Available online at http://www.csjonline.org/

The Caspian Sea Journal
ISSN: 1578-7899

Volume 10, Issue 1, Supplement 4 (2016) 124-132

Ranking Factors Affecting GSCM in Iranian Automotive Parts Manufacturer

Mahdieh Jalalpour,
Master graduate of EMBA(executive master of business administration)
Department of Management, University of Isfahan, Isfahan, Iran
mjalalpoor@gmail.com Email:
Behnaz Gharakhani,
Master graduate of Industrial Management
Department of Management, Islamic Azad University, Najafabad, Isfahan, Iran
Email: b.gharakhani22@gmail.com
Masoomeh Farrokh,
Master Graduate of Industrial Management
Department of Management, University of Yazd, Yazd, Iran
Email:m.farrokh14@gmail.com
Ghasemali Salman,
Department of Psychology, Islamic Azad University, Yazd Branch, Yazd, Iran
Email:gh.salman9@gmail.com
Mahdi Jalalpoor
Department of Environment, Islamic Azad University, Hamedan Branch, Hamedan, Iran
Email: jalalpoor60.mehdi@yahoo.com

ABSTRACT— In recent years, following the rapid industrialization of societies, much attention has been given to the environmental shortcomings and governments have begun to enforce environmental protection laws. Necessities of today's world and considering the fact that the automotive industry is an industry that all parts of its life cycle are directly or indirectly associated with the environment, make the green supply chain management an inevitable matter. This study has been carried out with two purposes of identifying and prioritizing the factors affecting green supply chain management in the automotive parts manufacturing companies and offering techniques for promoting green supply chain. In this study, after identifying the factors affecting green supply chain management in automotive parts manufacturing companies in Iran, these factors were ranked using saw, Topsis and vikore techniques. Since the results of these methods are different in some cases, for general consensus, Copeland technique was used.

Based on the results of the Copeland technique, inner management measure won the most points among all main criteria. Finally, we tried to propose some proper strategies to help managers of the industry for a better environmental management.

KEYWORDS: Green Supply Chain Management, Supplier Policies and Procedures, Supply Chain Management, Environmental Issue, Topsis Vikore, Copeland

Introduction

Today, global organizations are seeking competitive advantages through the creation of new methods. Some of these organizations get this benefit through improved environmental performance in compliance with laws and standards and increasing customer knowledge of environmental laws and standards, and reducing the negative environmental impacts of products and services. Factors such as globalization, increased regulatory of public and nongovernmental organizations and customer pressures for compliance with environmental issues has led organizations to consider the necessary measures for implementation of green supply chain management (GSCM) to improve their environmental and economic performance (Olfat ,khatami, and khodaverdi 2011). Researchers have defined environmental management as an attempt to minimize the negative environmental impacts of products of a company throughout the life cycle of the product. Due to organizational pressures, this action seems binding and appears to increase the efficiency of resources used in environmental management (Zanjirchi et al 2o13). The concept of "green" is visualization of products, systems, and processes which are environmentally friendly and affect the business-related activities (Vachon and Klassen 2006). Iran as a developing country which is following its own industrialization steps, has been faced with the problems related to industrial pollutants in some recent decades. Rapid growth of industry and Industrial development, keeps the natural environment of the country under pressure. Moreover, using inappropriate and old technologies and inefficient management in industries has caused inappropriate consumption of primary resources. Environmental pollution intensity because of waste materials in cities and industrial gathering centers is such that it has attracted the attention of scientific and executive resources for correctly discharge or essential recycling of these materials (Zanjirchi et al 2013). Automotive industry is an old and major industry which has accounted for an important share of GDP. All parts of its life cycle are directly or indirectly associated with the environment. Due to necessities such as joining the WTO, the increased international environmental laws and increasing interests of customers to use environment-friendly green products, creating green management for delivery of services and products in this industry is an inevitable matter. Applying green supply chain management can reduce the negative impacts of industrial development on the environment and bring them under control (Olfat ,khatami, and khodaverdi 2011). This study is an attempt to investigate the conditions of parts manufacturing firms, subset of Iran Khodro in terms of being green. In this

Copyright © 2016 by author and Scientific Research Publishing Inc. All Rights Reserved.

study, based on factors affecting the supply chain in being green, the selected companies have been ranked and based on the results of rankings some practical advices have been offered

Theoretical Research Basics

In this part, theoretical research basics including supply chain management, green supply chain management and green supply chain evaluation criteria have been discussed.

