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A practical step towards sustainable development

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Circular economy practices in the leather industry: A practical step towards sustainable development

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ABSTRACT

The concept of circular economy (CE), a recent popular global business trend, considerably minimizes waste and environmental pollution. However, studies exploring CE practices in the context of leather industry have been scant. To deal with this issue, this paper proposes a decision support framework for evaluating the challenges to CE practices in the context of leather industry. Best worst method, a generic decision support tool, is employed in the assessment process. The study findings reveal that "lack of financial support from authorities" is assigned the highest weight in the final ranking results. This indicates that the lack of financial facility poses a major challenge to the successful implementation of CE practices. The findings can assist industrial managers and authorities in taking the required actions to implement CE practices in the leather industry for the sustainable development of the leather sector.

1. Introduction

The use of global natural resources is essential to meet increasing demands; however, these resources are limited. Rapid industrialization has resulted in the excessive exploitation of resources (Chen et al., 2019; Achillas, 2018; Gandhi, 2017; Rasool et al., 2016), leading to resource degradation and environmental pollution. An eco-friendly manufacturing framework is essential for maintaining the environment and developing a sustainable manufacturing system (Gigli et al., 2019; Patra, 2018; Sarkis and Dou, 2018). Environmental problems including biodiversity loss, air and water pollution, and resource depletion have detrimental effects on Earth's life support systems (Rockström et al., 2009; Jackson, 2009). Furthermore, social problems including high unemployment, poor working conditions, and poverty adversely affect society (Badri Ahmadi et al., 2017a,b; Bai et al., 2019; Banerjee and Duflo, 2011; Banerjee and Duflo, 2011). Economic issues, including supply risk and problematic ownership structures, result in financial inconsistencies for corporations and economies (Sachs, 2015; Jackson, 2009). Accordingly, switching to more sustainable practices and production systems is essential (Meadows and Randers, 2012; Markard et al., 2012; Stahel, 2016). The circular economy (CE) concept has received considerable attention among policy advocacy groups to address the pressing sustainability issues (Hankammer et al., 2019; Tate et al., 2019; Brennan et al., 2015). CE practices reduce waste generation and facilitate the reuse of used products, thereby preventing environmental pollution (van Ewijk Stijn, 2014; Baltrusaitis, 2015; Nadeem et al., 2018; Yap, 2005). One of the major industrial sectors in developing countries is leather industry. Raw materials of leather industry come from raw hides and skins and it is available in Bangladesh. Hence, this sector is considered as one of the potential beneficial sectors. Moreover, leather industry needs complex chemical operations to convert the raw hides and skins into finished leather. In the process of converting, the leather industry pollutes environment greatly, therefore, it is considered as one of the most polluted industries (Sathish et al., 2019). CE practices are essential for environmental protection

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and sustainable manufacturing practices (Sfez et al., 2019). In the leather industry supply chain, eco-friendly leather manufacturing processes must be introduced to minimize waste and to reuse tannery waste. Accordingly, the potential challenges to CE practices in the leather industry must be assessed. Such an assessment will help industrial managers to formulate strategic policies for the implementation of CE practices. The literature defines CE as a process in which waste products are considered for reuse or are recycled for further consumption (Ellen MacArthur Foundation, 2015; Skene and Murray, 2015). CE is a closed-loop supply chain that involves the continuous use of materials (Bendikiene et al., 2019; Figge and Thorpe, 2019; Butterworth et al., 2013). Several researchers have evaluated CE practices by focusing on various issues. Due to limited studies on CE in leather industry, we look at a broader literature as we think the challenges to CE in other industries might have commonalities with what we face in leather industry. For example, Geng et al. (2013) measured China's CE performance. Evans and Bocken (2013) demonstrated the CE Toolkit. Through the Circularity Gap Report published in 2018, Circle Economy (2018) indicated the current state of CE in the global economy. Corrado and Sala (2018) reported the bio economy contribution to CE. Araujo Galvão et al. (2018) demonstrated the potential barriers such as technological, customer, financial and economic, policy and regulatory, managerial, performance indicators, and social to CE. It is imperative for the leather industry to implement CE practices, as CE has enormous potential benefits. Therefore, researches on CE in the domain of leather industry may give an overview of the current condition of the industry to develop new strategies for the CE practices implementation. In the context of developing countries, it is difficult to implement CE practices, as several potential challenges are existing. Hence, this study aims to investigate the challenges to CE in the leather industry for the purpose of sustainable development, in the context of emerging economies and developing countries. Specifically, this paper highlights the following research objectives:

(1) to determine the potential challenges to CE practices, with the goal of proposing a framework for evaluating these challenges in the leather industry context;
(2) to determine the relative importance of the challenges to CE practices in the leather industry;

To achieve the research objectives, a literature review is initially conducted to determine the general CE challenges in different industries including leather industry. These challenges are then subjected to several rounds of reviews by industrial managers to propose a comprehensive evaluation framework to address the CE challenges. The overall contributions of this study can be summarized as follows:

(1) A multi-criteria framework for evaluating the challenges to CE practices in the leather industry in an emerging economy context is proposed.
(2) The BWM, a novel multi-criteria decision analysis (MCDA) method, is employed to analysis and identify the importance of potential challenges in an empirical setting.
(3) A real world application of the proposed model is shown in a developing country context.

The remaining of this paper is organized as follows: Section 2 discusses CE, waste generation in the leather industry, existing work on CE, and research gaps. Section 3 provides the research design and methodology. Section 4 presents an example of the application of the proposed research design. Section 5 presents the discussion and managerial implications. Finally, Section 6 presents the conclusions.

2. Literature review

This section first focuses on the CE concept and examines waste generation in the leather industry. Next, this section presents the existing studies on CE and identifies the research gaps.

