



Social Sustainability Challenges Towards Flexible Supply Chain Management: Post-COVID-19 Perspective

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Abstract The COVID-19 pandemic has severely impacted the global social sustainability of the supply chains, pushing them towards a more flexible management approach. However, there is a paucity of literature that focuses on social sustainability issues for emerging economies. In the post-COVID-19 period, firms around the world will face several critical challenges to social sustainability, which will hinder achieving sustainable development goals (SDGs). Against this backdrop, this study identifies the pressing challenges to social sustainability in the post-COVID-19 context by a literature review and opinions from an expert panel, focusing on the footwear supply chain. In this paper, the best–worst method is applied to compute the criticality of social sustainability challenges towards the flexibility of the supply chains. The study findings reveal that among the nine identified critical challenges, “high level of lay off”, “health protocol development”, “complexity in ensuring workplace safety”, “facing trouble in mental health”, and “lack of government enforcement and regulations for social issues” are reported as the top five challenges, respectively. Furthermore, this study suggests several flexible managerial

guidelines, which will help practitioners and policymakers to achieve SDGs considering the COVID-19 pandemic.

Keywords Best–worst method · COVID-19 · Flexibility · Footwear supply chain · Social sustainability · Sustainable development goals

Introduction

In this twenty-first century, the most disastrous pandemic is COVID-19, which outburst in Wuhan, China, in December 2019 and has since spread to over 220 countries worldwide (Worldometer, 2021). According to a Worldometer study, there have been over 199 million confirmed cases of COVID-19, including about 4.24 million deaths, till 2nd August 2021. This life-threatening viral disease has not only changed our daily life activities but also altered the flexible business environment for many organizations around the globe (Chowdhury et al., 2021; D’Adamo & Lupi, 2021; Govindan et al., 2020; Shahed et al., 2021). According to Fortune, the COVID-19 has affected the supply chains (SCs) of 94% of Fortune 1000 organizations (Fortune, 2020). Due to the COVID-19 pandemic, the impact on global business resulted in a drop of 5.3% in 2020 (WTO, 2021). This pandemic hits the global poverty line severely resulting in 420–580 million people in poverty line (Sumner et al., 2020). Meanwhile, the International Labor Organization (ILO) estimates that 436 million businesses are at high risk of significant disruption and the COVID-19 crisis could result in the loss of up to 305 million full-time employment (ILO, 2020). This pandemic is exacerbating the world’s livelihood and employee’s well-being and thus, it has been emerged as a global threat towards achieving the United Nation’s Sustainable

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Development Goals (SDGs), more importantly, SDG-3 that focuses on “ensure healthy lives and promote wellbeing for all at all ages” (Zhou et al., 2020). More adversely, this pandemic can lead to several critical challenges in flexible supply chain management (FSCM), such as increased lay off (Bauer & Weber, 2020; ILO, 2020), delay and reduction in wages (Lipschutz, 2004), social security (Majumdar et al., 2020), poverty (He & Harris, 2020), mental health (Filho et al., 2020; Zhang & Ma, 2020), and potential health risks at workplaces (Kumar et al., 2020). Hence, these challenges need to be addressed in the way of achieving social sustainability (SS). While many businesses have restarted their activities with appropriate safeguards, those have not yet done so, should analyse their SCs now and investigate where they may need to take necessary flexible strategies to ensure employees’ social security in the post-COVID-19 situations. In such a challenging time, ensuring SS has become a wake-up call that deserves more attention from researchers and practitioners.

The increasing tension of the social security of employees urges SS at the focal point of the FSCM debate (New, 2015). While many researchers explored the concept of sustainability in supply chain management (SCM) from economic and environmental perspectives in the light of the COVID-19 pandemic, the social philosophy remained beneath the surface (Abid et al., 2020; Dubey et al., 2015). Ensuring SS increases the operational performance of an organization, which also favours organizational economic growth (Schönborn et al., 2019). Now, many companies around the world have begun to move on a recovery mode and started planning to address the social security of employees in the post-COVID period. Meanwhile, flexibility in decision making process has gained an important strategic approach in SCM to make a firm’s SCs more robust and resilient (Akhtar & Sushil, 2018; Settembre-Blundo et al., 2021). Therefore, SCM has come out as a noteworthy area to explore the critical challenges to SS towards FSCM in the post-COVID-19 period.

Because of the rapid growth and economic contribution of Bangladesh’s footwear industry, it has been designated as an emerging market. Bangladesh has been identified as a favourable outsourcing country for footwear than its competitors due to the availability of raw materials and low labour wages (Moktadir et al., 2018a). Currently, Bangladesh exports leather and non-leather footwear to many countries such as China, Italy, the USA, the UK, Germany, Sweden, Taiwan, and Japan. Many world-leading buyers, namely Timberland, Puma, Decathlon, H & M, and Hugo Boss, are sourcing footwear from Bangladesh. In the last fiscal year 2019–20, though the footwear industry was the third export earning sector in Bangladesh, it registered a drop of 21.24% in export volume than that of the previous year, generating 478.75 million US dollars (World

footwear, 2020a). Experts claimed that this export drop was largely happened due to the COVID-19 pandemic and non-compliance issues in this sector (Islam et al., 2020). Social compliance issues such as non-standard wages, long working hours, poor working conditions, child labour, workplace safety, and gender inequality are common phenomena in the Bangladeshi footwear industry (Munni et al., 2019). These non-compliance issues are getting worsen by the COVID-19 pandemic. Since, nowadays, global footwear brands are more concerned about SS in their SCs, there is no alternative way for Bangladesh, but SS can be an essential factor for this industry’s growth. Besides, during this pandemic, many footwear factories in this country face challenges to adopting social compliance issues that should be addressed. Therefore, the footwear supply chain (FSC) has been identified as an emerging area by the authors to explore the SS challenges in the post-COVID period, guiding the practitioners to prepare themselves to restore social compliance issues towards FSCM and to achieve several SDGs. Also, flexible systems management may help achieve sustainability of the SCs of manufacturing organizations including the footwear industry (Shukla et al., 2019; Sushil, 2015, 2018).

Most of the previous SC literature focused on environmental and economic sustainability from the COVID-19 perspective (Amankwah-Amoah, 2020; Appoloni et al., 2021; D’Adamo et al., 2020; Ozili & Arun, 2020; Somani et al., 2020; Yu & Aviso, 2020; Zambrano-Monserrate et al., 2020). Gerbeti (2021) discussed several flexible proposals for controlling industrial emissions in the way of achieving environmental sustainability. Ikram (2021) developed a sustainable energy development grey model for predicting renewable and non-renewable energy production and consumption. Settembre-Blundo et al. (2021) developed a risk management tool focusing on business sustainability, which can measure the progress of achieving SDGs. Until now, very few studies narrowly focused on SS. Among these studies, Kumar et al. (2020) suggested improving the present situation in the post-pandemic production system with proper concentrations on social distancing at work, employees’ welfare, mental wellness, and health screening procedures, workforce compensation, and benefits, and the implementation of new human resource policies by any manufacturing organizations. Majumdar et al. (2020) investigated the reasons behind the absence of SS in their study from the perspective of the clothing SC in Bangladesh. They found that the power dominance of clothing brands, unauthorized subcontracting of clothing manufacturing, and the use of contract labour are the main reasons for breaching the ‘code of conduct’ of social compliance. Sharma et al. (2020) mentioned in their study that an organization should not only focus on their employees’ health and well-being but also focus on the

organization's suppliers' health and well-being to control the COVID-19 impacts on SC. A study conducted by Bauer and Weber (2020) investigated that the rate of lay off has increased during the COVID-19 pandemic. They found that 60% of employees in Germany got into unemployment due to the shutdown measures in April 2020. Popkova et al. (2021) emphasized the role of corporate social responsibility (CSR) to tackle the economic crisis, emanated from the COVID-19 pandemic. In another study conducted by He and Harris (2020), argued that this pandemic has brought out an excellent opportunity to combat emergency global social and environmental challenges by businessmen, adopting genuine and authentic CSR. Meanwhile, Elias (2021) investigated the successful flexible strategies to combat the 1st wave of COVID-19 in Kerala, India. Paul and Chowdhury (2020) proposed some strategies to deal with SC disruption considering a case of a high-demand item, i.e. toilet paper in the context of COVID-19. Pérez Vergara et al. (2021) conducted a study on multi-product business inventory strategies to ensure adequate service levels for biosafety products in the context of COVID-19.

