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Identification and Evaluation of the Most Effective Factors in Green Supplier Selection Using DEMATEL Method

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ABSTRACT

Supplier selection is one of the key decisions in supply chain management which has considerable effect on production costs. On the other hand, importance of environmental protection has attracted attention of the governments, customers and organizations and has increased importance of environmental requirements for production. Since major compounds of the products are supplied by the external suppliers, it is important to pay attention to environmental requirements in supply chain process. In this article, a framework was presented for assessment of the suppliers with multi-criteria approach and 13 factors as indices of environment friendly suppliers. In this framework, the most effective factor in assessment of the suppliers was identified after determining the criteria hierarchy and weighting the criteria with use of DEMATEL.
Key words: green supply chain management, Sustainability, environmental management system, supplier's assessment, DEMATEL

1- INTRODUCTION

The study of the automotive supply chain and environmental issues is critical because its scope is international (Gonza´lez et al., 2008). nowadays, Managers are not only expected to reduce lead times, improve quality, reduce costs and increase flexibility, but also they are expected to become more environmentally responsible (Ann et al.,2006) and Clean production and green products have become important issues to manufacturers (Padma et al.,2008). The environmental protection and sustainable development are the complex process (Kralj, 2008) and organizations need cultural change to achieve sustainability (La¨nsiluoto and Ja¨rvenpa¨a¨, 2008). Waste of resources and creation of pollution are normally indicate important improvement and all of the EMS standards and green systems emphasize the need for continuous, never-ending improvement in attempting to protect the environment, not only for ourselves but also for future generations to come (Chavan ,2005). In today's global economy, organizations are more and more called upon to exhibit sound management of economic, social and environmental issues (Ann et al., 2006) and companies have recently begun to face increasing stakeholder concerns respecting the operational impact of the company on the environment and society as individuals become more aware of the fact that each operational process has the potential for producing a negative impact on ecological and social systems (Setthasakko, 2010). The use of such environmental management practices presents new needs of information for public organizations and they need information about their environmental impacts and the results of the initiatives that are developed (Ribeiro and Aibar-Guzman, 2010). On the other hand, it is very significant for facilities management (FM) sector to be careful about environmental issues and the ability of FM is to assist its corporate partners to exhibit efficient use of resources, especially with a good green strategy with environmental credentials, companies can earn a green passport for a larger market (Baharum and Pitt,2009). Also, an EMS encourages the corporations to accept responsibility for the protection of the environment, ensuring the continuous improvement of the ecological administration (da Silva and de Medeiros, 2004). The series of standards will help companies merge environmental considerations into company decision-making in a more organized and systematic mode. So ISO 14000 aids corporations to implement their commitment to environmental distinction, aids prevent multiple registrations, inspections, certifications, labels and conflicting requirements, and eliminates the need for certain regulatory "command and control" initiatives (Ann et al., 2006). Green supply chain management (GSCM) has appeared as a significant new approach for companies to obtain profit and market share objectives by reducing environmental risk and impact. With the increased environmental concerns during the past decade, awareness is growing that issues of environmental pollution attending industrial development should be addressed together with supply chain management, so contributing to the initiative of GSCM (Hu and Hsu , 2010) and the

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certification of quality management system in GSCM practice is significant (Buetow, 2003). In this study, we have used DEMATEL method to study the influence of the most important criteria for supplier assessment. This paper is organized as follows: Section 2 discusses the Green supply chain management (GSCM) in automotive companies. Section 3 discusses the important factors of this research. Section 4 discusses the methodology. Section 5 analyzes the results and Section 6 concludes the study.

