Evaluation of the Effective Barriers in GSCM implementation Using DEMATEL Method (Case study: Iran Khodro CO)

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Abstract: The purpose this study is Evaluation of the Effective Barriers in GSCM implementation Using DEMATEL Methods and the impact of these factors on each. To identify critical influential factors, the authors studied and reviewed relevant literature from numerous fields of study associated with the essential issues of GSCM. This research uses the DEMATEL method as the tool that determines the Prioritization and Influence severity of each factor. The results show Organization Management has great impact on success of GSCM implementation among main aspects. Among criteria of Organization Management, Lack of top management support has Great Influence on other criteria. Also, among criteria of Organizational Culture, the lack of incentive legislation for the Green Supply Chain has Great Influence on other criteria. Also, among criteria of Organizational Structure, Lack of information and data required has Great Influence on other criteria. Also, among criteria of Rules and guidelines , Lack of supply chain integration has Great Influence on other criteria.
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1. Introduction

The rapid of environmental issues throughout the world have increasing much concern from customers, buyers, communities and also government. For instance, both the local or international customers and buyers are now requiring their suppliers to make environmental friendly products. Ho et al. (2002), Giannakis and Croom (2004) and Chen and Paulraj (2004) take a strategic management perspective to address theory development in the SCM area. Likewise, New (1997) provides a thematic overview of the SCM literature. Some of the reviews are narrowly based along functional lines; for example, Skjoett-Larsen's (1999) review is focused on the logistics discipline while Larson and Halldorsson's (2002) review is based on the purchasing literature. GSCM is defined to be the addition of green issues into supply chain management (Hervani et al., 2005). In addition, Zhu and Sarkis (2004) state that GSCM supply chain involves from suppliers to manufacturers, customers and reverse logistics throughout the so called closed-loop supply chain. Hervani et al. (2005) indicate there are various activities involving GSCM such as reuse, remanufacturing, and recycling which are embedded in green design, green procurement practices, total quality environmental management, environmentally friendly packaging, transportation, and various product end-of-life practices. Green supply chain management (GSCM) is one of the corporate environmental management that had been recognized and applied by among manufacturing companies. It aims to reduce or minimize negative environmental impact such as pollution, waste of resources, and product dumping. GSCM was starting debated since the quality revolution of the 1980s and supply chain revolution of the 1990s.Zhu and Sarkis (2004) defined GSCM has a ranged from green purchasing to integrated supply chains starting from suppliers, to manufacturer, to customer and reverse logistics.

All of business activities related to green supply chain management (GSCM) have played as an important role to environmental management factors applied for the purpose of business manufacturer. Scholars and practitioners explore the close relationship between supplier's product quality and environmental performance influenced the customers in global market. They also consider how to manage operational firm more efficiently in the market competition (Sarmah, Acharya & Goyal, 2006).

2. Supply Chain Management

The term supply chain management (SCM) as a concept, a philosophy and a management process, emerged in the 1980s from then current practices (Svensson, 2003), gained academic focus gradually, and flourishing since the 1990s (Svensson, 2003). Recently, SCM is such an important topic that at the moment researchers in many different academic fields are conducting research in this and related fields. Today's global marketplace offers significant opportunities to conduct supply chain management

(SCM). Ogulin (2003) suggests that supply chain firms need to develop organizational, procedural, technical, and strategic capabilities to respond to four emerging requirements in the twenty-first century: customer and end consumer focus, technology adoption, relationships management, and styles of leadership. In addition, knowing that the firm's capabilities are limited in time and effort, management will need to choose the level of partnership appropriate for each particular supply chain member (Lambert and Cooper, 2000).

