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Evaluate and Rank the Risks in Supply Chain in Work and Initiative of Naghshe Jahan Company

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ABSTRACT

The fundamental objective of supply chain management is to integrate various suppliers to satisfy market demand. Supplier evaluation and selection is very important for establishing an effective supply chain. In fact, supplier selection consists of both qualitative and quantitative criteria, so it is considered as a multi-criteria decision-making problem. In this paper, evaluate and rank the risks in supply chain in order to determine and prioritize the critical, which is measured based on determined indexes. we got a list of risks by interviewing experts in this field using failure modes and effect analysis questionnaire the qualitative data are converted to quantitative data and identified risks have been evaluated and ranked by using gray analysis consequently. This study is looking for identifications and descriptions with proper samples of six main kind of confronted risk of supply chain. Hence, the method can be an efficient and effective methodology to be used by decision makers on supply chains. The proposed methodology can also be applied to found the most important known risks, which are proposed, to managers.

Keywords: Supply Chain, Risk, Grey Failure Mode and Effect Analysis
JEL Classification: R41

1. INTRODUCTION

Supply chain management (SCM) is a process of organizing the activities from the customer's order through final delivery for speed, efficiency, and quality (Barry, 2004). SCM has an increasing importance in today's competitive business world. Companies need to have strong relationships and integrations with their suppliers for a successful SCM system. They should establish appropriate relationships with their suppliers in order to achieve their strategic goals. Therefore, supplier selection is a fundamental step of SCM.

Variation in demands for production enforces outsourcing of activities. Primary problem in supply chain is control and coordinate activities (Chang et al., 2001). SCM is a process of organizing the activities from the customer's order through final delivery for speed, efficiency, and quality. SCM has an increasing importance in today's competitive business world.

As the importance of certain management areas increases, the need for suitable decision support in these areas also rises. Decision problems in SCM range from single quantitative criterion analyzes to multiple criteria and/or objectives problems, where quantitative as well as qualitative criteria must be incorporated. A very common decision problem in SCM is the single-criterion, purely quantitative consideration of inventory control. For such problems, classical methods only consider costs and minimize them under certain constraints, like customer service. However, even in such cases, authors tend to state that conflicting goals are balanced.

However, many strategic decisions are not subject to optimization, as they involve multiple imprecise, uncertain and qualitative criteria. Multi-criteria decision-making (MCDM) offers support for such strategic decisions (Xia and Chen, 2011), allowing for the consideration of conflicting and qualitative objectives (Chen et al., 2003). Zhang (2005) state that the most crucial support delivered by MCDM approaches to decision makers is probably the structured examination of the decision problem as part of the process. While many applications of such methods to SCM already exist, a literature survey of MCDM methods, allowing the consideration of qualitative information in SCM, is not available yet.

In categorizing different MCDM methods, there is no complete consensus between authors. However, categorizations of MCDM methods do not differ widely. Our categorization of MCDM methods follows (Wang et al., 2012) who distinguish multi-objective mathematical programming, multi-attributive utility theory, outranking and non-classical approaches.

To improve the traditional failure mode and effect analysis (FMEA), many other risk assessment methods based on MCDM methods (Chang et al., 2013; Ekmekçioglu and Kutlu; 2012) have been proposed The purpose of FMEA is to analyze the design characteristics relative to the planned manufacturing process to ensure that the resultant product meets customer needs and expectations. When potential failure modes are identified, corrective action can be taken to eliminate or continually reduce the potential for occurrence. The FMEA approach also documents the rationale for a particular manufacturing process. FMEA provides an organized, critical analysis of potential failure modes of the system being defined and identifies associated causes. It uses occurrence and detection probabilities in conjunction with a severity criterion to develop a risk priority number (RPN) for ranking corrective action considerations.