The pervasive literature review shows that very few studies were conducted that dealt with SS in SCM. However, we did not find any study that focused on the critical challenges to SS for the post-COVID-19 context. Most importantly, previous literature did not explore the SS challenges towards FSCM in the context of an emerging economy (i.e. Bangladeshi footwear industry) from the perspective of the post-COVID-19 pandemic. Therefore, we consider the FSC to investigate the critical challenges to SS in the post-COVID-19 context. In such an awful situation emanated by COVID-19, like many other industries, the footwear industry also faces a series of common questions to ask, which are taken as research questions in our study as follows:

1. What are the critical challenges of SS in the post-COVID-19?
2. How to assess the importance of SS challenges towards FSCM?
3. How does a firm can cope with SS challenges in the post-COVID-19 period?

Given the backdrop of these questions, the objectives of this study are set as follows:

- (a) To unveil the critical challenges to SS towards FSCM in the post-COVID-19 pandemic.
- (b) To prioritize the critical challenges to SS using the best–worst method (BWM).
- (c) To propose some flexible managerial guidelines needed in the post-COVID-19 era for ameliorating current SS conditions and achieving several SDGs.

Several multi-criteria decision-making (MCDM) tools have gained popularity among researchers in the SCM field whereby the degree of importance of several factors is identified in a decision-making process (Kumar et al., 2019). Practitioners use MCDM tools in developing a strategic plan to find the most important factors among the many factors. Among the various MCDM tools, the BWM is a powerful multi-criteria decision support tool that was developed by professor Rezaei in 2015 (Rezaei, 2015). This method is receiving special attention to academicians and researchers over other MCDM methods because (1) it is a unique, effective, and simple method for analysing decision-making problems within a concise time, (2) it needs less pair-wise comparison matrices than others established decision support tools, and (3) it can give consistent and reliable results with a simple calculation. Identification of SS challenges towards the FSCM system is a multi-criteria problem where experts might face ambiguity to select the best criterion. The BWM has overcome this problem along with the above-mentioned advantages (Faizi et al., 2021). Therefore, this study proposes a novel application of the BWM to identify the critical challenges to SS towards FSCM in the post-COVID-19 world.

This study has threefold contributions: First, this study identifies the critical challenges to SS in the FSC towards FSCM due to SC disruptions emanated from the COVID-19 pandemic. Secondly, the research focuses on utilizing the BWM as a decision support tool to assess the importance of each critical challenge. Thirdly, this study offers possible ways to alleviate these vital challenges on the way to achieving several SDGs.

The rest of the paper is arranged as follows: second section includes literature review, research methodology is discussed in third section, fourth section introduces a real-life case application of the proposed methodology, fifth section presents results and discussion, and sixth section summarizes the implications of the study. Finally, the conclusions and recommendations for future research are presented in seventh section.

Literature Review

This section discusses the impact of COVID-19 on supply chain management, social sustainability and the previous contributions, challenges to social sustainability in the post-COVID-19 context, application of MCDM tools in supply chain management, and research gaps and highlights, respectively.



Impact of COVID-19 on Supply Chain Management

The contemporary world has been facing severe challenges by the unprecedented disease, the COVID-19 (Lin et al., 2020), which has disrupted the global SCs and affected our social lives (Karmaker et al., 2021; Queiroz et al., 2020). The business world has been facing various types of SC disruptions from several disasters, but now, the effect of the COVID-19 outbreak on the global SCs has become so difficult to measure (Chowdhury et al., 2020). According to the World Economic Forum (2020), domestic and international trade transactions registered a week-on-week drop of 56% since mid-February of 2020. The US, the UK, and other European countries underwent a similar trend in trade transactions with an initial drop of 26% at the beginning of April, which ended up with a 17% drop in late April 2020. Meanwhile, according to the Bangladesh Garment Manufacturers and Exporters Association (BGMEA), Ready Made Garments (RMG), the first export earning sector in Bangladesh lost orders of about 1.5 billion USD by many international buyers (Lightcastle, 2020). Since the global economy has contracted due to the effect of COVID-19 pandemic, these effects are expected to be felt more strongly in major G20 economies, which are major importers of Bangladesh. According to a report published by World Footwear (2020b), there was a predicted drop in global footwear consumption of 22.5% in 2020 due to the COVID-19 effect. As a result of the COVID-19 impact, the FSC has been not only facing an economic downturn but also facing several social sustainability issues.

The global SC perspective is not constrained by geography; it spreads beyond the geographic borders of a country. Therefore, if one country is affected, it disrupts the total SC functions among the total SC members. Researchers have introduced several strategies regarding the SC resilience model to tackle any SC disruption in the last two decades. However, the existing SC model experienced more vulnerabilities, and about 35% of the manufacturers from the National Association of Manufacturers (NAM) claimed that their SCs network has been disrupted by the COVID-19 pandemic (Kumar et al., 2020). Sadly, the COVID-19 outbreak has clarified beyond a question that traditional SC strategies, such as robustness, surplus inventory, redundant capacity, agility, and flexibility, are not able to tackle such kind of SC disruption (Heckmann et al., 2015; Ho et al., 2015). It is eminent that the COVID-19 pandemic has displayed us the severe social, political, financial, and environmental consequences in SCM (Kumar et al., 2020).

Social Sustainability and the Previous Contributions

“Sustainability is the way of meeting today’s needs without compromising the future generations’ needs” (Keeble, 1988). Sustainability has three dimensions, namely economic, environmental, and social. SS is defined as an “ethical code of conduct for human survival and outgrowth that needs to be accomplished in a mutually inclusive and prudent way” (Sharma & Ruud, 2003). Other researchers defined SS as the management of product and process attributes that ensure human safety, welfare, and community development (Klassen & Vereecke, 2012; Wood, 1991). Sarkis et al. (2010) defined SS as the management of social resources that are connected with social values, social personal relationships, organizations, and people’s skills and abilities. SS encompasses employees’ wellbeing, fair treatment (Abid et al., 2020), philanthropy (Mani et al., 2018), cultural diversity (Meuleman, 2013), social equity (Bansal, 2005), and formal education (Sarkis et al., 2010). Meanwhile, Labuschagne and Brent (2005) classified the dimensions of SS into four areas, namely internal human capital, external population, stakeholder engagement, and macro social performance problems.