2- Green supply chain management (GSCM) in Automotive companies

A firm's environmental sustainability and ecological performance can be demonstrated by its suppliers and supplier selection in GSCM is clearly a important activity in purchasing management (Hu and Hsu , 2010) and with the rise in environmental awareness, governments have forced companies to improve their environmental outcomes (Lin and Chang, 2008). Automotive companies worldwide face increasing pressures in the environmental issues. Over the past decade, there has been a consistent trend toward the reduction of environmental releases in the automotive manufacturing sector (lee, 2008) and Automotive companies had to decrease environmental damages in recent decades with regard to increase of pressures in environmental fields (Geffen and Rothenberg, 2000). During the 1980s, the automotive industry developed management practices with the introduction of different pervasive quality management and leant manufacturing principles and this industry, in every area of the world, has been shown to have a consequential and pervasive environmental impact, which also affects other industries and they are incorporating "green" practices into their daily operations for various reasons (Gonza´lez et al.,2008) and globalization has resulted in pressure on multinational firms to improve environmental performance (lee,2008). Green supply chain (GSCM) requires investigation of the suppliers on the basis of environmental performance and performance of their activity on the basis of environmental laws and standards (Rao, 2002). GSCM can also advance efficiency and synergy among business partners and their lead corporations, and helps to improve environmental performance, minimize waste and save costs (Hu and Hsu, 2010) and Green supply chain management (GSCM) is usually understood to include screening suppliers based on their environmental performance and doing business only with those that meet certain environmental regulations or standards (Hsu and Hu, 2009). The concept of GCSM can be clearly defined as: an enterprise that collaborates with suppliers to improve products or manufacturing processes so as to promote environmental performances of suppliers and customers (Lin and Juang, 2008). So, each company requires a system of green supplier selection capable of determining the portion of each supplier. Also, suppliers who achieve environmental management system (EMS) certification, such as ISO14001 or EMAS, suggest that organization has installed a management system that documents all the environmental aspects and impacts, and recognizes a pollution prevention process that organization can be continuously improved over time (Hsu and Hu, 2009)

3- Important factors in this research

3-1 Green suppliers selection criteria

Green suppliers selection criteria should be based on environmental laws, characteristics of the suppliers and purchasing policies of the company. On this basis, 13 criteria were determined and classified in 4 main groups (table 1).

Table 1-criteria and sub criteria of supplier's selection

criteria	sub criteria	references
design management	process/product changeability	(Hsu and Hu,2009)
	ability to design	(Lee, et al., 2009), (Juang, et al., 2009), (Che, et al., 2010), (Hsu and Hu,2009)
	recycle	(Lee, et al., 2009), (Juang, et al., 2009), (Che, et al., 2010), (Hsu and Hu,2009)
technology management	technology level	(Lee, et al., 2009), (Che, et al., 2010)
	ability of R&D	(Lee, et al., 2009), (Beskse and Adil, 2010), (Juang, et al., 2009), (Hsu and Hu,2009)
	clean technology	(Lee, et al., 2009), (Juang, et al., 2009), (Che, et al., 2010)
customer management	controlled use of hazardous material	(Lee, et al., 2009), (Juang, et al., 2009), (Hsu and Hu,2009)
	energy consumption	(Lee, et al., 2009), (Juang, et al., 2009), (Che, et al., 2010)
	green packaging	(Lee, et al., 2009), (Juang, et al., 2009),
strategic management	green image	(Juang, et al., 2009), (Che, et al., 2010)
	green planning	(Lee, et al., 2009)
	supervision on and following environmental laws	(Lee, et al., 2009), (Beskse and Adil, 2010), (Juang, et al., 2009), (Che, et al., 2010)
	social responsibility	(Lee, et al., 2009)

3-2Green supplier's selection model

Many studies have been done on supply chain and suppliers problems. But there have been limited studies on green supplier and green supply chain in recent two decades while recent studies have emphasized selection of green supplier. There are limited studies which deal with environmental issues and characteristics of supplier. In this article, green suppliers assessment and selection model is suggested with regard to criteria and sub criteria in different dimensions in order to assess green suppliers. Executive stages of this research are as follows:

