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An investigation of key performance indicators for operational excellence towards sustainability in the leather products industry

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Abstract

Operational excellence refers to a mixed management structure that enhances the productivity of an industry by exercising the best practices and efforts for continuous improvement. In order to achieve sustainability, operational excellence initiatives are practiced by different organizations. The intent is to investigate how to perform the practices of operational excellence towards sustainability in industries. In the existing literature, some studies investigated key performance indicators (KPIs) for other domains that are not readily applicable in the background of an emerging economy, principally for the leather products industry. To fulfill these research gaps, this study contributes to the operational excellence literature by recognizing the KPIs of operational excellence towards sustainability by examining the peer-reviewed scientific articles and through expert's suggestions. The identified KPIs are segregated into six dominant categories and 27 sub-KPIs in the field of leather products industry. Further, the prioritization of the KPIs is established by adopting the best-worst method (BWM), which involves simple pairwise comparison matrices compared with other multicriteria decision making techniques. The findings indicate that the KPIs under the "Management" category are at the highest priority. It is anticipated that the results originated from the study will support the expert's to appropriately recognize the significant KPIs and drop insignificant KPIs for successful operational excellence towards sustainability practices in the supply chain of the emerging economy.

KEYWORDS

business strategy, key performance indicators, leather products industry, operational excellence, sustainability

1 | INTRODUCTION

Today's business scenarios are becoming more complicated due to the variety of customer demands, enhancements in technology, and global integration (Mukonz, & Swarts, 2020; Centobelli, Cerchione, & Ertz, 2020). Concerns about product quality, increased product diversity, and continually fluctuating markets are some of the essential components responsible for these varying business conditions (Agrawal & Singh, 2019; Bartolacci, Caputo, & Soverchia, 2019). Accordingly, leather, leather goods, and footwear manufacturing

industries are under tremendous pressure to innovate their operational performance to counter these recent advancements. These manufacturing industries are compelled to automate and upgrade, which further escalates the manufacturing expenditures (Kazancoglu, Sagnak, Kayikci, & Kumar Mangla, 2020). Moreover, the leather sector of Bangladesh is an essential domain for the financial growth of the country. In order to sustain a competitive edge, this industrial sector needs to be capable of reacting and adjusting to the modifications created by an ambiguous environment (Dahlmann & Roehrich, 2019; Schaltegger & Wagner, 2011). In order to actively react to market circumstances, this industrial sector must practice excellence in their business. One approach is the quest for operational excellence, which helps this industrial sector navigate a pathway to attain their ambitions and objectives.

The term "operational excellence" originated from the Shingo Institute at Utah State University and commonly referred to the continuous developments various industries employ within their ecosystems to attain a competitive edge (Sony, 2019). Operational excellence is a necessary element of industry architecture and business excellence that attempts to enhance essential functioning performance parameters and can be accomplished by meeting the expectations of all participants (Shehadeh, Al-Zu'bi, Abdallah, & Maqableh, 2016). However, industries require practical and comprehensive supervision to attain operational excellence. Similarly, industries operating in different domains aim to achieve excellence in business to enhance their overall performance. Many industries fail to attain the height of excellence because they do not fully understand the true meaning of the same (Fok-Yew & Ahmad, 2014). There is undoubtedly a need for a list of instructions illustrating how industries may attain operational excellence.

When considering operational excellence, academics and industry consultants prefer to associate it with the manufacturing division because the manufacturing process is one of the main strategic parts of a business (Ahmed & Nuland, 2017). In the present study, the leather products industry of Bangladesh, a dominant manufacturing sector, is taken into consideration. The Bangladeshi leather sector contributes significantly to the economy of the country and is the second-largest source of exports. It includes around 220 tanneries, 110 large firms, and 3,500 small and medium enterprises (SMEs) (Moktadir, Rahman, Jabbour, Ali, & Kabir, 2018). According to the Export Promotion Bureau (EPB) of Bangladesh, the Bangladeshi leather industry contributes around 10% to the global leather business. The data from the EPB confirmed that in the first 8 months of FY2019–2020, the export of leather goods and footwear was around USD 851 million (Report, 2020). The industry has the capability of generating jobs and venture capital by creating convenience for export businesses, as Bangladeshi leather products including leather bags, ladies purses, money bags, belts, shoes, leather jackets, gloves, and credit card cases are imported to many countries including Italy, Spain, Germany, United States, United Kingdom, and Canada (Hoque & Clarke, 2013).

A lump of waste is generated by different manufacturing operations functioning within the leather products industry. If the manufacturing operations are green, the amount of waste generated should be considerably low (Dwivedi, Agrawal, & Madaan, 2019; Yang et al., 2019). Therefore, the employment of sustainable operational practices in the Bangladeshi leather products industry is a challenge. Studies related to performance enhancement in different manufacturing industries functional in Bangladesh primarily focused on small and medium organizations. In the literature, a few studies were available in the sphere of the leather industry, which is entirely different from the operational excellence and sustainability in the leather products industry (Moktadir, Ali, Rajesh, & Paul, 2018; Moktadir, Ali, Paul, & Shukla, 2019; Moktadir, Ali, Kusi-Sarpong, & Shaikh, 2018). Previous studies disclosed how operations management has linked sustainability issues via the practice of operational excellence (Mani & Gunasekaran, 2018). To stay upfront in the competition, the leather products industry needs refining, achieved by incorporating the latest approaches and concepts into their businesses to attain superiority and sustainability. Operational excellence mostly contains the most comprehensive and latest technological approaches for industrial utilization in the form of blockchain, Internet of things, information and communication technologies, artificial intelligent, cloud computing, and others (Gai, Beath, Fang, & Lou, 2020; Sartal & Vázquez, 2017). Sustainable practices can significantly contribute to achieving brilliance in the industry performance (Luthra, Govindan, Kannan, Mangla, & Garg, 2017) and can intensify the architecture and sustainability aspects of the traditional supply chains (Mangla et al., 2019).

Operational excellence is an essential subject of interest but has been a challenge for both industry and academia. Most of the previous operational excellence studies considered the case of different manufacturing industries, but there is a paucity of studies linked to operational excellence practices concerning leather industries functional in Bangladesh (Paul, Antunes, Covington, Evans, & Phillips, 2013; Moktadir, Ali, Rajesh, et al., 2018; Moktadir, Rahman, Rahman, Ali, & Paul, 2018; Moktadir, Ahmadi, Sultana, Liou, & Rezaei, 2020). There has been very little research conducted to establish an operational excellence structure for the leather products industry. Therefore, scientific knowledge and research could assist the Bangladeshi leather products industry in employing operational excellence practices towards sustainability. To guide the leather products industry on their way towards sustainability via operational excellence approaches, this study addresses the following research questions (RQs):

RQ1: What are the potential key performance indicators (KPIs) for operational excellence towards sustainability in the context of the leather products industry?

RQ2: How to determine the relative significance of KPIs for operational excellence?

RQ3: How to articulate the performance index for the leather products companies considering KPIs?

RQ4: What would be the managerial and policy implications of the study findings for the business strategy development?

Therefore, the present study adds value to the operational excellence literature by addressing the above-mentioned RQs. The objectives of the study are

a. Identifying the most relevant KPIs under the six different prospects for practicing operational excellence towards sustainability in the leather products industry using a qualitative approach.
b. Determining the relative significance of the identified KPIs employing quantitative BWM.
c. Developing a performance index considering domain expert's input for the case companies to investigate the existing operational performance.
d. Introducing managerial and policy implications deduced from the study.

To respond to the proposed objectives listed above, an analytical framework based on qualitative and quantitative approaches for identifying and investigating the KPIs is developed for the leather products industry. For this, at first, a rigorous literature review is performed within the domain of operational excellence to identify the potential KPIs. Then, a qualitative approach based on expert's opinions is undertaken to identify and finalize the KPIs for the leather products industry. Next, to investigate the operational excellence, relative weights of the KPIs are determined and prioritized as per their influence on operational excellence towards sustainability, employing the BWM. Next, the performance index of case companies is obtained to comprehend the actual operational performance of these case companies concerning the identified KPIs.

In this study, a quantitative decision tool, BWM has used for the following reasons: (a) BWM is a novel technique where the number of pairwise comparison matrices is less compared with other MCDM techniques like analytical hierarchy process (AHP), fuzzy AHP, decision making trial and evaluation laboratory (DEMATEL), gray-DEMATEL, analytical network process (ANP) resulting time-saving in decision making process (Mi, Tang, Liao, Shen, & Lev, 2019; Rezaei, 2015); and (b) BWM generates exceptionally reliable results with lower consistency ratio (Gupta, Anand, & Gupta, 2017; van de Kaa et al., 2017).

The paper is arranged as per the following sections. Section 2 discusses the literature review on operational excellence, existing works on KPIs, research gaps and highlights, and categorization of KPIs. The research design and methodology are presented in Section 3. A real-world case presentation of the suggested methodology is explained in Section 4. Section 5 broadly discusses the results and findings from the study, and Section 6 includes the conclusion, implications, and recommendations of the study.