2.1. Circular economy

CE is a business concept that involves the further use of materials in a restorative and regenerative manner, thereby extending the utility and value of the materials (Gusmerotti et al., 2019; Rajput and Singh, 2019; Larsson, 2018; Sariatli, 2017). CE minimizes material consumption and reduces waste by generating value of the products. The CE concept resembles a closed-loop value chain in which waste materials are reused for consumption. According to Pomponi and Moncaster (2017), value chains are of two types: linear and closed-loop. In linear value chain (Govindan et al., 2020; Sehnem et al., 2019), the raw materials are collected from various sources and then manufactured. During the manufacturing process, a large number of wastes are generated. After manufacturing, the finished products are ready for distribution to different channels and that time logistics wastes are generated. Different types of packaging waste are produced during the subsequent sales and retails activities. Finally, after consumptions of finished products, huge amounts of usage wastes are formed. In the linear manufacturing system, these generated wastes are not considered for remanufacturing. In the circular economy context, the generated wastes from different activities of supply chains are collected from proper channels and returned to a special remanufacturing unit for further reuse. To incorporate the CE practices in supply chains, initially, the "3R" principles were introduced to reduce, reuse and recycle of the energy and materials consumptions (Huang et al., 2018; Wichai-utcha and Chavalparit, 2019). Currently, to improve the supply chain activities, 6R policies are introduced to literature, where additional three dimensions such as recover, redesign and remanufacture are considered (Ghisellini and Ulgiati, 2020). This 6R policy has become popular in developed countries and better results of the supply chains practices have been achieved. In addition, there are several concepts of CE that are existing in the literature, such as cradle to cradle (C2C) (Peterson, 2004), reverse logistics (Lu et al., 2020), closed loop supply chain (Mohtashami et al., 2020) and blue economy (Pauli, 2011). In C2C concept, the main focus is to minimize the environmental degradation via producing socially responsible and more sustainable manufacturing processes, distribution and disposal practices. In reverse logistics system, the take back products are collected to a disposal point to minimize the waste as well as to improve the sustainability of the supply chains (Rezaei, 2015a,b). It is very close to CE practices where the take, back products are used to remanufacture or refurbish. Closed loop supply chain is the circular design of supply chains. The basic idea of closed loop supply chain is quite close to the idea of CE. In closed loop supply chain, basically the recycling and the reuse of the products are considered for closing the loop. It focuses on the importance of coordination mechanism and governance to improve the circular system. It consists of forward and backward supply chain to maximize the profit of an organization. Lastly, the concept of blue economy is a philosophy where local environment and ecological features are focused for sustainable development of a nation economy.

The CE model has become popular for industries to build a sustainable business framework (Koszewska, 2018). One of the key elements for creating a more sustainable society is the CE concept (UNEP, 2006), with considerable implications for social well-being

(Geng et al., 2016) and eco-innovation development (de Jesus and Mendonca, 2018; Genovese et al., 2017). In the microeconomic context, CE business models indicate potential win–win opportunities for companies (Tse et al., 2016; Esposito et al., 2017; Jabbour et al., 2017; Chiappetta Jabbour et al., 2017). The CE concept has gradually developed (Winans et al., 2017) from the conventional linear supply chain and has influenced numerous existing production systems (Korhonen et al., 2018; Stahel, 2016; Lieder and Rashid, 2016). Ghisellini et al. (2016) argued that the limitation of natural resources is the main foundational philosophy of the CE concept. This concept involves the use of post utilization products, resources, and packaging to create additional value through the exchange of linear flows of material and energy for manufacturing and consumption in closed-loop networks (Kirchherr et al., 2017; Moktadir et al., 2018c; Yuan et al., 2006). Corporations have adopted disruptive technologies based on reuse, repair, upgradation, and capacity sharing (Moktadir et al., 2018c; Esposito et al., 2017). The CE concept is a solution for coordinating ambitions for economic gain and environmental conservation (Sassanelli et al., 2019; Geng et al., 2012; Park et al., 2010). CE is an economic system based on economic models (Kirchherr et al., 2018; Murray et al., 2017) and replaces the "end of life" concept with procedures that promote the reuse, reduction, and recycling of materials throughout the production and consumption processes (D'Amato et al., 2017; Shahbazi et al., 2016). Numerous business activists and policymakers have demonstrated their support for the CE concept (European Commission, 2008; Lacy and Rutqvist, 2016). However, research on CE is still in its early implementation phases (Ghisellini et al., 2016; Liu and Bai, 2014). The CE concept as a new economic concept was first adopted by China (de Sousa Jabbour et al., 2018). Within the CE concept, the linear sequence of "take–make–consume," which is the conventional flow of traditional business models, is transformed by the new sequence of "take–make–consume–dispose" (Lieder and Rashid, 2016; Urbinati et al., 2017). Scientific disciplines such as engineering, ecological economics, industrial ecosystems, cleaner production, and product service systems have developed the CE concept (Lifset and Graedel, 2002; Ayres, 1999; Chertow and Ehrenfeld, 2012; Ghisellini et al., 2016; Lieder and Rashid, 2016; Tukker, 2015; Welford, 1998). Murray et al. (2017) revealed that the integration of the social dimension of sustainability into the CE concept has received less consideration. Such limitations must be efficiently adressed for increasing the attractiveness of the CE concept to firms. CE classifies economic systems, positively affecting the environment and social dimensions (Geissdoerfer et al., 2017).

2.2. Waste generation in the leather industry

Leather is a valuable by-product of the meat industry (Swanson, 2018). The leather industry considerably contributes to foreign exchange, but negatively affects the environment. Closed-loop manufacturing practices may considerably minimize the negative environmental effects (Hidalgo et al., 2019; Hu et al., 2011). In the existing supply chain of leather manufacturing companies, considerable waste is generated during the production process. The linear manufacturing system does not consider waste disposal for further use. The closed-loop manufacturing system minimizes waste and protects the environment.

Fig. 1 depicts waste generation in leather manufacturing. The figure indicates that large quantities of waste are generated after the chemical processes involved in leather manufacturing. After the tanning process, from 1100 kg of raw hides and skins and 1462 kg of other tanning inputs, 1986 kg of other tanning waste is produced in addition to 99 kg of shaving waste, 20 kg of trimming waste, and 108 kg of unusable splits (Tegan Pringle, 2017). Furthermore, after the post-tanning process of grain leather, from 262 kg of wet blue grain leather and 4464 kg of other tanning inputs, only 190 kg of grain leather crust is produced. During the conversion of wet blue grain leather to crust leather, 4533 kg of other post tanning output and 3 kg of leather fibers are generated. Similarly, after the post-tanning process of split leather, from 88 kg of wet split leather and 1516 kg of post-tanning inputs, only 59 kg of split leather crust and 4 kg of leather fibers along with 1541 kg of other post-tanning waste are generated.

From the conversion of grain leather crust to finished crust leather, 190 kg of grain leather crust and 74 kg of other finishing inputs are used to produce only 195 kg of finished crust leather. In this process, 4 kg of grain leather offcuts, 1 kg of buffing dust waste, and 64 kg of other finishing output waste are generated. Similarly, from the conversion of split leather crust to finished split leather, 59 kg of split leather crust and 26 kg of finishing inputs are used and 24 kg of finishing waste and 1 kg of split leather offcuts are generated.

Finally, from 195 kg of finished crust leather and 60 kg of finished split leather, 152 kg of cutting waste is produced. After the distribution of leather goods, from 103 kg of leather goods, unknown similar weight of split of waste is generated. It is clear from the data that huge amount of waste is generated from the tanning process. In the current linear leather manufacturing process in Bangladesh, various types of waste is generated like trimmed waste leather, shaving dust, solid waste, tannery effluent. The existing leather manufacturing processes do not consider any optimal waste recovery techniques and policy for CE implementation. In addition, during the production of various types of leather goods and leather footwear, numerous amount of waste like trimmed leather, shaving dust, trimmed lining materials, packaging materials, various types of finishing agents, polymeric materials are generated. The existing linear manufacturing practices are responsible for polluting the environment and Bangladeshi leather industry reputation. In the current practices, a large proportion of the total waste generated from tanning process is still sent to landfill with no material or energy recovery. Hence, converting linear to closed loop manufacturing process helps to achieve resource efficiency by minimizing waste throughout the leather supply chains. The circular economy practice ensures that all wastes will be collected via proper channels and returned to the remanufacturing unit, to be reused. The closed loop leather processing may be implemented by considering 6R (Reduction, Reuse, Recycling, Recover, Redesign and Remanufacture) policy throughout the leather supply chains. The process of closed loop leather processing system can be explained according to the following Fig. 1.

