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Assessing green supply chain practices in Bangladesh using fuzzy importance and performance approach

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ABSTRACT

The contribution of this study is to apply a hybrid method to identify critical green supply chain practices (GSCP) based on importance and performance level under linguistic preferences. The leather industry in Bangladesh is facing acute pressure to minimize environmental pollution. Proper assessment of GSCP ensure effective implementation and thereby helping the industry face environmental challenges. However, there is lack of methods available for the assessment of GSCP concerning their importance and performance attributes under linguistic preferences. This study uses fuzzy set theory to handle fuzziness of human perceptions since the GSCP attributes usually expressed in linguistic preferences. Then, fuzzy importance and performance analysis (FIPA) approach was applied to identify GSCP importance and performance levels. Moreover, FIPA matrix was plotted to determine the critical GSCP as enablers of environmental performance enhancement. Additionally, a comprehensive measurement structure is also absent that requires the inclusion of supply chain partners as aspects. The objective is to assess GSCP based on importance and performance level. The study reveals that supplier and manufacturer viewpoints are the most critical aspects. Furthermore, designing for recycling water and minimizing waste during manufacturing, participation in an ISO 14001 environmental certification system, selection of suitable suppliers based on environmental criteria are the critical GSCP attributes. The managerial implications also are presented. The study presents certain limitations and thus proposes future studies.

1. Introduction

The leather industry has been relocated from the developed world to the developing world primarily of being the cause of environmental vulnerability (Karn and Harada, 2001). Accordingly, this industry has been established in Bangladesh due to having indigenous raw materials in plenty. Although each year the industry earns a considerable amount of foreign currencies through exports (EPB, 2016); it is facing acute pressure in the form of government regulations due to environmental degradation (Arias-Barreiro et al., 2010; Institute, 2013). Because of the government regulation the industry could not expand much despite its huge economic potential. The industry could easily excel in earning more revenue if the environmental issues were properly addressed and remedied. In addition to the government regulations, the industry is facing additional environmental pressures from environmentally conscious customers, as well as domestic and international environmental groups. Hence, the industry urgently needs to take care of the environmental issues. Tseng et al. (2014) highlight that manufacturers

can overcome environmental regulatory pressure by integrating environmental concerns into their supply chain practices. The integration of environmental concerns into supply chain practices is referred to as green supply chain practices (GSCP) (Sarkis et al., 2011). Thus, the adoption of GSCP can improve the environmental performance and thereby make the industry more sustainable. However, the lack of GSCP assessment method in the literature has made it difficult for practitioners to monitor and implement GSCP in the leather industry. Prior to such assessment, there is a need to develop a set of measures to properly assess and implement GSCP in the leather industry.

In the literature, Tseng (2009) presents that the integration of environmental concerns within supply chain management has emerged as a separate and growing discipline. Govindan et al. (2015a) presented GSCP as a hands-on solution to operations managers to achieve competitive advantages and improve their environmental performance. Rao and Holt (2005) concluded that GSCP achieves an efficiency and synergy effect among partner firms with the aim of improving environmental performance, saving costs and minimizing waste. The GSCP acts

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as a proactive measure when facing environmental pressure from national and international agencies by effectively meeting the environmental goals. The objective of the study is to assess GSCP in the leather industry of Bangladesh and identify the critical GSCP attributes for implementation. The question is, what is the proper method to address GSCP?

Previous studies have proposed various methods in assessing GSCP. For example, Tseng and Chiu, (2013) assessed GSCP in a printed circuit board manufacturer in Taiwan using fuzzy-grey relational analysis to select the best environment-friendly suppliers from among the alternatives. Rostamzadeh et al. (2015) employed a fuzzy VIKOR method to evaluate GSCP of a laptop manufacturer in Malaysia to identify the best partners who are concerned about the environment and to rank the important criteria based on preferences. Wu et al. (2015) evaluated GSCP in the Vietnamese automobile manufacturing industry using fuzzy DEMATEL to explore the effect of criteria within GSCP. In addition, Kusi-Sarpong et al. (2016) applied fuzzy-DEMATEL and an Analytical Network Process (ANP) to identify the perceived impact of GSCP on organizationally sustainable performance. However, prior studies are unable to identify the current state of GSCP implementation based on their importance and performance level. Because, it is not clear to what extent the leather industry is practicing GSCP. Thus, an appropriate method is essential to understand the current state of implementation. Moreover, there is a need to identify the critical GSCP for performance enhancement. The industry is currently under pressure to improve its environmental performance. Martilla and James (1977) developed importance and performance analysis (IPA) approach as an assessment tool. IPA is a useful technique to evaluate the attributes based on two-dimensional aspects such as importance and performance. Prior studies evaluate GSCP based on either its performance level or importance level. Thus, a proper assessment method should consider both the dimensions of each GSCP attribute. Therefore, this study applies IPA approach to understand GSCP status-quo properly based on importance and performance levels.