A study conducted by Filho et al. (2020) discussed how the COVID-19 pandemic jeopardizes achieving SDGs. They mentioned this pandemic has increased the global socio-economic pressures that are escalating poverty and worsening social wellbeing around the world and consequently, making it more challenging to achieve sustainability. Majumdar et al. (2020) investigated the reasons for lacking SS practices in the clothing industry and suggested appropriate ways to achieving sustainability in the context of COVID-19. They proposed a new sourcing model where disruption risk-sharing contracts between suppliers and buyers were mandated, and community development initiatives were prioritized. They suggested buyers should outsource their goods from those suppliers who consider the social safety benefits for employees and who have no contract labour. Basch et al. (2020) pointed out that mass media should promote news regarding enhance health safety rather than telecasting more negative news that creates negative emotions among humans, to achieve health sustainability. Petrudi et al. (2021) identified six SS innovation criteria in their study in the context of the COVID-19 pandemic where they found “safety and health practices”, “remote working conditions”, and “localization” are the most essential SS innovation criteria. A study performed by Sarkis et al. (2020) primarily focused on environmental sustainability dimensions and covered some major social issues from the COVID-19 perspective. Abid et al. (2020) investigated the impact of fairness perception on employee’s wellbeing. The study found that fairness perception positively correlates with employee’s

wellbeing, civility, and thriving at work towards achieving SS. Paying attention to the COVID-19 pandemic, Queiroz et al. (2020) proposed a framework for SC and operations management, which comprises six perspectives, i.e. “adaptation”, “digitalization”, “preparedness”, “recovery”, “ripple effect”, and “sustainability”. A literature review conducted by Govindan, et al. (2021) recorded forty barriers of SS under seven categories and pointed out thirty-nine drivers of SS under six categories in achieving SS. Mani et al. (2020) pointed out that investment and a firm’s size have a positive impact on practising SS. D’Eusanio et al. (2019) developed an SS assessment toolbox for decision-makers whereby they can measure a company’s progress towards SS. Mani et al. (2016) investigated six dimensions of supply chain social sustainability from the perspective of a developing country, namely ethics, philanthropy, health and welfare, human rights, safety, and equity, respectively. In another study conducted by Mani et al. (2018), found five dimensions of SS under eighteen validated social measures to design socially sustainable SC from the perspective of an emerging economy. The listed dimensions were “health and safety”, “societal responsibility”, “human rights”, “diversity”, and “product responsibility”. They also mentioned that collaborative efforts among SC members can minimize disruption risks and can amplify the performance and reputation of an emerging economy. Considering the Bangladeshi footwear industry as a case study, Moktadir et al. (2018b) identified twenty drivers of CSR under four perspectives where the financial driver was ranked as the first position. In addition, Munny et al. (2019) found nineteen enablers of SS whereas “workplace health and safety practices”, “wages and benefits”, and “customer requirements” were listed as the most critical SS enablers in the context of the FSC.

Challenges to Social Sustainability in the Post-COVID-19 Context

The post-COVID situation will be more challenging to industry managers to recover their disrupted SC and to meet the SDGs by 2030, which main philosophy is to “leave no one behind”. The post-COVID-19 period will compel all firms to practice the social issues of sustainability in their SCM to achieve sustainability. Therefore, manufacturing firms should take a rounded approach to tackle all the social problems emanated from the COVID-19 pandemic like increased lay off, health protocol development, workplace safety, and socio-cultural patterns. The United Nations (UN) has already urged all stakeholders to build a more inclusive society and sustainable economies and introduced a new strategic plan to lessen the socio-economic downgrading conditions by the COVID-19

pandemic. Sarkis et al. (2020) mentioned in their study that the new-normal world will require new public policy, financial investment, complex thinking, new behaviour, and thoughtful action to restore the world to a livable place again. A whole-hearted effort by the government, practitioners, employees and all other stakeholders can jointly make a company’s SC more sustainable to protect any future disruption like COVID-19.

Application of MCDM Tools in Supply Chain Management

SC managers often face problems in the decision-making process where they need to make a priority among multiple decision criteria, which is known as a multi-criteria decision problem. Many researchers developed several MCDM tools to solve this problem in a decision-making process, namely analytical hierarchy process (AHP) (Saaty, 1987), measuring attractiveness by a categorical-based evaluation technique (MACBETH) (Costa & Vansnick, 1997), interpretive structural modeling (ISM) (Hwang & Yoon, 1981), simple multi-attribute rating technique (SMART) (Edwards, 1977), weighted sum method (WSM) (Zadeh, 1963), conjoint analysis (CA) (Green & Rao, 1971), multi-objective optimization ratio analysis (MOORA) (Brauers & Zavadskas, 2006), discrete choice experiments (DCE) (Louviere & Woodworth, 1982, 1983), analytical network process (ANP) (Saaty, 1996), technique for order preference by similarity to ideal solution (TOPSIS) (Hwang & Yoon, 1981), level-based weight assessment (LBWA) (Žižović & Pamučar, 2019), full consistency method (FUCOM) (Pamučar et al., 2018), etc. We have found several applications of MCDM tools in the SCM field in the previous literature. For example, Kumar et al. (2019) applied intuitionistic fuzzy-based TOPSIS method to measure and compare the innovative performance of manufacturing firms in India. Sushil (2017) used the interpretive ranking process along with total interpretive structural modeling (TISM) to evaluate the flexibility initiatives of an organization. Ali et al. (2021) evaluated the efficacy of complex interval-valued Pythagorean fuzzy set (CIVPFS) in their study and they found this method provides consistent and reliable results. Biswas (2020) evaluated the performance of Indian health care SC where pivot pairwise relative criteria importance assessment (PIPRECIA) method was used to find the criteria weights and then multi-attributive border approximation area comparison (MABAC), combined compromise solution (CoCoSo), and measurement of alternatives and ranking according to compromise solution (MARCOS), were used to find the rank of alternatives. Ahmed et al. (2021) applied Pareto analysis and rough-decision making trial and evaluation laboratory (rough-DEMATEL) method to identify the



challenges in the education sector of Bangladesh due to COVID-19 and proposed 19 flexible strategies to combat these challenges. Sarker et al. (2021) developed a sustainability performance assessment model for the leather industry integrating several MCDM tools, i.e. fuzzy AHP, simple additive weighting (SAW), TOPSIS, and fuzzy multi-criteria optimization and compromise solution (VIKOR).

Research Gaps and Highlights

Nowadays, SS has gained significant momentum in the SC of the manufacturing industries because of stakeholders' consciousness regarding factory working conditions (McCarthy et al., 2010) and human resource policy. Implementation of the social responsibilities of a company largely influences its SC activities, operational performance, supplier performance, and customers' satisfaction that drive the financial success of a company (Mani et al., 2020). Though SS has become an inevitable stepping-stone for a company's success, it has not gained so much attention like environmental and economic sustainability in the previous literature (D'Adamo et al., 2019; D'Eusano et al., 2019; Gupta & Gupta, 2021; Kala et al., 2020; Somani et al., 2020). Most importantly, no study found the critical challenges to SS in the post-COVID-19 context. Moreover, we found several conceptual frameworks of SS where authors did not identify the degree of importance of the critical challenges. Also, we found very few studies that explored the SS challenges through the viewpoint of an emerging economy. To fill these research gaps, this study not only finds the critical challenges of SS but also investigates their degree of importance using the BWM in the context of the post-COVID-19 pandemic from an emerging economy perspective, i.e. the Bangladeshi footwear industry. Also, this study formulates several managerial guidelines to combat the SS challenges in the way of achieving several SDGs. Thus, this study will undoubtedly guide practitioners to take flexible strategic steps to combat the SS risks in post-COVID-19 situations.

Methodology

In this section, the research framework and the applied best–worst method (BWM) are described sequentially.