2.3. An overview of the existing work on circular economy

Several researchers have focused on the CE concept as a means to minimize waste and protect the environment. Moktadir et al., 2018c examined the determinants of sustainable manufacturing practices in the leather industry in Bangladesh. Geissdoerfer et al. (2018) proposed a framework to combine circular business models with circular supply chain management (SCM) to achieve sustainable development. Kazancoglu et al. (2018) proposed a framework for green SCM performance assessment based on the CE approach. García-Barragán et al. (2019) utilized a mathematical approach to define and measure CE. Gaustad et al. (2018) examined the application of CE principles to critical and strategic material disruptions. Leising et al. (2018) used three case studies to develop a framework for supply chain collaboration in circular buildings. Principato et al. (2019) investigated food loss and waste in the pasta supply chain based on the CE approach. In addition, Gupta et al. (2018) used big data to develop a stakeholder approach to CE to

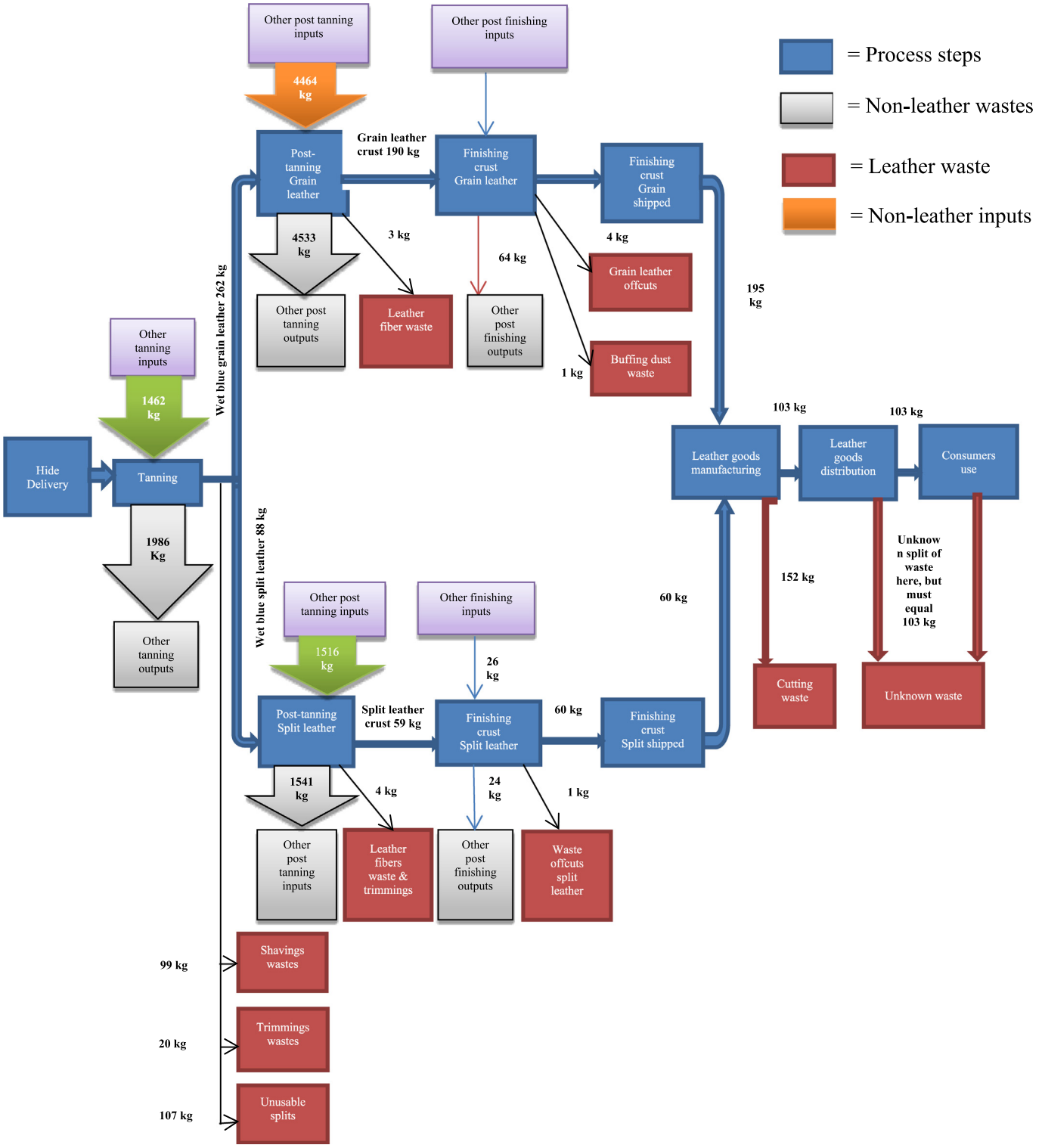

Fig. 1. Waste generated across the lifecycle of leather and leather products (adopted from the study by Tegan Pringle, 2017).

make decisions that can assist the implementation of sustainable business practices based on the CE concept. Kirchherr et al. (2018) used surveys and interviews to analyze the barriers to CE in the context of the European Union. They found that cultural barriers are the main CE barriers faced by businesses and policymakers. Kuzmina et al. (2019) developed five scenarios to investigate the fast-moving customer goods industry within the CE context. Ormazabal et al. (2018) examined the barriers and opportunities of CE implementation in Spanish small and medium enterprises.

