A Study on the Drivers Affecting the Implementation of Green Supply Chain Management

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Abstract— Green supply chain management has developed as an essential hierarchical logic to decrease ecological dangers. The aim of the article is to introduce the components that influence the executions of green production network administration utilizing an Interpretive Structural Modeling (ISM) system. There are external and internal variables that influence the greening of a supply chain. Making green supply chains come about because of a want to consider this idea inside the organization as well as its association with nature. Certification of suppliers' environmental management frameworks is a standout amongst the most critical factor for greening the supply chain. Environmental collaboration with customers and suppliers can also encourage the greening the supply chain. The greening supply chain has relied upon the environmental practices within the organizations. The various drivers of green supply chain management (GSCM) are identified based on the GSM literature and on consultations with experts in the industry.

Index Terms— Drivers, Environmental management, Factors, Green Marketing, Green supply chain management (GSCM), International Relations, Interpretive Structural Modeling (ISM), and Supply Chain Management

1 INTRODUCTION

Increasingly, organizations are perceiving that environmental management is a key strategic issue with the potential for an enduring effect on organizational performance. For instance, more than 40,000 organizations have executed ISO 14001, the environmental management framework standard [1]. Greening the supply chain is increasingly a concern for many business enterprises and a challenge for logistics management in the 21st century. Of particular concern is how to raise organizational environmental awareness incorporate environmental management practices into their logistics activities [2-4]. According to Zhu and Sarkis [5] and Zhu et al. [2-4] green supply chain management (GSCM) encompasses a set of environmental management practices which are useful for logistics management and are designed to incorporate environmental considerations into the forward and reverse logistics. Examples of green supply chain management practices include reducing packaging and waste, assessing suppliers based on environmental performance, developing more eco-friendly products, and reducing carbon emissions associated with the transport of goods [6].

At present, the decrease of monetary activity impact on environmental is a contemporary test, considering all production network's connections, the interrelationships and communications amongst them and the common habitat. Companies must begin to analyze its influence on the environment, not only for internal activity, but also for the whole supply chain, therefore the term "greening" supply chains becomes more popular. Companies try to integrate its environmental activities, have in mind that this is the most efficient and effective approach, which caused that term GSCM (Green Supply Chain Management) has showed up. The principle thought of the "greening" of the store network has turned into an association and collaboration.

The motivation behind this article is to recognize and attributes of chose factors prompting elements to "greening" of supply chain management.

The main objectives of this paper are:

- To distinguish and rank the drivers that can influence the usage of a green store network;
- To determine the interactions among the identified drivers; and
- To understand the administrative ramifications of this research.

2.1 Green supply chain definition

Various definitions of GSCM exist in the literature. The following paragraph summarizes some of the definitions of GSCM that have appeared in the literature.

According to Gilbert [7], greening the supply chain is the process of incorporating environmental criteria or concerns into organizational purchasing decisions and long-term relationships with suppliers. Indeed, there are three approaches to GSC: environment, strategy, and logistics. Furthermore, the concept of green productivity (GP) shows that, for any development strategy to be sustainable, it needs to have a focus on environment, quality, and profitability, which form the triple focus of GP [8-9]. Kogg [10] used the definition of GSCM given by Zsidisin and Siferd [11]: "the set of supply chain management policies held, actions taken and relationships formed in response to concerns related to the natural environment with regard to the design, acquisition, production, distribution, use, re-use and disposal of the firm's goods and services". Srivastava [12] defined GSCM as "integrating environmental thinking into supply chain management, including product design, material sourcing and selection, manufacturing processes, delivery of the final products to the consumers, and end-of-life management of the product after its useful life". GSCM is a concerted effort throughout the company and is more than simply putting some green practices in place, but rather a consistent, holistic improvement of the environmental

performance of all levels of management and on the shop-floor [13]. Rettab and Ben Brik (2008) defined the green supply chain as a managerial approach that seeks to minimize a product or service's environmental and social impacts or footprint. According to Zhu et al. [2-4], GSCM "ranges from green purchasing (GP) to integrated life-cycle management supply chains flowing from supplier, through to manufacturer, customer, and closing the loop with reverse logistics".

Green supply chain includes activities related to product design, material procurement, production and delivery of the final product to recipient, as well as product management in postconsumer phase [14]. Green supply chain management (GSCM) is in turn defined as the direct involvement of companies with suppliers and customers in a common plan to reduce the environmental impact of production processes. These actions mean that the cooperation between suppliers and customers should be enhanced in order to reduce the impact on environmental, connected with the flows in company's operational activities [15].

