International Journal of Mechanical Engineering and Applications
2015; 3(3-1): 57-66
http://www.sciencepublishinggroup.com/j/ijmea
doi: 10.11648/j.ijmea.s.2015030301.19
ISSN: 2330-023X (Print); ISSN: 2330-0248 (Online)

Vendor Selection Risk Management Framework in Automotive Industry

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To cite this article:

Kamran Mohtasham, Faieza Abdul Aziz, Mohd Khairol Anuar B. Mohd Ariffin. Vendor Selection Risk Management Framework in Automotive Industry. *International Journal of Mechanical Engineering and Applications*. Special Issue: Transportation Engineering Technology — Part II. Vol. 3, No. 3-1, 2015, pp. 57-66. doi: 10.11648/j.ijmea.s.2015030301.19

Received: October 11, 2016; **Accepted**: October 13, 2016; **Published**: November 7, 2016

Abstract: Disruption of the supply chain can happen at any level of the process; therefore, investigation on the possible risks in the supply chain is inevitable in any SCM activity. Supplier failure is a major threat to the supply chain and to ensure proper vendor selection, this study aimed to establish a vendor selection procedure that can reduce the risk of supply chain disruption. Linear weighting method is used to analyze the risk factors and construct an empirically reliable model for supplier evaluation. The result of multi-criteria vendor evaluation model showed that supplier product quality had the highest degree of influence on vendor selection risk management. It was found that in a sequential order, product quality, human resources, financial power, governmental support, IT and R&D opportunities, and environmental vulnerability of the supplier are critical to supply chain management. The outcome of the current research is a vendor selection framework that utilizes the proposed supplier evaluation model to reduce the risk in vendor selection.

Keywords: Vendor Induced Risks, Supply Chain, Risk Management

1. Introduction

In the early 1980s, manufacturers repeatedly stated the strategic importance of suppliers [1]. The manufacturers' relationship with supplier was changed from adversarial to cooperative and it was realized that a reliable supplier can enable firms to freely put their full attention on their main focus and goals such as cost reduction, timely product development, and products quality development plans at the same time. Different types of relationships according to the length of contraction has been identified from short-term to long-term and one-time contract to partnership [2]. It has been discussed that long-term contracts and relationships with a supplier may not necessarily be an optimal choice; as firms may expand their scope of work and grow globally their respective supply chain would change and involve with global suppliers and partners. Therefore, decision makers need to choose reliable and responsive vendors with low failure potential due to possible changes in enterprise agenda and production plans [3]. Thus, they are required to identify the critical vendor-induced risk factors in order to choose the more reliable vendors and construct a flexible supply chain that can accommodate the uncertainties and risks involved.

In the 1980s, Just-In-Time manufacturing technology was one of the new strategies that were utilized by companies to reduce their product cost and compete in different markets. Recently, it is discovered that such technologies that focus on manufacturing and supply chain cost reduction considerably enlarge the uncertainty and risks involved in the supply chain [4]. For instance, optimal inventory (especially Zero-inventory) and Just-In-Time delivery and movement of parts, which are utilized in many companies, significantly increase the supply chain sensitivity and little issues (e.g. a brief delay) can turn into big issues instantly [5]. Therefore, must make a balance between cost reduction activities such as Just-In-Time approach and resulting risks. It is worth mentioning that vendors' failure is the major driver of supply chain risk when Just-In-Time technology is applied. Therefore, vendor-induced risks and vendor selection uncertainties should be explored and incorporated into the decision-making process in order to overcome supply chain

disruption threat in Just-In-time technology application.

On the whole, supply chain is known to the industry and academia as a complex system, which involves considerable risk and uncertainties [6]. The basic step in supply chain management is the vendor selection, which is also of paramount importance to risk reduction in this process. In line with the stated importance of vendor-induced risks identification for proper supplier selection—to build a flexible supply chain or to run Just-In-Time technology—it should also be highlighted that 70% of production cost in manufacturing is aimed for purchasing goods and services from suppliers, which in high-tech firms this portion arise to 80% [7,8]. Ericsson [9] and Bosch [10] companies are well-known examples of the high-tech firms failure due to supplier failure in their supply chain. Therefore, it is of paramount importance to stressfully assess the potential vendors and evaluate their performance in terms of contributing risks and uncertainties to the supply chain. Thus, the present study investigates vendor-induced risks in supply chain to develop a low risk vendor selection framework for overall supply chain risk management.