2 | LITERATURE REVIEW

In this section, the objective is to add insights towards operational excellence studies. The objective is attained by addressing the existing literature related to operational excellence and KPIs. On the basis of literature review, the research gaps and the key highlights are identified. Further, the KPIs are segregated into six categories based on the literature survey and qualitative approach built on expert's suggestions under this section.

2.1 | Operational excellence

The literature assessment reveals various ways to describe operational excellence. The word "operational" refers to the assembly and distribution of a product and to accomplish a specific task, while "excellence" refers to a goal that must be met and sustained in order to remain outstanding (Mitchell, 2015). In addition, operational excellence is related to improving performance and efficiency across all dimensions of the industry. It is associated with both the operating performance (such as the measures of expense, quality, and resilience) and sustainable performance (such as dealing with individuals and resources effectively to support business expansion) (Zhu, Johnsson, Varisco, & Schiraldi, 2018). In order to increase customer worth, operational excellence is equally concerned with manufacturing processes as it is with waste minimization, and it generates interactions between employees and customers (Chakraborty, Sharma, & Vaidya, 2020; Dev, Shankar, & Qaiser, 2020). The architecture and administration of operational excellence escalate operating profits by achieving stable operational excellence in the production system, which supports customers by offering them correct value for products and services.

In order to attain operational excellence towards sustainable practices in industries, all three sustainability aspects (social, environmental, and economic) must be studied (Gimenez, Sierra, & Rodon, 2012). If operational excellence practices can assist in social improvement, this may lead to opening or attracting new businesses and sustaining the present collaborations (Sehnem, Jabbour, Pereira, & de Sousa Jabbour, 2019). The social aspect of sustainable operational excellence can escalate business expansion and stabilize operational excellence programs. Industries operate for economic gains and generation of profits. The economic aspect of sustainable operational excellence should moderately assure economic profitability. Sustainable operational excellence will only be achievable if it creates an economic impact, but this must not be at the expense of environmental and social impacts. The environmental aspect of operational excellence decisions that lead to negative environmental outcomes must be eradicated, even if such decisions are highly profitable for the industry (Sony, 2019).

Operational excellence is the continued monitoring of the industry's finest practices in the domain of operational performance, health and safety, process reliability, and environmental conduct (Bag, Wood, Mangla, & Luthra, 2020). It is a means of continuous enhancement in the operations of the industries. Operational excellence has been accredited and employed by various industries functioning in different domains. Many researchers have devoted substantial attention to operational excellence practices and suggested various frameworks for operational excellence in the context of different organizations. Moktadir, Ali, Rajesh, et al. (2018) identified the barriers to sustainable supply chain (SSC) management in the leather industry. The study identified 20 potential barriers in suggestion with the expert's and obtained the interrelationships among the barriers employing the gray-DEMATEL approach. Sony (2019) presented a combined perspective of achieving sustainable operational excellence in industries. In this study, the author suggests a framework for sustainable

operational excellence considering the triple bottom line of sustainability aspects. Uddin et al. (2019) suggested a framework to identify the barriers to green supply chain management (GSCM) in the leather industry. The study adopted ELimination Et Choice Translating REality (ELECTRE) and AHP approach to instigating GSCM in the leather industry. Dwivedi et al. (2019) suggested a sustainable manufacturing framework focusing leather industry. The study adopted the Total Interpretive Structural Modeling (TISM) approach and kappa analysis for obtaining the interrelation among the factors. Moktadir, Dwivedit, et al. (2019) identified the antecedents for the adoption of green human resource management in the context of the tannery industry. In this study, authors used TISM approach to make a contextual relationship among identified antecedents.

Similarly, Chakraborty et al. (2020) attained sustainable operational excellence through information technology (IT) applications in an Indian context. The study adopted ISM and fuzzy-MICMAC methodology to analyze the barriers in effective IT implementation, considering the expert's from the organized and unorganized logistics sectors. Hasan, Javed, and Farooq (2020) suggested strategies for the growth of the leather industry. The study has employed AHP and content analysis to identify and rank the strategies that can be employed by the leather industry for effectual growth. Also, Sehnem et al. (2019) performed an analysis for enhancing the performance of SSCs through the practices of operational excellence and circular economy (CE). This study suggests the companies to manage the success factors related to CE adoption and the influence of firms' in encouraging the CE. Muazu (2019) studied the antecedents of research within the domain of the oil and gas industry. The results from the study reflect that health, safety, and environmental performance has declined while incidents and fatalities issues are rising, irrespective of the adoption of operational excellence practices.

A number of studies are highlighted above in the context of operational excellence adoption towards sustainability in different manufacturing industries. Although, there are numerous studies in the field of the leather industry, still study related to the adoption of sustainable operational excellence practices in leather products industry is missing in the literature. Therefore, to attain operational excellence, the leather products industry must search for creative ideas to integrate conformity into its production and operational framework. Although there are numerous studies related to this field, several scopes of operational excellence still require further investigation.

2.2 | Existing work on KPIs

The important objectives for attaining operational excellence towards sustainability practices are primarily revealed by an enterprise's demand for success. Further, each objective is assisted by a list of specific indicators that contribute to attaining the desired objectives. As a set of quantitative and strategic measures that demonstrate the success of an organization, KPIs establish an enterprise's objectives and provide ways to measure and manage improvements for further learning to achieve these objectives. There are a set of standards that target the most relevant elements of organizational performance and are necessary for future progress (Parmenter, 2007). KPIs play a vital role in transforming organizational objectives into existence and support organizations to understand their performance within the context of their objectives. KPIs are an effective instrument for appraising performance and can be defined as a measure of success or consent. They allow industries to identify those operations that are performing well and those need future enhancements. They also facilitate to recognize and remodel the performance systems of the manufacturing industries. Because KPIs consist of an extensive range of elements in the form of objectives, such as analysis, modeling, and measurement, it becomes difficult to define them accurately. Therefore, organizations depend on managers to designate appropriate KPIs. The efficient adoption of KPIs is becoming increasingly important in the current business environment. KPIs are necessary for attaining operational excellence towards sustainability as

1. KPIs can specify decisive information which can lay the groundwork for enforcing development planning (Bag, Xu, Dhamija, & Kayikci, 2020);
2. KPIs present an approach to visualize whether strategic arrangements are working to drive the desired objectives;
3. The adoption of KPIs can lead to improvements in the productivity and profitability of the organizations (Horta, Camanho, & Da Costa, 2010).

In the literature survey, many studies highlighted the KPIs relevant to different industries. A few studies turned their attention to KPIs related to the leather industry, automobile industry, and healthcare, as well as looking at the pressures of sustainable manufacturing, but surprisingly study related to the leather products industry was missing. Addis, Dvivedi, and Beshah (2017) performed an analysis of the operational performance indicators in the background of Ethiopian leather industry using the customer preference rating approach. The study identified five key operational performance indicators that have high influence on the production performance of the Ethiopian leather industry. The results reported that flexibility and quality are the most imperative indicators for enhancing the industry's production performance. Also, Kaganski, Majak, and Karjust (2018) prioritized KPIs based on Specific, Measurable, Achievable, Relevant and Time-bound as well as Evaluated on a regular basis and Recognized (SMARTER) criteria. The study adopted the fuzzy AHP technique to identify 13 KPIs and further prioritized them based on expert's from different SMEs.

Similarly, Nurcahyo, Pustiwari, and Gabriel (2018) established KPIs for manufacturing industries in Indonesia. The study adopted the DEMATEL method to determine the causal relationship among the critical factors for improving corporate sustainability. Further, Kailash, Saha, and Goyal (2019) studied the KPIs of ISCM performance for Indian manufacturing industries. In this study, authors adopted an integrated fuzzy logic and AHP method to analyze the KPIs of internal supply chain management (SCM) based on select manufacturing companies. Amaladhasan, Parthiban, and Dhanalakshmi (2019) identified

the KPIs for green supply chain (GSC) assessment in the domain of the automobile industry. The study offered fuzzy-based VIseKriterijumska Optimizacija I Kompromisno Resenje (VIKOR) and gray relational analysis to prioritize the GSC performance in suggestion with the expert's from five different industries. Feiz et al. (2020) demonstrated the economic and environmental KPIs of the renewable energy production system by adopting a life cycle assessment (LCA) approach and ignored to examine the significance of proposed KPIs. Li, Hong, Lee, and Sofos (2020) proposed system-level KPIs for building performance evaluation using a simulation based approach, and the study findings were not suitable for the manufacturing industries. Zhu et al. (2018) identified the KPIs for the process industries, which were neglected by the KPIs series of ISO 22400. They offered a discussion and highlighted the difference between process industries KPIs and KPIs of the manufacturing operation.