At this point, it is worth to note the differences between the concept of cooperation and integration. Both are often treated as synonyms, because in both cases it is said about coupling the processes carried out between the supply chain partners. Integration refers, however, to more unified control of sequentially executed or similar processes that run independently. Therefore integration puts emphasis on the centralization of control, ownership supervision regulated by mutual agreements. Cooperation is, however, a kind of managing hybrid that connects horizontal integration with the market exchange. Cooperation, in the greater extent, is the relationship management between suppliers and customers. Therefore, it will verify in case of supply networks, that are more flexible, and acting, within its framework, entities more autonomous than in the classic supply chain [16].

Due to the complex nature of supply chain management, in the literature, the GSC is discussed from different perspectives (areas). According to M. M. Hervani, M.M Helms and J. Sarkis, green supply chain management includes: green purchasing, green manufacturing, and materials management, green distribution and marketing and reverse logistics [17].

3 Problem Description

The company under investigation is a leading firm which produces aluminum items in Bangladesh. The company produces aluminum sheets, circles and kitchenware items, for example, aluminum frying pans, pressure cookers, sauce pots and saucepans. The firm is well-known in Bangladesh as a pressure cooker manufacturer and a supplier of aluminum frying pan. The fabricated item is circulated in and around the state and to different states through a system of merchants. Because of environmental enactment the organization is intending to actualize green production network idea. Picking the drivers that are critical to executing green store network administration hones includes a writing audit and a basic leadership group which incorporates specialists from the business. The significant drivers engaged with this examination are given in Table 1.

Table 1. Drivers of green supply chain management

Sl. No	Drivers	References
1	Certification of suppliers' environmental management system	[1-5], [21], [23-24]
2	Environmental collaboration with suppliers	[1-5], [18-20],[23-28]
3	Collaboration between product designers and suppliers to reduce and eliminate product environmental impacts.	[1], [5], [18-20]
4	Government regulation and legislation	[6-8]
5	Green design	[1-5]
6	ISO 14001 certification	[1-5], [20], [22-28]
7	Integrating quality environmental management into planning and operation process	[1-4]
8	Reducing energy consumption	[20-22], [29]
9	Reusing and recycling materials and packaging	[20-24]
10	Environmental collaboration with customers	[2-4],[20-21],[23-24]
11	Reverse logistics	[2-4], [18-19], [22-28], [30]

5 Solution Methodology

In this work, the system of Interpretive Structural Modeling (ISM) is utilized. ISM was created for complex circumstances as a specialized instrument. The numerical establishments of the ISM strategy can be found in different reference works while the philosophical reason for the advancement of this approach has been displayed in literature [18-25]. ISM has been utilized for arrangement investigation [20-26] and, as of late, administration look into [27-30].

The primary advantages of the ISM technique is that it changes vague and inadequately explained models of frameworks into unmistakable and very much characterized models. Nonetheless, the ISM philosophy has certain disadvantages also in the literature [10-18]. There will be the subjective inclination of the individual who is judging the factors, as the relations among the factors dependably relies upon that individual's information and commonality with the firm, its operations, and its industry; this predisposition will influence the last model. Besides in ISM no weights are related with the factors to give their relative significance. The different advances associated with the ISM technique are given underneath in this paper.

Step 1: The drivers affecting the implementation of green supply chain management for the firm under study are listed.

Step 2: For each pair of drivers identified in Step 1, a contextual relationship is established.

Step 3: A Structural Self-Interaction Matrix (SSIM) is developed, which indicates pairwise relationships among drivers of the system under consideration.

Step 4: A reachability matrix is developed from the SSIM and the matrix is checked for transitivity. The transitivity rule states that if a variable 'A' is related to 'B' and 'B' is related to 'C', then 'A' is necessarily related to 'C'.

Step 5: The reachability matrix obtained in Step 4 is partitioned into different levels.

Step 6: Based on the relationships given above in the reachability matrix, a directed graph is drawn and the transitive links are removed.

Step 7: The resulting digraph is converted into an ISM by replacing the variable nodes with statements.

Step 8: The ISM model developed in Step 7 is reviewed to check for conceptual inconsistencies, and necessary modifications are made.

We now apply the ISM methodology to the firm under study. Each of the following subsections corresponds to one step of the ISM methodology.