Supply chain management

The supply chain encompasses all activities associated with the flow of materials and information from suppliers of raw materials to final product delivery to the customer and is focused on customer service improvement, profitability and organization performance. Variations in customer demands, recent advances in information systems, competition in the global environment and increasing government regulations, have made organizations obliged to have focus on supply chain (Asadian Ardakani 2012).Supply chain management is a set of methods used to efficiently and effectively integrate suppliers, manufacturers, warehouses and retailers in such a way that the goods are produced and distributed with the correct amount and in a timely manner to minimize the expenditures of the system and to fulfill the needs of services (Chiniforoosh and Sheikh Zadeh 2010). Management in supply chain can play an effective role in reducing the costs and preventing the loss of financial, human and temporal resources and may lead to energy consumption structural reform (Chiniforoosh and Sheikh Zadeh 2010).Thus by applying a scientific and rational management on supply chain as an important component of strategic management, competitive advantage can be accessed.In general, in recent years, the role of organizations in society and their responsibility in minimizing their impacts on the environment has become more important (MCWilliams and Seigel 2000).In the context of improving the environmental performance of supply chain, green supply chain management will have many benefits such as savings in energy resources, reducing emissions, elimination or reduction of wastes, creating value for customers, and ultimately improving the productivity for companies and organizations

Green supply chain management

Industrial activities due to their nature of the technologies potentially pollute the environment. So if its environmental consequences and effects are not considered, substantial costs should be paid to fix the damages and losses caused by the lack of attention to this issue. Controlling and prevention of environmental pollutions of industry can help to improve production processes, increasing (long-term) profitability and access to global markets which have recently become very sensitive to the environmental issues. Thus producing with minimal wastes and environmental damages should be one of the major goals of the industry(Rezaee 2011).Green supply chain management has its roots in environmental management and supply chain management literature. Adding the word "green" to supply chain management includes intrusion into and the relationship between supply chain management and the natural environment. Determining the boundaries of green supply chain depends on the aim of the researcher. Definition and scope of green supply chain management in the literatures include a range from green purchasing to integrated process of green supply chain from supplier to factory, the buyer, and even recycling(Zhu and Sarkis 2004).Serioustav (2007) has defined the green supply chain as follows: Consideration of environmental issues in supply chain management, including product design, materials sourcing and selection, manufacturing and producing processes, delivery of the final product to the customer and product management after its consumption and termination of its service life(Srivastava 2007).Green supply chain consists of a series of internal and external measures of firms across the supply chain which leads to improvement of the environment and preventing pollution. Using green supply chain management strategies results in reduced wastes, reduced use of resources and consequently reduced energy consumption and environmental pollution. This will ultimately increase the efficiency and will improve the performance of organizations and companies (Ahmadi and Shekari 2009).Green supply chain management is defined as the direct partnership of companies with their suppliers and customers in planning to reduce the environmental impacts of production processes, environmental management and exchange of technical information for learning the operational plans of each other and setting goals for environmental improvement. These activities lead to strengthening of cooperation between them in order to reduce the environmental impacts of material flows in GSCM(Bowen et al 2001; Tseng, Chiang and Lan 2009).Green supply chain management includes all production processes such as purchase of raw materials, production, recycling, reuse and re-manufacturing (Kainuma and Tawara 2006).The main objective of the green supply chain is reducing environmental pollution from the time of purchasing raw materials, production, and distribution to the time of sale of products and their consumptions. Other objectives to mention could be limiting the wastes in the industrial system in order to save energy and avoid the use of hazardous substances in the environment (Zanjirchi et al 2013). Observing the environmental considerations has created a synergy with green supply chain management, which creates an opportunity for upgrading productivity, quality and environmental performance of organizations (Hwa and Tay Joo 2001). Beard and Rees argue that organizations should use the ideas, innovations and creativity of their employees to achieve better environmental outcomes in the path of green supply chain management. In this regard the recommendation of many critics is using Green Teams. The process of applying for a Green Team includes: a review on environment, creating an environmental plan, establishing an environmental unit, establishing working groups for environmental activities (Beard and Rees 2000).

Koshibu (2001) believes that it is not enough for manufacturers to only produce and supply the green products; but they also need consumers demanding green products. In other words, green companies need green markets (Koshibu 2001).

Green supply chain evaluation indices

Various researchers have defined several indicators to measure the green aspect of supply chain which despite their multiplicities, they have a convincing convergence. Clean production is the continuous application of an integrated and preventive environmental strategy for products and services processes to increase the overall efficiency and reduce harmful effects on humans and the environment. This method is a global strategy to make required changes in existing technology and industry in order to build a society based on sustainable development. The concept of cleaner production has been developed with a more motivation to protect the environment (Nabibidhendi et al 2006). Ahmadi and Shekari (2009) in a research on the issue of providing a model to assess the success of organizations in green supply chain management, focused