Within the SCM domain there are many aspects that need to be tackled for the purpose of practical application, topics such as performance evaluation of a supply chain and its members, inter-organizational coordination and management, how the supply chain members share the outcome of the operations (Croxton et al., 2001); human interaction in a supply chain (Giannakis and Croom, 2004); knowledge (strategic and operational aspects) sharing among supply chain members. Supply chain management (SCM), represents the integration of key business processes among industry partners to add value for the end customers. It tightly links together several consecutive elements of the industry value chain: from upstream suppliers; to sub-assembly manufacturers; to final manufacturers; to distributors; to retailers; to end-customers. Supply chain refers to the end-to-end business processes, which are embodied in technologies such as Customer Relationship Management (CRM) and enterprise resource management (ERP). A supply chain links organizations directly with one or more flows of products, services, finances and information.

3. Green Supply Chain Management

In recent years, green supply chain management (GSCM) initiatives have gained considerable prominence. However, how much value it brings to organizations is still being investigated. Kogg (2003) used the definition of GSCM given by Zsidisin and Siferd (2001): "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 (2007) definedGSCMas "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". Generally, GSCM is understood to involve screening suppliers based on their environmental performance and doing business only with those that meet certain environmental regulations or standards (Rao, 2002). Supplier selection either in GSCM or sustainable supply chain management (SSCM) has been identified as significant in making purchasing decisions (Hu and Hsu, 2010). Simultaneously in the operational process of supply chain management, thus contributing to the initiative of green-supply chain management (G-SCM). Correspondingly, all the solutions, including logistics management, for managing the overall lifecycle of products should be integrated in a more comprehensive supply chain procedure.

Despite the importance of G-SCM in industrial ecology, the integration of logistics flows in a green-supply chain still remains as a critical issue in G-SCM for the following reasons. First, from an organizational strategic point of view, it is difficult to coordinate the activities of all the chain members, including the product-oriented logistics distribution channels and corresponding reverse-logistics channels. To a certain extent, this difficulty is rooted in the conflicts of operational goals among these chain members. For instance, maximizing the profits of one member in a reverse-logistics chain does not necessarily maximize the profits of a manufacturer in a given green supply chain due to the induced reverse logistics costs. Second, there is a lack of appropriate models for use as tools to manage the corresponding logistics flows associated with each chain member under the condition of system optimization in the process of G-SCM.

4. Effective Barriers in GSCM implementation

Based on the previous literature review, we focus on four main aspects including Organization Management, Organizational Culture, Organizational Structure and Rules and Guidelines. From these main aspects, 18 Effective Barriers in GSCM implementation are maintained. The classification of those main Criteria and their Sub-Criteria are shown in Table 1.

Table 1.Effective Barriers in GSCM implementation

Criteria	**Sub-Criteria**	**Reference**
Organization Management	Instability of the senior management	Sarkis (2009), Balasubramanian (2012), Ravi and Shankar, (2005), Yu & Hui , (2008)
	Lack of top management support	Helen and Neil (2012), Ravi and Shankar, (2005), Yu & Hui ,(2008)
	Lack of knowledge and experience of	Balasubramanian (2012), Ravi and Shankar,

	staff	(2005), Hall (2006)
	Employee dissatisfaction	Sarkis (2009), Balasubramanian (2012), Ravi and Shankar, (2005),
Organizational Culture	Weak Organizational Culture	Sarkis (2009), Balasubramanian (2012), Ravi and Shankar, (2005),
	Lack of attention in Green Innovation	Sarkis (2009), Balasubramanian (2012), Ravi and Shankar, (2005),
	Lack of resources	Sarkis (2009), Helen and Neil (2012), Ravi and Shankar, (2005),
	the lack of incentive legislation for the Green Supply Chain	Balasubramanian (2012), Ravi and Shankar, (2005), Hall (2006)
Organizational Structure	Uncertainty in the Supply Chain	Sarkis (2009), Balasubramanian (2012), Helen and Neil (2012)
	Lack of technical infrastructure	Sarkis (2009), Balasubramanian (2012), Ravi and Shankar, (2005)
	Lack of information needed	Sarkis (2009), Balasubramanian (2012), Ravi and Shankar, (2005)
	Lack of communication between members of the supply chain	Sarkis (2009), Balasubramanian (2012), Ravi and Shankar, (2005)
	attention to the short-term profit	Sarkis (2009), Balasubramanian (2012), Ravi and Shankar, (2005)
Rules and Guidelines	Lack of financial resources	Balasubramanian (2012), Ravi and Shankar, (2005)
	Lack of government support	Balasubramanian (2012), Ravi and Shankar, (2005), Sarkis (2009)
	Slow Return to capital after the implementation of green supply chain	Helen and Neil (2012), Ravi and Shankar, (2005),
	Lack of supply chain integration	Balasubramanian (2012), Ravi and Shankar, (2005), Hall (2006)
	Lack of appropriate strategies for green supply chain vision and mission	Balasubramanian (2012), Helen and Neil (2012), Sarkis (2009), Hall (2006)