2. Vendor Selection

One of the practices in the supply chain risk management (SCRM) is the supply management. It is claimed that within the supply management context, supplier selection risk mitigation can substantially reduce the supply chain risk [8]. In addition, vendor selection and purchasing process importance is escalated to a strategic level in supply chain management due to the emphasized modern focus on the relationships between focal companies and vendors—services and goods providers [11]. Furthermore, The amount of capital spent for the purchase of services and goods is commonly regarded as the largest single cost for companies to support their business operations [12]. Moreover, This is a vital issue in SCRM to define a way to best allocate orders for parts among several potential vendors or suppliers to satisfy consumer demand with low cost, best quality, and less risk of supply chain disruption [13, 14]. Therefore, vendor selection importance has come to the forefront of supply chain risk management and has attracted a lot of academicians and managers attention to establish a sound and flawless supplier selection process.

Supplier selection decision makers see the supplier selection as a complex matter inclusive of qualitative and quantitative factors. Enterprises must choose vendors that are more efficient towards increasing their supply chain competitiveness. How to select the more collaborative vendor/supplier that can establish a long-term relationship is the central key to develop a supply chain and improve its effectiveness [15]. It is commonly agreed that, in today's competitive markets, proper supplier selection is a key factor that affects competitiveness of products [7]. Supplier selection is the obvious source of uncertainty that can cause supply chain delay due to uncertain quality of delivered product and/or delayed part delivery. Literature has introduced various criteria for supplier selection such as price, quality, location, and reliability of vendor for on-time delivery, that may also conflict with one another [13, 16].

There is a very large number of performance metrics to be used for supplier selection, in which they also depend on the product type, marketplace, strategy and etc. Huang et al. [17] with special focus on the suppliers development capabilities defined four indexes for selection procedure; flexibility, satisfaction, risk, and confidence indexes. A finer classification of the metrics and criteria for supplier selection is given by Huang and Keskar [18]. They organized the criteria into three categories, product related (reliability, responsiveness, and flexibility metrics), supplier related (Cost and financial criteria, assets and infrastructure), and society related (safety and environmental). On the other hand, Chen [15] proposed a framework for vendor selection and evaluation that suggests choosing supplier selection criteria and indicators based on the main enterprise competitive strategy.

Zolghadri et al. [19] have also stated various criteria and metrics in supplier selection context, such as quality, delivery, delay, price, performance assessment, quality system assessment, cost, financial capability and stability, collaboration capacity, manufacturing possibilities, quality management programs, production capacity, geographical position, business structure/manufacturing capability assessment, technological infrastructure supporting data exchange, data sharing capability, supplying strategies, manufacturing scheduling. They have also stated the cost and quality as the most dominant metrics along with on-time delivery and flexibility.

In another research, cost and responsiveness have also been highlighted as commonly used metrics for supplier selection [7], where responsiveness is referred to supply chain ability to respond quickly to the costumers demand and new preferences and options. When supplier failure risk is considered in the SCM practices, financial power of the rest of suppliers in the SC is the main key to overcome the supply chain disruption. To this end, supplier financial evaluation metrics come to forefront, such as, suppliers maximum output capacity, flexibility factor, variable cost per unit, fixed management cost, variable premium cost per unit, transportation cost per unit from supplier location to demand point, loss cost per unit for failure to deliver order [14]. Besides, Weber et al. [20] in their review article about supplier selection criteria stated that suppliers geographical location, financial status and records, production facilities and capacity, and organization and management metrics have drawn notable attention by researchers.

Literatures draw the attention towards a debate on importance of price and delivery performance metric. Wilson [21] reported that supplier product quality and service considerations prevailed over the price and delivery metrics. On the contrary, Verma and Pullman [22] believe that the actual selection criteria of managers is the cost and delivery performance, although they may introduce quality as the most important criteria. However, Lam and co-workers [23]

according to their review of the supplier selection criteria, have reported that the price, delivery, quality, and services are the fundamental criteria to be utilized for vendor evaluation. In addition, they introduced the payment terms, past performance, reliability, and flexibility criteria as special requirements for industrial SC partners to be considered.

In supplier selection context, there are many decision making models to finalize the choice of supplier among the candidates. Those models are classified into four groups of single, mathematical, artificial intelligent-based, and combined models [15]. Examples of each model application can be found in studies by Aksoy and Öztürk [16] (artificial intelligent-based), Kilic [24] (combined), Azaron et al. [25] (mathematical), Lam et al. [23] (single). In the class of combined models, Omurca [26] proposed a model that combines the fuzzy c-mean approach with rough set theory technique in order to resolve the supplier selection and evaluation problem, wherein multiple conflicting factors and criteria must be considered in the selection process. Faez et al. [8] in an innovative approach took advantage of fuzzy set theory in case-base reasoning method for quantification of the vagueness in selection criteria. They, next, by applying the buyer's demand and vendors' capacity constraints to mixed integer programming model finalized their supplier selection model.