2.3 | Research gaps and highlights

From the above in-depth literature review, it was confirmed that, to date, no study has examined the KPIs for operational excellence towards sustainability in the field of the leather products industry. A few studies analyzed KPIs in the context of manufacturing industries but did not focus specifically on operational excellence towards sustainability. Also, no study has evaluated the KPIs for operational excellence towards sustainability based on six (management, operations, quality, economic, social, and environmental) different categories for the leather products industry. To successfully estimate operational excellence, KPIs must be precisely explained according to the intent and scope of the sustainability evaluation. In complex situations, correlations between KPIs might also occur (Tsai, Chou, & Hsu, 2009). Therefore, it is crucial to examine the significance of the various KPIs for the leather products industry. To deal with the challenges above, there is a need to establish a framework to identify KPIs for operational excellence towards sustainability practices in the leather products industry. Therefore, the present study is an effort to address the above-mentioned research gaps. The highlights of the research are listed below:

a. KPIs for operational excellence towards sustainability are identified through literature review and qualitative expert's suggestions.
b. An MCDM-based framework has been suggested, which supports the essential KPIs, and the priorities among the KPIs are determined to achieve operational excellence.
c. A performance index is established for the case companies by arresting feedback from case companies expert's to determine the operational performance of the industry.

2.4 | Categorization of the KPIs

KPIs can be arranged by a set of elements with similar characteristics. Each KPI reveals the performance aspect of an organization. Moreover, these KPIs must be reasonably categorized to explore the fundamental interactions between them. Therefore, it is appropriate to organize the KPIs into multiple groups at different levels with specific cross-links between them. In the present study, a set of KPIs for operational excellence in the background of manufacturing industries are determined through the literature review. The suggestions of the expert's in the domain of leather products industry are incorporated to finalize 19 potential KPIs relevant to the leather products industry. Further, the identified 19 KPIs are clubbed under six (management, operations, quality, economic, social, and environmental) aspects based on the qualitative approach, that is, expert's suggestions as reflected in Table 1.

2.4.1 | Management related KPIs

Manufacturing organizations find it challenging to attain their goals due to certain process restrictions smoothly. If these restrictions are well understood, KPIs can be identified more accurately and can also assist with the improvements required to achieve goals (de Sousa Jabbour, de Oliveira Frascareli, & Jabbour, 2015; Seleem, Attia, & El-Assal, 2016). Therefore, it is essential to understand all the existing restrictions before employing any performance employment initiatives. KPIs help management to determine the exercises that need improvements to support the setting of new objectives, assist in decision-making to attain the required performance, permit interpretation of the organization's responsibility into detailed operational practices, and assess the extent of the organization's success in achieving its goal. In suggestion with the expert's, KPIs such as the efficient inventory management facility, skilled management facility of capacity utilization, and management facility of production monitoring system are included within the category of management-related KPIs, are presented in Table 1.

2.4.2 | Operations related KPIs

KPIs can help maintain the capability of an organization to establish and transform itself while retaining productivity. They are employed to evaluate performance and effectiveness throughout the different manufacturing operations. Therefore, KPIs must be correctly identified and adopted to the particularity of the industry and should be comprehensive enough to evaluate various operations effectively. The suggested the KPIs such as product development accuracy, scheduled production, timely target completion, and timely machinery maintenance within the category of operations related KPIs are outlined in Table 1.

2.4.3 | Quality-related KPIs

The determination of, and improvement in, quality are the constant endeavors of manufacturing organizations. Typically, organizations

TABLE 1 List of identified KPIs from exploratory literature survey

Major KPIs	Sub-KPIs	Supported references
KPI_1 Management	Efficient inventory management facility	Nallusamy (2016).
	Skilled management facility of capacity utilization	Bendavid, Lefebvre, Lefebvre, and Fosso-Wamba (2009).
	Management facility of production monitoring system	Snatkin, Eiskop, Karjust, and Majak (2015), Kaganski et al. (2018).
KPI_2 Operations	Product development accuracy (PD)	Gunasekaran, Patel, and McGaughey (2004).
	Scheduled production (order fulfillment cycle time)	Lindberg, Tan, Yan, and Starfelt (2015), Bag et al. (2020).
	Timely target completion	Rabhi (2011).
	Timely machinery maintenance	Mydin (2014)
KPI_3 Quality	Customer satisfaction	Sawang (2011), Parmenter (2007), Bhatti, Awan, and Razaq (2014).
	Less number of defective products	Anggradewi, Aurelia, Sardjananto, and Ekawati (2019)
	Total quality management facility (TQM)	Friedli, Goetzfried, and Basu (2010)
KPI_4 Economic	Return on investment (ROI)	Wieder, Booth, Matolcsy, and Ossimitz (2006), Speaker (2009).
	Revenue growth rate	Fernandes, Raja, and Whalley (2006).
	Net profit	Demydyuk, G. (2012).
	Customer-based profitability	Setijono and Dahlgaard (2007).
KPI_5 Social	Workers' safety	Rajendran and Gambatese (2009), Zou and Moon (2014)
	Employee satisfaction	Tsai and Cheng (2012), Venkatraman and Ramanujam (1986), Radujković, Vukomanović, & Dunović (2010).
KPI_6 Environmental	Environmental management system	Teixeira, Mendes, Murta, and Nunes (2016), Kylili, Fokaides, and Jimenez (2016).
	Greenhouse gas emission rate	Wu, Ma, Ji, and Ma (2017), Kourkoumpas et al. (2018).
	Emission to water and land	Amrina and Yusof (2011), Shaw, Grant, and Mangan (2010).

Abbreviation: KPI, key performance indicator.

target quality because of their commitments to their patrons of products and operations (Heckl, Moormann, & Rosemann, 2010). As such, organizations are always in search of measures to examine and enhance their quality and are always ready to adopt the practices and methods essential for quality improvements in their operations and products. Customer satisfaction, less number of defective products, and total quality management facility are the KPIs within the category of quality-related KPIs as suggested by the expert's, reflected in Table 1.

2.4.4 | Economic KPIs

Economic KPIs embody the varying aspects of an organization that must be considered to stay competitive in their profession for the long term (Baumgartner & Ebner, 2010). These KPIs reflect the concerns of an organization about its economic structure, both on the national and international levels. This aspect of KPIs incorporates a set of standards to appraise the value generated by an organization and its collaborators. The recommended KPIs such as return on investment, revenue growth rate, net profit, and customer-based profitability within the category of economic KPIs are listed in Table 1.

2.4.5 | Social KPIs

Social KPIs are concerned with the effects of the social system on the organizations that operate within them. This dimension of KPIs aims to direct interactions between collaborators decisively, both in the present and in the future (Rodrigues, Pigosso, & McAloone, 2016).

KPIs such as worker's safety and employee satisfaction are included in the category of social KPIs, as shown in Table 1.

2.4.6 | Environmental KPIs

Environmental KPIs determine the efficiency of an organization in attaining its broader goals and targets while still achieving environmental goals. The information accumulated by organizations related to the environment must be utilized to the utmost extent (Boakye, TIngbani, Ahinful, Damoah, & Tauringana, 2020). Environmental KPIs must meet the binary goals of facilitating the organization and, at the same time, transfer the relevant information to its partners. Therefore, environmental KPIs should be relevant to the size of the organization and its requirements. The KPIs such as environmental management system, greenhouse gas emission rate, and emission to water and land under the category of environmental KPIs are outlined in Table 1.

3 | METHODOLOGY

3.1 | Research design

In this study, initially, a set of KPIs for operational excellence in the background of the leather products industry are identified through literature review and expert's suggestions, as reflected in Table 4. After that, using BWM, the weight of each identified KPIs is determined to examine the performance of each case company. Using those weights and ratings, we find out the performance of the case companies and rate them accordingly. This would ultimately result in determining how KPI index set to know the operations excellence of the case companies.

3.2 | Best worst method

The BWM was developed by Professor Jafar Rezaei in 2015 to explain complications in MCDM (Rezaei, 2015). The BWM method is gaining popularity in several disciplines due to its salient features compared with other MCDM techniques (Chowdhury & Paul, 2020). First, BWM needs less effort and time compared with other MCDM techniques such as AHP, ANP, and fuzzy AHP due to requiring less pairwise comparison vector (Mi et al., 2019). Second, results produced by BWM are more consistent and reliable than the other MCDM techniques (Rezaei, 2016). Third, BWM is recognized by the researchers and practitioners as a simple MCDM approach that can quickly assess the complex decision-making problem (Salimi & Rezaei, 2018). This method has already been practiced in various real-world problems. For example, Suhi et al. (2019) employed the BWM for the assessment of environmental criteria for SSCs, Moktadir, Ali, Jabbour, et al., (2019) used the BWM to evaluate the key factors of energy efficiency in the leather industry, Malek and Desai (2019) applied the BWM to assess barriers to sustainable manufacturing practices, and Munny et al. (2019) utilized BWM to evaluate enablers of social sustainability in the footwear industry. The rating scale used in BWM analysis is shown in Table 2.

