi.org/10.1016/j.ejor.2009.01.023

Upton, D. M. (1994). The Management of Manufacturing Flexibility. *California Management Review*, *36*(2), 72–89. https://doi.org/10.2307/41165745

Vilko, J., Rumpu, A., & Koivuniemi, J. (2012). An information-exchange perspective on supply-chain risk management: Systemic organisational motives and cognitive barriers. *International Journal of Logistics Systems and Management*, *12*(4), 460–482. https://doi.org/10.1504/IJLSM.2012.048369

Wan Ahmad, W. N. K., Rezaei, J., Sadaghiani, S., & Tavasszy, L. A. (2017). Evaluation of the external forces affecting the sustainability of oil and gas supply chain using best worst method. *Journal of Cleaner Production*, *153*, 242–252. https://doi.org/10.1016/j.jclepro.2017.03.166

Yoon, K. P., & Hwang, C. L. (1995). *Multiple attribute decision making: An introduction*. Sage publications. https://doi.org/10.4135/9781412985161

You, X. Y., You, J. X., Liu, H. C., & Zhen, L. (2015). Group multi-criteria supplier selection using an extended VIKOR method with interval 2-tuple linguistic information. *Expert Systems with Applications*, *42*(4), 1906–1916. https://doi.org/10.1016/j.eswa.2014.10.004

Zarbakhshnia, N., Govindan, K., Kannan, D., & Goh, M. (2022). Outsourcing logistics operations in circular economy towards to sustainable development goals. *Business Strategy and the Environment*. https://doi.org/10.1002/bse.3122

Zeng, Q. L., Li, D. D., & Yang, Y. B. (2013). VIKOR method with enhanced accuracy for multiple criteria decision making in healthcare management. *Journal of Medical Systems*, *37*(2), 1–9. https://doi.org/10.1007/s10916-012-9908-1

Zhang, X., Sun, B., Chen, X., Chu, X., & Yang, J. (2020). An approach to evaluating sustainable supply chain risk management based on BWM and linguistic value soft set theory. *Journal of Intelligent Fuzzy Systems*, *39*(3), 4369–4382. https://doi.org/10.3233/JIFS-200372

Zhao, X., Hwang, B. G., & Low, S. P. (2015). Enterprise risk management in international construction firms: Drivers and hindrances. *Engineering Construction and Architectural Management*, *22*(3), 347–366. https://doi.org/10.1108/ECAM-09-2014-0117

APPENDIX A

TABLE A1 Different MCDM techniques and their applications

Reference	Objectives and contributions	Findings	Context of the study	Methodology
(Wan Ahmad et al., 2017)	Assessing external factors of sustainable oil and gas supply chain	Economic and political stability are the most significant factors	Oil and gas industry	Best worst method
(Kumar & Garg, 2017)	Evaluating indicators of sustainable supply chain	Sustainability is affected more by environmental and social factors	Indian automotive industry	Fuzzy AHP
(Sharma et al., 2017)	Assessing performance measurement of GSCM adoption to implement GSC in agro-industry	The top performance indicator is internal environmental management	Agro-industry	AHP
(Mangla et al., 2014)	Calculating GSCM performance enhancement and helping to improve GSC productivity	Supplier selection and related issues come under cause group and design and operations, green purchasing and green productivity forms affect group	An Indian plastic manufacturing firm	DEMATEL
(Lin, 2013)	Evaluating the GSCM practices and solving the distortion of information of human judgments by converting linguistics preferences to fuzzy numbers	Stakeholders' pressures and regulations are the most important criteria for GSCM practices	Evaluation for firm's GSCM at a case firm	Fuzzy DEMATEL
(Cui et al., 2019)	Selecting factors that are critical in green business failure	Grey set theory can tackle the shortcoming of DEMATEL and A short-term investor mindset directly causes green business failure.	Holistic research in Chinese green business	Grey DEMATEL
(Memari et al., 2019)	Selecting sustainable supplier and proposing multi-criteria intuitionistic fuzzy TOPSIS approach	Cost and energy can be saved by selecting supplier AA	Automotive spare part industry	Fuzzy TOPSIS
(Nazam et al., 2020)	Investigating multiple risks in aviation supply chain (ASC) performance	The most important and typical risk is disruption risk	Aviation sector of Pakistan	Fuzzy VIKOR
(Chen et al., 2012)	Helping business functions through green supply chain management (GSCM) strategies	Derived four business functions from product lifecycle management and associates their related activities with "greenness"	Taiwanese electronics company	ANP
(Danai et al., 2019)	Providing a useful approach to fuzzy ANP for evaluation of issues related to supplier selection	The importance of objectives in the selection of supplier is not equal and the relative weight can be obtained by the ANP method	Automation industry of Iran	Fuzzy ANP
(Mirhedayatian et al., 2014)	Evaluating the GSCM practices	Evaluated different GSCM practices using novel network data development model considering fuzzy data, dual-role factors, and undesirable outputs.	Iranian companies producing soft drinks	Novel data envelopment analysis
(Liou et al., 2016)	Selecting the suppliers in the GSC context	Used complex proportional assessment under grey relation to evaluating best supplier in the global context. This approach can remove the problem of difference of opinion of the decision-makers and data of an electronic company from Taiwan was used in this regard.	Taiwanese electronics company	Hybrid COPRAS-G
(Awasthi et al., 2018)	Selecting a global sustainable supplier	Identified different criteria using expert opinion and scholarly article and then computed the weights	Electronic goods manufacturing company	Fuzzy VIKOR + Fuzzy AHP