However, it is claimed that the linear weighting method in the class of single models, which assigns a weight to each risk factor/selection-criterion and provides a total score by summing up the supplier score at every criterion, is the most employed method for supplier selection [8]. Quality, financial, cost, synergies, and production system supplier selection criteria were used in a study by Avila et al. [27]. They employed analytic hierarchy process (AHP) in the class of linear weighting approach to reflect the importance of each factor in SC partner selection. Ng [28] has also utilized linear weighting method to prepare a multi-criteria vendor selection model that can be easily implemented by decision makers. In an exhaustive application of linear weighting method, Moser and Rodrigues [29] developed a framework through Pearson correlation test and linear regression analysis for supplier selection.

Overall, it is seen that modelers and managers in accordance with their purpose of SCM take various actions to reduce the risk of SC disruption. This diversity is also highlighted when vendor selection is in the limelight as a strategy to SCRM.

Risk breakdown structure and conceptual model

Figure 1 summarizes the literature review findings in a form of Risk Breakdown Structure (RBS) in order to build a risk-associate conceptual model of relations within supply chain risk management.

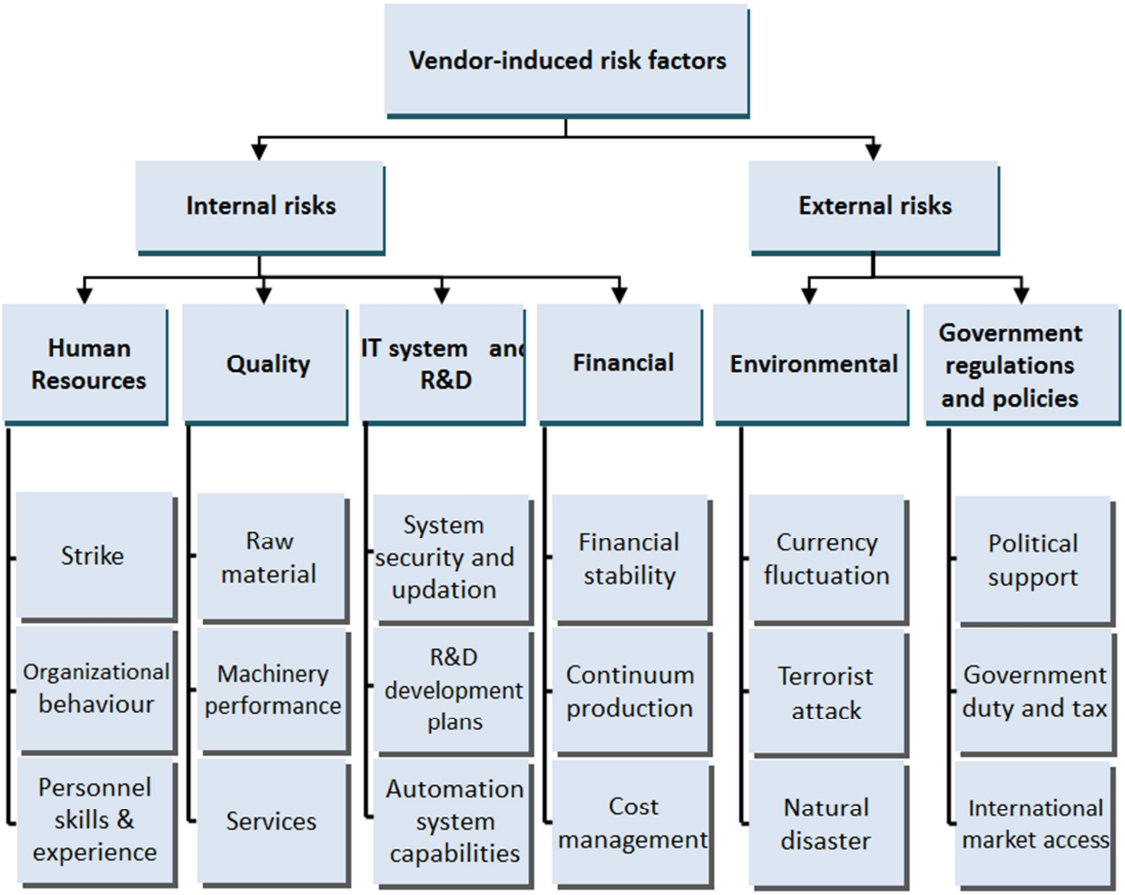

Figure 1. *Supply chain risks breakdown structure.*

In this structure, risks are mainly divided into two categories of internal and external factors [30]. Internal risk factors can also be called as organizational factors where management of these risk factors can be under direct control of the enterprises. The external factors are classified as factors that are beyond the companies control such as natural hazard and political instability. Internal risk factors are finer classified into human resources, product quality, IT system and R&D, and financial, where each class is further detailed to some terms in that class. Next, external factors are spilt into environmental, and government policies and regulations factors. In other words, possible vendor induced risk factors are summarized in this breakdown structure that can also be named as criteria for vendor selection. Next, within each risk factor, sub-criteria that can be used as tools to measure the risk factor in a specific supplier company are introduced. Those sub-criteria are general terms that can be split into several items for exclusive measurement. The present research instrument is organized based on the expanded measures and not only the general terms used in the breakdown structure.