on Iranian Alloy Steel Company. The main theme of this research is identifying the characteristics of green supply chain management which has been prepared by the study of literatures and using the opinions of experts of industry and has been used as a basis for preparing a questionnaire .After data collection and their analysis by LISREL software, they offered a six-factor model for evaluating the green supply chain management (Ahmadi and Shekari, 2009). Also in a research, Zanjirchi et all proposed a framework to evaluate and compare the green aspect of manufacturing industries. In this research using fuzzy multiple criteria decision making approaches, the green aspect of supply chain has been evaluated within five general measures including green supply and purchase, green design, green production, green transportation, green packaging. In order to evaluate the practical application of this framework, three key industries in Yazd province including textiles, steel and tiles were ranked in terms of being green(zanjirchi et al 2013). Koo et al (2010), taking into account all the six dimensions (quality, cost, delivery, serviceability, environment and corporate social responsibility) and using a combined method of neural networks and data envelopment analysis and hierarchical analysis, began to create a system for choosing the green supplier(Kuo et al 2010). Also, Lee and Wong (2012) identified the green logistic factors and associated green logistics management with operational and environmental performance (Lai and Wong 2012). Shang and colleagues (2010) defined the five dimensions of GSCM as green design, green suppliers, green logistics, green marketing and green production (Shang et al 2010) . Harvani et al (2005) and Zhu and Serkis (2006) suggest that green supply chain is composed of green purchasing, green production and materials management, green distribution and marketing and reverse logistics(Hervani et al 2005;Zhu and Sarkis 2006). Reviewing bibliographies of green supply chain management and environmental management, it becomes clear that most of studies carried out in the field of green aspect of supply chain have focused on six criteria which are indoor management, green shopping, green design, green production, reprocessing and pollution and in the following we will define each of these indicators.

Indoor management: Indoor management is a key element in improving company's performance and it is obvious that in this context, top management support is required. It is almost a key factor for the successful adoption and application of green innovation and technology, plans and activities (Hsu and Hu 2008).

Green purchacing: Green supplier and purchaser involves activities aimed at ensuring the compatibility of the purchased material with the environment, these activities include the ability to reuse, recycle and reducing the use of hazardous substances .

Environmental design: They include activities the target of which is minimizing environmental influences of a product in its whole life cycle (Eltayeb et al 2010).

Green production: Green production is defined as production processes which use inputs with relatively low environmental impacts, wastes and pollutions and high performance) Ninlawan et al. 2010).

Reprocessing: In order to reduce the variable costs of customers and meeting their expectations, improving the company's image and dominating on the market, some manufacturers resort to recycling the products. The sales of stocks or additional equipments are some other aspects of recycling) Zhu et al 2008b).

Pollution: Controlling land, water and air pollution by wastes, the final product and also reprocessing process are important factors to reduce environmental impacts (Rao 2004).

In this study, in order to measure the green aspect of supply chain among parts manufacturing companies of Iran Khodro, the six above-mentioned criteria were used. The summation and categorization of these criteria are given in **Table 1**.

General identified indicators obtained from scientific literatures to evaluate the status of green supply chain management assessment include: indoor management -green shopping - clean production- reprocessing - environmental design, and pollution (Ahmadi and Shekari 2009).

Table 1: identified factors and index related to Green Supply Chain Management

Source	Index	Factors
Zhu et al., 2008a	Green supply chain supported by senior and middle managements, integrated environmental quality management, having a certified ISO 14000, Environmental Management Systems	Indoor Management
Webb, 2009, Zhu et al., 2008a	Observation of required standards for raw material purchasing from, technical and environmental point of view, helping suppliers to design, supporting the suppliers for environmental goals, assessing suppliers in terms of environmental aspects, checking ISO 14000 certifications of suppliers	Green Shopping
Zhu et al., 2008a	Designing products to reduce energy consumption, designing products for reuse in recycling of materials, products designing in order to avoid the use of risky materials in the production process, designing products to meet the needs and demands of customers.	Clean Production
Stokes and Tohamy, 2009, Zhu et al., 2008b, Zhu et al., 2005, Zhu et al., 2008a, Zhu et al., 2005	Observation of required standards in purchase of machineries, equipments and tools from technical and environmental point of view, the use of new technologies for efficient use of energy , education and providing correct energy consumption patterns, setting the required standards for energy efficiency, the existence of necessary regulations to reduce raw materials consumption, ongoing analytical review of the machinery operating status and investigating their depreciation so that they don't cause environmental pollution and high energy consumption, analytical review of all stages of the production process from the essential standpoint of economizing the resources, existence of advanced equipments and devices for the transportation of materials, final products and wastes so as to minimize the wastes and losses, green packaging	Environmental Design
Zhu et al., 2008a	Recycling wastes and residues outside the company, Recycling wastes and residues inside the company, recycling the product after the end of its useful life, product longevity	Reprocessing
Ninlawan et al., 2010	Water, soil and air contamination of the final product, water, soil and air pollution by wastes, waste, water, soil and air pollution of the final product	Pollution

In terms of purpose, this study is an applied one and in terms of collection of data it is of survey type. Data compilation of the study has been carried out by field techniques and library studies. The entire automotive parts manufacturing companies

in Iran constitute the target population. Given that in this research, multi criteria decision making techniques are used for prioritization of the factors; in these techniques, the discussion is not about sampling from the population but from the research community some people are taken into consideration as experts of the desired field. In this study, 60 experts were qualified among the experts of parts manufacturing companies. First by studying research literature, the factors affecting supply chain management in the automotive parts manufacturing industry were extracted. A questionnaire was designed to gather the views of specialists and experts. The mentioned questionnaire is based on six parts and consists of 34 questions about the impact of factors on the green supply chain management.In order to collect data, the related questionnaires were given at the disposal of studied industry experts with previous experience and educations related to this field.