5. DEMATEL Technique

The DEMATEL method was first conducted by The Battelle Memorial Institute through its Geneva Research Centre in 1973. DEMATEL is an extended method for building and analyzing a structural model for analyzing the influence relation among complex criteria. However, making decisions is very difficulty in fuzzy environment to segment complex factors.

The procedures of the DEMATEL method (Fontela & Gabus, 1976) are discussed below.

Step 1: *Generating the direct-relation matrix.*

We use five scales for measuring the relationship among different criteria: 0 (no influence), 1 (very low influence), 2 (low influence), 3 (high influence), and 4 (very high influence). Next, decision makers prepare sets of the pair-wise comparisons in terms of effects and direction between criteria. Then the initial data can be obtained as the direct-relation matrix which is an $n \times n$ matrix T where each element of a_{ij} is denoted as the degree in which the criterion i affects the criterion j.

Step 2: *Normalizing the direct-relation matrix.* Normalization is performed using the following,

$$K = \frac{1}{max_{1 \le i \le n} \sum_{j=1}^{n} a_{ij}} \quad i, j = 1,2, \dots, n \qquad (1)$$

$$S = K.T \qquad (2)$$

Step 3: *Attaining the total-relation matrix.* The total relation matrix M can be acquired by using Eq. (3), where I is denoted as the identity matrix

$$M = X(I - X)^{-1} \quad (3)$$

Step 4: *Producing a causal diagram.* The sum of rows and the sum of columns are separately denoted as vector *D* and vector *R* through Eqs. (4-6). Then, the horizontal axis vector (*D* + *R*) named ''Prominence'' is made by adding *D* to *R*, which reveals the relative importance of each criterion. Similarly, the vertical axis (*D* - *R*) named ''Relation'' is made by subtracting *R* from *D*, which may divide criteria into a cause and effect groups. Generally, when (*D* - *R*) is positive, the criterion belongs to the cause group and when the (*D* - *R*) is negative, the criterion represents the effect group. Therefore, the causal diagram can be obtained by mapping the dataset of the (*D* + *R*, *D* - *R*), providing some insight for making decisions.

$$M = [m_{ij}]_{n\times n}, \quad i,j = 1,2,\dots,n \quad (4)$$

$$D = \left[\sum_{j=1}^{n} m_{ij}\right]_{n\times 1} = [t_{i.}]_{n\times 1} \quad (5)$$

$$R = \left[\sum_{i=1}^{n} m_{ij}\right]_{1\times n} = [t_{j.}]_{1\times n} \quad (6)$$

where D and R denote the sum of rows and the sum of columns, respectively. Finally, a causal and effect graph can be acquired by mapping the dataset of (D + R, D - R), where the horizontal axis (D + R) is made by adding D to R, and the vertical axis (D - R) is made by subtracting R from D.