2.4. Research gaps

Kazancoglu et al. (2018) indicated that research on CE is still in its early implementation phases and requires much more

investigation and empirical analysis, particularly in emerging economies and developing nations. Moreover, Moktadir et al. (2018c) argued that the leather industry in Bangladesh has negative environmental and social image because of large quantities of waste and material usage, which can be addressed and considerably reduced through the adoption and implementation of the CE concept. Although several studies have investigated the challenges to CE practices, according to the literature review and previous studies presented in Section 2.3, none of those works explore the challenges to CE practices in the context of the leather industry. In addition, some of the authors already worked on leather industry domain for CE model but neglected to investigate impact of CE challenges. As an example, Hu et al. (2011) worked on the CE model for leather industry and explained broadly the different tannery operation for reduce, reuse, recycle and recover of tannery effluent. Authors showed the treatment approaches of various tannery effluents for providing guidance for the sustainable development of leather industry. Authors neglected to identify the challenges for CE implementation which is imperative for policy development for CE implementation. Marques et al. (2017) investigated the waste generated in the Portuguese footwear companies and confirmed that waste produced from footwear industry is aggressive for environment. Authors argued that new approach of design principles including 4R policies for greening the manufacturing practices may help to achieve competitive advantages. Mohamed and Rachid (2015) tried to underscore the importance of implementing CE model in the tannery industry for the achievement of sustainable development goal. Authors suggested that treatment technologies like cleaner technology may help tannery industry to preserve the natural environment along with minimizing huge economic losses. Authors urged that policy is an important issue to overcome the current situation of the developing countries tannery industry. Pringle et al. (2016) proposed an economic decision-making model for recycling solution of leather waste. Authors tried to investigate the opportunities and challenges of CE implementation in the context of leather industry and showed the various recycling options of leather waste management. To fill this gap, this study investigates the challenges to CE practices, particularly focusing on the leather industry, in a developing nation context. Table 1 presents the potential challenges to CE practices, as identified through the literature review. For determination of the challenges (see Table 1) the following criteria were taken into account:

(1) We took into consideration several scientific articles on circular economy. Some keywords such as 'drivers/challenges/key factors/enablers' of circular economy for searching relevant papers on the various scholarly databases were employed.
(2) Scholarly databases including Science Direct, Scopus, Google Scholar, Emerald, Springer, Wiley, Taylor and Francis were used to search the above mentioned keywords. All collected scientific articles were written in English, peer-reviewed and suitable for the purpose of the current study. The next section describes the research design and methodology.

3. Methodology

3.1. Research design

A multiple case study design is followed to achieve the research objectives. Specifically, industrial managers and experts evaluate the challenges to CE practices in the leather sector of Bangladesh. According to Table 1, evaluating the challenges to CE practices is a multi-criteria problem; the MCDA technique can help to solve such problems. Several MCDA methods such as AHP, ANP and TOPSIS are available (refer to the study by Triantaphyllou, 2000; Rezaei, 2018). The current study applies the BWM, an MCDA method that has not been previously utilized in this area. BWM is employed to evaluate the proposed evaluation framework and rank the CE challenges according to their relative importance weights. The next subsection describes the BWM.

3.2. Best worst method

The BWM proposed by Rezaei (2015a,b, 2016) is a powerful and simple MCDA method based on pairwise comparison. The BWM requires less pairwise comparison data and produces more consistent results compared to other methods (Rezaei, 2015a,b). Several applications of the BWM indicate the popularity and robustness of this method, including social sustainability assessment, supply chain sustainability innovation, transportation, and supplier selection (Badri Ahmadi et al., 2017b; Kusi-Sarpong et al., 2018; Bai et al., 2019). The BWM (Rezaei, 2015a,b; 2016) is structured according to the following steps:

Table 1
Potential challenges to CE practices implementation.

Challenges to CE	Author(s)
Lack of technological advancement	Adams et al. (2017b), Tura et al. (2019), Mentink (2014), Winans et al.(2017)
Lack of financial supports from authorities	Paradowska (2017), Moktadir et al., 2018c, Winans et al. (2017), Venkata Mohan et al. (2016), Heyes et al. (2018)
Absent of strong legislation towards CE	Moktadir et al., 2018c, Li and Yu (2011), Borrello et al. (2017)
Complexity in reconfiguring of liner system to circular system	Bechtel et al. (2013), Leino et al.(2016), Ormazabal et al.(2018)
Lack of reverse logistics facility	Adams et al., 2017; van Buren et al., 2016; Zeqiang and Wenming, 2006, Esposito et al.(2018)
Lack of communication framework	Antikainen et al. (2018), Yang (2016), Ghisellini et al. (2018), Vermunt et al. (2019)
Lacking standardization of recycled products	Vermunt et al. (2019), van Buren et al. (2016), Araujo Galvão et al. (2018), Ritzén and Ölundh (2017)
Lack of awareness of CE	Moktadir et al., 2018c, Rizos et al. (2015), Ritzén and Ölundh (2017), Govindan and Hasanagic (2018)
Lack of pressure from social community	Melece (2016), Yang (2016), Geng et al. (2012)
Lack of accessibility on real data	Pheifer (2017), Xue et al. (2010), Pan et al. (2015), Huang et al. (2018), Tura et al. (2019)
Limited willingness to collaborate in the value chain	Mont et al. (2017), Bocken et al.(2016), Winans et al. (2017), Urbinati et al. (2017)
Lack of environment management commitment	Tukker (2015), Ghisellini et al. (2016), Ilić and Nikolić (2016)
Lack of waste management facility	Hu et al. (2011), Mohamed and Rachid (2015), Sathish et al. (2019), Zhu et al. (2010), Zhu et al. (2011)
Lack of guidelines for quality of refurbishment products	Benton and Hazell (2013), Chamberlin and Boks (2018), Masi et al. (2018)
Lack of facility of circular procurement	Matsumoto et al. (2016), Kirchherr et al. (2018), Geng and Doberstein (2008)
Uncertainty of return and profit	Despeisse et al. (2015), Tura et al. (2019)
Deficient firms framework to adopt CE practices	Matsumoto et al. (2016), Whalen et al. (2018)
Lack of market mechanisms for recovery	Bilitewski (2012), Bonciu (2014), Rizos et al. (2015), Poppelaars (2014), Zhu et al. (2015), Jagger (2016)

Step 1: Identification of decision attributes by the decision-makers (experts)

The attributes are finalized and denoted as follows. $\{c_1, c_2, ..., c_n\}$

Step 2: Identification of the best attribute and worst attribute by the decision-makers (experts).
Step 3: Construction of best-to-others (BO) vector using a 9-point scale by the decision-makers (experts).

In this step, a score of 1 indicates equal preference and a score of 9 indicates extreme preference. The BO vector is presented as follows:

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

Where, a_{Bj}denotes the preference of the best attribute B over attribute j.

Step 4: Construction of others-to-worst (OW) vector using a 9-point scale by decision-makers (experts).

In this step, a score of 1 indicates equal preference and a score of 9 indicates extreme preference. The OW vector is presented as follows:

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

Where, a_{jW}denotes the preference of the attribute j over the worst attribute W.

Step 5: Determination of optimal weights $(w_1^*, w_2^*, ..., w_n^*)$ of the attributes.

In this step, optimal weights of the attributes are determined such, for all j, that the maximum absolute differences of the pair-wise comparisons from their associated weight ratios are minimized.

A min-max model is then formulated as follows:

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

subject to

$$\sum_j w_j = 1 \quad (1)$$

$w_j \geq 0$ for all j.

Model (1) can be converted to the following linear programming problem and is presented as follows:

min. ξ^L

subject to,

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

$$|w_j - a_{jW}w_W| \leq \xi^L \text{ for all } j$$

$w_j \geq 0$ for all j

$$\sum_j w_j = 1 \quad (2)$$

for all j.

