Application of DEMATEL Method for Evaluation of the Effective Barriers in GSCM implementation

Sajjad Jalalifar[1], Kiamars Fathi Hafshejani[2]

[1]Department of Industrial Management, Qazvin branch, Islamic Azad University (IAU), Qazvin, Iran
[2]Assistant Professor, Department of Management, South Tehran Branch Islamic Azad University, Tehran, Iran

Abstract: The present research analyzes the barriers for the implementation of GSCM. 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.

[Jalalifar S, Fathi Hafshejani K. **Application of DEMATEL Method for Evaluation of the Effective Barriers in GSCM implementation.** *N Y Sci J* 2013;6(11):77-83]. (ISSN: 1554-0200). http://www.sciencepub.net/newyork. 12

Keywords: Supply Chain, Green Supply Chain Management, Multi-criteria decision making, DEMATEL

1. Introduction

Creating value through supply chain integration has become a potentially valuable way of securing competitive advantage and improving organizational performance, since competition is no longer between organizations, but among supply chains (Li et al., 2006). The integration of a supply chain not only focuses on tangible resources and assets, but also on intangibles such as knowledge. Knowledge is becoming the only resource capable of offering competitive advantage and continued growth and prosperity for supply chain partners. Thus, the effective creation of knowledge has become a top priority in a supply chain. The tangible consequences of knowledge creation include improved employee and customer satisfaction, an enhanced image, and an increased share valuation (Coulson-Thomas, 2004). Effective supplychain management (SCM) has become a potentiallyv aluable wayof securing competitive advantage and improving organizational performance since competition is no longer between organizations, but among supplychains.

Supply chain management (SCM) seeks to enhance competitive performance by closely integrating the internal functions within a company and effectively linking them with the external operations of suppliers, customers, and other channel members. The benefit of such supply chain integration can be attained through efficient linkage among various supply chain activities, and the linkage should be subject to the effective construction and utilization of various supply chain practices for an integrated supply chain.

The concept of SCM has received increasing attention from academicians, consultants, and business managers alike. Manyor ganizations have begun to recognize that SCM is the keyto building sustainable competitive edge for their products and/or services in an increasinglycro wded marketplace. Mentzer et al. (2001) define a supply chain as "a set of three or more entities (organizations or individuals) directly involved in the upstream and downstream flows of products, services, finances, and/or information from source to customer." Stank et al. (2005) describe supply chain management as a "strategic level concept." Supply chain management (SCM) is a technique that is linked to the adoption of the lean production system (Cox, 1999). For many organizations, developing the lean production system is a key element is their SCM practice. This involves seeking to:

. Improve value delivery to customers;
. Rely on just-in-time system;
. Eliminate waste;
. Get the involvement of all stakeholders in the value creation process;
. Develop close collaboration;
. Work closely with suppliers;
. Reduce the number of suppliers; and
. Develop efficient suppliers (Shadur and Bamber, 1994).

2. Green Supply Chain Management

Environmentally sustainable (green) supply chain management (GSCM) has emerged as an important organizational philosophy to achieve corporate profit and market share objectives by reducing environmental risks and impacts while improving ecological efficiency of these organizations and their partners. GSCM has emerged as an effective management tool and philosophy for proactive and leading manufacturing organizations. The scope of GSCM practices implementation 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. A number of definitions of GSCM exist (Zhu and Sarkis, 2004).

Literature survey has thrown light on various kinds of barriers that hinder an organization from going green. Simpson et al. (2004) found that most of the SMEs feel that they cannot gain competitive advantage by adopting good environmental practice and it was a financial cost added to the business which could not be passed on to the customers. Lee (2008) found that the government plays an important role in improving the awareness and knowhow about environmental improvement and SMEs' lack information resources or expertise to deal with the environmental issues and also attributed the firm's size to be a significant factor for a firm to practice green supply chain; a bigger size firm tends to be more willing to participate in green supply chain initiative. Also, firms with greater resources are more likely to incorporate pollution prevention innovations. Perron (2005) summarized that there are four barrier categories that impede the adoption of green initiatives in SMEs such as attitudinal and perceptions barriers (resistance of management to change, fear of failure etc.), information related barriers (lack of awareness on environmental legislations, environmental impact of the operations in an organization), resources barriers (financial barriers and human resource barriers) and technical barriers (lack of new technologies, materials or lack of technical expertise).