(Continues)

TABLE A1   (Continued)

Reference	Objectives and contributions	Findings	Context of the study	Methodology
		using AHP. Then using those weights best supplier was selected using the VIKOR method. Thus, integrated VIKOR and AHP were applied for selecting the best supplier in a global and sustainable context.		
(Polat, 2016)	Selecting sub-contractor	Integrated AHP and PROMETHEE for finding the best subcontractor for a company where AHP was applied to find the weights of the criterion and PROMETHE was applied not only for final weights but also for sensitivity analysis.	International construction project.	AHP + PROMRTHEE
(Malviya & Kant, 2018)	Prioritizing the solutions to eradicate the barriers of GSCM	Developed a framework of AHP and VIKOR in the fuzzy environment which evaluates 29 barriers using AHP and eventually used VIKOR for finding the best solution for the implementation of GSCM.	Indian automobile organizations	AHP + VIKOR
(Sreekumar & Rajmohan, 2019)	Evaluating the supply chain strategy for sustainable development	Introduced an innovative approach for selection sustainable strategy selection which is both flexible and structured and AHP, SOWIA, and TOPSIS method was used for this development.	Indian manufacturing industry	AHP + SOWIA + TOPSIS
(Kumar et al., 2019)	Assessing the human resource-related soft dimensions in GSCM	Since prion studies had limited research on the relationship between human-related soft dimensions and the implementation, this study used a hybrid BWM-DEMATEL approach for finding this relationship. BWM was applied for evaluating the weights of dimensions and used DEMATEL for constructing the interrelationship.	Automotive company in India	BWM + DEMATEL
(Sirisawat & Kiatcharoenpol, 2018)	Prioritizing the solutions for barriers of reverse logistic	Applied fuzzy AHP and fuzzy TOPSIS to evaluate the best solution of reverse logistic practices.	Thailand's electronics industry	Fuzzy AHP + Fuzzy TOPSIS
(Garg & Sharma, 2020)	Selecting a sustainable outsourcing partner	The best outsourcing partner was selected for sustainability where BWM was applied for evaluating the selection criteria and VIKOR for partner selection. Not only this hybrid approach was applied but also the robustness of the methodology was demonstrated using sensitivity analysis.	Electronics company of India	BWM + VIKOR
(Bai & Sarkis, 2019)	Selecting a sustainable 3PL logistics provider	TOPSIS and VIKOR were integrated with neighborhood rough set (NRS) for the first time for selection of the top 3PRLP.	Brazil	TOPSIS + VIKOR
(Gandhi et al., 2016)	Evaluating the factor for implementing GSCM	24 success factors were identified and prioritized using the AHP method. Furthermore, relationships between these SFs were also built using DEMATEL.	Indian manufacturing industry	AHP + DEMATEL

APPENDIX B

B.1 | Steps for TOPSIS method

Step 1: A matrix $(x_{ij})_{m \times n}$ is developed based on the experts' opinion where m and n is the number of alternatives and criteria respectively.

Step 2: The matrix $(x_{ij})_{m \times n}$ is then normalized $R = (r_{ij})_{m \times n}$ applying the following equation

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{k=1}^{m} x^2_{kj}}}, i = 1,2,...,m, j = 1,2,...,n \tag{1}$$

Step 3: The weighted normalized decision matrix is computed

$$t_{ij} = r_{ij} * w_j, \ i = 1,2,...,m, j = 1,2,...,n \tag{2}$$

where $w_j = {}^{w_j} / {}_{\sum_{k=1}^{n} w_k}$ so that $\sum_{i=1}^{n} w_i = 1$ and W_j is the original weight given to the indicator $v_j, j = 1,2,..,n$.