Through the use of Excel Solver (www.bestworstmethod.com), model (2) is solved and the optimal weights $(w_1^*, w_2^*, ..., w_n^*)$and ξ^{L*} are acquired. The notation ξ^{L*} indicates the comparison system's consistency. A lower value of ξ^{L*} means higher consistency in the comparison system; accordingly, the comparisons are more reliable.

4. A real-world application

Bangladesh is in the early phases of the implementation of sustainable manufacturing practices as well as the CE concept (Moktadir et al., 2018c). The proposed decision support tool is used to assess the challenges to CE practices in the leather industry in Bangladesh. The leather industry is one of the crucial industrial domains in Bangladesh. The leather industry considerably contributes to economic growth and is the second highest contributor of foreign exchange. This industry was established in 1970, as one of the largest industries in Bangladesh. Based on the report of Textile Today dated December 17, 2018 (Textile Today Report, 2018), Bangladesh houses 161 companies in the leather industry. The recent report of export promotion bureau (EPB) for July–Nov (2017–2018) has shown that that export performance was 626.57 million USD (LFMEAB Report, 2019). The data indicates that the annual economic contribution of the leather industry has been noteworthy (Moktadir et al., 2018a, 2018b, 2018c). Moreover, the Bangladeshi leather industry meets 10% of the world's leather demand (Moktadir et al., 2018c). Beside this potentially of the leather industry, Bangladesh ranks 179 among the 180 countries in the world in the 2018 Environmental Performance Index (EPI Report, 2018) which is alarming for the Bangladeshi leather industry. These facts indicate that the leather industry in Bangladesh has considerable scope to keep up with the world market by implementing CE practices. CE practices can help capture global business trends and save the environment and society. In addition, implementing CE policies will help to build a strong brand value and strengthen relationships with international buyers. In this study, six case companies and six experts from major Bangladeshi leather companies are invited to evaluate the challenges to CE practices. These experts are very knowledgeable in the industry. There are several studies in literature that have employed a small number of experts (e.g. Dou et al., 2014; Gupta and Barua, 2018), as in contrast to data-based methodologies, in expert-based methodologies we can rely on a small sample of experts (Rezaei et al., 2012). Hence, we proceeded with this number of managers, because we consider it sufficient for achieving reliable results. The experts are selected from top management, supply chain, logistics, technical, planning, and marketing departments. The experts possess at least 10 years of active work experience in their respective fields and have sound knowledge of environmental management systems. Table 2 presents the profiles of the experts and companies.

As can be seen from Table 2, the experts participated in this study represent a significant (more than 80%) part of the industry (all together produce 325 million square feet of leather out of the total annual production rate which is approximately 400 million square feet of leather). The proposed method is employed in a real-life example and can be found in the next subsection.

4.1. Identification of decision attributes

This section discusses the framework development process of the study. At the first stage, a comprehensive literature review is conducted and 18 potential challenges to CE practices are determined (Table 1). Subsequently, a survey with the mentioned challenges is designed and presented to each of the six managers for their review at different times. They were asked to identify challenges relevant to their firm supply chains by indicating "Yes" as relevant or accept, and "No" as irrelevant or reject. They were also asked to suggest any more relevant challenges to leather industry, according to their experience and knowledge. The research team

Table 2
Profile of assigned experts for evaluating challenges to CE practices.

Case companies with their annual production rate (Total annual production rate is approximately 400 million square feet of leather)	Role of assigned experts in the leather supply chain	Years of working experience
L (120 million square feet of leather)	Chief executive officer (CEO)	20 years
M (85 million square feet of leather)	Supply chain manager (SCM)	13 years
O (45 million square feet of leather)	Logistics manager (LM)	11 years
P (40 million square feet of leather)	Technical manager (TM)	15 years
Q (20 million square feet of leather)	Planning executive (PE)	10 years
R (15 million square feet of leather)	Marketing executive (ME)	12 years

agrees with the experts that the challenges approved by at least five experts would be considered in the next round of review. One additional challenge (Lack of long-term strategic goals) is suggested by one of the managers. In total, four rounds of interviews are carried out to refine the set of challenges. Finally, eight challenges are selected and included in the final list. Table 3 presents the evaluation framework of the study. Several studies in the literature have employed screening approach, and used experts input for the qualification purpose, i.e. whether a particular criterion should be included or not for the evaluation phase (see, for instance, Ahmadi et al., 2017b and Kusi Sarpong et al., 2018).

4.2. Identification of the best and the worst attribute

In this phase, using Step 2 of the BWM, the decision-makers (experts) mark the most critical (best) and the least critical (worst) challenges without any comparison. Table 4 presents the marked best and worst challenges by different decision-makers.

4.3. Best-to-others and others-to-worst attributes

In this phase, using a 9-point scale (see Table 5), the decision-makers construct the BO and OW vectors**.** The BO and OW vectors are presented in Table 6. Moreover, Table 7 demonstrates the weights of the challenges for each of six experts. The optimal attribute weights are simply computed using Excel Solver, fulfilling model (2), as indicated in Table 8.

4.4. Calculating the optimal attribute weights

In the final phase, the optimal weight for each challenge is computed which is shown in Table 7, and the average weight of each challenges obtained by the assigned six experts is presented in Table 8. All the consistency ratios (ξ^{L^*}) are close to zero; therefore, the comparisons are highly consistent and reliable. The ranking of each challenge is based on the final average weights of the challenges. Moreover, the graphical representation of the final weight of each challenge is provided in Fig. 2.

5. Discussion and managerial implications

The findings reveal that "lack of financial support from authorities (Cha2)", with the weight of 0.2023, is assigned the highest ranking, indicating a major challenge to CE implementation. In the leather industry, waste generated from the tannery operations needs proper treatment channel for greening the workforce and environment. For the reduction, reuse, recycling, recover, redesign and remanufacture of waste, huge investment is required. Also, policy development and network design for CE implementation need extra investment for the leather processing companies. Therefore, the financial support from the authorities may help to implement the CE policy for environmental protection and capacity building. Financial support can motivate industrial decision-makers to consider the required actions for the initiation of the CE policy. According to a study by Moktadir et al. (2018c), financial support can help motivate industrial decision-makers to implement sustainable manufacturing and circular economy practices for leather companies. A recent study conducted by Gusmerotti et al. (2019) showed that economic driver is considerable for the implementation of circular economy in the context of manufacturing firms. It is confirmed from the study conducted by Pringle et al. (2016) that financial support is essential for the leather industry because the industry involves complex technical operations for the recycling of waste materials produced from end-use or production process. Hu et al. (2011) urged that leather industry needs circular economy model for the utilization of tannery waste, which will help to achieve sustainability of supply chains. Some researches highlighted that eco-design is mandatory to minimize

Table 3
Final list of challenges to CE practices in the leather industry.