Hypothesis 1a. Index of the indoor management factor of the green supply chain management is effective on the automotive parts manufacturer in Iran

Hypothesis 1b. Index of the green purchasing factor of the green supply chain management is effective on the automotive parts manufacturing companies in Iran

Hypothesis 1c. Index of the green production factor of the green supply chain management is effective on the automotive parts manufacturing companies in Iran

Hypothesis 1d. Index of the reprocessing factor of the green supply chain management is effective on the automotive parts manufacturing companies in Iran

Hypothesis 1e. Index of the environmental design factor of the green supply chain management is effective on the automotive parts manufacturing companies in Iran

Hypothesis 1f. Index of the environmental design factor of the green supply chain management is effective on the automotive parts manufacturing companies in Iran

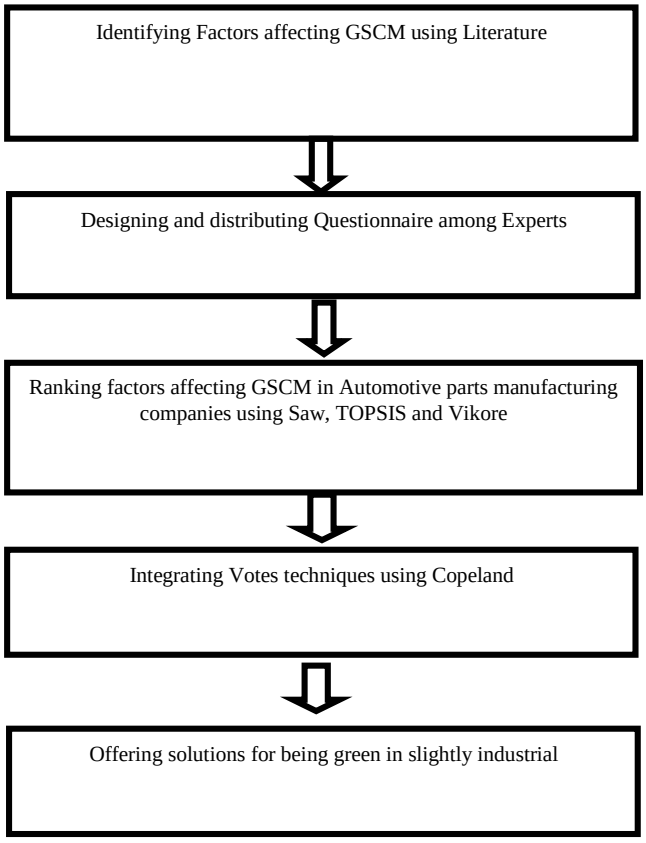
Hypothesis 1g. Index of the pollution factor of the green supply chain management is effective on the automotive parts manufacturing companies in Iran

Hypothesis 2. The difference between the effects of the 5 categories of factors influencing the green supply chain management in the automotive parts industry is not significant.

In this study, the factors affecting green supply chain were identified and were ranked using SAW, TOPSIS, and VIKOR techniques. Then using Copeland technique, the experts' views were merged. Implementation phases of the study are shown in Figure 1.

Figure1-implementation phase

Figure 1. Operational framework for research



When multiple criteria exist and sometimes they are contradictory, multi-criteria decision making techniques have found very large applications in complex decisions. High power of these techniques to reduce the complexity of decision makings, simultaneous use of both qualitative and quantitative criteria and granting a structural framework to decision-making issues and ultimately their easy to use applications has led them to be a good tool to be used by decision-makers in various fields. These techniques consider the decision-making issues in the form of a decision matrix, and decision analysis is being done on them as necessary(Azar and Rajab Zade,2010). In this study, three most commonly used and effective techniques in the field of multi-criteria decision making have been used under the following techniques. In the following a brief description of SAW ،TOPSIS and VIKOR techniques is presented.

SAW technique-Weighting simple set model (SAW) is one of the simplest methods of multi-criteria decision making. So that with the calculation of indices weights (w), the best option (A*) can be calculated as follows.