- Green suppliers selection problem was defined and general goal of this research was clarified.
- Green suppliers assessment and selection criteria were gathered by review of literature and interviewing with automotive industry experts.
- The most important criteria and sub criteria were extracted by the industry experts.
- On the basis of the selected criteria and sub criteria, a hierarchical framework was prepared in order to assess green suppliers.
- On the basis of suggested hierarchy, a questionnaire was prepared on which basis suppliers can be assessed. In this research, 4-point scale was used in order to score the suppliers.
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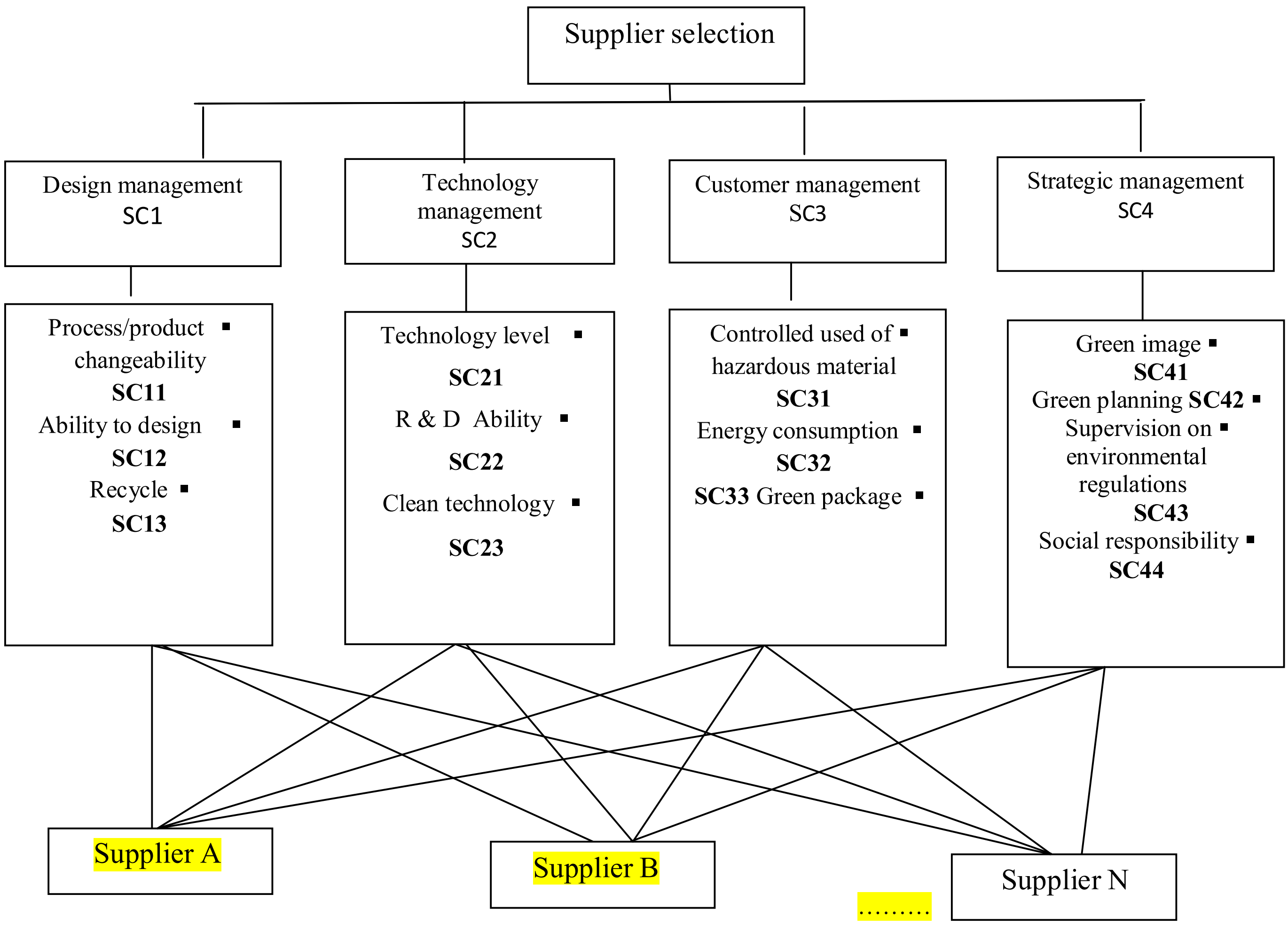
Figure 1-green suppliers assessment model



3-3 Definition of factors

3-3-1 Design management

The sub-factors that come under design management (SC1) are as follows: Process/product changeability (SC11), ability to design (SC12), and recyclability (SC13).