3. 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 staff	Balasubramanian (2012), Ravi and Shankar, (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)

4. 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,

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

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

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.

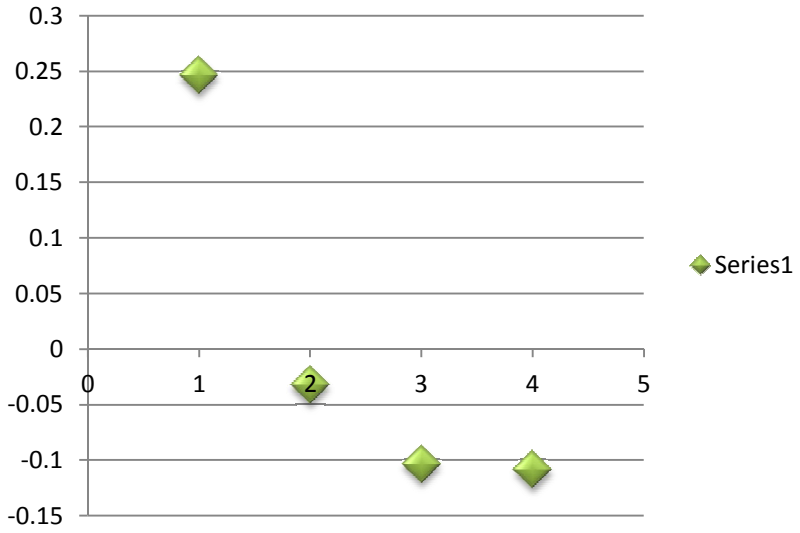
5. Data analysis

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.

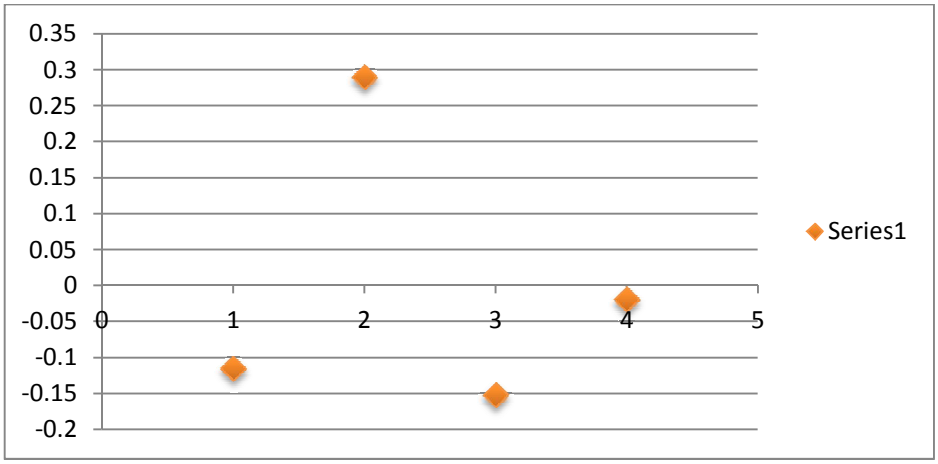
	Organization Management	Organizational Culture	Organizational Structure	Rules and Guidelines	D	D+R	D-R
Organization Management	0.453	0.481	0.521	0.416	1.871	3.496	0.246
Organizational Culture	0.475	0.574	0.216	0.281	1.546	3.125	-0.033
Organizational Structure	0.256	0.199	0.268	0.562	1.285	2.674	-0.104
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.