Research Framework

The identification and prioritization of the critical challenges to SS in the post-COVID-19 period is a multi-criteria problem. A panel of industry experts was formed to identify the pressing challenges. BWM, an MCDM tool, was used to rank the SS challenges. Furthermore, some managerial flexible strategies are proposed to tackle these challenges. The research framework of this study is depicted in Fig. 1.

Best–Worst Method (BWM)

In this method, experts select the best criterion and the worst criterion and then formulate two preference vectors by comparing criteria best to other and other to worst using a 1–9 point rating scale (Moktadir et al., 2020). Previous literature showed the various successful application of the BWM in the SCM decision-making process. For example, Sharma et al. (2021) used the BWM to identify and analyse essential barriers of big data analytics in SCs. Moktadir et al. (2021) identified the most critical risk factors for sustainable supply chain management (SSCM) in the leather industry using the BWM. Sahebi et al. (2020) applied the BWM to rank the blockchain barriers in humanitarian SC. With the BWM, Gupta et al. (2020) ranked several strategies for SC sustainability innovation. Munim et al. (2020) applied the BWM to select an appropriate governance model for green port management and they reported that the BWM is a more reliable decision-making tool than ANP. Fartaj et al. (2020) used the BWM to identify the critical transportation disruption factors. Grida et al. (2020) applied the BWM to rank the COVID-19 prevention policies in SCM. Some other notable applications of the BWM method comprise assessment of environmental sustainability indicators (Suhi et al., 2019), identification of critical success factors of energy-efficient SC (Moktadir et al., 2019), and prioritization of sustainable manufacturing barriers (Malek & Desai, 2019). These successful applications and several advantageous features of BWM against other MCDM tools, as shown in Table 1, motivated us to apply the BWM in this study to explore the critical challenges to SS towards FSCM in the context of the post-COVID-19 period.

The step by step procedure of the BWM is mentioned as follows (Rezaei, 2015):

Fig. 1 The proposed research framework

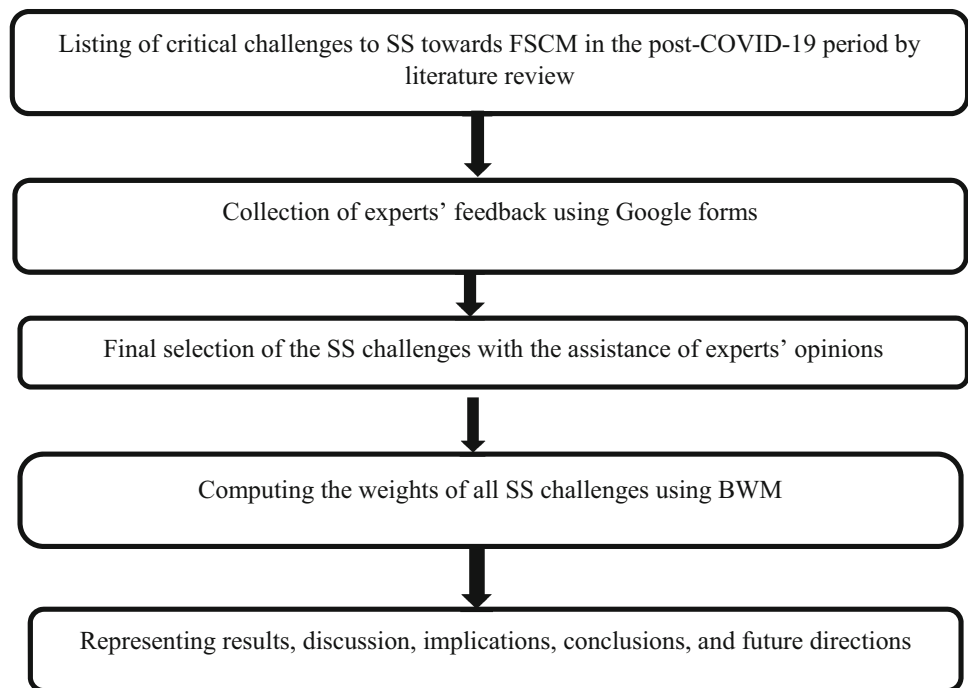


Table 1 Advantages of BWM over other MCDM tools (Németh et al., 2019; Rezaei, 2015)

Method	Required resource level	Requirement of software	Bias level	Complexity in calculation
AHP	Moderate	Not necessarily	Moderate	Moderate
SMART	Low	No	Moderate-high	Low
MACBETH	Moderate	Yes	Moderate-low	Moderate
DCE	High	Yes	Low	High
CA	High	Yes	Low	High
Applied BWM	Low	No	Moderate-low	Low

Step 1 Selection of a set of challenges to SS in the post-COVID-19 pandemic.

With the help of an expert panel, a set of challenges $\{pc_1, pc_2, \dots, pc_n\}$ to SS in the post-COVID-19 context is selected.

Step 2 Identification of the best and worst challenges to SS in post-COVID-19.

Here, the decision-makers identify the best and worst challenges to SS in the post-COVID-19 pandemic. Interestingly, no comparison is needed for this job.

Step 3 Identification of the order of preference of the best challenge to other challenges to SS in post-COVID-19.

Here, a rating scale of 1–9 is used to formulate the comparison matrices among challenges to SS in the post-COVID-19 pandemic for m th decision-makers. In this regard, point 1 represents equal importance, whereas point

9 denotes a higher priority. The Best-to-Others (BO) vector for the m th decision-makers is established as follows:

$$A_B^m = (a_{B1}^m, a_{B2}^m, \dots, a_{Bn}^m)$$

where a_{Bj}^m represents the significance of the best challenge B , compared to challenges j .

Step 4 Identification of the order of preference of other to the best challenge to SS in post-COVID-19.

Here, a rating scale of 1–9 is used to formulate the comparison matrices among others to the worst challenge to SS in the post-pandemic period for the m th decision-makers. The others-to-worst (OW) vector for the m th decision-makers is established as follows:

$$A_W^m = (a_{1W}^m, a_{2W}^m, \dots, a_{nW}^m)^T$$

where a_{jW}^m represents the importance of challenges j , over the worst challenge W .



Step 5 Calculating the optimal weights of challenges to SS in the post-pandemic period.

In this step, the weights of challenges ($w_1^{m*}, w_2^{m*}, \dots, w_n^{m*}$) to SS in the post-pandemic period are computed such that the maximum absolute difference for all j is minimized for the following set: $\{|w_B^m - a_{Bj}^m w_j^m|, |w_j^m - a_{jW}^m w_W^m|\}$. The problem is translated and denoted as follows:

$$\begin{aligned} & \min \{|w_B^m - a_{Bj}^m w_j^m|, |w_j^m - a_{jW}^m w_W^m|\} \\ & \text{Subject to} \\ & \sum_j w_j^m = 1 \quad (1) \\ & w_j^m \geq 0 \text{ for all } j \end{aligned}$$

Model (1) is altered to a linear programming problem, which is expressed as follows:

$$\begin{aligned} & \min \zeta^L \\ & \text{subject to,} \\ & |w_B^m - a_{Bj}^m w_j^m| \leq \zeta^L \text{ for all } j \\ & |w_j^m - a_{jW}^m w_W^m| \leq \zeta^L \text{ for all } j \quad (2) \\ & \sum_j w_j^m = 1 \\ & w_j^m \geq 0 \text{ for all } j \end{aligned}$$

By solving model (2), the optimized weightings ($w_1^{m*}, w_2^{m*}, \dots, w_n^{m*}$) are determined while minimizing the value of ζ^{L*} . It is noted that the closer the value of ζ^{L*} to zero represents higher consistency in the results, and vice versa. The value of ζ^{L*} is the optimal objective function of the constructed linear programming model, which helps to compute the consistency ratio of the constructed comparison matrix explained as $CR = \frac{\zeta^{L*}}{\text{Consistency Index } (\zeta^L)}$, where $CR \in [0, 1]$. The consistency index for different values of PC_{BW} is given in Table 2. It is also noted that the closer the value of CR to zero indicates the better consistency of the system.