Challenges to CE	Notation	Explanation
Lack of technological advancement	Cha1	CE practices need advanced technological facilities to reuse, recycle, and minimize waste. Lack of technological advancement poses a major challenge to the implementation of CE practices in the leather industry.
Lack of financial support from authorities	Cha2	To develop and implement the CE policy, budget expansion is crucial. Currently, financial facilities do not exist in the leather supply chain.
Absence of strong legislation toward CE	Cha3	Strong legislation facilities may induce industrial decision-makers to implement CE practices to protect the environment and society. Absence of strong legislation toward CE implementation currently poses a major challenge in the current.
Lack of reverse logistics facilities	Cha4	Reverse logistics facility is a prerequisite for CE implementation because of in CE practices, it is necessary to collect used products for reuse. Therefore, CE implementation is not possible without appropriate reverse logistics facilities.
Lack of communication platforms	Cha5	Communication among manufacturers, buyers and sellers, and consumers is crucial for CE implementation. For the effective implementation of CE practices, strong communication platforms framework in supply chains is essential.
Lack of awareness of CE	Cha6	Manufacturers must possess accurate knowledge of CE and world business trends. Currently, decision-makers of the leather industry do not possess adequate knowledge of CE practices.
Lack of pressure from social community	Cha7	A noble society may emphasize the implementation of CE practices for environmental sustainability. However, in developing countries, the people are not aware of sustainable manufacturing practices and the CE concept.
Lack of long-term strategic goals	Cha8	Manufacturers should focus on building strategic goals for the sustainable development of the leather sector. Long-term strategic goals through the practice of current business trends are crucial for sustainable development.

Table 4
Identification of the best and worst challenges.

Challenges to CE	The most important (Best) challenge marked by decision-makers	The least important (Worst) challenge marked by decision- makers
Lack of technological advancement (Cha1)	SCM, LM	
Lack of financial supports from authorities (Cha2)	CEO,TM	
Absent of strong legislation towards CE (Cha3)	ME	
Lack of reverse logistics facility (Cha4)		SCM, LM
Lack of communication framework (Cha5)		
Lack of awareness of CE (Cha6)	PE	
Lack of pressure from social community (Cha7)		CEO,TM, ME
Lack of long term strategic goals (Cha8)		PE

Table 5
Evaluation scale for BWM.

Equally important	Equal to moderately more important	Moderately More important	Moderately to strongly More important	Strongly More important	Strongly to very strongly more important	Very strongly more important	Very strongly to extremely More important	Extremely more important
1	2	3	4	5	6	7	8	9

Table 6
Comparison vector obtained through feedback from decision-makers.

Decision Makers		Challenges to CE							
		Cha1	Cha2	Cha3	Cha4	Cha5	Cha6	Cha7	Cha8
CEO	Best (Cha2)	7	1	3	6	4	5	9	3
	Worst (Cha7)	3	9	5	3	6	2	1	6
SCM	Best (Cha1)	1	3	4	9	5	6	7	2
	Worst (Cha4)	9	6	7	1	3	2	4	5
LM	Best (Cha1)	1	2	4	9	3	6	5	3
	Worst (Cha4)	9	5	3	1	5	2	9	7
TM	Best (Cha2)	3	1	4	5	6	3	9	7
	Worst (Cha7)	2	9	5	3	4	6	1	3
PE	Best (Cha6)	2	4	5	3	7	1	6	9
	Worst (Cha8)	7	6	3	4	2	9	3	1
ME	Best (Cha3)	3	6	1	3	5	4	9	2
	Worst (Cha7)	6	3	9	7	2	3	1	6

Table 7
The weights of eight challenges for 6 experts using BWM.

Challenges	CEO	SCM	LM	TM	PE	ME
Cha1	0.0616	0.3237	0.2855	0.1305	0.2011	0.1243
Cha2	0.3542	0.1360	0.1947	0.3664	0.1006	0.0621
Cha3	0.1437	0.1020	0.0973	0.1074	0.0805	0.3080
Cha4	0.0719	0.0266	0.0202	0.0859	0.1341	0.1243
Cha5	0.1078	0.0816	0.1298	0.0716	0.0575	0.0746
Cha6	0.0862	0.0680	0.0649	0.1432	0.3305	0.0932
Cha7	0.0308	0.0583	0.0779	0.0337	0.0670	0.0270
Cha8	0.1437	0.2040	0.1298	0.0614	0.0287	0.1864
	0.0770	0.0842	0.1038	0.0632	0.0718	0.0648

Table 8
Final rankings obtained via the BWM.

Challenges to CE	Average weight	Rank
Lack of technological advancement (Cha1)	0.1878	2
Lack of financial supports from authorities (Cha2)	0.2023	1
Absent of strong legislation towards CE (Cha3)	0.1398	3
Lack of reverse logistics facility (Cha4)	0.0772	7
Lack of communication framework (Cha5)	0.0871	6
Lack of awareness of CE (Cha6)	0.1310	4
Lack of pressure from social community (Cha7)	0.0491	8
Lack of long term strategic goals (Cha8)	0.1257	5

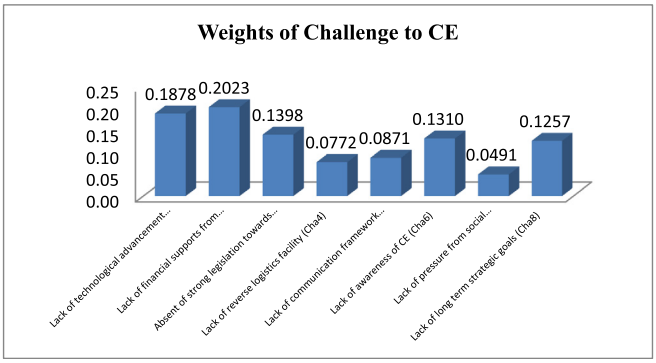

Fig. 2. Weights of challenges to CE practices.

waste in eco-friendly production systems (Pringle et al., 2016; Vermunt et al., 2019; van Buren et al., 2016). Hence, it is clear from the discussion that financial support would help leather industry to develop eco-friendly production systems, one of the major goals of the CE strategy.

Next, the "lack of technological advancement (Cha1)" with weight of 0.1878, is assigned the second-highest weight in the final rank. This result indicates that lack of technological advancement

hampers the CE implementation process. Tannery effluent treatment needs advanced technological facility, which can minimize the waste and protect the environment. Every year huge amount of tannery effluent is directly disposed to the river side which is the major causes of environmental pollution. Therefore, technological advancement optimizes the chemicals used in operations and recycles the effluents generated from chemical operations. To collect used products as well as waste generated in the manufacturing process, well organized supply chain framework is essential. Hence, the technological advancement is essential to implement CE practices in the leather industry for recycling and reducing waste. Advanced technological facility can help to improve the existing problem to implement CE practices. To implement CE practices, leather industry needs advanced technological framework for tannery effluent treatment. Moktadir et al. (2018b) argued that lack of cleaner technology is one of the main barriers for the implementation of sustainable supply chains management practices in the leather industry. Lopes de Sousa Jabbour et al. (2018) confirmed that technological advancement is mandatory for the implementation of CE practices in the supply chains. Another study conducted by Pringle et al. (2016) in the context of leather domain and confirmed that current recycling technologies are not suitable for processing waste associated with the production of finished leather and leather products. Therefore, decision-makers must establish a research and development section within the leather industry for the innovation of cleaner technologies to fulfill the current demand for the minimization of waste and the reuse of waste and chemicals.