TABLE 2 Linguistic rating scale used in the best worst method

Rating value	Linguistic rating
1	Equally important
2	Somewhat between equal and moderate
3	Moderately more important
4	Somewhat between moderate and strong
5	Strongly more important
6	Somewhat between strong and very strong
7	Very strongly important
8	Somewhat between very strong and extreme
9	Extremely more important

The stepwise procedure of the BWM (Rezaei, 2015) is given as follows.

Step 1: Identify a set of KPIs $\{KPI_1, KPI_2, \ldots, KPI_n\}$ to reach a decision.
Step 2: The respondent determines the best and worst KPIs and sub-KPIs without any comparison.
Step 3: Decision makers rate the best KPI over all the other KPIs using a 1–9 scale rating value. This is similarly applicable for all other sub-KPIs. The vector of KPIs and sub-KPIs would be as follows:

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

where a_{Bj} denotes the preference of the best KPI B over KPI j. It can be concluded that the value of a_{BB} would be 1.

Step 4: Decision makers rate all the KPIs over the worst KPI using a 1–9 scale rating value, as for all other sub-KPIs. The vector of others-to-worst KPIs and sub-KPIs would be as follows:

$$A_w = (A_{1w}, A_{2w}, \ldots, A_{nw}),$$

where A_{jw} denotes the preference of KPI j over the worst KPI w. The value of a_{ww} would be 1.

Step 5: The weights of $(w_1^*, w_2^*, \ldots, w_n^*)$ are calculated.

The final weights of each KPI and sub-KPI are where, for each group of w_B/w_j and w_j/w_w, we have $w_B/w_j = a_{Bj}$ and $w_j/w_w = a_{jw}$. To fulfill these conditions for all j, we need to search the optimal solution where the maximum absolute differences $|w_B/w_j - a_{Bj}|$ and $|w_j/w_w - a_{jw}|$ for all j are minimized. Finally, the nonlinear optimixation model can be formed as follows:

$$\left\{\left|w_B - a_{Bj}w_j\right|\left|w_j - a_{jW}w_W\right|\right\},$$

$$\min \max \{|w_B - a_{Bj}w_j|, |w_j - a_{jW}w_W|\},$$

s.t.

$$\sum_j w_j = 1,$$

$$w_j \geq 0, \text{for all } j. \quad (1)$$

Model 1 is converted to a linear model and is displayed as

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

To determine the optimal weights of $(w_1^*, w_2^*, \ldots, w_n^*)$ for each KPI and sub-KPI and the optimal value of ξ^L, Model 2 needs to be solved. For better consistency (ξ^L) of KPIs comparisons, a result close to "0" is desired.

After determination of the weights of the main KPIs and sub-KPIs from the BWM analysis, the final weight or global weight for individual KPIs is acquired by multiplying the major KPIs weights with their respective weight of sub-KPIs. The global weight is used further for performance determination. The KPI ratings of several companies are then collected based on the 1–9 rating scale to try and enhance the performance of each of the companies. Finally, the overall performance indexes of the case companies are calculated by the following equation:

$$V_i = \sum_{j=1}^{n} w_j p_{ij}, \quad (3)$$

where w_j is the weight of sub-KPI j, which is obtained from the BWM analysis, and p_{ij} is the preference rating of the case company i over sub-KPI j.

4 | THE CASE APPLICATION

The proposed method was practiced in real-life case from the leather products industry in emerging economies. In this study, the leather products industry was highlighted to investigate the KPIs due to its remarkable contribution to the growth of the country's economy as well as its need for operational excellence in its manufacturing systems. To be more sustainable in their manufacturing activities, it is imperative to understand the actual performance that will further support the improvement of operational performance. To achieve the desired research goals, initially, the 19 KPIs were identified considering the scientific articles from the scholarly databases, that is, Google Scholar, ScienceDirect, and Scopus. After that, to validate, finalize, and assess the KPIs, the expert's were invited in multiple stages of data collection using a purposive sampling technique. In this non-probability sampling technique, respondents are chosen selective way. In the first stage of data collection, we invited 25 industrial and five academic professionals via email communication along with the list of identified 19 KPIs collected from different scientific articles. In the first stage of data collection, we have received a total of seven responses; six from the six case companies and one from an academic professional. The six case companies were the reputed leather products industry of Bangladesh, and they are producing and exporting high-quality leather goods (i.e., leather bags, wallets, belts, passport cases, ladies purses, credit card cases etc.). The six respondents are working in the area of production, merchandising, and the research and development department in the respective industry. They have a keen interest in the research topic and showed interest in participating in the next stages of data collection. Accordingly, one professional expert from the institution domain responded to participate in the initial stage as well as the next stages of data collection. The particulars of the respondents are given below in Table 3.

The application of the proposed method is separated into the three phases described as follows.

4.1 | Phase-1: Finalization of KPIs by expert's feedback

In this phase, the relevant KPIs are finalized with the help of expert's feedback. In the first stage of data collection, we received eight new KPIs from the seven respondents. Further, in the second stage of data collection, we have communicated and arranged face-to-face

TABLE 3 Expert profiles for best worst method analysis

Name of expert's	Name of company or educational institute	Designation	Years of experience (including part-time working experience)
Industry expert (E_1)	X_1	Production Officer	7
Industry expert (E_2)	X_2	Jr. Merchandiser	3
Academic expert (E_3)	X_3	Lecturer	5
Industry expert (E_4)	X_4	Sr. Merchandiser (PD)	4
Industry expert (E_5)	X_5	Merchandising Manager	7
Industry expert (E_6)	X_6	Production Officer	3
Industry expert (E_7)	X_7	R&D Manager	11

meetings to categorize the finalized KPIs, and only the relevant KPIs in the background of emerging economies were considered for further evaluation process. Finally, with the expert's feedback, the identified KPIs were categorized under the six potential KPIs divisions, that is, management, operations, quality, economic, social, and environmental. The identified and finalized 27 sub-KPIs under the six potential KPIs divisions are listed in Table 4.

4.2 | Phase-2: Assessment of identified KPIs and sub-KPIs

In this phase, the assessment process of KPIs and sub-KPIs is broadly described.

4.2.1 | Determination of the best and worst KPIs and sub-KPIs

In the third phase of face-to-face data collection, each of the seven expert's was approached to determine the best and worst KPIs and sub-KPIs from each of the six questionnaires (presented in the Supporting information) provided to them. Finally, the determined best and worst KPIs and sub-KPIs are given in Table 5.

4.2.2 | Determination of the best KPI and sub-KPIs over all the other KPIs and sub-KPIs

In this step, the experts constructed the vectors for the best KPI over other KPIs, exercising the 1–9 point rating scale. The best or most

TABLE 4 Final list of KPIs and sub-KPIs validated by expert's feedback

Major KPIs	Sub-KPIs	Supported references
KPI_1 Management	KPI_{11}: Time gap between buyer approach and order placement	Expert's feedback
	KPI_{12}: Efficient inventory management facility	LR
	KPI_{13}: Skilled management facility of capacity utilization	LR
	KPI_{14}: Products marketing management facility	Expert's feedback
	KPI_{15}: Management facility of production monitoring system	LR
KPI_2 Operations	KPI_{21}: Product development accuracy (PD)	LR
	KPI_{22}: Scheduled production (order fulfillment cycle time)	LR
	KPI_{23}: Timely target completion	LR
	KPI_{24}: Accuracy in sewing operation	Expert's feedback
	KPI_{25}: Timely machinery maintenance	LR
KPI_3 Quality	KPI_{31}: Customer satisfaction	LR
	KPI_{32}: Customer complaints rate	Expert's feedback
	KPI_{33}: Lesser number of defective products	LR
	KPI_{34}: Total quality management facility (TQM)	LR
KPI_4 Economic	KPI_{41}: Penalty achievement rate	Expert's feedback
	KPI_{42}: Return on investment (ROI)	LR
	KPI_{43}: Revenue growth rate	LR
	KPI_{44}: Net profit	LR
	KPI_{45}: Customer-based profitability	LR
KPI_5 Social	KPI_{51}: Staff advocacy rate (recommendation of staffs regarding working conditions)	Expert's feedback
	KPI_{52}: Workers' safety	LR
	KPI_{53}: Maternal facility	Expert's feedback
	KPI_{54}: Employee satisfaction	LR
KPI_6 Environmental	KPI_{61}: Solid waste management system	Expert's feedback
	KPI_{62}: Environmental management system	LR
	KPI_{63}: Greenhouse gas emission rate	LR
	KPI_{64}: Emission to water and land	LR

Abbreviations: LR, literature review; KPI, key performance indicator.