METHOD AND PROCEDURE

2.1. The Statistical Population

Senior industry experts, experts in logistics, production and trading company Top services 95 persons are following from the formula, which is used to determine the sample volume:

$$n = \frac{NZ^2_{\alpha/2}PQ}{\xi^2(N-1)+Z^2_{\alpha/2}PQ}$$

P=0.05
x=0.05

2.2. FMEA

2.2.1. Traditional FMEA procedure

The procedures for carrying out an FMEA can be divided into several steps are defined as follows. These steps are briefly explained here (Chang et al., 2013; Ekmekçioglu and Kutlu, 2012):

Step 1: Identify what the system is supposed to do when it is operating properly.
Step 2: Divide the system into sub-systems and/or assemblies to localize the search for components.
Step 3: Identify components and relations among components use schematics, blue prints and flow charts.
Step 4: List complete component for each assembly.
Step 5: Identify environmental and practical pressures that can affect the system. Consider how these pressures might affect the performance of individual components.
Step 6: Determine failure modes of each component and assess the effects of failure modes on assemblies, sub-systems, and the entire system.
Step 7: Define the hazard level of each failure mode.
Step 8: Evaluate the probability. This can also be done by employing qualitative evaluations in the absence of solid quantitative statistical information.
Step 9: Calculate the RPN, which is given as the multiplication of the index representing the probability, severity and detectability.
Step 10: Make a decision whether action needs to be taken according to the RPN.
Step 11: Propose recommendations to enhance the system performance, which may fall into two categories:
Preventive actions: Prevent failure from occurring:

- Compensatory actions: Minimizing the cost in the event that a failure occurs.

Step 12: Summaries the analysis, which can be accomplished in a tabular form

Shortcomings in traditional FMEA.

Traditionally, the prioritization of failure modes is determined by calculating the RPN, which is defined as follows:

RPN=O×S×D

Where O is the probability of occurrence of a failure mode, S is the severity of a failure effect and D is the probability of a failure being detected.

In general, each risk factor has 10 numerical ratings from 1 to 10.

The failure mode with higher RPN is assumed more significant and should be given a higher priority than those having lower one. Although traditional FMEA has been acknowledged to be a useful tool in system, design, process and service, traditional RPN method has also been criticized for many shortcomings.

- The relative importance among O, S and D is not taken into consideration in determining the priority of the failure modes. However, the weights of the risk factors may be different in practical applications.
- The calculation of multiplication of RPNs is questionable. Small variations may lead to vastly different effects on the RPN. For example, if O and S are both 10, then a 1-point difference in detection rating results in a 100-point difference in the RPN; if O and S are equal to 1, then the same 1-point difference results in only a 1-point difference in the RPN; Hence, the conclusion acquired is meaningless.
- The RPN considers only three factors mainly in terms of safety, but it makes no sense why other important factors are not taken into account.
- Different operation of O, S and D may produce exactly the same value of RPN, but their hidden risk impacts may be totally ignored. For example, two different failures with the values of 2, 3, 4 and 2, 2, 6 correspond to O, S, D, respectively, having the same RPN value of 24. The hidden risk impact of the two failures, however, may be different and a high-risk

failure mode may be overlooked in some cases.
- It is difficult or even impossible to give exact numerical evaluations associated with the risk factors. The FMEA team members often give inconsistent assessments to the same risk factors, some of which may be uncertain, ambiguous and incomplete because of different background and experience (Dey, 2006).
- The RPNs are not continuous. Many empty elements exist in the RPN scales because many numbers between 1 and 1000 cannot be obtained by the product of O, S and D. It comes the problem in exploring the meaning of different RPNs (Chang et al., 2013).

2.3. Gray System Theory

A grey number is a figure that represents a range of values rather than an exact value when the exact value for the said figure is not known. The range of a grey number can be an interval or a general number set. Grey numbers are usually expressed as the symbol "⊗", which is called grey. A grey number represents the degree of information uncertainty in a given system. As the basis of grey systems theory, research on grey numbers and grey measures has attracted increased attention over the past years (Chang et al., 2001).