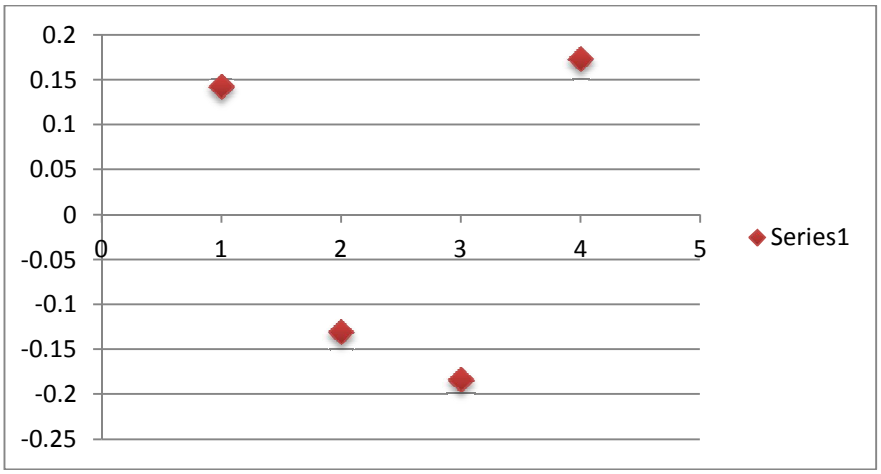
	Instability of the senior management	Lack of top management support	Lack of knowledge and Experience	Employee dissatisfaction	D	D+R	D-R
Instability of the senior management	0.568	0.412	0.458	0.369	1.807	3.73	-0.116
Lack of top management support	0.625	0.365	0.305	0.445	1.74	3.191	0.289
Lack of knowledge 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.

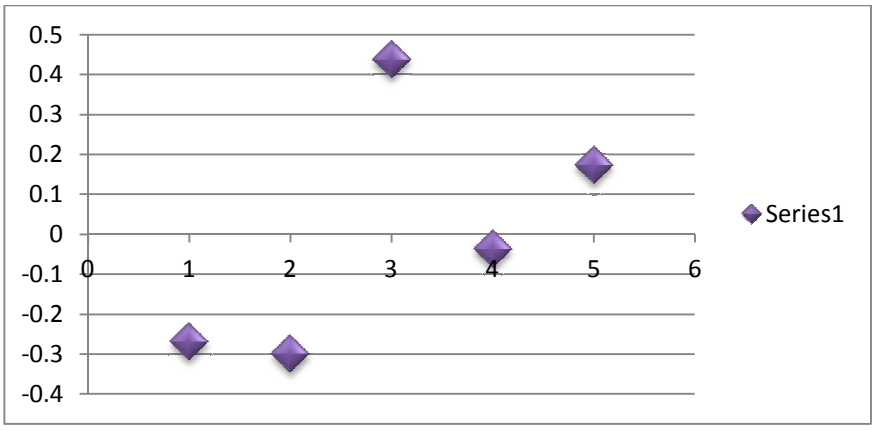
	Poor organizational culture	Lack of green initiatives	Lack of resources	The lack of incentive rules	D	D+R	D-R
Poor organizational culture	0.344	0.524	0.412	0.257	1.537	2.932	0.142
Lack of green initiatives	0.524	0.257	0.452	0.367	1.6	3.331	-0.131
Lack of resources	0.287	0.361	0.415	0.247	1.31	2.804	-0.184
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.

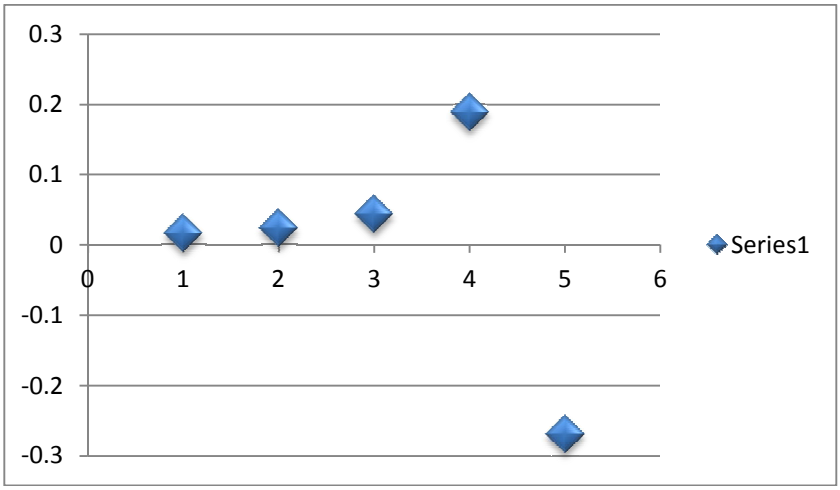
	Uncertainty in the Supply Chain	Lack of technical infrastructure	Lack of information	Lack of communication between members of the supply chain	Attention to short-term profit	D	D+R	D-R
Uncertainty in the Supply Chain	0.314	0.521	0.268	0.336	0.415	1.854	3.978	-0.27
Lack of technical infrastructure	0.287	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.