A Real-Life Case Application

The critical challenges of ensuring SS and achieving SDGs in the post-COVID-19 period will be a burning issue for every industry around the world. This study takes the footwear industry as a real-life case study to focus on SS. In Bangladesh, the footwear industry has been marked as an emerging economy where sustainability issues should be addressed appropriately to further escalate this sector.

Identification of a Set of Challenges to SS in the Post-COVID-19 Pandemic

In this step, a set of critical challenges to SS in the post-COVID-19 context were listed by an extant literature review. Then, google forms was designed to collect responses from the footwear industry's experts on the critical challenges to SS. The data collection form was sent to the e-mail addresses of fifty industry experts following the purposive sampling approach. The minimum criteria for experts' selection were 4 years of working experience in the SCM field along with a Bachelor's degree. The data collection period was from 2nd January to 28th February 2021. During the data collection period, several phone calls and e-mail reminders were executed to get experts' feedback. In the data collection form, there was an option of Yes/No for selecting the critical challenges to SS by the respondents. Additionally, there was an option to add further challenges. After collecting the responses, we paraphrased the new challenges proposed by the industry experts and set a threshold value to screen out the most critical challenges. Finally, we considered eight critical challenges based on the threshold value. The challenges are listed in Table 3 with a brief definition.

This study followed the purposive sampling technique to get the responses from industry experts. In this sampling technique, researchers choose respondents randomly based on respondents' knowledge, expertise, and experience in the desired field (Guate & Barrios, 2006). We found several previous studies that followed the purposive sampling technique to explore any problem from an industry standpoint (Masudin et al., 2021; Sarker et al., 2021).

We finally got responses from eight experts from the invited fifty experts. Rezaei et al. (2018) reported that 4–10 respondents are enough to get credible results from the

Table 2 Consistency index for BWM

PC_{BW}	1	2	3	4	5	6	7	8	9
CI	0	0.44	1.0	1.63	2.3	3.0	3.73	4.47	5.23

Table 3 Critical challenges to SS in FSC in the post COVID-19 scenario

Code	Name of challenge	Definition	Reference
PC ₁	Complexity in ensuring workplace safety	Lack of capabilities to maintain a clean, safe, and hygienic factory environment	Kumar et al. (2020), Sharma et al. (2020) and Tonne (2021)
PC ₂	Health protocol development	Providing proper guidelines for ensuring employees' health wellbeing	Proposed in this article
PC ₃	Lack of training facility on health hygiene	Absence of training, education, and awareness programs for better health of employees	Proposed in this article
PC ₄	Unavailability of primary medical services	Lack of ensuring essential medical services for employees (e.g., monthly medical check-up)	Kumar et al. (2020)
PC ₅	High level of lay off	The degree of temporary or permanent job cut down due to the shortage of work	Bauer and Weber (2020)
PC ₆	Facing trouble in mental health	The problem of employees in dealing with their thoughts, emotions and/or behaviors	Bu et al. (2020)
PC ₇	Lack of government enforcement and regulations for social issues	The preparation of guidelines for social compliance issues and their lack of supervision and control in implementation by the government	Proposed in this article
PC ₈	Problem in socio-cultural patterns and practices	Changes in socio-cultural condition and culture (e.g., inequality due to poverty)	Fenner and Cernev (2021)
PC ₉	New normal community needs	The emergence of a new pattern of lifestyles (e.g., remote working)	Proposed in this article

BWM. In this regard, this study meets the sample requirements for the BWM. The details of the expert panel are described in Table 4.

significant (worst) challenge among the defined nine challenges. In this regard, a second-round survey was conducted using google forms. The results of this step are depicted in Table 5.

Identification of the Best and the Worst Challenges to SS in the Post COVID-19 Pandemic

In this step, eight industry experts (decision-makers) were asked to find the most significant (best) and the least

Table 4 Profile of industry experts from footwear companies

Experts (E)	Years of experience	Area of expertise/ department	Education	Number of employees in working company	Presence of social compliance certification	Age of working company (Years)	Designation
E-1	4–6	Production and operations management	Bachelor	101–1000	Yes	126	Executive officer
E-2	4–6	Production and operations management	Master's	101–1000	Yes	44	Sole expert and compound developer
E-3	7–10	Merchandising	Master's	1–100	Yes	98	Quality compliance analyst
E-4	7–10	Quality assurance/control	Master's	Above 1000	Yes	29	Deputy manager
E-5	4–6	Product conception and development	Bachelor	Above 1000	Yes	44	Footwear Product Engineer
E-6	4–6	Supply chain management	Master's	101–1000	Yes	7	Deputy manager
E-7	4–6	Quality assurance/control	Bachelor	Above 1000	Yes	44	Quality production leader
E-8	4–6	Footwear development and industrialization	Bachelor	1–100	Yes	45	Development and industrialization production leader



Table 5 Best and worst challenges to SS in the post-COVID-19 context identified by experts

Code	Name of challenge	Best (most significant) challenge mentioned by experts	Worst (least significant) challenge mentioned by experts
PC ₁	Complexity in ensuring workplace safety	E2, E7	
PC ₂	Health protocol development	E4	
PC ₃	Lack of training facility on health hygiene		E1, E6
PC ₄	Unavailability of primary medical services		
PC ₅	High level of lay off	E1, E3, E5, E6, E8	
PC ₆	Facing trouble in mental health		
PC ₇	Lack of government enforcement and regulations for social issues		
PC ₈	Problem in socio-cultural patterns and practices		E2, E4, E5, E7, E8
PC ₉	New normal community needs		E3

Identification of the Priority of the Best Challenge to Other Challenges to SS in the Post-COVID-19 Pandemic

In this step, the decision-makers were asked to provide their responses regarding the best challenge over the other challenges based on a 1–9-point rating scale. Table 6 represents the rating of the best challenge over the other challenges by industry Expert-1. The best challenge of SS in FSC in the post-pandemic period over the other challenges by Experts-2–8 are attached in “Appendix” (see Table 10).

Identification of the Priority of Other Challenges to the Worst Challenge to SS in the Post-COVID-19 Pandemic

In this step, the decision-makers provided their responses on other challenges over the worst challenges based on a 1–9-point rating scale. Table 7 represents the rating of other challenges over the worst challenge by industry Expert-1. The comparisons of other challenges of SS in FSC in the post-COVID-19 pandemic to the worst challenges constructed by Experts-2–8 are attached in “Appendix” (see Table 11).