Regarding the measure structure, previous studies suggest that assessment requires set of multiple GSCP attributes. However, there is a lack of studies that concentrate and organized the attributes according to the viewpoints of supply chain partners such as suppliers, customers, logistics service, and manufacturers. Literature suggests that there is a need to develop the GSCP measurement structure based on the viewpoint of supply chain partners (Tseng et al., 2017). Therefore, this study developed a set of GSCP attributes as measurement structure based on four aspects such as suppliers, customers, logistics service providers, and manufacturers.

GSCP attributes typically express in a qualitative manner which requires human subjective perceptions. Subjective perceptions or linguistic descriptions sometimes reflect fuzzy human judgment. However, traditional IPA is based on human subjective perceptions which result in uncertainty. There is a need to address the limitation of uncertainties tainted with human subjective perceptions. Therefore, this study applies fuzzy set theory (Zadeh, 1965) to minimize the uncertainty of human subjective preferences. Finally, the current study employs fuzzy importance and performance analysis (FIPA) to assess GSCP in the leather industry. The applied FIPA hybrid method is useful in collecting and analyzing the data under uncertainties. For instance, Tseng and Bui (2017) had used FIPA to conduct performance and importance levels of qualitative information in the textile industry. Additionally, Chen (2016) applied FIPA technique to identify the critical attributes in the Asia's cruise tourism industry. The application of the FIPA technique in assessing GSCP is scarce in the existing literature. The study questions are as follows:

- What are the GSCP attributes in this study?
- What is the current GSCP importance and performance level?
- How effective is the FIPA approach for identifying critical GSCP for environmental performance enhancement?

The contributions of this study to the existing literature are three-fold. First, this study has developed a novel measure for evaluating GSCP in the leather industry. Second, the proposed FIPA technique in the assessment of GSCP is new. Thus, this study contributes to the existing literature from the methodological aspect. Third, the data from emerging countries also add value to existing knowledge. Moreover, there is lack of scientific study on GSCP from Bangladeshi context (Malviya and Kant, 2015). Therefore, the current study contributes to the literature from an emerging country context. The managerial contributions of this study are twofold. Firstly, this study provides managers with an understanding of how to evaluate GSCP in the leather industry and identify the critical GSCP for performance enhancement. Secondly, this study helps managers to face the challenges from environmentally-conscious buyers and to comply with the environmental regulations by implementing critical GSCP.

The rest of the paper is structured as follows: Section 2 begins with the concepts of GSCP and theoretical background. Section 3, discusses the method used in this study while the results of the study are presented in Section 4. The theoretical and managerial implications are discussed in Section 5. The study is finalized with the conclusion, limitations and direction for future research in Section 6.

2. Theoretical background

This section presents the green supply chain concept and GSCP to understand the debates from prior studies. The sub-sections discuss the proposed measures and assessing method.

2.1. Green supply chain (GSC)

The practice of a GSC among operations managers is gaining popularity, especially those who are pursuing environmental performance within their operations. GSC management refers to environmental management including sharing of information and knowledge with a mutual willingness among customers, suppliers, and logistics service providers to improve environmental performance (Tseng et al., 2016). In the literature different authors defined GSC management in different fashions (Ahi and Searcy, 2013). However, the definitions use several common terms (Sarkis et al., 2011) such as supply chain environmental management, green purchasing and procurement, green logistics and environmental logistics, sustainable supply network management, etc. The GSC network encompasses the suppliers to the manufacturer then to customers, and finally closes the loop (reverse logistics) via the logistics service provider with the help of the customer (Zhu et al. (2008); Tseng et al., 2017). Suppliers are part of the firms' upstream integration and play a significant role in GSC. Conversely, customers are the part of the downstream integration who can collaborate with the firms to protect the environment. Additionally, the logistics service is another partner who works between upstream and downstream and plays a vital role in minimizing the environmental impact through reverse logistics. Finally, the manufacturer is the key partner in the GSC who not only takes care of the environmental impact but also collaborates with customers, suppliers, and logistics service providers to minimize the negative environmental impact.

Several studies have concluded upon the importance of the GSC to minimize environmental regulatory pressure, to handle environmentally conscious customers and community pressure, and to achieve competitiveness (Tseng and Chiu, 2013; Tseng et al., 2018; Zhu et al., 2005). Savita et al. (2016) and Eltayeb et al. (2011), studying ISO14001 certified manufacturing firms in Malaysia, found that GSC management practices significantly improve environmental performance. Rao and Holt (2005), studying the GSC management practices among the organizations in South East Asia, conclude that GSC management not only improves environmental performance but also leads to competitiveness and economic performance. Zhu and Sarkis (2004) conducted empirical research among Chinese manufacturing firms and

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