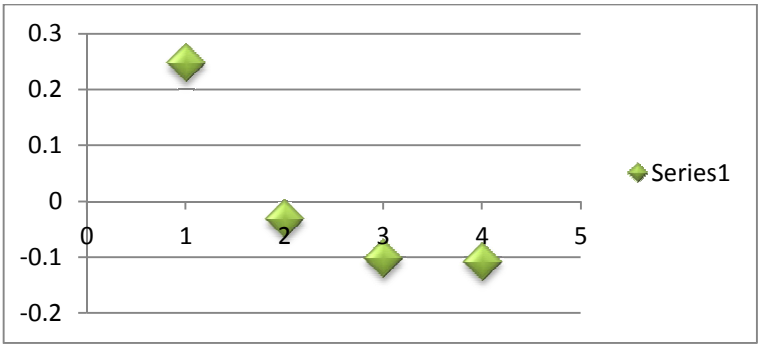
6. Data analysis

Data collected from the experts was analyzed with the DEMATEL method. The degree of central role (D_x + R_x)in DEMATEL represents the strength of influences both dispatched and received. On the other hand, if (D_x - R_x) is positive, then the evaluation criterion x dispatches the influence to other evaluation criteria more than it receives. If (D_x - R_x) is negative, the evaluation criterion x receives the influence from other evaluation criteria more than it dispatched. Total relationships matrices are demonstrated in Tables 2 to Table 6.

The results show Organization Management has great impact on success of GSCM implementation among main aspects.

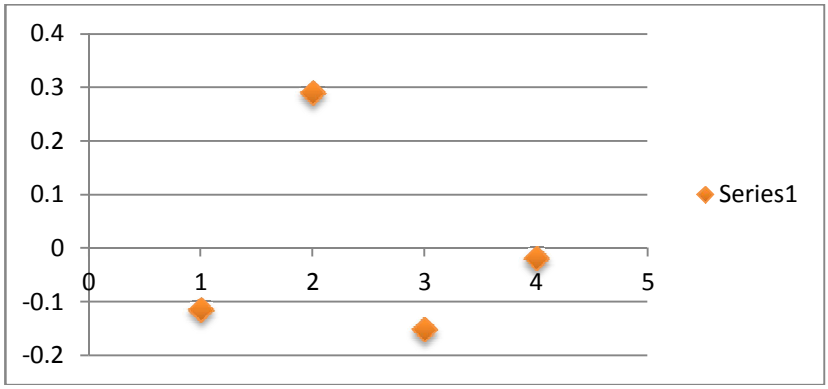
Table 2.The matrix $X(I-X)^{-1}$ for Main aspect.

	Organization Management	Organizational Culture	Organizational Structure	Rules and Guidelines	D	D+R	D-R
Organization Management	0.453	0.481	0.521	0.416	1.871	3.496	0.246
Organizational Culture	0.475	0.574	0.216	0.281	1.546	3.125	-0.033
Organizational Structure	0.256	0.199	0.268	0.562	1.285	2.674	-0.104
Rules and Guidelines	0.441	0.325	0.384	0.157	1.307	2.723	-0.109
R	1.625	1.579	1.389	1.416			



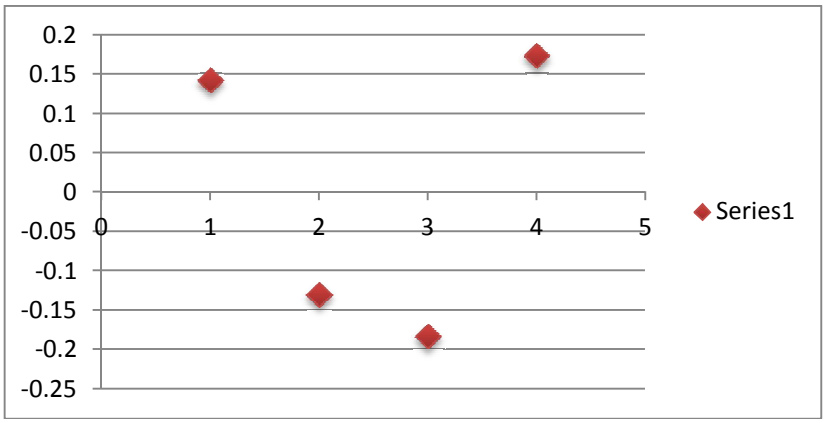
Among criteria of Organization Management , Lack of top management support has Great Influence on other criteria.