Table 6 Best challenge over other challenges by Expert-1

Best to others	PC ₁	PC ₂	PC ₃	PC ₄	PC ₅	PC ₆	PC ₇	PC ₈	PC ₉
PC ₅	2	3	9	8	1	4	5	7	6

Calculating Optimal Weights ($w_1^{m*}, w_2^{m*}, \dots, w_n^{m*}$) of SS Challenges in the Post-COVID-19 Pandemic

Here, the optimal weights of all SS challenges are calculated by fulfilling the constraints and the optimization model given in Eq. (2) for every decision-makers. The optimization model for Expert-1 is depicted below:

$$\begin{aligned}
 & \text{Min, } \zeta^L \\
 & \text{Subject to} \\
 & |w_{PC_5}^1 - 2w_{PC_1}^1| \leq \zeta^L; |w_{PC_5}^1 - 3w_{PC_2}^1| \leq \zeta^L; |w_{PC_5}^1 - 9w_{PC_3}^1| \leq \zeta^L; \\
 & |w_{PC_5}^1 - 8w_{PC_4}^1| \leq \zeta^L; |w_{PC_5}^1 - 1w_{PC_5}^1| \leq \zeta^L; |w_{PC_5}^1 - 4w_{PC_6}^1| \leq \zeta^L; \\
 & |w_{PC_5}^1 - 5w_{PC_7}^1| \leq \zeta^L; |w_{PC_5}^1 - 7w_{PC_8}^1| \leq \zeta^L; |w_{PC_5}^1 - 6w_{PC_9}^1| \leq \zeta^L; \\
 & |w_{PC_1}^1 - 8w_{PC_3}^1| \leq \zeta^L; |w_{PC_1}^1 - 6w_{PC_3}^1| \leq \zeta^L; |w_{PC_1}^1 - 1w_{PC_3}^1| \leq \zeta^L; \\
 & |w_{PC_1}^1 - 3w_{PC_3}^1| \leq \zeta^L; |w_{PC_1}^1 - 9w_{PC_3}^1| \leq \zeta^L; |w_{PC_1}^1 - 7w_{PC_3}^1| \leq \zeta^L; \\
 & |w_{PC_1}^1 - 4w_{PC_3}^1| \leq \zeta^L; |w_{PC_1}^1 - 2w_{PC_3}^1| \leq \zeta^L; |w_{PC_1}^1 - 5w_{PC_3}^1| \leq \zeta^L; \\
 & w_{PC_1}^1 + w_{PC_2}^1 + w_{PC_3}^1 + w_{PC_4}^1 + w_{PC_5}^1 + w_{PC_6}^1 + w_{PC_7}^1 + w_{PC_8}^1 \\
 & \quad + w_{PC_9}^1 = 1; \\
 & w_{PC_1}^1, w_{PC_2}^1, w_{PC_3}^1, w_{PC_4}^1, w_{PC_5}^1, w_{PC_6}^1, w_{PC_7}^1, w_{PC_8}^1, w_{PC_9}^1 \geq 0
 \end{aligned}$$

By solving the above-mentioned model in an Excel solver, the optimal weights of all SS challenges were obtained and are presented in Table 8. Similarly, the optimal weights of the SS challenges in FSC with Experts-2–8 are calculated and the results are attached in



Table 7 Other challenges over the worst challenge constructed by Expert-1

Others to the worst challenge	PC_3
PC_1	8
PC_2	6
PC_3	1
PC_4	3
PC_5	9
PC_6	7
PC_7	4
PC_8	2
PC_9	5

Table 8 Optimal weights of the critical SS challenges by Expert-1

Code of challenge	Optimal weight
PC_1	0.1941
PC_2	0.1294
PC_3	0.0253
PC_4	0.0485
PC_5	0.3080
PC_6	0.0970
PC_7	0.0776
PC_8	0.0554
PC_9	0.0647
ζ^{L*}	0.08015

“Appendix” (see Table 12). Later, the average weights (arithmetic mean), standard deviation, and average consistency were observed for the obtained data from the eight experts, which is depicted in Table 9. The closer the

value of the objective function of the constructed linear programming model to zero indicates that the results are highly reliable and consistent. Our study findings show that the average value of the objective function is 0.0923, which is very close to zero. Therefore, it can be concluded that our results are more reliable and consistent. Besides, the computed lower standard deviation indicates the homogeneity of the responses of the eight experts. The overall weights of the critical SS challenges are also depicted in Fig. 2.

Results and Discussion

Table 9 represents the ultimate results of the SS critical challenges towards FSCM in the context of the post-COVID-19 pandemic. The prioritization of the critical challenges is established based on their calculated weights using the BWM. The ranking of the critical challenges is “high level of lay off”, “health protocol development”, “complexity in ensuring workplace safety”, “facing trouble in mental health”, “lack of government enforcement and regulations for social issues”, “unavailability of primary medical services”, “lack of training facility on health hygiene”, and “new normal community needs”, “problem in socio-cultural patterns and practices”, respectively.

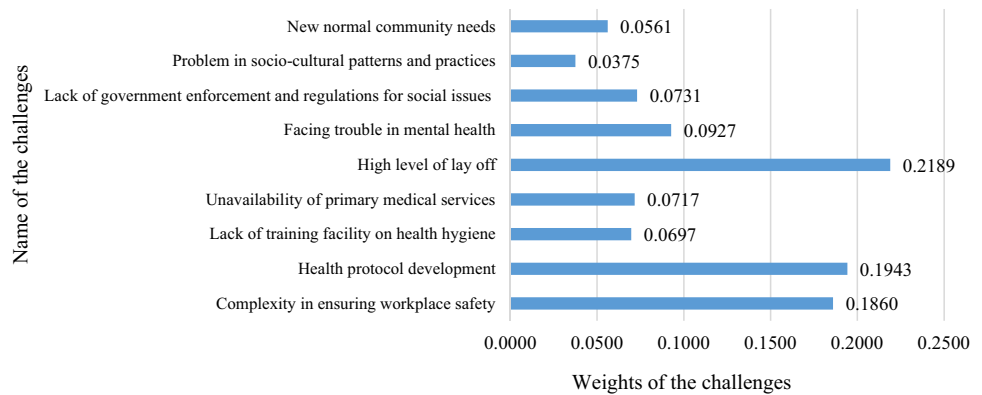
“High level of lay off” is the most critical challenge to SS in the post-COVID-19 period with the highest optimal weight of 0.2189, which denotes that job security is the most important issue to ensure SS in the post-COVID-19 world. On 23rd March 2019, a lockdown policy has been initiated by the government of Bangladesh to detain the spread of the contagious COVID-19 virus. When writing this article, during April 2021, the second wave of COVID-19 has emerged more deadly than that of the previous wave. However, the government of Bangladesh is strictly

Table 9 Average weights of the critical SS challenges from the eight experts

Code	Name of critical challenge	Average weight	Deviation	Consistency	Rank
PC_1	Complexity in ensuring workplace safety	0.1860	0.0544	0.0923	3
PC_2	Health protocol development	0.1943	0.0413		2
PC_3	Lack of training facility on health hygiene	0.0697	0.0229		7
PC_4	Unavailability of primary medical services	0.0717	0.1138		6
PC_5	High level of lay off	0.2189	0.0452		1
PC_6	Facing trouble in mental health	0.0927	0.0198		4
PC_7	Lack of government enforcement and regulations for social issues	0.0731	0.0198		5
PC_8	Problem in socio-cultural patterns and practices	0.0375	0.0216		9
PC_9	New normal community needs	0.0561	0.0162		8



Fig. 2 Weights of the critical challenges to SS in post-COVID-19



monitoring the lockdown measures to control the severe impact of this pandemic. Due to the COVID-19 effect, like other industries, the footwear industry of Bangladesh has been facing cancellation of buyers' orders, supply chain disruption, and supply–demand shock. As a result, many practitioners of the footwear industry are downsizing employees' jobs, as an alternate way, to minimize the financial loss of a company. Dhaka Tribune (2021) reported that the pandemic has affected 77% of Bangladesh's clothing and footwear industries, which are the most export-earning sectors of this country. A survey conducted by the Bangladesh Institute of Development Studies from 5th May to 29th May 2020, reported that around 13% of employees lost their jobs, due to the COVID-19 effect in Bangladesh (Dhaka Tribune, 2021). Due to the loss of their jobs, employees are struggling to meet their family and social needs, which are ultimately affecting the SS status of the FSC. In the post-COVID-19 period, many footwear companies like other manufacturing firms will restructure their SCs that will decline the job market, resulting in a threat to restart employees' jobs who have already lost their jobs during this pandemic. A previous study conducted by McCloskey et al. (2020) claimed that "high level of lay off" is one of the biggest challenges emanated from the COVID-19 pandemic, however, they did not discuss this challenge for FSCM in the post-pandemic period for ensuring SS, as our study reported.