TABLE 5 Best and worst KPIs and sub-KPIs selected by expert's (E_1–E_7)

Main and sub-KPIs	Most important	Least important
Management (KPI_1)	E1, E2, E4, E5, E6, E7	
KPI_{11}: Time gap between buyer approach and order placement		E2, E6
KPI_{12}: Efficient inventory management facility	E3	E7
KPI_{13}: Skilled management facility of capacity utilization	E1, E6, E7	E4
KPI_{14}: Products marketing management facility	E4, E5	E1, E3
KPI_{15}: Management facility of production monitoring system	E2	E5
Operations (KPI_2)	E3	
KPI_{21}: Product development accuracy	E3, E4, E5	E1
KPI_{22}: Scheduled production (order fulfillment cycle time)	E1, E2, E6	
KPI_{23}: Timely target completion	E7	
KPI_{24}: Accuracy in the production system		E2, E4, E6, E7
KPI_{25}: Timely machinery system		E3, E5
Quality (KPI_3)		
KPI_{31}: Customer satisfaction	E2, E3, E4, E5, E6	
KPI_{32}: Number of customer complaints		E2, E5, E7
KPI_{33}: Lesser number of defective products		E1, E3, E4
KPI_{34}: Total quality management facility (TQM)	E1, E7	E6
Economic (KPI_4)		E2
KPI_{41}: Penalty achievement rate		E4, E5, E7
KPI_{42}: Return on investment (ROI)	E1, E2, E3, E5, E6	
KPI_{43}: Revenue growth rate		E1,E6
KPI_{44}: Net profit	E7	E2
KPI_{45}: Customer-based profitability	E4	E3
Social (KPI_5)		E1, E5, E6, E7
KPI_{51}: Staff advocacy rate (recommendation of staff about working environment among others)	E4	E3, E5, E7
KPI_{52}: Workers' safety	E3, E5	
KPI_{53}: Maternal facilities		E1, E2, E4, E6
KPI_{54}: Employee satisfaction	E1, E2, E6, E7	
Environmental (KPI_6)		E4, E5
KPI_{61}: Solid waste management system	E1, E2, E3, E6	
KPI_{62}: Environmental management system	E4, E5, E7	
KPI_{63}: Greenhouse gas emission rate		E1, E2, E3, E4, E5, E7
KPI_{64}: Emission to water and land		E6

Abbreviation: E, expert; KPI, key performance indicator.

important KPI recognized over the other KPIs for Expert 1 (E_1) is given below in Table 6. Those identified by Experts 2–7 are provided in the Supporting information.

Similarly, the identified best or most important sub-KPI over the other sub-KPIs for Expert 1 (E_1) is given below in Table 7. Those identified by Experts 2–7 are provided in the Supporting information.

TABLE 6 Best KPI over all other KPIs by Expert 1(E_1)

Best-to-others	KPI_1	KPI_2	KPI_3	KPI_4	KPI_5	KPI_6
Best KPI: KPI_1	1	2	5	4	8	7

Abbreviation: KPI, key performance indicator.

4.2.3 | Determination of the other KPIs and sub-KPIs over the worst KPI and sub-KPI

In this step, the experts were invited to signify their preference of the remaining KPIs over the worst KPI using the 1–9 point rating system. In this context, the feedback of Expert 1 (E_1) is presented below in Table 8. The responses from Experts 2–7 are given in the Supporting information.

Similarly, the identified sub-KPIs over the worst sub-KPI for Expert 1(E_1) are given in Table 9. Those for Experts 2–7 are given in the Supporting information.

4.2.4 | Determination of the optimal weights of the KPIs and sub-KPIs

In this step, the optimal weights of individual KPIs and sub-KPIs were processed by satisfying the mentioned model and constrictions (see Equation 2) in the previous section for Expert 1 (E_1). For KPIs, an example of the model for Expert 1 is reflected below:

min ξ^L

subject to,

$$|w_{KPI1} - 1w_{KPI1}| \le \xi^L; |w_{KPI1} - 2w_{KPI2}| \le \xi^L; |w_{KPI1} - 5w_{KPI3}| \le \xi^L;$$
$$|w_{KPI1} - 4w_{KPI4}| \le \xi^L; |w_{KPI1} - 8w_{KPI5}| \le \xi^L; |w_{KPI1} - 7w_{KPI6}| \le \xi^L;$$
$$|w_{KPI1} - 8w_{KPI5}| \le \xi^L; |w_{KPI2} - 7w_{KPI5}| \le \xi^L; |w_{KPI3} - 4w_{KPI5}| \le \xi^L;$$
$$|w_{KPI4} - 5w_{KPI5}| \le \xi^L; |w_{KPI5} - 1w_{KPI5}| \le \xi^L; |w_{KPI6} - 2w_{KPI5}| \le \xi^L;$$
$$w_{KPI1} + w_{KPI2} + w_{KPI3} + w_{KPI4} + w_{KPI5} + w_{KPI6} = 1;$$
$$w_{KPI1}, w_{KPI2}, w_{KPI3}, w_{KPI4}, w_{KPI5}, w_{KPI6} \ge 0.$$

TABLE 8 Other KPIs over the worst KPI by Expert 1 (E_1)

Others-to-worst	Worst KPI: KPI_5
KPI_1	8
KPI_2	7
KPI_3	4
KPI_4	5
KPI_5	1
KPI_6	2

Abbreviation: KPI, key performance indicator.

Similarly, the models for Expert 1 for sub-KPIs are established and presented below:

For sub-KPIs of the management division

min ξ^L

subject to,

$$|w_{KPI13} - 5w_{KPI11}| \le \xi^L; |w_{KPI13} - 3w_{KPI12}| \le \xi^L;$$
$$|w_{KPI13} - 1w_{KPI13}| \le \xi^L; |w_{KPI13} - 6w_{KPI14}| \le \xi^L;$$
$$|w_{KPI13} - 2w_{KPI15}| \le \xi^L; |w_{KPI11} - 2w_{KPI14}| \le \xi^L;$$
$$|w_{KPI12} - 3w_{KPI14}| \le \xi^L; |w_{KPI13} - 6w_{KPI14}| \le \xi^L;$$
$$|w_{KPI14} - 1w_{KPI14}| \le \xi^L; |w_{KPI15} - 5w_{KPI14}| \le \xi^L;$$
$$w_{KPI11} + w_{KPI12} + w_{KPI13} + w_{KPI14} + w_{KPI15} = 1;$$
$$w_{KPI11}, w_{KPI12}, w_{KPI13}, w_{KPI14}, w_{KPI15} \ge 0.$$

For sub-KPIs of the operations division

min ξ^L

subject to,

$$|w_{KPI22} - 5w_{KPI21}| \le \xi^L; |w_{KPI22} - 1w_{KPI22}| \le \xi^L;$$
$$|w_{KPI22} - 3w_{KPI23}| \le \xi^L; |w_{KPI22} - 2w_{KPI24}| \le \xi^L$$
$$|w_{KPI22} - 4w_{KPI25}| \le \xi^L; |w_{KPI21} - 1w_{KPI21}| \le \xi^L;$$
$$|w_{KPI22} - 5w_{KPI21}| \le \xi^L |w_{KPI23} - 3w_{KPI21}| \le \xi^L$$
$$|w_{KPI24} - 4w_{KPI21}| \le \xi^L; |w_{KPI25} - 2w_{KPI21}| \le \xi^L;$$
$$w_{KPI21} + w_{KPI22} + w_{KPI23} + w_{KPI24} + w_{KPI25} = 1;$$
$$w_{KPI11}, w_{KPI12}, w_{KPI13}, w_{KPI14}, w_{KPI15} \ge 0.$$

TABLE 7 Best sub-KPI over all other sub-KPIs by Expert 1 (E_1)

	Best-to-others sub-KPIs	KPI_{11}	KPI_{12}	KPI_{13}	KPI_{14}	KPI_{15}
Management (KPI_1)	**Best sub-KPI: KPI_{13}**	**5**	**3**	**1**	**6**	**2**
Operations (KPI_2)	Best-to-others sub-KPIs	KPI_{21}	KPI_{22}	KPI_{23}	KPI_{24}	KPI_{25}
	Best KPI: KPI_{22}	5	1	3	2	4
Quality (KPI_3)	Best-to-others sub-KPIs	KPI_{31}	KPI_{32}	KPI_{33}	KPI_{34}	
	Best KPI: KPI_{34}	2	4	5	1	
Economic (KPI_4)	Best-to-others sub-KPIs	KPI_{41}	KPI_{42}	KPI_{43}	KPI_{44}	KPI_{45}
	Best KPI: KPI_{42}	3	1	2	5	7
Social (KPI_5)	Best-to-others sub-KPIs	KPI_{51}	KPI_{52}	KPI_{53}	KPI_{54}	
	Best KPI: KPI_{54}	3	2	4	1	
Environmental (KPI_6)	Best-to-others sub-KPIs	KPI_{61}	KPI_{62}	KPI_{63}	KPI_{64}	
	Best KPI: KPI_{61}	1	3	7	5	

Abbreviation: KPI, key performance indicator.

