Journal of Cleaner Production 107 (2015) 229–236

Contents lists available at ScienceDirect

Journal of Cleaner Production

journal homepage: www.elsevier.com/locate/jclepro

Application of analytical hierarchy process to evaluate pressures to implement green supply chain management

K. Mathiyazhagan [a], Ali Diabat [b], Abbas Al-Refaie [c], Lei Xu [d, *]

[a] Mechanical Engineering, ITM University, Gurgaon 122017, Haryana, India
[b] Department of Engineering Systems and Management, Masdar Institute of Science and Technology, Abu Dhabi, United Arab Emirates
[c] Department of Industrial Engineering, The University of Jordan, Amman, Jordan
[d] School of Management, Tianjin University of Technology, Tianjin 300384, PR China

ARTICLE INFO

Article history:
Received 18 February 2015
Received in revised form
23 April 2015
Accepted 25 April 2015
Available online 8 May 2015

Keywords:
Green supply chain management practices
AHP
Mining and minerals industry
India

ABSTRACT

Adoption of environmental management practices is essential in every industry to fulfill the requirement of environmental regulations and customer demands. Globally, developed and developing countries are revising their existing environmental policies to opt for ways to sustain the environment. In this regard, all countries have started to focus on implementing environmental practices like Green Supply Chain Management (GSCM) in all types of industries. Specifically for the case of India more importance has been given to industries which have a big role to play in the nation's economy. In India, mining and mineral industries like multi-national corporations (MNCs) and small & medium enterprises (SMEs) are important contributors to the nation's economy. Indian industries have initiated moves to adopt GSCM practices in their traditional activities due to added pollution from automobiles and also due to tough market competition for a green image, government regulations, pressures from non-governmental organizations (NGOs), customers' demands and media. Similar pressures have occurred in the mining and mineral industries to adopt GSCM concepts. It is practically hard to respond to all the pressures simultaneously and it is also difficult for managers to make decisions in this regard. This paper helps managers identify the primary pressure among available pressures for GSCM adoption. The objective of the study is to investigate the pressures for GSCM adoption and to rank the pressures based on experts' opinion through an Analytical Hierarchy Process (AHP) technique in the mining and mineral industry context.

1. Introduction

Presently, all countries have started to consider environmentally friendly concepts to reduce pollution and to increase environmental awareness (Salimifard and Raeesi, 2014). Green Supply Chain Management (GSCM) and Sustainable Supply Chain Management (SSCM) concepts ensure that environmental practices are adopted by all departments in the industry and that it is also helpful to adopt reverse logistics concept like recycling (Govindan et al., 2015b; Mudgal et al., 2009; Tyagi et al., 2015). This reduces consumption of virgin resources and increases used items (Diabat and Al-Salem, 2015; Diabat et al., 2015). Because of these benefits, GSCM and SSCM concepts are now receiving special attention from academics, practitioners and researchers in the last decade (Abdallah et al., 2013; Govindan et al., 2015a; Al Zaabi et al., 2013; Kannan et al., 2015; Xu et al., 2013a,b; Muduli et al., 2013a,b; Yihui et al., 2014; Kannan et al., 2014; Govindan et al., 2015c). Environmental concepts now receive attention due to pressures like tough market competition for a green image, government regulations, non-governmental organizations, customers' demands, media etc. (Govindan et al., 2015c; Jia et al., 2014; Luthra et al., 2015; Diabat et al., 2014; Mathiyazhagan and Haq, 2013). In addition to this, environmental issues are becoming a serious problem for business research and practice in the last decade due to the rapid depletion of natural resources and concerns over wealth disparity and corporate social responsibility (CSR). Environmental practices are not a stand-alone department process; they are a team activity that involves all departments in the industry from procurement to after sale service (Santos et al., 2013). For example, Eltayeb et al. (2011) pointed out that environmental collaboration of suppliers includes activities to integrate the environmental issues in their traditional activities without violating industrial expectations

* Corresponding author.
E-mail address: chully.xu@gmail.com (L. Xu).

http://dx.doi.org/10.1016/j.jclepro.2015.04.110
0959-6526/

through the capabilities of suppliers at undertaking joint projects to develop green products and innovations. It is evident that industrial environmental improvement depends upon the adoption and maintenance of practices in all departments, to ensure a sustainable environment (Govindan et al., 2014a; Luthra et al., 2015; Zhu et al., 2007; Jindal and Sangwan, 2013; Alzaman, 2014). Mathiyazhagan et al. (2014) and Xu et al. (2013a,b) pointed out that industries are adopting GSCM practices based on indirect motivation (pressure) from different directions. Mining and mineral industries are a sector facing pressure to adopt GSCM practices (Muduli et al., 2013a,b; Jia et al., 2014; Govindan et al., 2014a; Sivakumar et al., 2014). Analyzing pressures for GSCM adoption is a challenging task for all industries, especially those who want to improve their environmental image (Mathiyazhagan et al., 2014; Mathiyazhagan and Haq, 2013; Zhu et al., 2007). Many pressures ensure that environmental practices (GSCM) are adopted by the industry, but industries find it hard to respond to all pressures simultaneously. A detailed analysis is required to identify the pressures influencing to implementation of GSCM in a mining and mineral sector perspective. Past literature about environmental practices like GSCM and SSCM in a mining and mineral industry perspective showed that researchers have started to analyze environmental issues with the help of different aspects like barriers to GSCM (Muduli et al., 2013a,b); and evaluating drivers of corporate social responsibility (Govindan et al., 2014a). But, there is still a research gap in analyzing the pressures for GSCM adoption and ranking those pressures based on importance (Aouam et al., 2009). Accordingly, the objective of this work is to find, analyze and rank pressures for GSCM with the help of Analytical Hierarchy Process (AHP) based on experts' judgments from the Indian mineral and mining industry.