"Health protocol development" is identified as another influential critical challenge to SS for FSCM, with the optimal weight of 0.1943. Industry managers should develop and execute a health protocol to prevent, screen, and/or management of the pandemic condition. Though the mass vaccination program has started in Bangladesh on 7 February 2021, it will take a long time to vaccinate the mass people of this country. Therefore, preventive flexible strategies, such as effective health protocol development are necessary to control this pandemic. This study suggests, in the post-COVID-19 period, practitioners should implement a health protocol to limit the advancement of this

viral disease. There was no previous literature that identified the health protocol development, as a part of FSCM strategy, for ensuring SS in the post-pandemic period.

"Complexity in ensuring workplace safety" is the next critical challenge, with the optimal weight of 0.1860 for ensuring SS for FSCM. The post-pandemic period will require personal safety practices (e.g. physical distancing, face coverings, gloves, and hand hygiene) to ensure a safe workplace. Previous studies, such as Kumar et al. (2020) mentioned that the post-pandemic production system should monitor workplace safety to ensure employees' health wellbeing and Sharma et al. (2020) discussed that even industry managers should focus on their suppliers' workplace environment to ensure SS in their SCs. Though few previous studies discussed the aforementioned challenge as an essential factor for ensuring SS in SCM, they did not highlight its importance as a strategy for FSCM in the post-pandemic period.

Our study finds "Facing trouble in mental health" as another critical challenge to SS in the post-pandemic period, with the optimal weight of 0.0927. Due to fear, lockdown, salary cut down, and lay off emanated from COVID-19, employees are being put under pressure, which troubles their mental health. Bu et al. (2020) and Kumar et al. (2020) found that employees' mental health has been strongly affected by this pandemic. However, previous studies did not point out how this challenge could affect SS. If employees are unsatisfied with his/her working environment or feel traumatized while working, ultimately, it will not only hamper SS but also lessen their working efficiency. Our study finds this challenge as an essential driver for achieving SS in the post-COVID-19 pandemic period.

In this study, "Lack of government enforcement and regulations for the social issue" is identified as another influential challenge to SS as a part of FSCM strategy in the post-pandemic period. Though the footwear industry is an emerging economy of Bangladesh, social compliance issues are not strictly followed in this industry, excluding

some leading factories. Though the government has imposed several guidelines for the industries of Bangladesh during the COVID-19 period, they are not strictly following these guidelines. Therefore, the government of Bangladesh should closely monitor the social issues of this industry. We have found this challenge as a novel driver for ensuring SS, which was not found in any other previous studies.

This study finds another important challenge to SS as a part of FSCM strategy in the post-COVID context, namely “Unavailability of primary medical services”. As a part of ensuring workplace safety and employees’ health security, companies should have primary medical services (e.g. measuring body temperature, checking oxygen saturation, and blood pressure monitoring). The COVID-19 pandemic has pointed out the importance of the presence of these primary medical services to continue SC functions in the post-pandemic period. Several footwear companies in Bangladesh lack primary medical services. No other previous SCM research found this challenge to SS issues in the literature.

“Lack of training facility on health hygiene” is identified as another critical challenge to SS in our study. Since COVID-19 is a viral disease, personal protection is a prerequisite condition to be safe. Practitioners of the footwear industry should not only develop the health protocol but also train their workforces on how to keep them clean and safe. To draw a comparison, we found no other previous literature that included this challenge to SS.

In the post-pandemic period, the world will not be the same as it was before; we will get a new normal world where a big challenge needs to be addressed as “new normal community needs”, which has been recognized as a critical challenge to SS as a part of FSCM approach in our study. The COVID-19 pandemic predominantly affects the lifestyles of employees, e.g. online meetings, remote working, and physical activity. Moreover, throughout the pandemic, people were more interested in online shopping. Our study finds “New normal community needs” as a newly found critical challenge to SS in the post-COVID-19 period.

This study finds another challenge to SS of the FSC that is “problem in socio-cultural patterns and practices”. Sadly, due to COVID-19, people all around the world are being deprived of the most basic of human needs (e.g. food and education). As the pandemic forwards, the issues regarding socio-cultural patterns as of social and economic inequity are exacerbating. Several companies have come forward to help communities with such good practices as providing food, masks, and hand sanitizers during this pandemic. However, in the post-pandemic period, reducing inequalities among communities will be an essential challenge for ensuring SS in SCM. Among the previous studies,

Fenner and Cernev (2021) discussed that reducing inequalities will be a great challenge for ensuring SDGs in the post-COVID-19 period; in contrast with that study, we find “problem in socio-cultural patterns and practices” as a critical challenge to SS for implementing FSCM strategies in the post-pandemic period.

Implications of the Study

The implications of this study can be categorized into two sections, i.e. theoretical and practical implications. Theoretical implications highlight the application of this research based on the applied framework. On the contrary, the real-world applications of this study in policy formulating are discussed under practical implications.

Theoretical Implications

To our knowledge, this is a new study in identifying the critical challenges to SS for implementing FSCM strategies in the post-COVID-19 context. As a result of this study, practitioners and policymakers will gain awareness about the SS problems in the post-COVID era, which will ensure the flexibility of the FSC. This study introduces four new critical challenges, i.e. “health protocol development”, “lack of training facility on health hygiene”, “lack of government enforcement and regulations for social issues”, “new normal community needs” among the identified total nine challenges, which were not found in any other previous literature. This study adopts the real-life application of the BWM to find out the relative importance of each challenge by computing their weights where we find consistent results by less pair-wise comparisons. Thus, we find the suitability of the BWM that can be further applied in such MCDM problems. The obtained ranking of the challenges will help practitioners and policymakers to understand the severity of each SS challenge, which will aid them in prioritizing and preparing themselves to address these challenges by undertaking flexible strategies. Furthermore, the relative weight of each challenge can be used as a reference for future research to explore the performance of SS of any company and manufacturing firm.

Practical Implications

This research will guide not only the footwear industry managers but also the other industry managers in formulating flexible strategic policies to ensure SS within their SCs. Also, from this study, other developing countries can learn about the critical challenges to SS in the post-COVID-19 period. In this study, we recommend the following flexible strategic approaches based on the identified



critical challenges that will not only ameliorate the social issues exacerbated by COVID-19 but also help in achieving several SDGs in the FSC.