In this model, the ranking of the options is based on weights derived from them with respect to equation 1. Thus, the preferred option would be that it weighs more than the other options (Azar and Rajabzadeh 2010).

$$A^* = \left\{A_i \mid \max\left[\frac{\sum_j w_j \quad r_{i_j}}{\sum_j w_j}\right]\right\} \qquad (1)$$

TOPSIS technique-TOPSIS technique has been proposed by Hwang and Young in 1981. This model is one of the best models of multi-criteria decision making and it is being used extensively. In this procedure n options are also evaluated by n index. This technique is based on the notion that the choice should have the minimum distance to the positive ideal solution (best possible state Ai +) and have the maximum distance to the negative ideal solution (worst-case scenario, Ai-). It is assumed that the desirability of each index is monotonically increasing or decreasing. TOPSIS problem solving method consists of six steps as follows(Asghar pour,2011).

Step One: Converting the Decision Matrix to Dimensionless Matrix

$$n_{ij} = \frac{r_{ij}}{\sqrt{\sum_{i=1}^{m} r_{ij}^2}} \qquad (2) \qquad ,(\ j= 1, 2\ ,\ldots\ldots n\ )$$

The resulting matrix is called nd.

Step Two: Creating Dimensionless Weighted Matrix

$$V = N_D\ .W_m \quad (3)$$

Where v is Dimensionless Weighted Matrix and w, Diagonal Matrix is calculated by the weights obtained for the indices.

Step Three: Calculation of positive and negative ideal solution using the relationships of the shown equations:

$$A^+ = \left\{\left(Max \quad V_{ij} \quad I_j \quad \in \quad J\right)\left(Min \quad V_{ij} \quad I_j \quad \in \quad J'\right)\right\} \quad (4)$$

$$A^+ = \{V_1^+ \quad V_2^+ \quad V_3^+ \ldots\ldots V_N^+\}$$

J = {j=1,2,3,…n} $\xrightarrow{j}$ profit

$$A^+ = \left\{\left(Min \quad V_{ij} \quad I_j \quad \in I\right)\left(Max \quad V_{ij} \quad I_j \quad \in \quad J'\right)\right\} \quad (5)$$

$$A^- = \{V_1^- \quad V_2^- \quad V_3^- \ldots\ldots V_N^-\}$$

In these relationships the best values for positive indices are the largest values and for negative indices are the smallest values and the worst values for positive indices are the smallest values and for negative indices are the largest values

Step Four: Calculation of the distance between the options from positive and negative ideal alternatives using the following equations

$$d_1^- = \{\sum_{j=1}^{n}(V_{ij} \quad - \quad V_j^-)^2\}^{½} \quad (6$$

$$d_1^+ = \{\sum_{j=1}^{n}\left(V_{ij} \quad - \quad V_j^+\right)^2\}^{½} \quad (7)$$

Step Five: Calculation of the relative closeness

$$C_i = \frac{d_i^-}{d_i^+ \ + \ d_i^-} \quad (8)$$

Step Six: Rating the option. Each option with largest ci, will be the best option.

VIKOR method-VIKOR method was introduced by Aproquick and Tezan. This method is a multiple criteria decision making method for solving discrete decision making problems with disproportionate (different units of index) and contradictory measures. The purpose of this method is to focus on ranking and selection from a set of options in a problem with conflicting criteria(Opricovic and Tzeng 2004).

The basics of Vikor method are derived from the method of compromise programming

The steps of Vikor technique with n criteria and m options are as follows:

Step one: Given to evaluation of all options with respect to different criteria, decision matrix is formed.

Step Two: Determining the weight vector of criteria; according to importance factor of various criteria in decision making and using methods such as entropy and AHP, weight vector is defined.

Step Three: Determining the positive and negative ideal point; for each factor, the best and worst of each one among all the options are determined which will be called the f *j and fj.

Step Four: Calculating the utility and regret of criteria, S represents a relative distance of i-th option from the positive ideal solution.

$$L_{l,I} = \mathrm{S_i} = \sum_{\mathrm{j=1}}^{\mathrm{n}} \mathrm{w} \times \frac{\mathrm{f_j^* - f_{ij}}}{\mathrm{f_j^* - f_j^-}} \quad (9)$$

$$L_{\infty,I} = \mathrm{R_i} = Max\left\{\mathrm{w} \times \frac{\mathrm{f_j^* - f_{ij}}}{\mathrm{f_j^* - f_j^-}}\right\} \quad (10)$$

Fifth step: calculating the Q, for each index option, Q is calculated with the following equation.

$$Q_i = \left[\frac{S_i - S^*}{S^- - S^*}\right] + (1 - V)\left[\frac{R_i - R^*}{R^- - R^*}\right] \quad (11)$$

$$S^- = \underset{i}{Max}\, S_{i,} \quad S^* = \underset{i}{Min}\, S_i$$

$$R^- = \underset{i}{Max}\, R_{i,} \quad R^* = \underset{i}{Min}\, R_i$$

Step Six: Options are sorted based on the values of S, R, Q in descending order. Option with least Q amount is the best option.

Data Collection and Analysis

After collecting data obtained from the viewpoint of experts in this research, decision matrix was formed.

Before performing computational phases of following methods, importance factors of indices must be determined first. In this study, using Shannon entropy, these coefficients have been obtained. The results of the implementation of the above techniques are shown in Table 2.