2.3.1. Gray numbers

A grey number is the most fundamental concept in grey systems theory. In the original definitions, a white numbers is a real number, $x \in R$. A grey number, written ⊗x, means an indeterminate real number that takes its possible values within an interval or a discrete set of numbers. Let G[R] denotes the set of all grey numbers within the set of real numbers, R, the definitions of discrete grey numbers, continuous grey numbers, and general grey numbers are presented as follows:

Definition 2.1: A discrete grey number x is an unknown real number with a clear lower bound ⊗ x and an upper bound

$\bar{x}, \underline{x}, \bar{x} \in R$, taking its value from the closed interval, $[x, \bar{x}]$ denoted:

$\otimes x \in R\ \{x_1, x_2, \ldots, x_n\}$

Definition 2.2: If the two numbers is grey, then we have the following assumptions:

$\otimes_1 \in [a,b], \otimes_2 \in [c,d]$ then $\otimes_1 + \otimes_2 \in [a+c, b+d]$

$\otimes_1 \in [a,b], \otimes_2 \in [c,d]$ then $\otimes_1 - \otimes_2 \in [a-d, b-c]$

$$\otimes_1^{-1} \in [\frac{1}{b}, \frac{1}{a}]$$

$$\otimes_1 \in [a,b], \otimes_2 \in [c,d] \text{ then} \in \otimes_1 \times \otimes_2 \in [\min\{ac,ad,bd\}$$
$$\max\{ac.ad.bc.bd\}]$$

$$\otimes_1 / \otimes_2 \in \otimes_1 \times \otimes_2^{-1}$$

$$\otimes_1 / \otimes_2 \in \left[\min\{\frac{a}{c},\frac{a}{d},\frac{b}{c},\frac{b}{d}\} \max\{\frac{a}{c},\frac{a}{d},\frac{b}{c},\frac{b}{d}\}\right]$$

For comparing two grey numbers, should use to the feasible grey:

Definition 2.3: If there is a common part of the two grey numbers then (Chang et al., 2001):

$$P(\otimes_1 < \otimes_2) < 0.5 \quad then.... \otimes_2 < \otimes_1$$

$$P(\otimes_1 > \otimes_2) > 0.5 \quad then.... \otimes_2 > \otimes_1$$

3. RESULT ANALYSIS

The questionnaire was designed with questions related the risks then the managers and experts For collecting the data in the work and initiative of the world's office, By using grey theory to be analyzed which leads to better identify supply chain risks, evaluated and ranked improvement in critical areas and therefore improve the performance of the supply chain And the model was proposed by according to the rating.

Research plays an important role in the both directions and the recycling industry in Iran. First, it provides a framework for understanding factors that recycle supply chain risks; the second, process Gray FMEA.

Analysis method to determine the degree of importance in weighting and which offers new and significant efforts in the field. In addition, compared to previous research in the field of supply chain risks that are focused on qualitative aspects, this research seeks to study the issues of risk assessment in the company's service.

The FMEA method in this study is formed to prioritize the various risks within the organization. As per this method, first priority considers the severity of risk and then Occurrence of that risk comes in precedence, finally yet importantly is Detection of risk. Thus, the firm has Risk Priority by the use of FMEA method.

Here the most critical risks are industrial risk and then Decision Making risk according to their value that require optimization at maximum level. The industrial risk must be dealt with to reduce the losses to the SCM. The sub factors associated with the industrial risk should be solved according to their ranking. Therefore, it is advised to the company to deal with reducing the most ranked risks so that the supply chain of the firm can function without loss.

For ranking the criteria of risks and certain numbers is used the average the upper bound and lower bound, And for gaining that weight in the interval [0,1], whole numbers divided to the average, and the final weight of the resulting risks for Tables 1 and 2 is attached in the index.

According to the risk evaluation and rating of grey breakdown structure, the quality model has been provided by software Visio, which are defined in Figure 1.