To manage the use of hazardous material in production, companies should do preventive management for limited chemicals. All approaches should be fully documented and regularly inspected in order to track and monitor mistakes and defects systematically. One of the most significant criteria in supplier selection is the capability of green design, which can promote product-oriented green supply chain implementation and we can develop more environmental friendly products in accordance with the requirements of environmental regulations (Hsu and Hu, 2009). Probably the strongest testament to the greening of the international market is the expanding number of firms seriously addressing environmental aspects as part of their product development process (Hu and Hsu, 2010) and design change of products is a necessary activity for organizations (Jonghoon and Lee, 2002) and Involving suppliers in the design process can generate important environmental and business benefit (Hu and Hsu, 2010). Firms may also decide to undertake the recovery of used products on their own or to set up cooperation via local or more extended networks for the collection and recycling of similar products (Tsoulfas and Pappis, 2006).

3-3-2 Technology management

The sub-factors that come under Technology management (SC2) are as follows: Technology level (sc21), R & D ability (SC22), and clean technology (SC23).

Supporting companies with technology needed for green supply chains is one way to promote industry competence. With use of a green industry revolution, companies must be environment friendly and must collaborate with supply chain partners. Also, we can develop alternative materials, products, equipment and methods and supplier manufacturing process must use new environment-friendly technology (Lin and Juang, 2008). When the capability of R&D is decided by suppliers, suppliers may be able to aid customers understand environmental effects and their causes in the supply chain if a collaborative approach is employed in purchasing (Hu and Hsu, 2010).

3-3-3 Customer management

The sub-factors that come under customer management (SC3) are as follows: Controlled used of hazardous material (SC31), Energy consumption (SC32), and Green package (SC33).

Globalization permits working with a lot of different suppliers to get raw materials and preliminary products (koplin et al., 2007). Each organization should Formulate environmental protection related policies or plan “product environment quality assurance” and regulation restricted product environment quality objectives (Lin and Juang, 2008). Firms use materials’ coding and recording to separate hazardous and non- hazardous materials in storage in order to evade material mixture. This management system helps identify troublesome events immediately when a product is found to contain excessive amounts of hazardous substances and environmental regulations have progressively increased the number of controlled items for hazardous material (Hsu and Hu, 2009). Also, green package involves: Product package design (e.g., reusable package, high recovery package) complying with recycle requirements (Lin and Juang, 2008)

3-3-4 Strategic management

The sub-factors that come under Strategic management (SC4) are as follows: Green image (SC41), green planning (SC42), supervision on environmental regulations (SC43), and social responsibility (SC44).

Organizations respond to the environmental management requirements in many different ways (P.K Humphreys, 2003). Owing to an increase in social awareness and the number of governmental laws supporting environment, organizations must consider environmental issues if they are about to enter global markets. Companies are not only supposed to comply with the environmental laws to sell their product, but they are also required to plan some micro strategies to decrease environmentally disturbing influence of their products. To achieve sustainable development, integrating all social, economic and environmental criteria is the biggest challenge (Verghese and Lewis,2007) and companies have begun to formulate green plans to organize their supply chains in terms of environmental effectiveness (Lin and Chang,2008) and the company can promote GSCM practices by establishing an environmental policy for its suppliers as a manifestation of its situation regarding green purchasing, green design, and supplier auditing, among others (Hu and Hsu , 2010).

4- METHODOLOGY

In this study ,we have used DEMATEL method to study the influence of the most important criteria for supplier assessment .The DEMATEL method was first conducted by the Battelle Memorial Institute through its

Geneva Research Centre in 1973 (Gabus, 1973). DEMATEL is an extended method for building and analyzing a structural model for analyzing the influence relation among complex criteria.