3. Methodology

The literature review in this context helped to develop a questionnaire to survey automotive industry of Iran. Supply chain management experts and statisticians tested questionnaire content validity [31] and then, it was distributed among the decision makers of several departments in each company that are involved in vendor selection and evaluation process. After the data collection, responses analysis was done through several methods. Reliability of the questionnaire is tested through internal consistency method. In internal consistency method, Cronbach's alpha is used to check the reliability of the constructs within the questionnaire [32, 33]. The reliability of the proposed conceptual model was tested using Pearson correlation test. Multiple regression model in the category of liner weighting methods [15] [34] was then used to define the importance of each risk factor in the conceptual model and develop a vendor evaluation model. The outcome of the research, which is a framework for supplier selection under lower risk to supply chain, is obtained through complete utilization of all the results in the study. For the final stage of the work, the proposed framework was presented to the main enterprises to assess the generalization ability and applicability of the developed vendor selection framework [35, 36].

Iran-Khodro, Zagross-Khodro, and Kerman-Khodro car manufacturer companies of Iran were the selected enterprises for the research survey. Personnel of the following departments were interviewed through the questionnaire: financial & administration, quality assurance, quality control, maintenance & services, production planning & control, warehouse & inventory control, logistic, procurement, HSE, business development, IT, R&D, sales & marketing. These departments in each company are directly and indirectly involved in the supplier selection process. A total of 200 questionnaires were distributed and 150 valid questionnaires were collected from all the companies.

4. Results and Discussion

The automotive manufacturers' opinion and experience in dealing with supply chain risks with focus on supplier selection risks is analyzed through their responses to the questionnaire. In this chapter, the firms responses and given scores to the questioned items are scaled from 1 to 5, 1 being very low importance and 5 the highest. Their entries are analyzed using statistical package of SPSS.

4.1. Questionnaire Reliability Test

Table 1 demonstrates the result of reliability test upon the surveyed variables. Unidimensionality of each construct is proved by satisfactory Cronbach alpha values of above 0.7 at every variable, except IT and R&D factor that is 0.66 but still is within acceptable range. Therefore, it can be concluded that all the items being questioned to measure importance of a particular factor are actually related to that particular factor and measuring the same issues in the same dimension. Overall, this concept validates the questionnaire design in terms of having asked reliably related questions to measure a variable.

Table 1. *Reliability test results.*

	N of Items	Cronbach's Alpha
Human resources	7	0.702
Quality	6	0.806
IT and R&D	9	0.66
Financial	5	0.714
Environmental	4	0.723
Government policies	3	0.781
Risk management success	4	0.702

4.2. Descriptive Statistics

To overview the general characteristics of the variables (risk factors) that have been measured through the research instrument, the exploratory data analysis (EDA) results are presented in Table 2. The skewness and kurtosis along with other parameters are used to define the distribution of the obtained data and it is proved that all the data follow the normal distribution, because the values of skewness and kurtosis statistics are between +1 and -1.

Table 2. *Descriptive data of the measured items.*

	Mean	Variance	Standard Deviation	Skewness	Kurtosis
Human resource	3.880	0.204	0.451	-0.545	0.831
Quality	4.243	0.318	0.564	-0.820	-0.334
IT and R&D	3.701	0.165	0.406	-0.105	-0.083
Financial	3.897	0.348	0.590	-0.172	-0.889
Environmental	3.707	0.496	0.704	-0.230	-0.888
Government	3.838	0.437	0.661	-0.308	-0.897
Risk management	3.880	0.471	0.686	-0.372	-0.303

4.3. Conceptual Model

Based on the defined risk breakdown structure (RBS), a conceptual model of the relationships in supply chain risk management is provided in Figure 2. In this model, the general idea of the research theory for SCRM is illustrated. In order to manage the supply chain risk, supply management is considered as the focus of this research. Next, within the supply management side, the supplier selection risk management is proposed to be studied for notable reduction of total risk in the supply chain. It is theoretically defined that all the highlighted major risk factors in RBS can strongly affect the functionality of risk management practices in vendor selection (Figure 2). Therefore, the relations within supply chain in terms of risk management strategy are depicted as Figure 2.