References

1. Balasubramanian, S, (2012). A Hierarchical Framework of Barriers to Green Supply Chain Management in the Construction Sector Journal of Sustainable Development; Vol. 5, No. 10.PP15-27.
2. Coulson-Thomas, C. (2004), "The knowledge entrepreneurship challenge: moving on from knowledge sharing to knowledge creation and exploitation", The Learning Organization, Vol. 11 No. 1, p. 84.
3. Cox, A. (1999), "Power, value and supply chain management", Supply Chain Management: An International
4. Journal, Vol. 4 No. 4, pp. 167-75.
5. Fontela, E., & Gabus, A. (1976). The DEMATEL observer. DEMATEL 1976 report. Geneva, Switzerland: Battelle Geneva Research Center.
6. Hall, J. (2006). Environmental supply chain innovation. In J. Sarkis (Ed.). Greening the Supply Chain, Springer, London.
7. Handfield, R., Walton, S., Sroufe, R., (2002). Applying environmental criteria to supplier assessment: A study of the application of the analytical hierarchy process. European Journal of Operational Research 141, 70–87.
8. Handfield, R.B. Sroufe, R. Walton, S.V. (2005). Integrating environmental management and supply chain strategies, Business Strategy and the Environment 14 (1) 1–19.
9. Helen, W., & Neil, J. (2012). Sustainable supply chain management across the UK private sector. Supply Chain Management: An International Journal, 17(1), 15-28.
10. Kainumaa, Y., Tawarab, N., 2006. A multiple attribute utility theory approach to lean and green supply chain management. International Journal of Production Economics 101 (1), 99–108.
11. Lee, S.Y., 2008. Drivers for the participation of small and medium sized suppliers in green supply chain initiatives. Supply Chain Management International Journal 13, 185-198
12. Li, S., Ragu-Nathan, B., Ragu-Nathan, T.S. and Rao, S.S. (2006), "The impact of supply chain management practices on competitive advantage and organizational performance", Omega, Vol. 34 No. 2, pp. 107-24.
13. Mentzer, J.T., DeWitt, W., Keebler, J.S., Min, S., Nix, N.W., Smith, C.D. and Zacharia, Z.G. (2001), "Defining supply chain management", Journal of Business Logistics, Vol. 22 No. 2, pp. 1-25.
14. Perron, G.M., 2005. Barriers to Environmental Performance Improvements in Canadian SMEs. Dalhousie University, Canada.
15. Ravi, V., & Shankar, R. (2005). Analysis of interactions among the barriers of reverse logistics. International Journal of Technological Forecasting and Social Change, 72(8), 1011-1029.
16. Sarkis, J. (2009). A boundaries and flows perspective of green supply chain management. GPMI working Papers. No-7, October.
17. Shadur, M.A. and Bamber, G.J. (1994), "Toward lean management? International transferability of Japanese management strategies to Australia", The International Executive, Vol. 36 No. 3, pp. 343-54.
18. Simpson, M., Taylor, N., Barker, K., 2004. Environmental responsibility in SMEs: does it delivercompetitive advantage.Business Strategyand the Environment13,156-171.
19. Stank, T.P., Davis, B.R. and Fugate, B.S. (2005), "A strategic framework for supply chain oriented logistics", Journal of Business Logistics, Vol. 26 No. 2, pp. 27-45.
20. Yu L., C., & Hui H, Y. (2008). An empirical study on logistics services provider, intention to adopt green innovations. Journal of Technology, Management and Innovation, 3(1), 17-26.
21. Zhu, Q., Sarkis, J., 2004. Relationships between operational practices and performance among early adopters of green supply chain management practices in Chinese manufacturing enterprises. Journal of Operations Management 22 (3), 265–289.

11/12/2013