4-1 DEMATEL method

The original DEMATEL method searched for integrated solutions to fragmented and antagonistic societies around the world. The DEMATEL method has recently become very popular in Japan, because of its ability to pragmatically visualize complicated causal relationships.

Specifically, the DEMATEL method is based on digraphs, which separate involved factors into cause group and effect group. Directed graphs, known as digraphs, are more useful than directionless graphs because digraphs demonstrate the directed relationships of sub-systems. The digraph may portray a basic concept of contextual relation among elements of a system, in which the values represent the strength of influence. Hence, The DEMATEL can convert the relationship between cause and effect factors into an intelligible structural model of the system. The DEMATEL can propose the most important criteria which affects other criteria.

The DEMATEL can reduce the number of criteria for evaluating factor effectiveness, concurrently; companies can improve effectiveness of specific factors based on the impact digraph map. Therefore, The DEMATEL evaluates supplier performance to find key factor criteria to improve performance and provide decision-making information in SCM supplier selection. The DEMATEL method converts the relationship between cause and effect factors into an intelligent structural model of the system as stated in previous sections. Suppose that a system contains a set of elements $K = \{k_1, k_2, k_3 \dots . k_n\}$ and particular pairwise relations are determined for modeling with respect to a mathematical relation E. Next, the method portrays the relation E as a direct-relation matrix that is indexed equally on both dimensions by elements from the set T. Then, besides the case where number 0 appears in the cell (i, j), if the entry is a positive integral that has the meaning of (1), the ordered pair (k_i, k_j) is in relation to E, and (2) there exists a relation in element k_i that effects element k_j. This investigation uses the DEMATEL method for analyzing the data in this study, and refines the essential DEMATEL steps below. First, the pair-wise comparison scale may be designated into four levels, where scores of 1, 2, 3, and 4 represent ''very low influence'', ''low influence'', ''high influence'', and ''very high influence'' respectively. An initial direct-relation matrix T is a $n \times n$ matrix obtained by pair-wise comparisons in terms of influences and directions between criteria, in which T_{ij} is denoted as the degree to which the criterion i affects the criterion j, i.e..., $T = [\,T_{ij}\,]_{n\times n}$. Then a normalized direct-relation matrix S, i.e., $S = [\,S_{ij}\,]_{n\times n}$. And $0 \leq S_{ij} \leq 1$ can be obtained through the formulas (1) and (2), in which all principal diagonal elements equal to zero

-1 $$K = \frac{1}{\max 1 \leq i \leq n \ \sum_{i=1}^{N} a_{ij}}$$

-2 $$S = K \times T$$

A total-relation matrix M can be acquired by using the formula (3), in which the I is denoted as the identity matrix

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

The sum of rows and the sum of columns are separately denoted as D and R within the total-relation matrix M through the formulas (4)–(6):

4- $$M = M_{ij} \qquad i,j = 1,2\dots\dots,n$$

5- $$D = \left[\sum_{j=1}^{N} m_{ij}\right]_{n\times 1}$$

6- $$R = \left[\sum_{i=1}^{N} m_{ij}\right]_{1\times n}$$

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- ANALYSIS AND RESULTS

5-1The calculation process of DEMATEL method

This study uses an expert interview method. The subjects were professional experts working in purchasing departments of automotive industries in Iran. The evaluation criteria symbols in this study are as follows: Process/product changeability (SC11), ability to design (SC12), recycle (SC13),Technology level (SC21), clean technology (SC23), R & D ability (sc22), Controlled used of hazardous material (SC31), Energy consumption (SC32), Green package (SC33) Green image (SC41), green planning (SC42), supervision on environmental regulations (SC43) and social responsibility (SC44). Data collected from the experts was analyzed with the DEMATEL method. The major nine steps were conducted as the following.

Step1. Set up Direct-Relation Matrix T

The first step of the DEMATEL analysis sets up a direct relation matrix T from the data collected as Table 2.