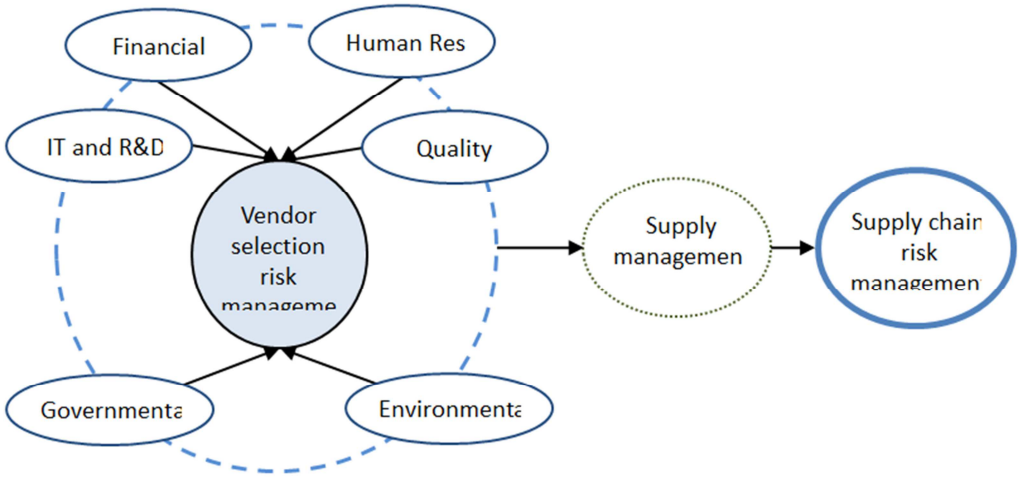

Figure 2. *Risk-associated conceptual model.*

Pearson correlation test was run to measure the strength of the drawn relationships between dependent variable—vendor selection risk management success—and each of the independent variables—risk factors—in the conceptual model. The correlation coefficients of approximately 0.6 and above between risk factors and the dependent variable validates the research design and the theoretical sketch of relationships between vendor selection risk management and its risk factors (Table 3).

Table 3. *Pearson correlation coefficient of variables.*

	Human Resources	Quality	IT and R&D	Financ.	Environ.	Govern.
Risk Management	.696**	.701**	.596**	.709**	.697**	.711**

**. Correlation is significant at the 0.01 level (2-tailed).

4.4. Vendor Evaluation Model

Multiple regressions analysis resulted in a model that explains the interactions between risk factors and supply chain responses (Table 4). The obtained regression model can be described in the form of an equation as below:

$$VSR = 0.238(Quality) + 0.213(Human - Resources + 0.183\ (Financial\ ) + 0.155\ (Governmental) + 0.143\ (ITandR\&D) + 0.137\ (Environmental)$$

where VSR is the vendor selection risk, which is predicted by its predictors with different coefficients or weights.

Table 4. *Regression model summary and coefficients.*

Risk factors	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	Beta	Std. Error	Beta		
(Constant)	-1.462	0.319		-4.581	0
Quality	0.29	0.074	0.238	3.93	0
Human Resources	0.324	0.095	0.213	3.419	0.001
Financial	0.212	0.075	0.183	2.828	0.005
Governmental	0.158	0.071	0.155	2.224	0.028
IT and R&D	0.247	0.094	0.143	2.619	0.01
Environmental	0.136	0.068	0.137	1.993	0.048

In other words, the degree of influence of each risk factor on supplier selection is defined through multiple regression analysis and structured formula describes the changes in supply chain according to change in any of the risk factors in a multi-objective supply chain risk management system. The significance level of below 0.05 in all the predictors confirms that every risk factor in the model has a significant degree of influence on the supplier selection risk management success and cannot be deleted from the model. Accuracy of the model has to be examined in order to certify the obtained result. Therefore, the model R-square is reviewed to check the goodness of fit of model to the data. The obtained R-square is 0.735, the Adjusted R-square is 0.724, which is a strong indicator of model accuracy, and it shows that how well predictors explain variation of the dependent variable. Adjusted R-square of 1 represents a great model fit and values above 0.7 represent a strongly satisfactory model fit.

Degree of influence of each risk factor on vendor selection is extracted from the analysis of multiple regression model. Coefficients of the risk factors in regression model are transformed to percentage form for better explanation of the effects of risk factors in a multivariable risk management system (Table 5).

Table 5. *Risk factors degree of influence (%) on supply chain risk.*

	Human resources	Quality	Financial	IT and R&D	Governmental	Environmental
Weight	19.9	22.3	17.1	13.4	14.5	12.8

Table 5 demonstrates effect of each factor on vendor selection risk management in a multi-criteria decision-making process. It shows that companies are most concerned with supplier product quality when every other factor is also involved in the supplier selection process. It is concluded that 22.3% of risks in supply chain disruption caused by suppliers is related to the quality of delivered products (Table 5). Following the product quality, human resources factor is the next factor that can critically affect the supply chain through supplier failure. 19.9% of the risk in supply chain failure according to survey results is explained by vendor human resources management instability (Table 5).