"Absence of strong legislation toward CE (Cha3)", with weight of 0.1398, is identified as the third major challenge to CE implementation. Leather industry is producing finished leather, without considering any environmental issues as well as worker safety. During the tannery operations, workers handle the chemical without safety precautions. Also, during the leather processing, leather industry does not consider any treatment facility for tannery discharge. It is matter of sorrow that currently, no strong legislation is available for CE practices in the context of Bangladeshi leather sector. Strong legislation will compel the leather industry to implement CE practices. It can force manufacturer to consider environmental issues as well as pollution control facility. A study by Moktadir et al. (2018c) urged that strong legislation can force the leather industry to implement sustainable manufacturing practices which will help to obtain circular economy goals. Another study by Moktadir et al. (2018b) showed that lack of strong legislation in the developing countries such as Bangladesh act as crucial barriers for leather industry to implement sustainable supply chain management practices. A couple of other works conducted on other domain and stated that strong legislative system helps to provide legal protection for the development of a CE (Li and Yu, 2011; Veenstra et al., 2010). Veenstra et al. (2010) showed the legislation for the waste of electrical and electronic equipment in the context of CE practices of China. Authors mentioned that China adopted 'CE Promotion Law of the People's Republic of China' for the circular economy practices in the year 2009. It is clear from the literature that strong legislation may act as a strong influential driver for the implementation of CE practices.

"Lack of awareness of CE (Cha6)", with the weight of 0.1310, is the fourth major challenge to the implementation of CE practices. Based on the findings, both of manufacturers and customers are not well aware on CE practices. Maximum people of Bangladesh do not consider green products during selling and buying process, as they are not knowledgeable on CE issues. Manufacturers always try to minimize the production cost. Therefore, currently, leather manufacturer of Bangladesh are omitting to produces green products. Awareness which comes from the customer may force the manufacturer to produce green products, as it is a basic requirement of CE practices. Additionally, accurate knowledge of CE practices can motivate decision-makers to implement CE practices in the leather sector, which is also supported by Moktadir et al. (2018c). Malek and Desai (2019) showed that lack of knowledge and training program is the critical barriers for Indian automobile sector towards implementing sustainable manufacturing practices. In the perspective of leather industry, Moktadir et al. (2018b) evaluated the barriers of sustainable supply chain management implementation and mentioned that lack of awareness is the causal barrier and it is the big challenges in Bangladesh for the practices towards CE implementation. Pringle et al. (2016) demonstrated the challenges in attaining circular economy within leather recycling context of European countries, and ignored to take these challenges in the evaluation process. Jacobi and Bensen (2011) mentioned that lack of awareness of society is the obstacle for achieving sustainability in Brazil. Lieder and Rashid (2016) demonstrated the existing literature on CE and confirmed that societal awareness is the crucial driving fuel for transition of linear to circular economy, as customer is an integral part of a CE. Various researches on CE in the context of others domain and other countries confirmed that awareness is the imperative for CE implementation. As an example, Liu and Bai (2014) conducted research on impact of customer awareness in CE practices in the china manufacturing firms context and stated that "a striking "gap" existed between a firm's awareness and its actual behavior in developing a circular economy"; Liu et al. (2009) examined the public awareness and performance for promoting CE in China and confirmed that China residents have poor understanding and a limited awareness about the CE program. It can be stated from the existing literature that customers' awareness for promoting CE can act as the crucial factor. In this regard, appropriate training and knowledge sharing concerning CE issues can enhance the current practices in the industry.

Next, "lack of long-term strategic goals (Cha8)" with weight of 0.1257, is assigned the fifth position in the ranking. Developed countries are now more aware on sustainable development. They are formulating long-term strategic goals for achieving sustainable development goals in industrial sector. Bangladesh is a developing country and the absence of long-term strategic goals in the leather industry is the crucial barriers for CE implementation, as CE needs long-term strategic plan. Without proper long-term strategic plan, it is impossible to achieve the sustainable development goals. Leather industry faces huge trouble in this regards and current export downgrades in the world market. The leather manufacturers are still long way from long-term strategic goals. Long-term strategic goals can help to motivate industrial decision-makers to implement CE practices. CE practices through environmentally friendly practices, such as reverse logistics as well as reuse, recycle, and reduction of waste, can help achieve sustainable business growth in the long-term. CE practices protect the environment by minimizing waste. Therefore, long-term strategic goals are necessary to achieve benefits in supply chain networks. According to Moktadir et al. (2018a), long-term strategic goal may act as crucial challenges to industry 4.0 implementation in the leather domain. Hanmin (2006) showed the importance of strategic goals for sustainable manufacturing in the context of CE. Korhonen (2004) gave an importance of strategic plan for industrial ecology in the context of CE. Therefore, it is concluded that leather industry needs long-term strategic goals to implement CE practices, to ensure the manufacturing practices towards achieving sustainability.

"Lack of communication platform (Cha5)" is assigned the sixth position in the final ranking. A strong communication framework can facilitate the task of smoothening the production system in the leather industry, and such a framework is required to integrate the entire manufacturing system, reducing waste and material

consumption. Currently, leather manufacturers don't consider any communication platform, including enterprise resource planning (ERP) software for integration of supply chain activities. CE implementation needs strong communication platform for maintaining good connection among supplier to manufacturer to consumers. Therefore, leather industry needs to think about communication platform for successfully implementation of CE practices. Several researchers emphasis on communication platform for the successfully implementation of CE practices. For example, Lopes de Sousa Jabbour et al. (2018) demonstrated the roadmap and research agenda for industry 4.0 and CE for the sustainable operations, and showed that communication platform is the key driving fuel for CE implementation. Kalmykova et al. (2018) showed the importance of communication platform for CE practices. So, communication platform is a key element for the CE practices, but the matter of sorrow that leather industry in the context of Bangladesh faces such challenges for the CE implementation.

"Lack of reverse logistics facility (Cha4)" is assigned in seventh position. Reverse logistics facility can help to achieve resource optimization through waste minimization in supply chains. In addition, implementation of CE practices with reverse logistics facility is essential to compete with the global market. Leather products need a good network of reverse supply chains, where manufacturer can take back the waste products as well as used products for 4R policies. Reverse logistics facility may emphasize the tannery and leather goods industry to implement CE practices. Reverse logistics facility is the prerequisite for the CE practices, which is confirmed by previous literature (Adams et al., 2017; van Buren et al., 2016; Zeqiang and Wenming, 2006; Esposito et al., 2018). Lopes de Sousa Jabbour et al. (2018) mentioned that reverse logistics can drive the manufacturing firms to develop industry 4.0 policies towards CE.