This paper is prepared as follows: Section 2 presents a literature review of GSCM adoption in mining and mineral industries with the help of available resources (journal articles, conference proceedings, etc.). Section 3 illustrates a case study for research. The solution methodology of the study is presented in Section 4. Section 5 describes the questionnaire development and data collection. Section 6 summarizes the findings of the study. Ranking pressures for GSCM adoption are discussed in the results and discussion, Section 7. Finally, Section 8 summarizes the conclusions of the study through the results obtained with the help of AHP.

2. Literature review

The literature review section explores the past research on environmental issues like analyzing the implementation of GSCM practices in mining and mineral industries globally and, more specifically, in an Indian scenario. Improving environmental performance in Traditional Supply Chain Management (TSCM) is a difficult task for company managers (Mathiyazhagan et al., 2014; Muduli et al., 2013a,b; Jia et al., 2014; Mathiyazhagan and Haq, 2013). Managers need a detailed analysis to make decisions regarding environmental aspects for different sectors. These issues are major obstacles in the mining and mineral industries, where the objective of creating a green environment is especially difficult.

Hilson and Murck (2000) analyzed sustainable development in the mining industry from the perspective of corporate responsibility. Humphreys (2001) investigated benefits for implementing sustainable development practices in the mining industry and found that image and returns to capital are improved. Muduli et al. (2013a) analyzed the obstacles for implementing the GSCM in an Indian context with the help of a graphic, theoretic approach. Similarly, Jia et al. (2014) also investigated the needs of SSCM practices in the Indian mining and mineral industry and found the influential SSCM practices with the help of ISM approach. Vintró et al. (2014) analyzed the status of environmental sustainability in Spain's mining sector through a case study. Following this, Kusi-Sarpong et al. (2014) evaluated the green supply chain practices in a Chinese mining industry context by using a joint rough sets and fuzzy TOPSIS approach. Govindan et al. (2014a,b) evaluated the motivations (drivers) of CSR in the mining industry by using the multi-criteria approach of multi-stakeholder perspective. Muduli et al. (2013b) analyzed the role of behavioral variables in GSCM adoption and identified the key variables in Indian mining industries through Interpretive Structural Modeling (ISM). Fonseca et al. (2013) analyzed and summarized the report about sustainability in a mining corporation with the help of a constructive critique of the GRI approach. Gomes et al. (2014) evaluated the main factors for improving business performance through sustainability practices in a Brazilian mineral sector context. More detailed research is available from the following researchers: Fleury and Davies (2012), Giurco and Cooper (2012), Franks et al. (2011), Muduli and Barve (2011), Corder et al. (2010), Nikolaou and Evangelinos (2010).

2.1. Research gap

From the available resources (journal articles, online materials and conference proceedings), the majority of mining and mineral studies are from Australia. Generally, different countries have different opinions about analyzing the environmental issues based on their regulations and customers' demands. So, it is essential to analyze the pressures for the adoption of GSCM (Zhu and Sarkis, 2006; Mathiyazhagan et al., 2013; Govindan et al., 2014b). It is clearly evident that there is a reasonable research gap in analyzing indirect motivations (pressure) to ensure environmental management practices like GSCM. But there is no research, analysis, or ranking of the important pressures which confirms that environmental improvements in an Indian context to analyze the criteria for the green supplier selection are lacking. Only a few studies analyzed the environmental issues from an Indian aspect: the barriers category for GSCM adoption (Muduli et al., 2013a,b; Al Zaabi et al., 2013); the sustainable development review and drivers for GSCM (Diabat and Govindan, 2011), and the critical factors for adoption of GSCM (Luthra et al., 2015). These studies did not focus on ranking the important pressures from a mining and mineral industry perspective. According to Zhu and Sarkis (2006), different countries and industries have different opinions for each factor about GSCM analysis. For this reason, this study is essential to analyze the pressures for GSCM adoption in mining and mineral industries. This work aims to fill this research gap and helps industries, especially managers, affix the primary responsibility for important pressures to GSCM adoption. The literature review demonstrates a research gap for analyzing and ranking the pressures for GSCM adoption in mining and mineral industry perspective with the help of AHP technique.

Table 1 summarizes the 15 identified pressures for GSCM adoption from the literature review and from a discussion with academics and practitioners from the mining and mineral industry. Five groups of academics and ten practitioners were involved in shortlisting the pressures under four categories, namely regulations, external source, financial factors, production and operation factors. These four categories emerged as a result of their similarity in defining their various pressures. This research study was applied to 10 mining and mineral industries located in north India. These 10 industries come under the SME category. These 10 industries extract mineral and coal from the earth. Also, each industry has a good transportation network to send their material to the