For sub-KPIs of the quality division

$\min \xi^L$

subject to,

$$|w_{KPI34} - 2w_{KPI31}| \le \xi^L; |w_{KPI34} - 4w_{KPI32}| \le \xi^L;$$
$$|w_{KPI34} - 5w_{KPI33}| \le \xi^L; |w_{KPI34} - 1w_{KPI34}| \le \xi^L$$
$$|w_{KPI31} - 4w_{KPI33}| \le \xi^L; |w_{KPI32} - 2w_{KPI33}| \le \xi^L;$$
$$|w_{KPI33} - 1w_{KPI33}| \le \xi^L; |w_{KPI34} - 5w_{KPI33}| \le \xi^L$$
$$w_{KPI31} + w_{KPI32} + w_{KPI33} + w_{KPI34} = 1;$$
$$w_{KPI31}, w_{KPI32}, w_{KPI33}, w_{KPI34} \ge 0.$$

For sub-KPIs of the economic division

$\min \xi^L$

subject to,

$$|w_{KPI42} - 3w_{KPI41}| \le \xi^L; |w_{KPI42} - 1w_{KPI42}| \le \xi^L;$$
$$|w_{KPI42} - 2w_{KPI43}| \le \xi^L; |w_{KPI42} - 5w_{KPI44}| \le \xi^L$$
$$|w_{KPI42} - 7w_{KPI45}| \le \xi^L; |w_{KPI41} - 3w_{KPI45}| \le \xi^L;$$
$$|w_{KPI42} - 7w_{KPI45}| \le \xi^L; |w_{KPI43} - 5w_{KPI45}| \le \xi^L$$
$$|w_{KPI44} - 2w_{KPI45}| \le \xi^L; |w_{KPI45} - 1w_{KPI45}| \le \xi^L w_{KPI41}$$
$$+ w_{KPI42} + w_{KPI43} + w_{KPI44} + w_{KPI45} = 1;$$
$$w_{KPI41}, w_{KPI42}, w_{KPI43}, w_{KPI44}, w_{KPI45} \ge 0.$$

For sub-KPIs of the social division

$\min \xi^L$

subject to,

$$|w_{KPI54} - 3w_{KPI51}| \le \xi^L; |w_{KPI54} - 2w_{KPI52}| \le \xi^L;$$
$$|w_{KPI54} - 4w_{KPI53}| \le \xi^L; |w_{KPI54} - 1w_{KPI54}| \le \xi^L$$
$$|w_{KPI51} - 2w_{KPI53}| \le \xi^L; |w_{KPI52} - 3w_{KPI53}| \le \xi^L;$$
$$|w_{KPI53} - 1w_{KPI53}| \le \xi^L; |w_{KPI54} - 5w_{KPI53}| \le \xi^L$$
$$w_{KPI51} + w_{KPI52} + w_{KPI53} + w_{KPI54} = 1;$$
$$w_{KPI51}, w_{KPI52}, w_{KPI53}, w_{KPI54} \ge 0.$$

For sub-KPIs of the environmental division

$\min \xi^L$

subject to,

$$|w_{KPI61} - 1w_{KPI61}| \le \xi^L; |w_{KPI61} - 3w_{KPI62}| \le \xi^L;$$
$$|w_{KPI61} - 7w_{KPI63}| \le \xi^L; |w_{KPI61} - 5w_{KPI64}| \le \xi^L$$
$$|w_{KPI61} - 7w_{KPI63}| \le \xi^L; |w_{KPI62} - 5w_{KPI63}| \le \xi^L;$$
$$|w_{KPI63} - 1w_{KPI63}| \le \xi^L; |w_{KPI64} - 3w_{KPI63}| \le \xi^L$$
$$w_{KPI61} + w_{KPI62} + w_{KPI63} + w_{KPI64} = 1;$$
$$w_{KPI61}, w_{KPI62}, w_{KPI63}, w_{KPI64} \ge 0.$$

The above-mentioned linear programming models are solved in the Excel Solver. The optimal weights for the objective function, KPIs, and the sub-KPIs for Expert 1 were then computed and are presented in Table 10.

Similarly, other models for KPIs and sub-KPIs were constructed for Expert's 2–7 (E_2–E_7), and the optimal weights were computed using Excel Solver. After that, the final average weight of each KPI and sub-KPI was computed by using a simple averaging technique (we used arithmetic mean). The average weights of KPIs and sub-KPIs and the global weights of sub-KPIs are presented below in Table 11. Multiplying the weight of the KPIs with their respective sub-KPIs, the global weights of sub-KPIs were computed.

4.3 | Phase-3: Evaluation of the performance indexes of case companies

In this phase, the performance index of case companies was calculated with the assistance of expert's feedback from respective fields using the Equation 3. In this study, we adopted the following threshold values for marking the case companies to categorize their performances motivated from the previous study Elhuni and Ahmad (2017). The performance levels were categorized as follows:

If the score belongs to 1 ≤ scores ≤3, then the company's performance level is poor.

If the score belongs to 3 < scores ≤7, then the company's performance level is fair.

If the score belongs to 7 < scores ≤9, then the company's performance level is good.

If the score belongs to scores >9 then the company's performance level is excellent.

Therefore, the data were collected again from the domain experts based on their working experiences providing the rating scale to rate the performance against each sub-KPI. A rating of 1 stands for the lowest performance, and 10 stands for an excellent performance. In this study, we evaluated the performance of four case companies based on the 27 listed sub-KPIs. The case companies were

X_1 stands for case Company 1.

X_4 stands for case Company 4.

X_5 stands for case Company 5.

X_7 stands for case Company 7.

The ratings of each company against each sub-KPI are listed below in Table 12, which was constructed with the assistance of previously purposively selected experts (E_1, E_4, E_5, and E_7) from the case companies (X_1, X_4, X_5, and X_7). In the performance evaluation, we have considered four case companies as they have high potentiality and decision makers are more experienced than others.

For each of the case companies, the ratings for different sub-KPIs were multiplied by their respective global weights and then summed. The summation result provided the performance index of the respective company.

Using Equation 3 the global weights obtained from Table 11 multiply with the performance rating presented below in Table 12, the performance index of company X_1 was calculated as $V_{X1} = 6.5330$.

Similarly, we determined the performance indexes of the rest of the companies.

The performance index of X_4 (V_{X4}) is 6.6140.

The performance index of X_5 (V_{X5}) is 7.5147.

The performance index of X_7 (V_{X7}) is 4.5875.

TABLE 9 Other sub-KPIs over the worst sub-KPI by Expert 1

Management (KPI_1)		Operations (KPI_2)		Quality (KPI_3)		Economic (KPI_4)		Social (KPI_5)		Environmental (KPI_6)	
Others-to-worst	Worst KPI: KPI_{14}	Others-to-worst	Worst KPI: KPI_{21}	Others-to-worst	Worst KPI: KPI_{33}	Others-to-worst	Worst KPI: KPI_{45}	Others-to-worst	Worst KPI: KPI_{53}	Others-to-worst	Worst KPI: KPI_{63}
KPI_{11}	2	KPI_{21}	1	KPI_{31}	4	KPI_{41}	3	KPI_{51}	2	KPI_{61}	7
KPI_{12}	3	KPI_{22}	5	KPI_{32}	2	KPI_{42}	7	KPI_{52}	3	KPI_{62}	5
KPI_{13}	6	KPI_{23}	3	KPI_{33}	1	KPI_{43}	5	KPI_{53}	1	KPI_{63}	1
KPI_{14}	1	KPI_{24}	4		5	KPI_{44}	2		4		3
KPI_{15}	5	KPI_{25}	2	KPI_{34}		KPI_{45}	1	KPI_{54}		KPI_{64}	

Abbreviation: KPI, key performance indicator.

5 | RESULTS AND DISCUSSIONS

In this section, the results achieved from the BWM are discussed broadly with a practical point of view. Further, the performances of the case companies with respect to KPIs are discussed.

5.1 | Discussions on KPIs ranking

The findings of the study are reflected above in Table 11. In the initial stage of BWM analysis, "Management (KPI_1)" received the highest weightage (0.3677), indicating its importance in achieving operational excellence in the leather products industry. Skilled management teams can help advance operational performance in the leather products industry. Also, in the leather products industry, the quality of the products as well as performances largely depends on skilled management (Lindberg et al., 2015). Therefore, management-related KPIs were prioritized the highest by the industry experts. When

TABLE 10 Optimal weights of KPIs according to Expert 1

KPI	Weights	ξ^{L^*}	Sub-KPIs	Weights	ξ^{L^*}
KPI_1	0.4147	0.0829	KPI_{11}	0.0984	0.0615
			KPI_{12}	0.1639	
			KPI_{13}	0.4303	
			KPI_{14}	0.0615	
			KPI_{15}	0.2459	
KPI_2	0.2488		KPI_{21}	0.0717	0.0573
			KPI_{22}	0.4158	
			KPI_{23}	0.1577	
			KPI_{24}	0.2366	
			KPI_{25}	0.1183	
KPI_3	0.0995		KPI_{31}	0.2796	0.0645
			KPI_{32}	0.1398	
			KPI_{33}	0.0860	
			KPI_{34}	0.4946	
KPI_4	0.1244		KPI_{41}	0.1616	0.0428
			KPI_{42}	0.4420	
			KPI_{43}	0.2424	
			KPI_{44}	0.0970	
			KPI_{45}	0.0570	
KPI_5	0.0415		KPI_{51}	0.1724	0.0517
			KPI_{52}	0.2586	
			KPI_{53}	0.1034	
			KPI_{54}	0.4655	
KPI_6	0.0711		KPI_{61}	0.5718	0.1064
			KPI_{62}	0.2261	
			KPI_{63}	0.0665	
			KPI_{64}	0.1356	

Abbreviation: KPI, key performance indicator.