Financial situation of the supplier company is ranked the third leading supplier selection criteria that 17.1% of the supply chain disruption caused by supplier failure can be attributed to this factor (Table 5). Financial power of supplier company defines issues like supplier financial vulnerability against unstable market, rate of return on investment, production cost, and financial investment for future production enhancement. Government policies and regulations was considered as a main risk factor that can affect the supply chain more severely in third world contraries as well as developing countries, where changing foreign policies and domestic instability can affect supplier performance. In the designed multi-criteria supplier selection model, it is found that 14.5% of the supplier selection risk management activities are influenced by governmental issues that affect supplier performance (table 5).

Vendors IT systems and R&D plans and opportunities importance in supplier selection process is rated as the fifth critical criteria by 13.4% influence on the supply chain failure (Table 5). Malfunction of IT systems is usually less likely to happen [37]; but when rating vendors capabilities for future developments and continuous production, importance of IT systems and R&D plans cannot be neglected. The regression analysis of the designed vendor selection model revealed that 12.8% of the supply chain risks are related to the environmental issues that may have negative effects on supplier performance (Table 5). It is worth mentioning that in large enterprises that their supply chain cooperates with international suppliers, environmental issues [38] with above items are of paramount importance to the enterprises for supplier selection.

5. Vendor Selection Risk Management Framework

Research findings are integrated in this section and a supplier selection model is proposed. The proposed framework suggests critical areas to be considered for proper supplier selection while it allows companies to have their own evaluation method in the beginning. In fact, the proposed model or framework summarizes that how any of the risk factors and into what extent may affect their supply chain through supplier selection. It suggests areas to be inclusively studied and assessed in supplier evaluation. The proposed vendor selection framework applies constraints to lower the uncertainty in the final decision. Figure 3 demonstrates the proposed supplier selection framework with every details of the selection process.

In a top to bottom approach, primarily, the main companies are given the option to have their personalized evaluation process of the available suppliers. In such a way, the framework is enabled to incorporate in the companies' selection method and refine the available vendor evaluation process. Next, six fundamental risk factors or criteria, which are extracted from the literature and are tested through the questionnaire data analysis for their actual importance and influence on the supply chain and supplier selection, are proposed to the supply chain managers to reconsider their supplier evaluation. Vendors' product quality, financial power, human resources, IT and R&D, environmental risks resilience, and governmental support and threat are the six criteria to be revised within the selection process. To be more specific in each criterion, based on the descriptive data analysis result, several sub-criteria or factors are pointed for critical vendor assessment in a particular criterion or risk factor.

For the assessment of the vendor's product quality, it is

advised to look into its machinery and equipment performances in terms of technology advancement and flexibility, machineries production capacity, and performance of its quality control department regarding raw material and final products quality control. In terms of human resources in supplier company, it is recommended to investigate the vendor's level of stability in their organizational and manufacturing operations, level of stability of management board, partners and stakeholders to assess stability in company plans and decision making, and personnel skill and expertise.