Identification of the various drivers involved in the implementation of green supply chain management under study:

The various drivers important to the implementation of green supply chain management practices were identified based on literature review and a decision-making team which included experts from the industry. The major drivers identified in this study are given in Table 1. The different drivers imperative to the usage of green production network administration rehearses were distinguished in view of writing audit and a basic leadership group which included specialists from the business. The real drivers recognized in this examination are given in Table 1.

Improvement of Structural Self-Interaction Matrix (SSIM):

In view of logical relationship among recognized drivers, a Structural Self-Interaction Matrix (SSIM) was created (Table 1). This matrix indicates the pairwise relationships among the drivers affecting the implementation of green supply chain management initiatives for the firm under consideration.

The symbol used to indicate the course of the connection between the drivers are given underneath. Let us assume that the drivers under study are i and j, then the symbol 'V' signifies that driver i will help to achieve driver j, the symbol 'A' means that driver j will be help to achieve driver i. The symbol 'X' means that drivers i and j will help each other to be achieved, and the symbol 'O' means the drivers are unrelated.

V – Driver i will accomplish Driver j;

A – Driver j will accomplish Driver i;

X – Drivers i and j will help to achieve each other; and

O – Drivers i and j are random.

The following statements illustrates the use of symbols V, A, X and O in the SSIM matrix.

• Green design driver will accomplish decrease in energy utilization (V); and

• Green design driver will be achieved by reverse logistics driver (A).

Reachability matrix:

We got the reachability grid from the auxiliary self-collaboration framework (SSIM) created in the past advance. The underlying reachability lattice is built from the basic self-connection network (SSIM) utilizing the accompanying standards:

• If the (i, j) section in the SSIM is V, the (i, j) passage in the reachability framework is set to 1 and the (j, i) section is set to 0.

• If the (i, j) section in the SSIM is A, the (i, j) passage in the reachability framework is set to 0 and the (j, i) section is set to 1.

• If the (i, j) entry in the SSIM is X, the (i, j) entry in the reachability matrix is set to 1 and the (j, i) entry is set to 1.

• If the (i, j) entry in the SSIM is O, the (i, j) entry in the reachability matrix is set to 0 and the (j, i) entry is set to 0.

The last reachability network is developed from the underlying reachability lattice considering the transitivity run, which expresses that if a variable 'An' is identified with 'B' and 'B' is identified with 'C', at that point 'An' is fundamentally identified with 'C'.

Level partitions:

The reachability matrix obtained in Section 4.3 above was partitioned into different levels. The reachability and antecedent set for each driver discussed in Table 1. The reachability set for an individual driver consists of itself and the other drivers which it may help to achieve.

The antecedent set consists of the drivers themselves and the other drivers which may help in achieving it. The intersection of both these sets was also derived for all drivers. If the reachability set and the intersection set for a given driver are the same, then that driver is considered to be in level I and is given the top position in the ISM hierarchy. With this partition, iteration 1 is completed. After the first iteration, the drivers forming level I are discarded and with the remaining drivers, the abovementioned procedure is continued in iteration 2. These iterations are continued until the levels of each driver has been found. Table 1 implies that the green design, integrating quality environmental management into planning and operation process, reducing energy consumption, and reusing and recycling materials and packaging drivers are positioned at level I and form the top level in the ISM hierarchy.

The environmental collaboration with suppliers, environmental collaboration with customers and ISO 14001 certification drivers are positioned; the certification of suppliers environmental management system driver is placed in Fig. 1; the

collaboration between product designers and suppliers to reduce and eliminate product environmental impact drivers is discussed and the remaining drivers (government regulation and legislation; reverse logistics) are described in Flow chart 1 & 2 (Appendix Section) .The initial iteration and final level of each driver is given in Tables 1 and Flow chart 1 & 2 (Appendix Section), respectively.

CONCLUSION

The drivers associated with the execution of green supply chain management for the firm under investigation posture impressive difficulties for the administration of the firm. Because of the intricacy of GSCM practices, client and cost weights and direction vulnerability. Decision makers must know about the relative significance of the different drivers and the procedures for executing them. Featuring the 11 types of drivers Flow Chart 2 (Appendix Section), an ISM show was created and the collaboration between these drivers were dissected for the firm under examination utilizing the ISM demonstrate.It is evident that government regulation and legislation and reverse logistics are significant drivers to achieve the collaboration between product designers and suppliers to reduce and eliminate product environmental impact driver, which is in tern critical to achieving the GSCM certification of suppliers' environmental management system driver. Environmental collaboration with suppliers, Environmental collaboration with customers and ISO 14001 certification are placed at an intermediate level of the ISM model. Green outline, integrating quality environmental management into the arranging and operation process, decreasing vitality utilization, and reusing and reusing materials and bundling drivers are at the best level of the ISM progressive system.