Table 2 - Direct-relation matrix T.

	sc11	sc12	sc13	sc21	sc22	sc23	sc31	sc32	sc33	sc41	sc42	sc43	sc44
sc11	0	1.000	2.380	3.022	2.034	2.155	2.737	2.034	2.380	1.669	1.811	2.246	1.919
sc12	1.669	0	2.737	1.669	1.952	1.952	2.340	2.246	2.119	1.669	2.034	1.811	1.486
sc13	1.842	2.034	0	2.034	1.575	2.246	2.119	2.340	2.340	2.672	2.000	2.340	2.034
sc21	1.486	1.811	2.246	0	2.155	1.739	2.034	2.420	2.380	2.246	1.811	2.034	1.739
sc22	1.739	2.034	1.873	2.627	0	2.672	2.583	2.583	1.426	2.380	2.246	2.380	1.486
sc23	1.575	3.536	1.426	1.952	2.737	0	1.919	2.246	1.811	2.737	2.479	3.022	2.438
sc31	1.842	2.246	2.380	2.119	2.901	1.486	0	2.583	2.340	3.074	2.737	2.034	2.246
sc32	2.034	2.737	2.246	1.575	2.479	2.246	2.155	0	1.919	2.521	2.380	2.119	2.737
sc33	1.641	2.034	2.208	2.737	2.246	2.692	2.155	2.479	0	2.479	2.119	2.246	2.380
sc41	2.034	1.919	3.203	2.521	1.666	1.919	1.768	2.380	2.901	0	2.784	2.340	2.246
sc42	2.340	2.034	2.246	2.420	2.246	1.739	1.842	2.479	2.901	2.380	0	2.901	2.627
sc43	2.119	2.034	1.811	2.438	2.155	2.340	2.034	1.919	2.155	2.784	2.737	0	2.034
sc44	2.627	1.486	2.246	2.208	2.284	1.919	2.119	1.919	2.155	2.340	2.155	2.119	0

Low influence, low influence, high influence and very high influence, Table 3

Table 3- the linguistic scale.

Linguistic terms	Influence score
No influence (No)	0
Very low influence (VL)	1
Low influence (L)	2
High influence (H)	3
Very high influence (VH)	4

Step4. Set up the generalized direct-relation matrix S.

The study obtains a generalized direct-relation matrix S through the formula (1) in which all principal diagonal elements are between 1 to zero. The generalized direct-relation matrix is shown as Table 4

Table 4 -The generalized direct-relation matrix S.

	sc11	sc12	sc13	sc21	sc22	sc23	sc31	sc32	sc33	sc41	sc42	sc43	sc44
sc11	0	0.036	0.085	0.107	0.072	0.077	0.097	0.072	0.085	0.059	0.064	0.080	0.068
sc12	0.059	0	0.097	0.059	0.069	0.069	0.083	0.080	0.075	0.059	0.072	0.064	0.053
sc13	0.065	0.072	0	0.072	0.056	0.080	0.075	0.083	0.083	0.095	0.071	0.083	0.072
sc21	0.053	0.064	0.080	0	0.077	0.062	0.072	0.086	0.085	0.080	0.064	0.072	0.062
sc22	0.062	0.072	0.067	0.093	0	0.095	0.092	0.092	0.051	0.085	0.080	0.085	0.053
sc23	0.056	0.126	0.051	0.069	0.097	0	0.068	0.080	0.064	0.097	0.088	0.107	0.087
sc31	0.065	0.080	0.085	0.075	0.103	0.053	0	0.092	0.083	0.109	0.097	0.072	0.080
sc32	0.072	0.097	0.080	0.056	0.088	0.080	0.077	0	0.068	0.090	0.085	0.075	0.097
sc33	0.058	0.072	0.078	0.097	0.080	0.096	0.077	0.088	0	0.088	0.075	0.080	0.085
sc41	0.072	0.068	0.114	0.090	0.059	0.068	0.063	0.085	0.103	0	0.099	0.083	0.080
sc42	0.083	0.072	0.080	0.086	0.080	0.062	0.065	0.088	0.103	0.085	0	0.103	0.093
sc43	0.075	0.072	0.064	0.087	0.077	0.083	0.072	0.068	0.077	0.099	0.097	0	0.072
sc44	0.093	0.053	0.080	0.078	0.081	0.068	0.075	0.068	0.077	0.083	0.077	0.075	0

Step 5 sets up the total-relation matrix M. The total-relation matrix M is acquired using Eq. (3) from the generalized direct-relation matrix. The total-relation matrix is shown as Table 5.