After collecting data from the viewpoint of research, decision matrix was formed .The matrix consists of 34 rows (number of index) and 60 columns (number of people), respectively .Before performing the following procedures must compute the coefficients of the variables to be determined .In this study, the coefficients are obtained using Shannon entropy .The results of the implementation of the above techniques are shown in **Table 2**.

Table 2: Ranking green supply chain management factors and index based on Topsis,Vikore and Saw techniques.

Ranking			Index	Factors
TOPSIS	VIKOR	SAW		
7	4	26	Green supply chain supported by top and middle managers	Indoor Management
13	12	24	Integrated environmental quality management conditions	
19	5	30	Certified to ISO 14000	
1	3	31	Implementation of environmental management systems	
5	6	23	Control and monitoring systems for compliance with environmental standards	
14	11	27	Training and advice on environmental issues to individuals	
28	22	28	Creating an environment conducive to study and make recommendations on environmental issues	
2	2	9	Promoting green culture(observing environmental considerations in corporate workspace(	
10	8	25	Creating systems to inform employees and staff	
17	7	10	Observing standards for raw materials purchasing from technical and environmental point of view	Green Shopping
15	15	17	Assigning suppliers to design	
29	14	16	Cooperation with suppliers for environmental objectives	
4	19	33	environmental evaluation of suppliers	
22	1	20	Controlling iso 14000 certification for suppliers	
30	32	34	Observing standards required in the purchase of machinery and tools from technical and environmental point of view	Clean Production
8	29	29	The use of new technologies for efficient use of energy	
27	21	13	Education and providing correct patterns of energy consumption	
31	13	21	Setting standards and criteria for energy efficiency	
18	34	1	necessary terms for green raw materials usage	
21	25	32	ongoing analytical study of working conditions of machinery and checking the status of their depreciation	
3	16	19	Checking all stages of production process from essential point of view of saving the resources	
23	17	18	Using advanced equipment's and tools for the transportation of materials , final products and wastes	
16	10	14	Green packaging	
9	9	15	Recycling wastes and residuals outside the company	Reprocessing
12	28	7	Recycle waste and residuals within the company	
24	30	2	product recycling after its useful life	
25	18	8	Long product life	
26	20	22	Designing products to reduce energy and material consumptions	Environmental Design
20	33	11	Designing products for reuse in recycling materials	
6	23	3	Product design in order to avoid using risky materials in the production process	
11	27	5	Products designed for the needs and demands of clients	
33	31	6	Water, soil and air contamination of the final product	Pollution
34	24	4	Water, soil and air pollution by waste	
32	26	12	Water, soil and air pollution in the process of reprocessing	

May be due to different techniques mentioned, different ratings are obtained for a single problem, For consensus on different rankings, combined methods can be used such as the average ranks method, Breda technique, and Copeland technique. In this search for a consensus on ratings, Copeland technique has been used. This method specifies the number of wins and losses for each factors. For example, if we refer to the data from the original table, different methods that prefer factor 1 on Factor 6 are the two methods of SAW and TOPSIS. Similarly, it is observed that only in the VIKOR method Factor 6 is preferred Factor 1. There more methods that prefer Factor 1 on Factor 6 than the methods that prefer Factor 6 on Factor 1. Thus, according to the most of methods Factor 1 is preferred on Factor 6. In this paired comparison, this case is shown with m. If in paired comparison, there was a not majority vote or the votes were equal, it will be coded with x. M means that rows are preferred on columns and x represents that columns are preferred on rows. Each paired comparison will be reviewed individually. Last column of the table shows∑c, the number of wins for each factor. The points which Capland allocates to each option, is calculated by subtracting the number of losses ∑r from the number of wins∑c. Options rating using this method is shown in **Table 3.**

Table 3: ranking green supply chain management Factors and index based on Copeland technique.

Copeland	Index	Factor
5	Green supply chain supported by top and middle managers	Indoor Management
6	Integrated environmental quality management conditions	
20	Certified to ISO 14000	
13	Implementation of environmental management systems	
2	Control and monitoring systems for compliance with environmental standards	
30	Training and advice on environmental issues to individuals	
1	Creating an environment conducive to study and make recommendations on environmental issues	
15	Promoting green culture(observing environmental considerations in corporate workspace)	
23	Creating systems to inform employees and staff	
8	Observing standards for raw materials purchasing from technical and environmental point of view	Green Shopping
31	Assigning suppliers to design	
25	Cooperation with suppliers for environmental objectives	
4	environmental evaluation of suppliers	
7	Controlling iso 14000 certification for suppliers	
10	Observing standards required in the purchase of machinery and tools from technical and environmental point of view	Clean Production
21	The use of new technologies for efficient use of energy	
11	Education and providing correct patterns of energy consumption	
26	Setting standards and criteria for energy efficiency	
3	necessary terms for green raw materials usage	
27	ongoing analytical study of working conditions of machinery and checking the status of their depreciation	
18	Checking all stages of production process from essential point of view of saving the resources	
14	Using advanced equipment's and tools for the transportation of materials , final products and wastes	
22	Green packaging	
28	Recycling wastes and residuals outside the company	Reprocessing
24	Recycle waste and residuals within the company	
29	product recycling after its useful life	
17	Long product life	
9	Designing products to reduce energy and material consumptions	Environmental Design
12	Designing products for reuse in recycling materials	
16	Product design in order to avoid using risky materials in the production process	
19	Products designed for the needs and demands of clients	
32	Water, soil and air contamination of the final product	Pollution
34	Water, soil and air pollution by waste	
33	Water, soil and air pollution in the process of reprocessing	