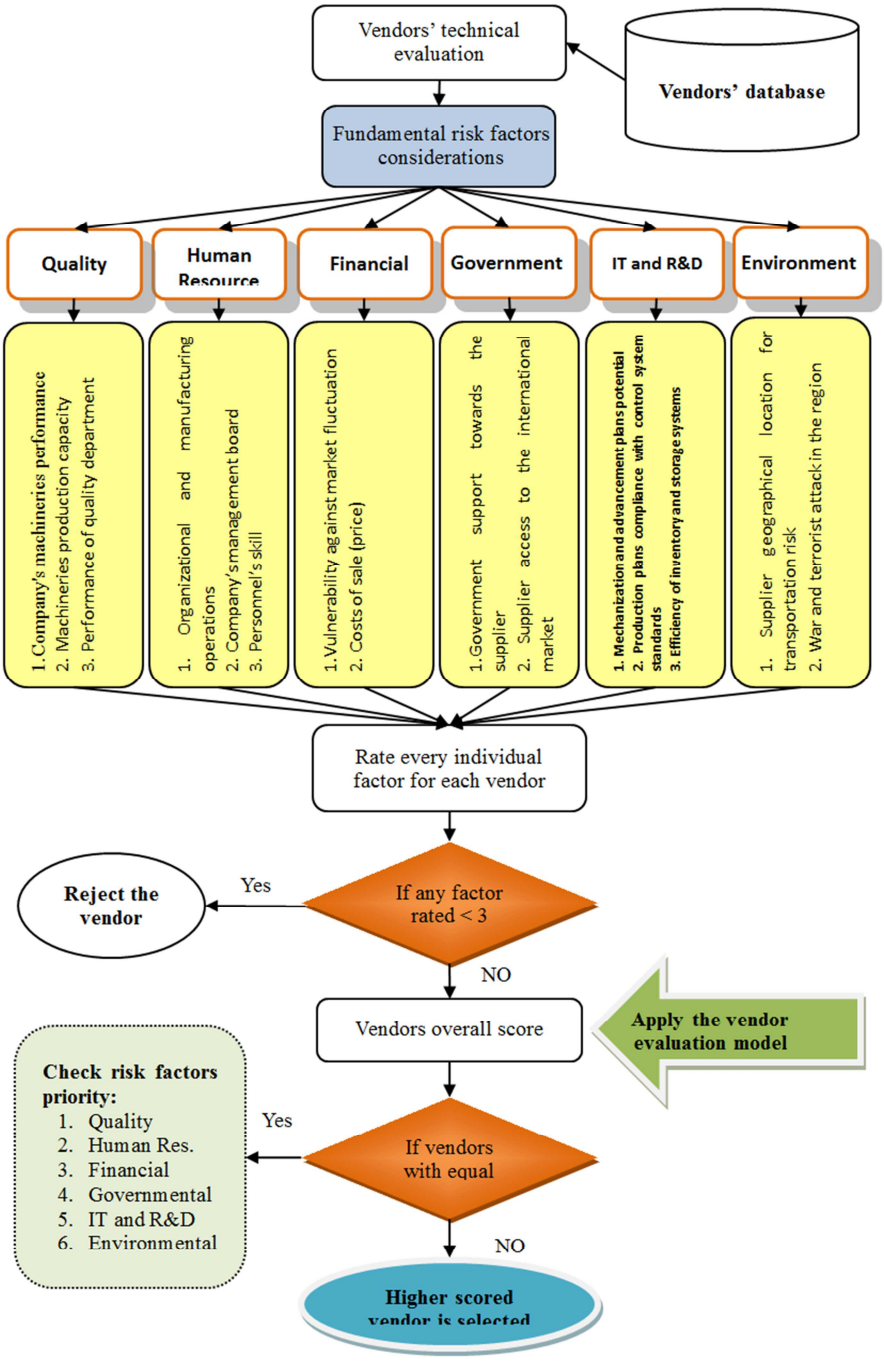

Figure 3. *Workflow of the outlined model (Framework).*

To assess vendors' financial power, the proposed framework highlights the investigation on the vendors' vulnerability against market fluctuation, level of costs of sale operation according to desired standards (pricing). In order to evaluate the vendors IT systems and R&D development opportunities also some critical area within this context are stressed to the main companies decision makers to be noted; supplier mechanization and advancement plans potential, production plans compliance with control system standards, efficiency of inventory and storage systems.

Within the environmental uncertainty issue and its effect on the vendor's performance, it is recommended to consider

the level of product transportation risk based on the supplier geographical location, and level of war and terrorism in the suppliers' respective country and region. The next external risk factor in the conceptual model within the framework is governmental support and threat towards the vendors. To assess the vendors in this perspective, it is recommended to look into the level of governmental support towards the company and its products, and level of supplier access to the international market according to the governmental policies and regulations.

In a general sense, it is believed that looking into the proposed critical areas for assessment of a particular risk factor or criteria in a specific supplier company, are crucial in defining the level of importance of that risk factor in the particular company. However, numerous sub-criteria can be utilized for a more comprehensive evaluation of the presence of any type of risk in a company.

The framework uses scaling of one to five for evaluation of the companies in each risk factor. Companies receive a score between one and five at every risk factor based on the supply chain managers' judgments. The proposed supplier selection framework recommends omitting the vendors with scores of below 3, at any of the criteria, from the selection process. For instance, if a supplier can score high in any of the factors but low (< 3) in product quality it cannot be an appropriate choice for the supply chain, because a great deal of quality failure risk will be involved in this case.

Accordingly, the overall score of each vendor is calculated based on the obtained model and risk factors weights form multiple regression analysis. In this step, each risk factor score of the company is multiplied by its computed weight and the summation of all components results in the total score of company' eligibility (Vendor evaluation equation). Obviously, the vendor with higher total score is selected. The proposed supplier selection framework defines a selection criterion when two or more suppliers have equal scores. It is suggested to compare vendors' individual score at every risk factor relevant to the presented priority base, which was obtained from the data analysis section. Quality is the first criteria to be compared across the vendors who have equal scores; the next factors are human resources, financial, governmental, IT and R&D, environmental criteria, respectively. Therefore, between the vendors with the same score, the vendor with higher score at quality qualification assessment is selected; and if they have the same quality score then next factors will be compared until the best supplier is chosen.