Table 5 - Total-relation matrix M.

	sc11	sc12	sc13	sc21	sc22	sc23	sc31	sc32	sc33	sc41	sc42	sc43	sc44
sc11	0.937	1.050	1.169	1.199	1.134	1.090	1.130	1.183	1.164	1.224	1.165	1.186	1.096
sc12	0.935	0.952	1.113	1.088	1.065	1.021	1.053	1.120	1.088	1.151	1.103	1.104	1.018
sc13	1.007	1.090	1.101	1.177	1.128	1.101	1.118	1.201	1.011	1.263	1.180	1.198	1.108
sc21	0.944	1.027	1.115	2.324	1.087	1.030	1.059	1.142	1.113	1.186	1.113	1.127	1.042
sc22	1.134	1.108	1.181	1.212	1.093	1.130	1.150	1.227	1.161	1.274	1.206	1.218	1.108
sc23	1.073	1.217	1.237	1.261	1.248	1.108	1.195	1.286	1.187	1.357	1.283	1.307	1.201
sc31	0.939	1.184	1.275	1.276	1.261	1.167	1.139	1.306	1.267	1.376	1.298	1.286	1.204
sc32	1.064	1.167	1.235	1.223	1.214	1.157	1.177	1.185	1.218	1.322	1.252	1.252	1.185
sc33	2.004	1.157	1.245	1.270	1.219	1.181	1.188	1.278	1.166	1.334	1.256	1.268	1.186
sc41	1.083	3.048	1.285	1.274	1.209	1.167	1.185	1.285	1.271	1.263	1.285	1.281	1.191
sc42	1.107	1.180	1.274	2.361	1.245	1.179	1.205	1.306	1.288	1.360	1.213	1.316	1.219
sc43	1.049	1.126	1.201	1.229	1.184	1.140	1.153	1.228	1.206	1.307	1.242	1.162	1.144
sc44	1.030	1.070	1.173	1.182	1.148	1.090	1.118	1.186	1.165	1.251	1.183	1.190	1.038

Step 6 obtains the sum of rows and columns. The sum of rows and the sum of columns are separately denoted as D and R within the total-relation matrix M as below: Sum of rows =14.759 13.809 14.683 15.310 15.201 15.959 15.976 15.651 16.749 17.829 17.252 15.368 14.823

Sum of columns = 14.304 16.375 15.603 18.074 15.234 14.559 14.869 15.931 15.305 16.667 15.778 15.896 14.720

Step 7 sets up degrees of central role and relation. The first calculation obtains amount from MATLAB. Secondly, we calculate these direct/indirect matrix M values in this step. The results are showed in Table 6.

Table 6 -The degree of central role (D + R).

	R	J	R+J	R-J
sc11	14.726	14.304	29.030	0.422
sc12	13.809	16.375	30.183	-2.566
sc13	14.683	15.603	30.286	-0.921
sc21	15.310	18.074	33.383	-2.764
sc22	15.201	15.234	30.434	-0.033
sc23	15.959	14.559	30.518	1.400
sc31	15.976	14.869	30.845	1.107
sc32	15.651	15.931	31.582	-0.280
sc33	16.749	15.305	32.054	1.444
sc41	17.829	16.667	34.496	1.162
sc42	17.252	15.778	33.030	1.473
sc43	15.368	15.896	31.264	-0.528
sc44	14.823	14.740	29.563	0.084

Step 7 sets up the causal diagram. The causal diagram was built by the horizontal axis (D + R) which the degree of central role. The vertical axis (D _ R) which is the degree of relation.

