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# Analyzing the SSCM practices in the mining and mineral industry by ISM approach

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ABSTRACT

Sustainable development is a concept that attempts to shape the interaction between environment and society, so that advances in wellbeing are not accompanied by deterioration of the ecological and social systems which support life into the future. In this view, Indian mining and mineral industries, especially Small and Medium Enterprises (SMEs), are focused on developing their environmental performance through integrating sustainability practices into traditional supply chain management. They struggle, however, in their attempts to analyze and to identify influential sustainable supply chain management (SSCM) practices in order to increase sustainable performance. This paper analyzes and identifies dominant SSCM practices in the mining and mineral industries with the help of Interpretive Structural Modeling (ISM). The study uses three different research phases: identification of SSCM practices from the literature, interviews with various department managers of the Indian mining and mineral industries, and a survey conducted within the mining and mineral industries. In this paper, 25 SSCM practices were considered in fewer than six categories. Finally, the approach was applied to fifteen mining and mineral industries in India. The results of this study show that suppliers' ISO14000 certification practice acts as an influential role over the recommended 25 SSCM practices. It is inferred that environmental management certification is therefore essential to increase sustainability performances in Indian mining and mineral industries.



## Introduction

Azapagic (2004) pointed out that minerals are essential to everyday life; minerals play a central role in the numerous products we use. Also, mining industries serve an important role in human life through electrical power production. Hence, because both industries are essential for human life, it is important to integrate environmental issues into mining and mineral industries to ensure a pollution-free environment. Mining and mineral industries provide vital raw materials for many industries, including ceramics, construction, cosmetics, detergents, drugs, electronics, glass, metal, paint, paper, and plastics. But mining and minerals industries face challenges in their attempts to maintain sustainability developments in traditional supply chain management. Sustainable Supply Chain Management (SSCM) is a concept to ensure sustainability in Traditional Supply Chain Management (TSCM) (Kuik et al., 2010). In recent years Indian mining and mineral industries play a notable role in the Indian economy (Muduli et al., 2013a, 2013b) and they also face many pressures from government regulations and foreign customers. Based on these points, there is no way for mining and mineral industries to escape the adoption and analysis of sustainability in TSCM. Indian mining and mineral industries need to think about adopting sustainability practices in TSCM. In this regard, many industries have started to analyze the environmental issues in Indian mining and mineral industries (Muduli et al., 2013a). But because they did not focus on analyzing sustainable practices, they have struggled to identify the influential SSCM practices with the intent of improving sustainable performance. There is a significant research gap in analyzing SSCM practices, and similarly, there is no research to identify influential SSCM practices in Indian mining and mineral industries. For this reason they have started to think about developing the industry as it is one that strongly supports the Indian economy financially. Consequently, the objective of this study is framed to analyze SSCM practices in mining and mineral industries.

The objective of this work is to identify the dominant SSCM practice from the recommended SSCM practice list and to investigate the essential and mutual relationship of the 25 practices for adoption of SSCM in 15 mining and mineral industries in India using an ISM technique and experts' judgments. The results might impact environmental adoption in traditional supply chain management. It can also be extended to all industries in India. The resulting discussions and conclusions are achieved from an extensive survey, site visits, and

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interviews. This paper is organized as follows. Section 2 summarizes literature support for this study and Section 3 presents the justification for the research gap of this paper. Section 4 describes the case study. Section 5 describes the methodology for a solution. Section 6 reveals developed questionnaires for data collection, and Section 7 presents the results of this study. Section 8 provides the conclusions and remarks, managerial implications and limitations, and considers the future scope of this research.