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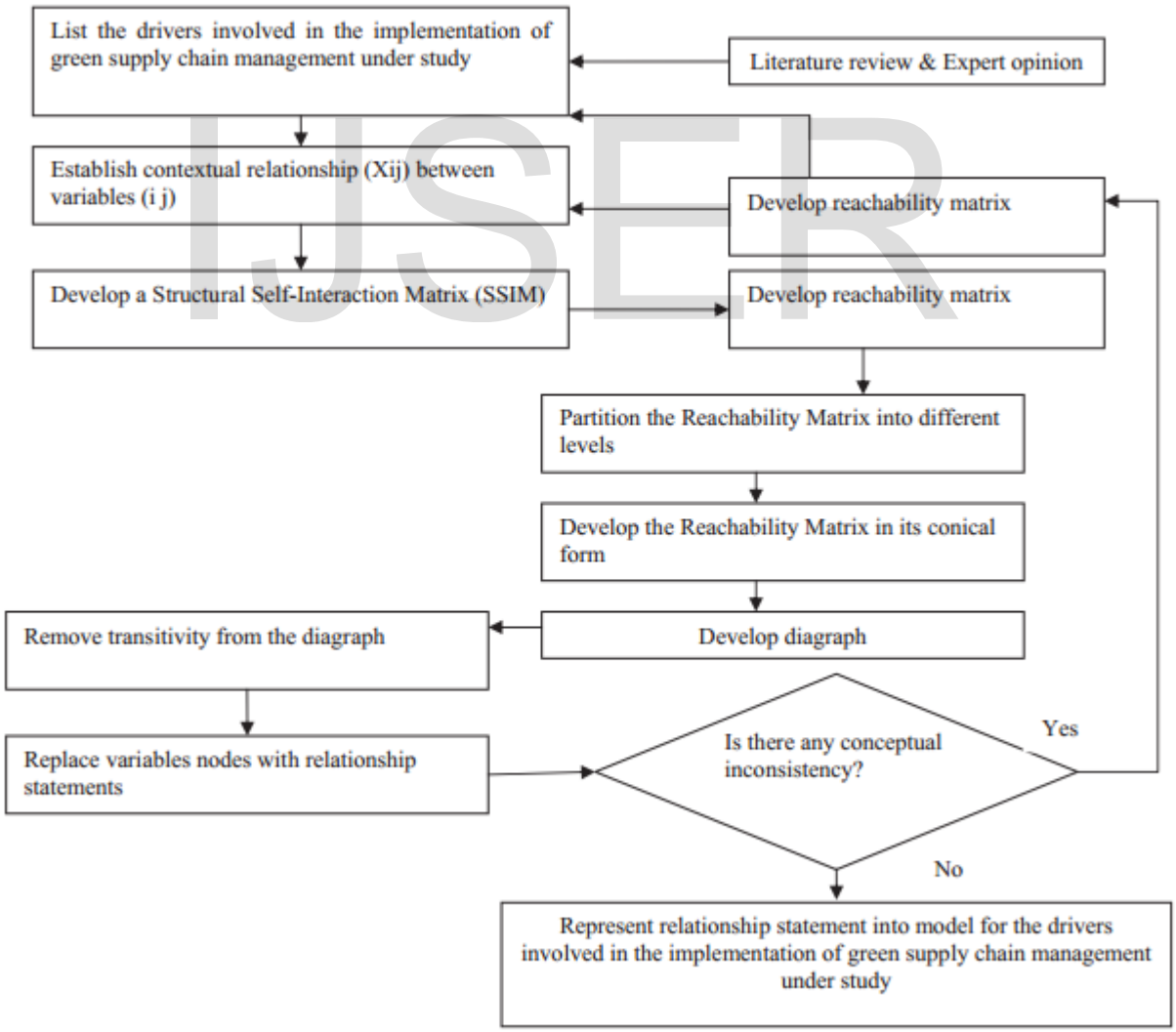
APPENDIX:

Flow chart 1: Flow chart for the ISM methodology.



Flow Chart 2: ISM model for the drivers affecting the implementation of green supply chain management.