Results and Discussion

Today, preserving and optimal use of limited and irreplaceable resources in each country ensures the sustainable development of that country. The purpose of this study is to identify and rank the factors affecting on green aspect of supply chain in parts manufacturing companies of Iran Khodro using Multi Criteria Decision Making techniques. So in this context, these factors were identified and categorized using the techniques of Multi Criteria Decision Making. Finally, in order to integrate the experts' opinions, Copeland technique was used. The results of this technique showed that the main factors affecting green supply chain management from the perspective of automobile parts manufacturing companies respectively included these items: creating an environment for research and offering suggestions about environmental issues, monitoring and control systems for checking compliance with environmental standards, and existence of essential criteria for using green raw materials and evaluating the

suppliers on environmental basis. Among the main criteria, the indoor management measure has earned the most points and then environmental design, green shopping, cleaner production, reprocessing, and pollution are ranked respectively

So in environment-related programs, the indoor management should be a priority. However, this also has an important role in satisfaction of the main customer (Iran Khodro). Without attention to green supply chain management factors, automobile parts manufacturing companies cannot survive that long. So in order to be in line with Iran Khodro plans, they inevitability should implement the green supply chain management factors. To establish an integrated strategy, the key customer needs to regard the environmental standards as a requirement for parts manufacturing partners and it must constantly monitor the situation of parts manufacturing companies about this matter. Using the multi criteria decision making techniques, decision-maker managers in the automotive service and industry, will be able to prioritize factors affecting green supply chain management and according to the priorities, make plans to address to strengthening and reforming the turmoil.