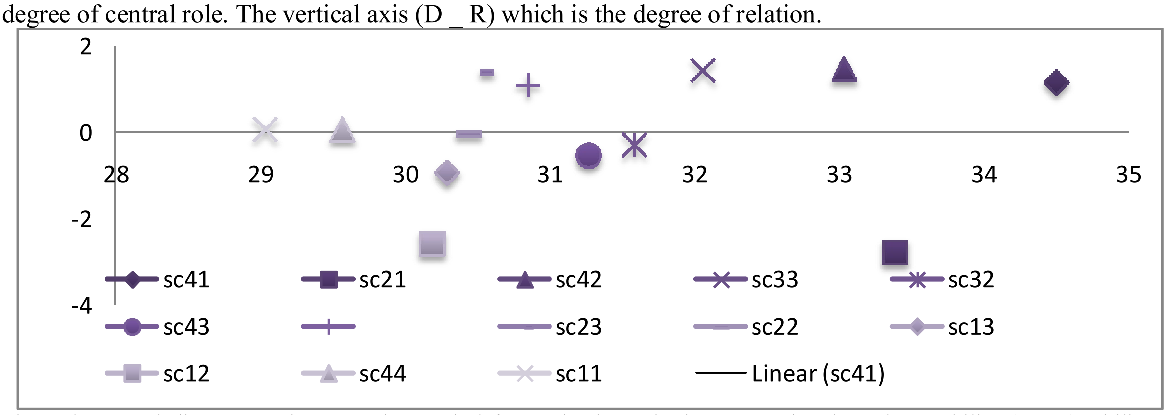


Fig.2. the causal diagram. Using _ as the symbol for evaluation criteria: Process/product changeability (SC11), ability to design (SC12), recycle (SC13), Technology level (SC21), clean technology (SC23) ,R & D ability (SC22), Controlled used of hazardous material (SC31), Energy consumption (SC32), Green package (SC33) ,Green image (SC41), green planning (SC42), supervision on environmental regulations (SC43) and social responsibility (SC44).

5-2 analyzing the evaluation criteria of significance

This study integrates seventeen questionnaires from expert interviews to find out the evaluation criteria of significance and then calculates the average values as shown in Table 9. Research results show the most important criteria green planning (SC42), Green package (SC33), clean technology (SC23), Green image (SC41), Controlled used of hazardous material (SC31), Process/product changeability (SC11), social responsibility (SC44), R & D ability (sc22), Energy consumption (SC32), supervision on environmental regulations (SC43), recycle (SC13), ability to design (SC12) and Technology level (SC21).

5-3 Analyzing the degree of central role and relations

This work establishes a threshold value to sift important evaluation criteria from the total-relation matrix M from Table 7. 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 $(D_x - R_x) > 0$, then the evaluation criterion x dispatches the influence to other evaluation criteria more than it receives. If $((D_x - R_x) > 0$, the evaluation criterion x receives the influence from other evaluation criteria more than it dispatched.The $(D_x - R_x)$ values are reported in Table7.

Table 7- Evaluation criteria of significance

Evaluation criteria	Average value	Ranking
Process/product changeability (SC11)	0.422	6
ability to design (SC12)	-2.566	12
Recycle (SC13)	-0.921	11
Technology level (SC21)	-2.764	13
Clean technology (SC23)	-0.033	3
R & D Ability (SC22)	1.400	8
Controlled used of hazardous material (SC31)	1.107	5
Energy consumption (SC32)	-0.280	9
Green package (SC33)	1.444	2
Green image (SC41)	1.162	4
Green planning (SC42)	1.473	1
Supervision on environmental regulations (SC43)	-0.528	10
Social responsibility (SC44)	0.084	7

6- Conclusion

With increase of environment importance, strict environmental laws of the country in production and import and attention to end users, environmental criteria have been added to traditional criteria of supplier's assessment. In This study we have used DEMATEL method to study the influence of the most effective criteria for green supplier assessment and the most effective factor in assessment of the suppliers was identified after determining the criteria hierarchy and weighing the criteria with use of DEMATEL. Study of the identified criteria shows that criteria of green planning, green packaging, green technology and green image are more important than other criteria are.

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