Step 4: The worst alternative (A_w) and the best alternative (A_b) are determined:

$$A_w = \left\{ (\max(t_{ij}|i = 1,2,...,m)|j \in J_-), (\min(t_{ij}|i = 1,2,...,m)|j \in J_+) \right\}$$
$$\equiv \{ t_{wj} \,|\, j = 1,2,...,n \} \tag{3}$$

$$A_b = \left\{ (\min(t_{ij}|i = 1,2,...,m)|j \in J_-), (\max(t_{ij}|i = 1,2,...,m)|j \in J_+) \right\}$$
$$\equiv \{ t_{wj} \,|\, j = 1,2,...,n \} \tag{4}$$

where

$J_+ = \{j = 1,2,...,n \,|\, j\}$ associated with the criteria having a negative impact

$J_- = \{j = 1,2,...,n \,|\, j\}$ associated with the criteria having a positive impact

Step 5: The L^2-distance between the target alternative and the worst condition, A_w, and the distance between the alternative i and the best condition A_b is calculated.

$$d_{iw} = \sqrt[i]{\sum_{j=1}^{n} (t_{ij} - t_{wj})^2}, i = 1,2,...,m \tag{5}$$

$$d_{ib} = \sqrt{\sum_{j=1}^{n} (t_{ij} - t_{bj})^2}, i = 1,2,...,m \tag{6}$$

where d_{iw} and d_{ib} are L^2-norm distances from the target alternative to the worst and best conditions, respectively.

Step 6: The similarity to the worst condition is calculated:

$$s_{iw} = {}^{d_{iw}} / {}_{(d_{iw} + d_{ib})}, 0 \le s_{iw} \le 1 \tag{7}$$

$s_{iw} = 1$ or 0 if and only if the alternative solution has the best condition or worst condition respectively

Step 7: The barriers are ranked based on s_{iw}

B.2 | Steps for VIKOR method

Step 1: A linguistic scale which is provided in Table B1 is used to develop a pairwise matrix by each expert for each strategy.

Step 2: Equation (8) is used to average decision matrix.

$$F = \frac{1}{k} \sum_{k=1}^{k} F_k \tag{8}$$

Here F is equal to average matrix for alternative, k, expresses the number of experts, and the rating value of k is expressed by F_k.

Step 3: The values of f_p^* and f_p^- of all recorded ratings of criteria are found, $p = 1, 2, ..., n$.

$$f_p^* = \max\{f_{ap}\} \tag{9}$$

$$f_p^- = \min\{f_{ap}\} \tag{10}$$

Here, f_p^* and f_p^- denote the positive and negative value for the pth criterion respectively.

Step 4: The values of Sa and Ra $(a = 1,2,...,m)$ are calculated by solving the equations shown below:

$$S_a = \sum_{p=1}^{n} W_p \left[\frac{f_p^* - f_{ap}}{f_p^* - f_p^-} \right] \tag{11}$$

$$R_a = \overset{max}{\underset{p}{}} \left[W_p \left(\frac{f_p^* - f_{ap}}{f_p^* - f_p^-} \right) \right] \tag{12}$$

Here, S_a, R_a and W_p denote the distance of ath alternative to the positive ideal solution, the distance of ath alternative to the negative ideal solution, and the weights of barriers which are calculated from TOPSIS respectively.

TABLE B1 Linguistic scale that is used in the VIKOR method

Linguistic scale	Favorable index
1	Totally unfavorable
3	Low unfavorable
5	Medium favorable
7	High favorable
9	Extremely high favorable

Step 5: The values of Q_a $(a = 1, 2, \ldots, m)$ is calculated using the following equation:

$$Q_a = v \frac{S_a - S^*}{S^- - S^*} + (1 - v) \frac{R_a - R^*}{R^- - R^*} \qquad (13)$$

$S^- = \max_a S_a$, $R^- = \max_a R_a$, $S^* = \min_a S_a$, $R^* = \min_a R_a$. The weight of the maximum group utility is considered by v. We have considered the value 0.5 here.

Step 6: For ranking the alternative strategies to remove barriers, the value of Q_a is used.

Step 7: Alternatives of strategies are ranked using the lowest estimation of Q_a values if two conditions stated below are satisfied,

(1) The alternative $Q(A^{(1)})$ is chosen if $Q(A^{(2)}) - Q(A^{(1)}) \geq 1/n - 1$ where $A^{(2)}$ is the second position in the analysis and n is the total number of alternatives.

(2) The alternative $Q(A^{(1)})$ has the highest rank based on S_a and R_a values.

Step 8: The best trade-off alternative is selected first by picking the value of Q_a which is satisfied by the conditions mentioned above.

APPENDIX C

Questionnaires for selecting and ranking barriers

Q.1 Which type of company/department are you working at?

Q.2 What is your designation and experience/role in your company/university?

If the Barriers to Sustainable Supply Chain Risk Management in an Emerging Economy are suitable, please write Yes. If the Barrier is not relevant, please write No. Further, please mention your recommendation about any additional barriers if necessary (Table C1).