- *Assurance of job security and new employment opportunities* During this pandemic, employees face temporary/permanent job cut down, which pushes them into a new miserable situation. Companies should not lay off employees; instead, they might cut a portion of wages, reducing the working hours of employees and through proper negotiations with trade unions to compensate for any economic losses of companies. Strong trade unions can negotiate with industry managers to protect any kind of lay off. Therefore, the presence of strong trade unions should be ensured in each company. Employees would need more secured jobs in the post-pandemic world, which should be ensured by employers. Companies should also concentrate on creating more job openings to rehire laid off staff. Industry managers may create more low wages jobs rather than high-paid salaries, which will increase more employment opportunities. Job security and more employment opportunities will help directly in achieving the SDG-8 (“Decent work and economic growth”) and also play a pivotal role in attaining SDG-1 (“No poverty”) and SDG-2 (“Zero hunger”) by any business entity.
- *Government regulations and strict enforcement* Government may play an essential role in ensuring SS by establishing strict guidelines and enforcing them. Developing countries, like Bangladesh, are facing a lack of this approach. The government of Bangladesh has taken an initiative to provide cash incentives on exporting leather, leather products, and footwear. However, the government can also provide a benefits package to companies who follow social compliance issues, which will encourage practitioners to adopt social compliance issues strictly.
- *Ensuring workplace safety and health wellbeing* Workplace safety not only protects the health and wellbeing of workers but also boosts a company’s productivity. Practitioners should establish a health protocol to fight against viral diseases like COVID-19, train workers to keep the workplace healthy and clean and ensure that their employees have access to primary medical care. Furthermore, businesses should provide social opportunities (such as games and cultural programs) to enhance their mental health conditions. The policy as mentioned earlier will help any industries in achieving SDG-3 (“Good health and wellbeing”).
- *Company new policy development focusing on new normal community needs* Companies should update

their workstations in the post-COVID-19 era to create a safe workplace, which will consider physical distancing. Industry managers should reinvestigate the efficacy of distant, flexible, and blended working in the post-COVID 19 periods. Meanwhile, customers will be less interested in physical shopping in the near future due to safety concerns. Therefore, retail companies should be proactive to open an online sales channel to expand their businesses.

Conclusions and Recommendations for Future Research

The COVID-19 pandemic has demonstrated the vulnerability of global SC sustainability. During this pandemic, emerging economies have been severely impacted. As such, Bangladesh’s footwear industry has been subjected to the same social vulnerabilities as the economic downturn. We discovered that SS problems were not articulated nearly as much as the financial crisis caused by the pandemic. Therefore, this study was taken to observe the critical challenges to SS for FSCM in the context of FSC. This study contributes to the recent research articles in several ways. First, this is the first study that examines the critical challenges to SS in the post-COVID-19 era for formulating FSCM strategies. Secondly, this research identifies a total of nine critical challenges, four of which are new to any other study, namely “health protocol development”, “lack of training facility on health hygiene”, “lack of government enforcement and regulations for social issues”, and “new normal community needs”. Thirdly, this research uses the BWM to determine the degree of criticality of SS challenges, which needs fewer pair-wise comparison matrices, and the findings are consistent. Finally, in the post-COVID-19 era, we provide some flexible managerial guidelines whereby the footwear industry and the other industries may contribute to the achievement of SDG-1, 2, 3, and 8 along with their SCs.

This research has several drawbacks, even though it has many contributions. Only eight experts from eight footwear companies in Bangladesh are considered in this study. Any potential research could include more experts from different countries to obtain a deeper understanding of the critical challenges to SS and to strengthen the validity of the findings. Moreover, the applied BWM is incapable of dealing with uncertainty and ambiguity in decision-making processes, which can be handled by integrating fuzzy, rough, or Z numbers into this method (Petrucci et al., 2021). Also, for group decision-making, in the future Bayesian

BWM can be applied in different industrial cases. There might have causal relationships among the identified challenges, which could not be explored by the BWM. Other MCDM tools, such as FANP, ISM, and rough-DEMATEL can be applied in any future research to investigate the causal relationships among the identified challenges. In addition, the new methods named FUCOM and LBWA models can be used in any future studies to compare the efficiency of these models with the BWM for criteria evaluation. Though our study findings can be generalized for other similar industries for developing economies, the findings might be different for other industries, because the challenges to SS largely depend on the nature of an industry and the context of a country, thus future research might look at the critical challenges to SS for other sectors of different countries and compare them to the findings of this study. In our study, we find only nine critical challenges to SS in the post-COVID-19 pandemic,

any future studies can include more SS challenges under several categories and sub-categories.

The proposed model applied in this study could be used to investigate the challenges to SDGs posed by the COVID-19 pandemic in the future. The study’s SS challenge indexes, along with their respective weights, might be used to evaluate any firm’s SS performance in any future studies. Since the COVID-19 pandemic has also shaken the economic sustainability of companies over the world, the given model could be used in the future to explore the critical challenges to economic sustainability in the context of the COVID-19 pandemic for any industry’s SC activities.

Appendix

See Tables 10, 11 and 12.

Table 10 Best challenge over other challenges by Experts-2–8

Best to others		PC_1	PC_2	PC_3	PC_4	PC_5	PC_6	PC_7	PC_8	PC_9
E-2	Best challenge (PC_1)	1	2	6	8	3	5	4	9	7
E-3	Best challenge (PC_5)	3	2	7	6	1	5	4	8	9
E-4	Best challenge (PC_2)	2	1	3	8	7	4	6	9	5
E-5	Best challenge (PC_5)	3	2	8	4	1	7	5	9	6
E-6	Best challenge (PC_5)	4	3	9	6	1	2	8	5	7
E-7	Best challenge (PC_1)	1	2	3	4	6	5	8	9	7
E-8	Best challenge (PC_5)	3	2	5	4	1	7	6	9	8

Table 11 Other challenges over the worst challenge constructed by Experts-2–8

Others to worst	E-2	E-3	E-4	E-5	E-6	E-7	E-8
	Worst challenge						
	PC_8	PC_9	PC_8	PC_8	PC_3	PC_8	PC_8
PC_1	9	5	7	4	4	9	4
PC_2	6	7	9	7	7	8	6
PC_3	4	2	8	2	1	7	5
PC_4	8	3	2	8	5	6	7
PC_5	7	9	4	9	9	5	9
PC_6	5	8	5	3	6	4	8
PC_7	6	6	6	5	2	3	3
PC_8	1	4	1	1	8	1	1
PC_9	3	1	3	6	3	2	2



Table 12 Optimal weights of critical challenges by Experts-2–8

Code of challenge	E-2 Optimal weight	E-3	E-4	E-5	E-6	E-7	E-8
PC_1	0.2908	0.1320	0.1948	0.1308	0.0990	0.3133	0.1333
PC_2	0.2006	0.1980	0.3061	0.1962	0.1320	0.1920	0.1999
PC_3	0.0669	0.0566	0.1299	0.0491	0.0222	0.1280	0.0800
PC_4	0.0501	0.0660	0.0487	0.0981	0.0660	0.0960	0.1000
PC_5	0.1337	0.2977	0.0557	0.3022	0.2977	0.0640	0.2925
PC_6	0.0802	0.0792	0.0974	0.0561	0.1980	0.0768	0.0571
PC_7	0.1003	0.0990	0.0649	0.0785	0.0495	0.0480	0.0666
PC_8	0.0201	0.0495	0.0247	0.0235	0.0792	0.0270	0.0206
PC_9	0.0573	0.0222	0.0779	0.0654	0.0566	0.0549	0.0500
ξ^{L*}	0.1103	0.0982	0.0835	0.0903	0.0982	0.0707	0.1074

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Declarations

Conflict of interest 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.

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Key Questions Reflecting Applicability in Real-life

1. What are the critical challenges of social sustainability in the post-COVID-19?
2. How to assess the importance of social sustainability challenges towards flexible supply chain management?
3. How does a firm can cope with social sustainability challenges in the post-COVID-19 period?

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