The final challenge in the final ranking is "lack of pressure from social community (Cha7), with the weight of 0.0491." Society can act as a pivotal driving force for the implementation of CE practices in the leather industry by motivating decision-makers to redesign the current manufacturing framework. In Bangladesh, the social community is not aware on CE practices. If they aware on CE practices, it can be a great help for the successfully implementation of CE practices across the leather processing supply chains. Geissdoerfer et al. (2017) confirmed the importance of societal pressure for CE practices, for the sustainable development of manufacturing firms. Moktadir et al. (2018a, b) confirmed that societal pressure may act as a driving fuel for sustainable development of leather sector in Bangladesh.

Through the study findings, practitioners and decision-makers can build a resilient business strategy to overcome challenges and cope up with the world market. Financial support from the authorities may help initiate CE practices in supply chains. Accordingly, decision-makers may specifically focus on improving current practices by formulating proactive strategies. The specific managerial implications of this study based on the research findings are as follows:

(1) *Expanding financial facility for CE practices*: Based on the results of this study, lack of financial supports from authorities is the most critical challenge in the leather industry of Bangladesh specifically, and developing countries in general. In order to deal with this issue, Industrial managers from leather industry of Bangladesh could be linked with the government or private organizations in order to receive more financial support for the implementation of CE practices. Implementation of CE practices in supply chains requires considerable investment and budget expansion. Authorities should expand financial facility for the implementation of CE practices, which can help the leather industry to develop a sustainable business policy.

(2) *Establishing technological facility for the initiation of CE practices*: lack of technological advancement is the second most critical challenge in the final ranking. To deal with this challenge, Industrial managers of leather industry in Bangladesh in specific and other developing nations in general, might try to develop some effective technological facilities and attempt to upgrade their technology level in order to better implement CE in their leather supply chains. Leather supply chains involve multiple chemical and mechanical operations. Technological advancement may help to minimize waste and smoothen the CE implementation process. Decision-makers and practitioners should focus on technological advancement to initiate CE practices.

(3) *Developing legislation for CE implementation*: According to the final result, absent of strong legislation towards CE ranked the third most critical challenge. Industrial managers of leather manufacturing companies in Bangladesh could be connected with authorities and government in order to develop some efficient codes and regulations for implementing CE in the leather supply chains. A strong legislation facility is essential to compel practitioners and decision-makers to implement CE practices for environmental protection, especially in the leather industry in Bangladesh.

(4) *Expanding knowledge of CE*: Lack of awareness of CE is in the fourth place in the final ranking list. This challenge seems not to be very important from the managers of Bangladesh leather industry point of view. However, leather industry managers in Bangladesh and other developing nations could try to understand and employ well this concept through linkage with diverse research institutions and environmental conservation organizations in developed countries. Moreover, they can be aware of the potential benefits they can achieve through implementation of this concept in their company. Additionally, authorities should initiate programs for expanding knowledge of CE. Most consumers and manufactures lack knowledge about the CE concept. Accurate knowledge of the CE concept is crucial to sustain in the world market.

(5) *Developing long-term strategic goals*: lack of long-term strategic goals is in the fifth place in the final ranking. Although this challenge is placed in the middle in the final ranking list and it is not the most critical one, however industrial managers from leather industry in Bangladesh as well as other leather companies in developing countries can attempt to establish practical long-term objectives and strategic policies which can broadly take into consideration implementation of CE as well as other sustainable initiatives in their leather supply chains to attain sustainable development. Additionally, industrial decision-makers should forecast the upcoming global trends and develop long-term strategic goals for the initiation of CE practices.

6. Conclusions

Up to now, several researchers have tried to investigate circular economy practices from variety of contexts and categories (e.g. Bendikiene et al., 2019; Gigli et al., 2019; Sassanelli et al., 2019; Gusmerotti et al., 2019). This work proposes a decision framework for evaluating the challenges to CE practices in the leather industry in Bangladesh. This research is the first attempt to determine the challenges to the implementation of CE practices in the leather industry, and to emphasize the importance of CE practices.

Initially, several potential challenges to CE practices were determined according to literature review, and were subjected to several rounds of reviews by leather industrial managers to develop the framework. The framework comprises eight challenges: “lack of technological advancement (Cha1)”; “lack of financial support from authorities (Cha2)”; “absence of strong legislation toward CE (Cha3)”; “lack of reverse logistics facility (Cha4)”; “lack of communication framework (Cha5)”; “lack of awareness of CE (Cha6)”; “lack of pressure from social community (Cha7)”; and “lack of long-term strategic goals (Cha8).” The BWM, a novel MCDA method, was utilized for the first time in this area to assist managers in the evaluation process, as well as in the decision-making and implementation processes. A sample comprising six experts from the Bangladeshi leather industry was used in the evaluation process. CE is a key business strategy for manufacturing industries to reduce waste. The implementation of CE practices is crucial for waste minimization and environmental protection. CE implementation in the leather industry would help to minimize waste. The findings of this study reveal that lack of financial support from the authorities poses a major challenge to the implementation of CE practices in leather supply chains. Lack of advanced technology is the second major challenge. Advanced technology may assist decision-makers in implementing CE strategies in supply chains.

However, this study has several limitations. These limitations provide directions for possible future studies on this topic. One of the main limitations of this study is that a limited number of challenges were considered to identify the impact of challenges on the leather industry context. In addition, we did not investigate the interactions and interdependencies among the identified challenges to CE practices. Another limitation is that limited number of experts and companies participated and provided the data. In future, pilot study can be done to cross check and validate the existing findings, using statistical analysis. We suggest that future researchers try to design policies based on the findings to help the leather industry in Bangladesh. Further, in future, researchers can investigate the interdependences among CE challenges to make policy for leather industry. Possible future studies could use the framework in other countries, industries and manufacturing sectors to assess the challenges to CE practices. Moreover, future studies could investigate the link between the challenges to see how effective policies could make the most improvement. Also, future researches could investigate the link between private sector and government to find solutions against these challenges. In addition, life cycle engineering may facilitate the implementation of CE practices. Clearly, this area of research requires more investigation and managerial focus, particularly in emerging economies and developing nations. This study is considered to help set the foundation for further research on this subject.

Author contribution

Md. Abdul Moktadir proposed the research idea, collected data from case industry, analyzed the data, and wrote the paper. Hadi Badri Ahmadi improved the introduction and literature review sections, completed the research methodology, conclusion and case application sections. Mrs. Razia Sultana helped to collect data, helped to analyze the data and writing the paper as well. Mrs. Fatema-Tuj-Zohra reviewed the manuscript and gave some interactive suggestions at the initial stage. James Liou improved the literature review, conclusion and revised the paper. Jafar Rezaei improved the quality of the whole paper.

Declaration of interests

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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