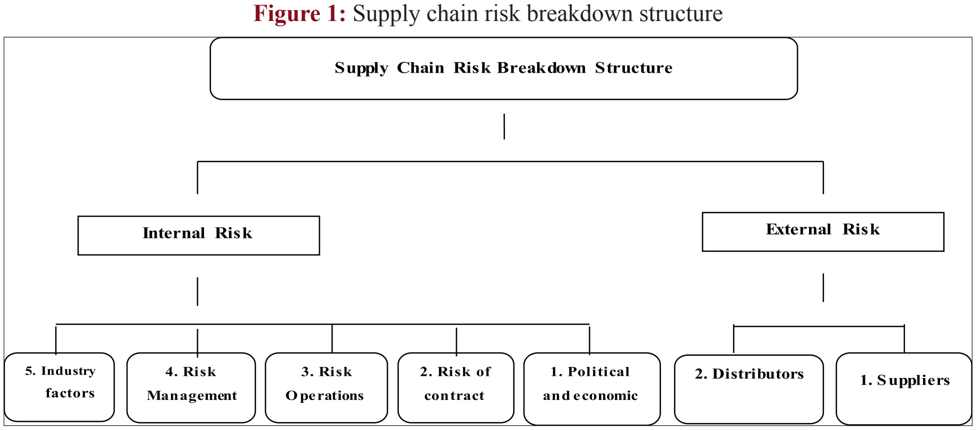
Table 1: Prioritize risks of supply chain using GFMEA (internal risk)

Internal risk	Risk	Weight	Rating
Industry factors	Changes in regulation, industry	0.76758	2
	Inappropriateness of with the technology	0.815778	1
Risk of contract	Lack of financial resources	0.680357	3
	Lack of prioritization	0.698571	2
	Delays in payments	0. 875929	1
Risk management	Job rotation managers	0.603225	8
	Lack of raw materials	0.564341	9
	Failure in the recruitment and retention of specialists	0.647171	7
	Instability in the management	0.694875	5
	Lack of clear goals	0.664387	6
	Delays in the schedule	0. 828414	1
	Lack of knowledge and experience of the project team	0.751285	3
	High rate in order	0.712464	4
	Workers strike	0.804346	2
Risk Operations	Lack of equipment	0.569536	6
	Problems caused by natural hazards	0.677785	5
	Failure Machine tools	0.882148	1
	Lack of coordination and cooperation among the members of the organization	0.827875	2
	High traffic	0.684375	4
	The unavailability of spare parts	0.698715	3
	Non-compliance with safety issues	0.553571	7
Political and economic	Inflation and recession	1	1
	International sanctions	0.689758	2

Table 2: Prioritize risks of supply chain using GFMEA (external risk)

External risk	Risk	Weight	Rating
Distributor	No validity relative to the market	0.75434	3
	Damage to products	0.87	2
	Transportation inappropriate	0.671432	4
	Lack of financial resources and cost	0.98631	1
	Lack of response	0.514298	5
Supplier	Exit supplier of business environment	0.595731	4
	Asymmetry of supply and demand	0.517857	8
	Lack of reputation, knowledge and experience of the supplier	0.674291	3
	Lack of financial resources and cost	0.875143	1
	Poor quality raw materials	0.536431	6
	Delays in the timely supply of raw materials	0.796429	2
	Dependence on the particular supplier	0.564344	5
	Failure to respond changes new product	0.514357	7

Figure 1: Supply chain risk breakdown structure



4. CONCLUSIONS

The FMEA concepts in manufacturing supply chain should be considered with meticulousness, which is the need of the time, as manufacturing supply chain, is becoming less vertically integrated and the manufacturer is focusing on its core competency. Using FMEA method the study of various risks is done here that which risk is more critical here for any industry. Therefore, a structured, simple and efficient proposed decision framework is proposed and has the ability to show the direction to determine the degree of impact level of each Risk Factor. The degree of impact level of each Risk Factor of the firm will give idea for optimally allocating the efforts to gain maximum benefit. Further research is suggested to develop a decision framework that can able to find out optimal number of solutions for identifying and mitigating the most influencing Risk factors of the supply chain in a specific environment.

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