References

1. Ahmadi, SeyedAli Akbar; Shekari, Hamideh . "Providing a model for assessing the success of organizations in green supply chain management (Case Study: Iran Alloy Steel Company)" 2009.Retrieved from http://www.sid.ir/fa/VEWSSID/J_pdf/51213926605.pdf
2. Azar, Adel, Rajab Zadeh, Ali . "Applied decision-making of MADM approach ". Negahe danesh press, First Edition, Fourth publication,2010. Retrieved from http://www.forouzesh.com/book/bookdetail.aspx?code=GfTbzfTfTfTJXbzaYMnfTultZrdulrdtZQkYErd
3. Asadian Ardekani, Faezeh. Prediction of risk in supply chain with artificial neural network approach (Case Study: Iran Alloy Steel Company - Yazd), M.Sc Thesis, University of Yazd, 2012.
4. Imani, DinMuhammadi, Ahmadi, Afsaneh. "Green supply chain management, new business strategies for competitive advantage." Journal of Automobile Engineering and related industries, the first year, 2009, No. 10.
5. Jafari Nejad, Seyed Abolfazl . "Evaluation of major supply chain management processes in organizations." Automobile industry. Issue 16 - 2009 - SPECIAL issue of supply chain, 2009.
6. Rezaei, Amir . "Study and providing solutions for realization of green supply chain management in the construction industry of Iran." Master's thesis. Tehran University, 2011.
7. Safai Ghadikalaei, AbdulHamid; Haji Abadi, Fatemeh . "Comparative Study of lean and green paradigms", First National Conference on Modern Management Sciences, Golestan Province Gorgan,2011.
8. Olfat, Laeya; Khatami Firoozabadi, Ali; Khodaverdi, RoohAllah (2011). "The requirements of fulfilling green supply chain management in the automotive industry in Iran." Journal of Management Sciences in Iran, the sixth year, No. 21, Spring 2011, pp. 122-140.
9. NabiBidhendi ,Gholamreza; Hovaidi, Hassan; Nasrabadi, Tooraj; and Shahin Mohammad Nejad, the introduction of cleaner production approach for energy consumption efficiency in industry, case study: Food industry, First Environmental Engineering Conference, Tehran, Tehran University, Faculty of environment , 2006. 46-59 .
10. Beard, Colin and Rees, Stephen, Green teams and the management of environmental change in a UK county council, Environmental Management and Health, Vol. 11, No. 1, 2000, pp. 27-38.
11. Bowen,F.E., et al. The role of supply management capabilities in green supply, Production and Operations Management, Vol. 10, No. 2,2001, PP. 174-189.
12. Eltayeb,T., S., Zailani, T.,Ramayah .2010. Green Supply Chain initiatives among certified companies in Malaysia and environmental sustainability: Investigating the outcomes, Resources, Conservation and Recycling, Vol. 55, PP. 495-506.
13. Hervani,A.A., M.M., Helms, J.,Sarkis .2005. Performance measurement for green supply chain management, Benchmarking: An International Journal, Vol. 12, No. 4, PP. 330-363.
14. Huang, Niven, Eco-Efficiency and an Overview of Green Productivity, Conference on Enhancing Competitiveness Through Green Productivity, China, 25-27 May, 2001.
15. Hwa, Tay Joo ,Green Productivity and Supply Chain Management, Conference on Enhancing Competitiveness Through Green Productivity, China, 25-27 May, 2001.
16. Kainuma,Y., N.,Tawara .2006. A multiple attribute utility theory approach to lean and green supply chain management, International Journal of Production Economics, Vol. 101, PP. 99-108.
17. Koshibu, Hiroaki, Greening the Market: The Effort by Fuji Xerox and The Green Purchasing Network, Japan, Conference on Enhancing Competitiveness Through Green Productivity, China, 25-27 May, 2001.
18. Kuo,R.J., F.C.,Tein . Integration of artificial neural network and MADA methods for green supplier selection, Journal of Cleaner Production, Vol. 18, 2010, PP. 1161-1170.
19. Lai,K.H., C.,Wong . Green logistics management and performance: Some empirical evidence from Chinese manufacturing exporters, Omega, Vol. 40, 2010, PP. 267-282.
20. McWilliams, A. and Siegel, D. Corporate social responsibility and financial performance: correlation or misspecification? Strategic Management Journal, 21, 2000, PP. 603–609.
21. Ninlawan,C., et al . The Implementation of Green Supply Chain Management Practices in Electronics Industry, Proceeding of the International Multiconference of Engineers and Computer Scientists, 2010, PP. 17-19.
22. Opricovic,S;Tzeng,GH. Compromise solution by MCDM methods:A comparative analysis of VIKOR and TOPSIS.EUR J OPER PRES ,156(2), 2004, pp: 445-455 JUL.
23. Shang,K-C., Lu, C.H., S.,Li, A taxonomy of green supply chain management capability among electronic-related manufacturing firms in Taiwan, Journal of Environmental Management, Vol. 91, 2010, PP. 1218-1226.
24. Srivastava, S. K. Green supply-chain management: A state-of- the-art literature review. International Journal of Management Review, 9(1), 2007, pp: 53-80

25. Tseng, M.L., J.H.,Chiang, L.W.,Lan . Selection of optimal supplier in supply chain management strategy with analytic network process and choquet integral, Computers and Industrial Engineering, Vol. 57, No.1, 2009, PP. 330-340.
26. Vachon,S., R.D.,Klassen . Extending green practices across the supply chain: the impact of upstream and downstream integration, International Journal of Operations and Production Management, Vol. 26, 2006, PP. 795–821.
27. Vachon,S., R.D.,Klassen . Green project partnership in the supply chain: the case of package printing industry, Journal of Cleaner production, Vol. 14,2006, PP. 661–71.
28. Yu, Ning, The Creen Consumption Movement: The Roles of Government, Business, Academia ,NGOs and Consumers, Conference on Enhancing Competitiveness Through Green Productivity ,China, 2001, pp: 25-27.
29. Zhu, Q. and Sarkis, J. An inter-sectoral comparison of green supply chain management in China: Drivers and practices. Journal of Cleaner Production, 14, 2006, pp: 472-486 .
30. Zhu, Q., and Sarkis, J. Relationships between operational practices and performance among early adopters of green supply chain management practices in Chinese manufacturing enterprises. Journal of Operation Management, 22,2004, pp: 265-289.
31. Zhu, Q., Sarkis, J., and Geng, Y. Green supply chain management in China: Pressures, practices and performance. International Journal of Operations andProduction Management, 25(5), 2005, pp: 449-468 .
32. Zhu, Q., Sarkis, J., and Lai, K. Green supply chain management :Pressures, practices and performance within Chinese automobile industry. Journal of Cleaner Production, 15, 2007, 1041-1052 .
33. Zhu, Q., Sarkis, J., and Lai, K. Initiatives and outcomes of green supply chain management implementation by Chinese manufacturers . Journal of Environmental Management, 85, 2007, pp: 179-189 .
34. Zhu, Q., Sarkis, J., and Lai, K. Green supply chain management implications for closing the loop. Journal of Transportation Research ,Part E, 44, 2008, pp: 1-18 .
35. Zhu,Q., J.,Sarkis . An intersectional comparison of green supply chain management in China: drivers and practices, Journal of Cleaner Production, Vol.14, 2006, PP. 472–86.