TABLE 11 Average overall weights of KPIs along with global weights and ranking

KPI	Weights	Sub-KPIs	Weights	Global weight	Rank
Management (KPI1)	0.3677	KPI11: Time gap between buyer approach and order placement	0.1408	0.05176	7
		KPI12: Efficient inventory management facility	0.1977	0.07269	3
		KPI13: Skilled management facility of capacity utilization	0.2561	0.09418	1
		KPI14: Products marketing management facility	0.1916	0.07044	4
		KPI15: Management facility of production monitoring system	0.2138	0.07861	2
Operations (KPI2)	0.1880	KPI21: Product development accuracy (PD)	0.2576	0.04842	9
		KPI22: Scheduled production (order fulfillment cycle time)	0.2676	0.05031	8
		KPI23: Timely target completion	0.1989	0.03739	10
		KPI24: Accuracy in sewing operation	0.1485	0.02793	14
		KPI25: Timely machinery maintenance	0.1274	0.02396	20
Quality (KPI3)	0.1337	KPI31: Customer satisfaction	0.4283	0.05726	6
		KPI32: Customer complaints rate	0.1710	0.02286	21
		KPI33: Lesser number of defective products	0.1302	0.01741	23
		KPI34: Total quality management facility (TQM)	0.2704	0.03615	11
Economic (KPI4)	0.1683	KPI41: Penalty achievement rate	0.1494	0.02514	18
		KPI42: Return on investment (ROI)	0.3674	0.06183	5
		KPI43: Revenue growth rate	0.1508	0.02538	16
		KPI44: Net profit	0.1897	0.03193	13
		KPI45: Customer-based profitability	0.1428	0.02403	19
Social (KPI5)	0.0669	KPI51: Staff advocacy rate (recommendation of staffs among others regarding working condition)	0.1904	0.01273	24
		KPI52: Workers' safety	0.2965	0.01983	22
		KPI53: Maternal facility	0.1349	0.00902	26
		KPI54: Employee satisfaction	0.3782	0.02529	17
Environmental (KPI6)	0.0755	KPI61: Solid waste management system	0.4287	0.03235	12
		KPI62: Environmental management system	0.3481	0.02626	15
		KPI63: Greenhouse gas emission rate	0.0914	0.00689	27
		KPI64: Emission to water and l and	0.1318	0.00994	25

Abbreviation: KPI, key performance indicator.

management plays its role effectively, all the other KPIs remain under control and run accordingly (Ferreira, Shamsuzzoha, Toscano, & Cunha, 2012).

In the category of "Management" related KPI, five sub-KPIs were analyzed for their influence on each KPI in the leather products industry. These five sub-KPIs were "time gap between buyer approach and order placement (KPI_{11})," "efficient inventory management facility (KPI_{12})," "skilled management facility of capacity utilization (KPI_{13})," "product marketing management facility (KPI_{14})," and "management facility of the production monitoring system (KPI_{15})," and they were ranked seventh, third, first, fourth, and second, respectively, in the final ranking. The results indicated that "skilled management facility of capacity utilization" was the crucial sub-KPI for achieving operational excellence in the leather products industry. Better utilization of resources in an organization emerges as a key performance indicator for the manufacturing industries (Bhatti et al., 2014). Hence, the sub-KPI "skilled management facility of capacity utilization" is a very crucial KPI for the leather products industry to improve operational performance. Next, under the category of management KPI, "management facility of production monitoring system" ranked second in the evaluation process, indicating that a well-established management facility of the production monitoring system can help to achieve a better performing production process. In the assessment, an "efficient inventory management facility" was ranked third. The effective management of inventory systems is essential for enhancing business performance as inventory management frequently narrates a significant share of SCM costs and improves service levels (Yang, Pan, & Ballot, 2017). Therefore, a highly efficient leather products industry should have a good inventory management system. "Products marketing management facility" was at the fourth position in the final KPI ranking, confirming its importance in attaining operational excellence. Lastly, the sub-KPI "time gap between buyer approach and order placement" ranked seventh. With most of the industries functioning on a just-in-time basis, there is less space for error in the delivery

TABLE 12 Performance rating of case companies

Experts	Case companies	Sub-KPIs code	KPI_{11}	KPI_{12}	KPI_{13}	KPI_{14}	KPI_{15}	KPI_{21}	KPI_{22}	KPI_{23}
			Global weights (*j*)							
			0.05176	0.07269	0.09418	0.07044	0.07861	0.04842	0.05031	0.03739
E_1	X_1	Rating of case companies (*i*)	5	8	7	6	6	9	9	9
E_4	X_4		7	6	7	6	6	8	8	8
E_5	X_5		7	6	9	7	8	7	7	9
E_7	X_7		4	3	3	5	5	4	5	5

Abbreviation: KPI, key performance indicator.

TABLE 12 Continued

	KPI_{24}	KPI_{25}	KPI_{31}	KPI_{32}	KPI_{33}	KPI_{34}	KPI_{41}	KPI_{42}	KPI_{43}	KPI_{44}
	Global weights (*j*)									
Experts	0.02793	0.02396	0.05726	0.02286	0.01741	0.03615	0.02514	0.06183	0.02538	0.03193
E_1	7	7	8	9	7	5	1	1	7	8
E_4	8	6	8	7	5	7	6	6	6	7
E_5	8	6	9	6	5	8	6	9	9	9
E_7	7	4	7	7	7	5	6	3	1	3

TABLE 12 Continued

	KPI_{45}	KPI_{51}	KPI_{52}	KPI_{53}	KPI_{54}	KPI_{61}	KPI_{62}	KPI_{63}	KPI_{64}	
	Global weights (*j*)									Performance index ($V_i = \sum_{j=1}^{n} w_j p_{ij}$)
Experts	0.02403	0.01273	0.01983	0.00902	0.02529	0.03235	0.02626	0.00689	0.00994	
E_1	8	5	7	7	6	7	7	5	1	6.5330
E_4	7	5	7	7	5	5	6	3	5	6.6140
E_5	8	7	8	9	6	7	7	1	1	7.5147
E_7	5	5	6	6	6	7	5	2	1	4.5875

Abbreviation: KPI, key performance indicator.

process (Chan, Chung, & Wadhwa, 2004). Better time management with buyer approach and order placement may perform as important KPI for the leather products industry.

The next highest-ranked KPI was "operations (KPI_2)" with a weight of 0.1880. Thus, after attaining effective management, the next priority should be given to operations throughout a factory as the overall performance of an industry largely depends on the efficient operations of the production systems. Manufacturing firms often try to improve their operational efficiency for the overall improvement of the firms' performance (Badawy, El-Aziz, Idress, Hefny, & Hossam, 2016). In the leather products industry, many operations-related KPIs could be helped by better knowledge of the actual operational performance. The operations KPI contains different sub-KPIs based on the running of the entire production floor. In this category, five sub-KPIs were assessed for their performance index. In the primary analysis, "scheduled production (order fulfillment cycle time)" was in the eighth position of the BWM analysis. Scheduling is linked with decisions built when the production process is under operation, while planning is associated with decisions made before the production process initiates (Nakamura & Salvendy, 1994). In the leather products industry, scheduled production is an imperative sub-KPI for operational performance.

Next, the sub-KPI "product development accuracy" came ninth in the final ranking. Product development has become a potential strategic activity in many industries as a new product creates an escalating significant contribution to sales and profits (Koufteros, Vonderembse, & Jayaram, 2005). This indicates that accuracy in product development in the leather products industry is crucially important KPI. The sub-KPI "timely target completion" was ranked the tenth position in the global rank. Production achievement is measured in terms of attaining the objectives and fulfilling it on time (Haque et al., 2011). This KPI specifies that the timely completion of production with a target quantity could be an important factor for achieving operational excellence in the industry. The "accuracy in sewing operation" and "timely machinery maintenance" came 14th and 20th in the global ranking. It is important to have accuracy in sewing operations for the manufacturing of quality products; otherwise, it can impact on the performance of the companies. Accordingly, robust machinery maintenance is urgently necessary for

the leather goods manufacturing industry, which can regulate the maintenance costs at the ground level and conserve the overall equipment effectiveness at the highest level (Tu, Yam, Tse, & Sun, 2001). For operation, "scheduled production" is the most important KPI in the category of operations KPI, whereas timely machinery maintenance was ranked toward the bottom. However, it does not mean maintenance is not important because without machinery maintenance, production will be hampered. For operational excellence, both KPIs can contribute significantly.