The proposed framework can be of a great use for reducing the risk of supply chain disruption through proper vendor selection in the supply chain management universe. The framework can be beneficiary to every automotive manufacturer company regardless of having a prior vendor selection and evaluation model; because the proposed framework is applicable to incorporate into running models and can also perform as a primary vendor selection process.

The proposed supplier selection framework was validated using a survey on its implementation capabilities among the automotive industry managers and decision makers of the studied car manufacturing companies. A total number of 50 questionnaires have been distributed among the companies and 30 reliable questionnaires have been collected.

The proposed framework received positive comments from all the three companies (Figure 4). According to the analysis of the obtained data, 90% of the respondents mentioned that the stated risk factors cover all the risks in supplier selection. The large majority of the respondents (90%) believed that the weights assigned to the risk factor, which are calculated by regression analysis, are compatible with real world situation in the industry.

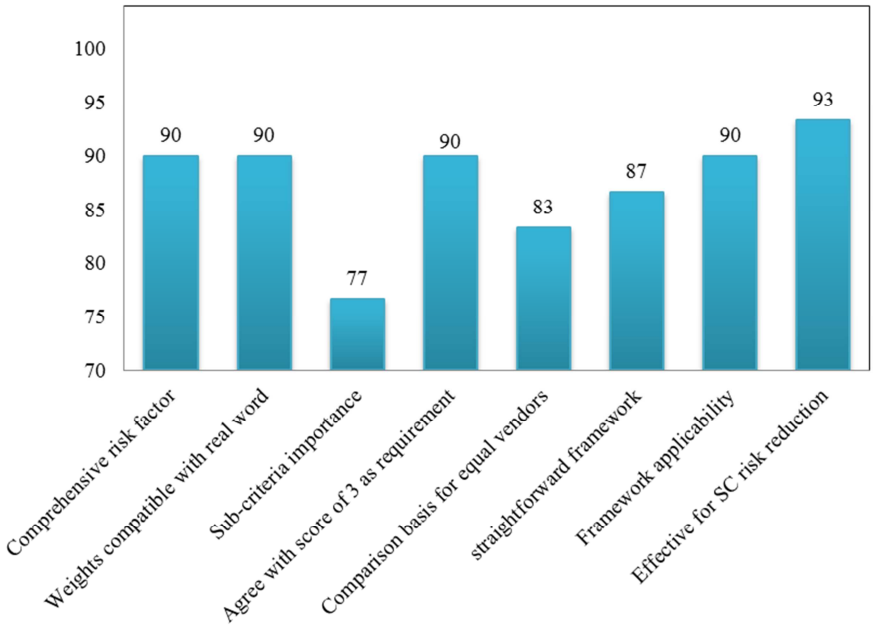

Figure 4. *Responses to implementation questionnaire.*

Frequency analysis of the data showed that 77% of the responses believed that the sub-criteria or critical areas introduced within each risk factor are actually crucial in supplier selection considerations. It was found that 90% of the respondents were strongly agreed to take the limiting score of three (average out of 5) at every risk factor evaluation in order to take into account the supplier for further evaluation. The proposed comparison basis for vendors of equal score received 83% agreement among the respondents. General characteristics of the framework such as its straightforwardness and its applicability to the automotive industry were highlighted by respectively 87% and 90% of the supply chain managers and decision makers. Finally, the proposed vendor selection framework was marked as effective for supply chain risk reduction by 93% of the Iranian automotive manufacturer managers and practitioners (Figure 4).

6. Summary and Conclusions

This research was designed to study the supply chain risk management with focus on the supplier selection risk reduction. It is believed that the majority of the risks involved in the supply chain are caused by supplier failure. The literature review helped to define the major risk factors in supplier selection. Several criteria for vendors selection were selected; supplier product quality, financial resources, IT and R&D, human resources, government regulation, and environmental issues. Based on the obtained results from the industry responses a vendor selection framework was presented that can help enterprises to have a proper supplier selection with less risk to their supply chain. The proposed framework is then validated through another questionnaire, which was sent back to the automotive manufacturers for evaluation and confirmation of its applicability. The positive responses on the proposed model and framework for supplier selection confirmed its applicability.

Final, it is found that supplier product quality has the highest impact on supplier selection risk management. Supplier human resources, financial power, governmental support and policies, IT and R&D advancement, environmental effects vulnerability are the successive influential factors on supplier selection risk management and eventually the SCRM. It is recommended to only choose vendors that can score more than 3 out of 5 in each risk factor evaluation (as an optimal mark to achieve basic requirements), for further consideration. The proposed vendor selection risk management framework received very promising comments regarding its applicability in reducing the risk in supplier selection and eventually the supply chain risk management.

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