Table 3.The matrix X $(I-X)^{-1}$ for factor of Organization Management.							
	Instability of the senior management	Lack of top management support	Lack of knowledge and Experience	Employee dissatisfaction	D	D+R	D-R
Instability of the senior management	0.568	0.412	0.458	0.369	1.807	3.73	-0.116
Lack of top management support	0.625	0.365	0.305	0.445	1.74	3.191	0.289
Lack of knowledge and Experience	0.369	0.257	0.357	0.469	1.452	3.057	-0.153
Employee dissatisfaction	0.361	0.417	0.485	0.256	1.519	3.058	-0.02
R	1.923	1.451	1.605	1.539			



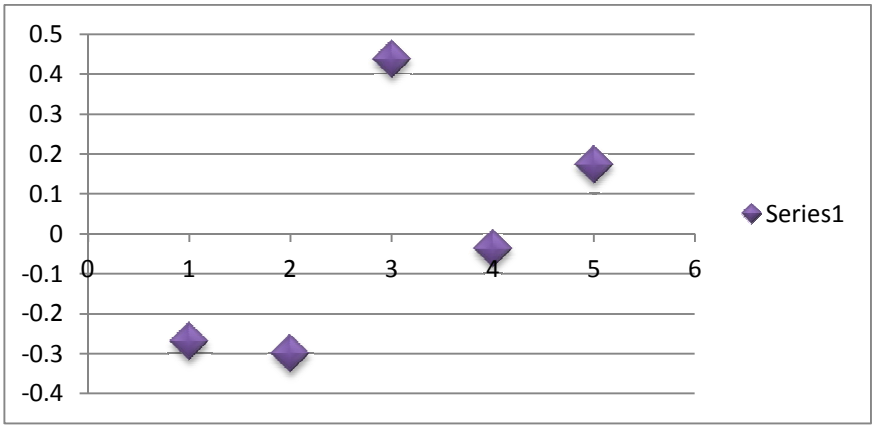
Among criteria of Organizational Culture , the lack of incentive legislation for the Green Supply Chain has Great Influence on other criteria.

Table 4.The matrix X $(I-X)^{-1}$ for factor of Organizational Culture.							
	Poor organizational culture	Lack of green initiatives	Lack of resources	The lack of incentive rules	D	D+R	D-R
Poor organizational culture	0.344	0.524	0.412	0.257	1.537	2.932	0.142
Lack of green initiatives	0.524	0.257	0.452	0.367	1.6	3.331	-0.131
Lack of resources	0.287	0.361	0.415	0.247	1.31	2.804	-0.184
The lack of incentive rules	0.258	0.352	0.452	0.524	1.586	2.999	0.173
R	1.395	1.731	1.494	1.413			



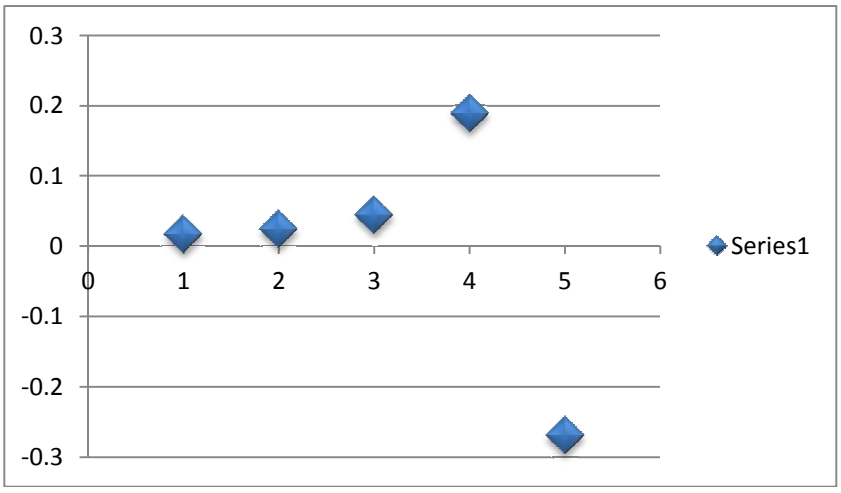
Among criteria of Organizational Structure, Lack of information and data required has Great Influence on other criteria.