## Background of research

Due to pressures from government regulations (Govindan et al., 2014; Jayaram et al., 2012) and societies toward environmental protections from pollution and from transport (Salimifard and Raeesi, 2014), mining and mineral industries have started to adopt environmental management practices in the last two decades (Nikolaou and Evangelinos, 2010). Hilson and Murck (2000) explore the needs of mineral resources of contemporary society and the current debates about mining, because mining and mineral industries are in a position to pursue the adoption of sustainability issues. Nikolaou and Evangelinos (2010) analyzed the Strengths, Weakness, Opportunities, and Threats (SWOT) faced by the industry when adopting environmental management practices from a Greek mining and mineral perspective. They also highlighted the benefits and challenges in adopting environmental management practices in mining and mineral industries. These industries have benefited from recent updates and new technologies and innovations such as thickened tailings, dry stacking, and paste backfill which are used to dispose waste and improve sustainable development. Generally, sustainable development is a challenging process for researchers and practitioners. It needs further analysis and it requires the support of all levels of the organization, from top management and all lower level laborers. Sustainable development is a concept that integrates the needs of both the environment and society, so that advances in wellbeing are not accompanied by the deterioration of ecological and social systems which support life into the future (WCED, 1987). Sustainable development is important and essential strategies are incorporated into all actions related to the planning and management of natural resources from economic, environmental, and social perspectives (Muduli et al., 2013a; Kannan et al., in press). Analyzing sustainability management is challenging for tailings and waste rock disposal because several questions need to be considered. Is the material inert? If not, is it stable and contained? The objective is to minimize water and energy inputs and to reduce the surface waste footprint with the larger goal of locating alternate uses. From an Indian and global perspective many researchers and practitioners have analyzed environmental and sustainability issues in TSCM of mining and mineral industries. Specifically, many Indian researchers contributed research on analyzing the barriers for green supply chain management (GSCM) in mining and mineral industries through a graph theoretic approach (Muduli et al., 2013b). Worldwide research on sustainable and environmental issues in mining and mineral industries, demonstrating practices similar to India, were broadly summarized in the research gap section. This research gap section clearly informs that there are no current research initiatives that successfully analyze SSCM practices in an Indian context, and there is no research specifically devoted to the identification of influential SSCM practices in an Indian perspective.

## Research gap

The primary focus areas of research on environmental practices in Indian mining and mineral industries from different perspectives include an such as analysis of barriers to GSCM (Muduli et al., 2013b), the role of green issues (Muduli and Barve, 2011), sustainable development of the Indian coal sector (Chikkatur et al., 2009), and challenges of adopting environmental management practices (Barve and Muduli, 2011). But these studies do not pursue SSCM practices in Indian mining and mineral contexts, and no research for identifying the influential SSCM practices exists. It should be apparent that a significant research gap is present with the important objective of improving environmental performance in mining and mineral industries. This paper fills that gap and brings a benchmark study in analyzing SSCM practices in the Indian mining and mineral industries.

## Case study description

Corder et al. (2010) pointed out that integrating sustainable development elements into the mining and mineral industries are increasing in importance. Kumar et al. (2006) mentioned that SMEs' contribution to Indian mining and mineral industries are notable and that this sector contributes to the economy and employment.

More than 3000 SME mining and industrial units contribute about 50% of non-fuel mineral production to the Indian economy. Also, these SMEs provide jobs for more than 300,000 people. Generally, Indian SME owners have less awareness about technical and financial capabilities for proper exploitation, mining development, mineral extraction or processing, so it is more difficult for these owners to get a clear idea about analyzing sustainability issues in TSCM in their industries. Nevertheless, the goals of improving the environmental performance and reducing pollution are critical. Perhaps the most challenging problem for Indian mining and mineral industries is an effective analysis of sustainable practices, so this paper gives a solution to the above problem by exploring sustainability issues in TSCM. We also examine SSCM practices from all available approaches, under six categories, and we identify the most influential SSCM practices from the recommended list. From the detailed literature review and from discussions with industry experts, 25SSCM practices have been identified and categorized under six groups based on their meaning and similarities. Table 1 illustrates these SSCM practices with appropriate references.

## Solution methodology

This paper uses an ISM approach to identify the influential role of 25 SSCM practices in an Indian mining and mineral context. The importance of the ISM approach and steps for the ISM are described below.

### *Interpretive structural modeling*

In 1974, Warfield introduced the ISM approach to identify interrelationships between factors from a recommended list (Jindal and Sangwan, 2013; Kannan and Haq, 2007a; Kannan et al., 2009). This approach was also used to identify the influential role of factors from a recommended list, and it suggested the use of expert opinions based on various management techniques such as brainstorming, nominal technique, etc. to develop a contextual relationship among variables. Attri et al. (2013) summarized that the ISM technique was an interactive learning process where a set of different and directly related elements are structured into a comprehensive system model. In addition, ISM is a better approach to solve the complexity of relationships with many elements (Mathiyazhagan and Haq, 2013). Similarly, Ansari et al. (2013) pointed out that ISM enables individuals or groups to develop a map of the multiple relationships between many