Q.3 Please put numbers from the linguistic scale as presented in Table C2 to Tables C3 and C4,

TABLE C1 Barriers to sustainable supply chain risk management

Barrier category	Barriers to adoting SSCRM	Yes/no
Managerial and organizational barriers	Unwillingness to share risks	
	Lack of trust among supply chain members	
	Arm's-length or adversarial relationships	
	Lack of strategic risk planning	
	Inadequate ERM training	
	Lack of ERM understanding	
	Complex structure of supply chain	
	Organizational complexity	
	Rigid ERM framework	
	Lack of management buy-in for ERM	
	Non-effective change management	
	Goal misalignment	
	Managers cannot agree on quantification of uncertainty/subjective probability assessment	
	Lack of top managers/supervisors' support	
Information-related barrier	Lack of coordination and collaboration	
	Lack of loss assessment metrics due to risk for the supply chain	
	Lack of information technology support for ERM	
	Difficulty in understanding and interpreting outcomes of the risk management process	
	Difficulty in obtaining input estimates to assess risk probabilities	
Financial barriers	Lack of budget for risk management	
	High cost of risk management process techniques	
	Expensive resources of ERM	
	Low-profit margin of sustainable activities	
Socio-cultural barriers	Lack of corporate social responsibility practices	
	Insufficient application of government legislation	
	Insufficient societal pressure	

TABLE C2   Linguistic scale

Linguistic scale	Importance index
1	Not important
3	Low
5	Medium
7	High
9	Extremely high

TABLE C3   Barrier category

Barrier category	Point
Managerial and organizational barriers	
Information-related barrier	
Financial barriers	
Socio-cultural barriers	

TABLE C4   Barriers to adopting SSCRM

Name of the barrier	Point
Unwillingness to share risks	
Lack of trust among supply chain member	
Arm's-length or adversarial relationships	
Lack of strategic risk planning	
Inadequate ERM training	
Lack of ERM understanding	
Complex structure of supply chain	
Organizational complexity	
Rigid ERM framework	
Lack of management buy-in for ERM	
Non-effective change management	
Goal misalignment	
Managers cannot agree on quantification of uncertainty/ subjective probability assessment	
Lack of top managers/supervisors' support	
Lack of coordination and collaboration	
Lack of loss assessment metrics due to risk for the supply chain	
Lack of information technology support for ERM	
Difficulty in understanding and interpreting outcomes of the risk management process	
Difficulty in obtaining input estimates to assess risk probabilities	
Lack of budget for risk management	
High cost of risk management process techniques	
Expensive resources of ERM	
Low-profit margin of sustainable activities	
Lack of corporate social responsibility practices	
Insufficient application of government legislation	
Insufficient societal pressure	
Your suggested barrier (Optional)	

TABLE C5   Expert profile

Industry sector	Positions (number of experts)	Total number of experts
Electrical and electronics	Chief Operating Executive (1) Supply Chain Manager (2) Supply Planner (1)	4
Apparel	Production Department Executive (2) Supply Chain Manager (2)	4
Hygiene, health and nutation products	Production Department Executive (1) Supply Chain Manager (2) Supply Planner (1)	4
Thread	Supply Chain Manager (2) Supply Planner (1)	3
Food	Supply Chain Manager (2)	2

APPENDIX D

Questionnaires for selecting and ranking strategies

If the strategies to overcome barriers to adopting Sustainable Supply Chain Risk Management in the context of an Emerging Economy are suitable, please write Yes. If the strategy is not relevant, please write No. Further, please mention your recommendation about any additional strategies if necessary (Table D1).

Please write the value in Table D3 of how favorable a strategy is to overcome the barrier using the scale shown in Table D2.

TABLE D1   List of strategies

No.	Name of the strategy	Yes/no
S1	Top management commitment	
S2	Increasing the visibility of the information	
S3	Active and passive support from executives	
S4	Being proactive towards risks	
S5	Flexibility in supply chain	
S6	Provide adequate training to the staffs	
S7	Sharing risk with partners	
S8	Developing performance metrics for supply chain	
S9	Specifying sustainability goals in the supply chain strategy	
S10	Providing incentives and motivating people	
S11	Engage in corporate social responsibility (CSR) activities	
S12	Considering SSCRM as an industrial requirement as well as customer need	
S13	Assuring governmental support	

TABLE D2   Linguistic scale

Linguistic scale	Favorable index
1	Totally unfavorable
3	Low unfavorable
5	Medium favorable
7	High favorable
9	Extremely high favorable

TABLE D3   Barriers versus overcoming strategies

Strategies	Barriers																										
	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13	B14	B15	B16	B17	B18	B19	B20	B21	B22	B23	B24	B25	B26	B27
S1																											
S2																											
S3																											
S4																											
S5																											
S6																											
S7																											
S8																											
S9																											
S10																											
S11																											
S12																											
S13																											