Table 5.The matrix X $(I-X)^{-1}$ for factor of Organizational Structure.								
	Uncertainty in the Supply Chain	Lack of technical infrastructure	Lack of information	Lack of communication between members of the supply chain	Attention to short-term profit	D	D+R	D-R
Uncertainty in the Supply Chain	0.314	0.521	0.268	0.336	0.415	1.854	3.978	-0.27
Lack of technical infrastructure	0.287	0.342	0.269	0.645	0.357	1.9	4.101	-0.301
Lack of information	0.447	0.526	0.361	0.452	0.360	2.146	3.855	0.437
Lack of communication between members of the supply chain	0.392	0.441	0.426	0.306	0.520	2.085	4.208	-0.038
Attention to short-term profit	0.517	0.293	0.385	0.462	0.472	2.129	4.086	0.172
R	2.124	2.201	1.709	2.123	1.957			



Among criteria of Rules and guidelines , Lack of supply chain integration has Great Influence on other criteria.

Table 6.The matrix X $(I-X)^{-1}$ for factor of Rules and guidelines.								
	Financial implications	lack of government support	Slow Return of Capital	Lack of supply chain integration	Lack of sustainable GSCM Strategies in organizations vision and mission	D	D+R	D-R
Financial implications	0.256	0.514	0.482	0.360	0.287	1.899	3.782	0.016
lack of government support	0.524	0.413	0.288	0.355	0.514	2.094	4.165	0.023
Slow Return of Capital	0.462	0.384	0.185	0.309	0.410	1.75	3.457	0.043
Lack of supply chain integration	0.373	0.446	0.390	0.350	0.419	1.978	3.768	0.188
Lack of sustainable GSCM Strategies in organizations vision and mission	0.268	0.314	0.362	0.416	0.412	1.772	3.814	-0.27
R	1.883	2.071	1.707	1.79	2.042			



7. Conclusion

This research uses the DEMATEL method as the tool that determines the Prioritization and Influence severity of each factor. The results show Organization Management has great impact on success of GSCM implementation among main aspects. Among criteria of Organization Management , Lack of top management support has Great Influence on other criteria. Also, among criteria of Organizational Culture , the lack of incentive legislation for the Green Supply Chain has Great Influence on other criteria. Also, among criteria of Organizational Structure, Lack of information and data required has Great Influence on other criteria. Also, among criteria of Rules and guidelines , Lack of supply chain integration has Great Influence on other criteria.

Handfield et al. (2002) developed a decision model to measure environmental practice of suppliers using a multiattribute utility theory approach. Kainumaa and Tawarab (2006) proposed the multiple attribute utility theory method for assessing a supply chain including re-use and recycling throughout the life cycle of products and services. Handfield et al. (2005) observed the increasing importance of supply-chain strategy as management increasingly adopts environmental practices. Effectively achieving corporate green goals means linking an environmental corporate strategy with every business functional strategy, thus eliminating obstacles to environmental integration. Decision-makers should appropriately modify the contents and aims of environmental practices to match changes in business development. Many companies have just begun exploring environmental concerns and implemented environmentally-friendly activities, so they have not yet identified many environmentally-related factors.

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