Next, the KPI "Economic" received the third position in the final ranking, carrying a weight of 0.1683. This KPI is naturally important for the leather products industry as operational excellence significantly depends on economic KPIs. In this category, five sub-KPIs were considered to guide the operational excellence of the leather products industry. The analysis revealed that the KPI "return on investment (ROI)" ranked highest in this category and received the fifth position in the final rank, whereas the sub-KPI "customer-based profitability" was ranked the lowest under this category and nineteenth in the final ranking. "Return on investment," the main KPI under the economy heading, is achieved only when capacity is fully utilized with a lesser number of rejected outputs (Demydyuk, 2012). The KPI "net profit" is ultimately the main concern regarding profit and loss. But almost as important is revenue growth, which is only sustainable when a company's motto is to grow with time. Customer-based profitability is an important sub-KPI as the services and products are sold by the organizations with scant knowledge, disturbing the customers who purchased the products earlier. A transformation from this product-centered to a customer-centered environment is visible in the current environment (Coussement & Van den Poel, 2008). Customer-based profit should probably be included within net profit as net profit plays an inherent part in the economic functioning of the organization (Elzahar, Hussainey, Mazzi, & Tsalavoutas, 2015). "Penalty achievement rate" was rated a little lower because if the other KPIs are prioritized, then penalties can generally be avoided.

Next is the KPI "Quality" got the fourth position in the ranking and confirmed that without quality, a company's reputation is hindered in the market, ultimately affecting all the economic factors. Under the quality KPI, "customer satisfaction" is the leading KPI because the customers' standards guide the quality standard. In the present competitive business environment, customer satisfaction is a progressively significant element of an efficient organization (Fornell, Mithas, Morgeson, & Krishnan, 2006). In order to satisfy customers, a TQM facility should be maintained within the industry. TQM has become an essential management philosophy adopted for enhancing the quality and productivity of the organizations (Karia & Asaari, 2006). The KPI "Total Quality Management (TQM) facility" was ranked 11^{th}. Ensuring these KPIs adhere that would lead to lesser customer complaints. Therefore, the KPI "customer complaints rate" received less priority in the rank. Finally, this would result in a lesser number of rejected defective products. It would seem that quality-related KPIs are more significant for the performance improvement of a company.

The environmental KPI was regarded slightly higher than the social KPI, but not by much. In many factories, they are major concerns because the surroundings must not be affected by the industry. Also, both environmental and social KPIs are key points for satisfying compliance. Thus, if all of the higher ranked KPIs run correctly, the lower ones are automatically taken care of (Bean & Geraghty, 2003). Sustainability and sustainable implementation in businesses can be described as an amalgamation of environmental, social, and economic performance. Therefore, it becomes important for businesses to understand the KPIs to be employed to quantify the environmental, economic, and social aspects (Kocmanová & Dočekalová, 2014).

Environmental and social KPIs are principle points of compliance for industry, and these days, compliance has become a vital issue (Rabhi, 2011). Although these KPIs might come lower down in regard to productivity improvement, they do affect the industry in the long run. In the leather products industry, solid waste is a serious concern. The leather products industry generates an enormous amount of solid wastes far exceeding the quantum of finished goods. It must be disposed of properly so as not to affect the surrounding environment. A major focus of any "environmental management system" is the proper management of solid waste. While being ranked the lowest, social KPIs are still a vital issue. The most significant sub-KPI of social KPI is "employee satisfaction." Employee satisfaction refers to a person's evaluation of the overall quality of his current mission (Jung & Yoon, 2015). Employees who are convinced that their jobs are closely related to improved profit margins and enhanced productivity (Al-Refaie, 2015).

Further, satisfied employees dedicate their full potential for the sake of the company. Workers' safety is also important to keep employees protected from any adverse effects of the industry. Promoting worthy occupational safety practices to workers in the leather products industry results in various advantages, such as enhancements in productivity, lower costs, and increases in organizational capability (Tafere, Beyera, & Wami, 2019). When both the above KPIs are managed effectively, "staff advocacy rate" automatically increases. Lastly, "maternal facility" does not need any separate priority because it would be managed under "workers' safety" and "employee satisfaction" (Shamsaei, Pourshahid, & Amyot, 2010).

5.2 | Discussions on the performance index of case companies

After the assessment of KPIs, we performed some case investigations for four leather products companies, using the identified KPIs. This analysis revealed that the case company "X_5" had the highest performance score of 7.5147, being within the index value rated "good performance level." Next, the performance of case companies X_1 and X_3 were valued as "fair performance level" with performance indexes of 6.5330 and 6.6140, respectively. Although companies X_1 and X_3 have gone through some ups and downs in recent times, they focused on achieving a perfect industrial environment throughout the premises, which further boosted their performance in a short time, even quicker than X_5. Lastly, company X_7 received the lowest performance index of

4.5875. Being a small and young company, it struggles to keep its head within the competition. However, they work hard to build their foundation, offering both local and export orders to progress their commitment to quality gradually.

6 | CONCLUSIONS, IMPLICATIONS, RECOMMENDATIONS AND FUTURE SCOPE

Business organizations are finding it difficult to accomplish operational excellence within their supply chains. However, manufacturing firms in the emerging economies context are trying to achieve operational excellence by being sustainable in the world market. Therefore, only recent business trends reflect the performance of organizations in attaining operational excellence in manufacturing firms. To assist manufacturing firms in achieving operational excellence, they must develop a framework. In this study, such a framework for assessing operational excellence in the leather products industry was proposed using a BWM. A list of 27 KPIs were identified from a literature survey and using feedback of expert's from the case companies. Finally, an assessment model was developed using BWM to assess the individual KPIs and investigate their performance indexes, which helped further to comprehend the current functioning of these case companies. The findings revealed that "Management" KPI received the highest priority, followed by operations, economic, quality, environmental, and social. When management is strong and disciplined, every other aspect remains under control. To advance the operational excellence of the leather products industry, management must play the key role for full capacity utilization, with complete accuracy in product development, satisfying customers by giving them what they need, keeping in mind what returns are achieved for the investments made, ensuring an effective waste management system, and always prioritizing employees' needs and satisfaction (Lindberg et al., 2015).

The analysis also revealed the following priority order of KPIs: skilled management facility of capacity utilization > management facility of production monitoring system > efficient inventory management system facility > product marketing management facility > return on investment (ROI) > customer satisfaction > time gap between buyer approach and order placement > scheduled production (order fulfillment cycle time).

Further, in this study, we examined the case companies' operational performance to develop a policy for sustainable development of the leather products industry. The following implications may assist the leather products industry in advancing their operational performance:

a. *Maximize capacity utilization through skilled management team*: For operational excellence, manufacturing firms need a skilled management team to use the capacity to its highest level. Proper utilization of resources can help achieve the sustainability of supply chains as well as profit maximization. Therefore, leather products manufacturing firms need to develop proper facilities or programmable tools to maximize the utilization of resources.
b. *Proper* management facility of *production monitoring system*: Industry decision makers need to think about the production monitoring system for achieving operational excellence. There is no reliable mechanism available to allow continuous monitoring of all process conditions and quality of leather products (i.e., leather bags, wallet, jacket, and ladies' purse) manufacturing (Gut{t\hskip-0.7ex\char "B8}ă & Dumitrache, 2015). A robust IT framework can assist leather products industry to monitor their real-time production. Therefore, decision makers and the IT department need to work together to develop better production monitoring systems that could enhance the performance of the Bangladeshi leather products industry.
c. *Develop efficient inventory management system*: Real-time monitoring systems must be developed for efficient inventory management in order to achieve a good performance score, indicating operational excellence for their production systems. Therefore, managers of the leather products industry must need to develop a better inventory management system considering various types of inventory control models like production order quantity, economic order quantity, and probabilistic models.
d. *Strong product marketing management facility*: A strong marketing management facility can help to achieve the goals of the supply chain. Hence, decision makers should pay excess attention to product marketing management facilities to enhance the performance of the leather products industry. Therefore, they may develop some business strategies to enhance the performance of the industry.
e. *Maximize the return on investment (ROI)*: Both profit margins and better quality are important issues for operational excellence and sustainability of the leather products industry. Decision makers should establish well-structured supply chain networks for maximizing the ROI.
f. *Better customer satisfaction*: Customer satisfaction is an essential element to success for business organizations. Without considering quality products, a leather product manufacturing firm cannot achieve operational excellence. Therefore, better customer satisfaction can help the leather products industry by providing quality products to the end consumers.

This study provides a pathway to use KPIs to attain operational excellence in the manufacturing industry, but mainly for the leather products industry. However, this study does have some limitations. It did not consider the supply chain 4.0 aspects, a key tool for achieving operational excellence in the industry. In the future, an interrogation of KPIs and supply chain 4.0 could be assessed with statistical validation. Further, an integrated dynamic tool could be established to assess the KPIs and the performance indexes of industry supply chains. The present study could be improved by including more KPIs by organizing a large-scale survey of manufacturing industries.

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SUPPORTING INFORMATION

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