

# **A conceptual framework for vendor selection based on supply chain risk management from a literature review**

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**Abstract:** With the increased competition in the global supply chain, the significance of vendor selection based on supply chain risk management has reached the agreement. The structure of this study is to categorize the recent researches according to the supply chain risk management, vendor selection and vendor selection under supply chain risk. Further, this paper offers a conceptual framework to summarize the research comprising three parts research. Finally, conclusions and potential areas for future research are presented.

**Keywords:** supply chain, risk, supplier selection, review

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## **1. Introduction**

With the increasingly demanding customers, growth in out-sourcing and off-shoring, and geographical dispersion of supply chain, supply chain management has become one of the key elements for companies to gain the competitive advantage.

Vendor selection is of prime importance in the enterprise supply chain management. Modern trend of purchasing management is to reduce the number of vendors, and establish the long-term and stable partnership of mutual trust, benefit and support. These trends aggravate the risk of vendor selection. So enterprises in selecting vendors should measure all aspects of the performance of candidate vendors, not only the product quality, price, vendor performance and services, but also the risk factors of vendor selection.

Previous research focused on supply chain risk management and vendor selection respectively, however the research of vendor selection based on supply

chain risk management is very little. But the latter must further the inter-field research on the basis of the first two types of research studies. Therefore, according to the classification methods of the supply chain risk management, vendor selection and vendor selection based on supply chain risk management, this article systematically introduces the related researches and analyzes their application situation to supply the study reference about vendor selection based on supply chain risk management.

## **2. Review of Related Research**

### **2.1 The Research on Supply Chain Risk Management**

According to the definition of project managers Association, risk is an uncertain event or condition, and will have an impact on one or more target if it occurs. In this definition, it emphasizes the concepts, goals, events and effect. Accordingly, a typical risk management process consists of the following four basic steps.

(1)The first step is the risk identification.

Supply chain risk identification is the first stage of effective SCRM. Scholars define on supply chain risk from various perspectives. The basic meaning is as follows: ①Various uncertain factors exist in the supply chain.② Bull effect make the supply chain risk magnify.③ the supply chain vulnerability.

(2)The second step is the risk assessment, referring to the event probability in the system, and determining the consequences of these risk events defined in the first step.

For risk probability, Harland pointed out that the probability or possibilities of risk event depended on the degree of risk exposure and the possibility of triggering factors(Harland et al., 2003). For risk consequence, Mitchell thought risk measure was available to calculate the probability of the risk occurrence multiplied by the risk consequence(Mitchell, 1995).

(3) The third step is the implementation of risk management actions. For example, these actions may be backed up by a predetermined risk scenarios (such as response action), or taking direct action mitigates the identified risk, so as to reduce the degree of occurring probability or the serious consequences (such as positive action). About ways to mitigate the risk, Miller distinguished five general strategies from the perspective of a single agency for reducing the company risk, four of which are suitable to supply chains: ①avoidance, ②control, ③cooperation, ④resilience(Miller, 1992).

(4) The final step is the risk monitoring system, supervising and detecting risks.

For controlling the scope of supply chain risks and ensuring the normal operation of the supply chain, we should establish and improve supply chain risk early warning indicators system.

Many real cases related to the supply chain risk management have attracted a lot of attention from both researchers and enterprise decision makers. Norrman described the approach of supply chain risk analysis, assessment and management, which had been implemented by Ericsson after a immense fire at a sub-supplier(Norrman and Jansson, 2004). Ritchie developed a framework to encapsulate the main strands of risk management and demonstrated its application in two empirical settings(Ritchie and Brindley, 2007).

## **2.2 The Research on Vendor Selection**

The vendor selection process is divided into two stages like the formation of selection criteria, determination of vendor selection method.

### **2.2.1 Vendor Selection Criteria**

In the today's competitive environment, a company is impossible to produce low-cost, high-quality products if you haven't the satisfactory vendors. Selecting the right vendors has always been one of the most important functions of the Purchasing Department of a company. Over the past 20 years, many studies have shown that vendor selection problem (VSP) is the key to establish the effective evaluation criterion. Early research was based on 23 criteria (such as price, delivery, quality, and so on), to evaluate and select the right vendor and decide each vendor's order quantity. Forty-seven out of seventy-six articles used more than one criterion (multi-criteria) in the vendor selection(Weber et al., 1991). There are twelve articles, which had shown that the cost, quality and response time are the main traditional continues criteria of the vendor selection(Olson and Wu, 2006).

### **2.2.2 Vendor Selection Method**

At this stage, for getting the set of approved vendors from all potential vendors, decision makers divided all vendors into two categories: agree or disagree. According to the vendor's selection criteria, Boer determined a set of approved vendor using the following methods: cluster analysis, data envelopment analysis and artificial intelligence methods (case-based reasoning approach)(De Boer et al., 2001).

When selecting vendor, the various decision methods under different situations are summarized as follows.

- Data envelopment analysis (DEA): Charnes proposed DEA which had been extensively used to compare the efficiencies of non-profit and profit organizations by evaluating the relative efficiency of homogeneous units(Charnes, 1978).
- Analytic hierarchy process (AHP): Chan applied an Interactive Selection Model to determine the buyer-supplier relationships and selection criteria, and then implemented the Analytic Hierarchy Process with the Multi-Criterion Decision Making software(Chan, 2003).
- Mathematical programming models: Mathematical programming is a very important method to solve optimization problems, including multi-objective programming, linear programming, mixed integer programming and so on. Ng proposed a weighted linear program for the multi-criteria supplier selection and studied a transformation technique when there was no optimizer in this model(Ng, 2008).
- Other approaches: Gender developed an analytic network process (ANP) model by evaluating the relations between supplier selection criteria in a feedback systematic(Gencer and Gurpinar, 2007). Choy described a knowledge-based supplier selection and evaluation system, which was a case-based reasoning decision support system for outsourcing operations at Honeywell Consumer Products (Hong Kong) limited in China(Choy et al., 2005).

### **2.3 Vendor Selection under Supply Chain Risk**

In the ever-changing competitive environment, the vendor selection depends on not only cost and quality, but also various risks, socio-economic factors. In terms of the supply chain risk management which associated with the vendor selection, Ojala analyzed the supplier networks risk and their potential impact on the network, and then considered the portfolio of different approaches between the supplier network into supplier risk taking, customer risk taking and risk sharing strategies for handling investment risks(Ojala and Hallikas, 2006). Chan considered the risk factors of the relevant issues like geographical location, political stability, economic conditions and terrorism, as one of the global supplier selection criteria(Chan and Kumar, 2007). Vinodh developed the supplier selection framework in five criteria, which consisted of the risks criterion that was described as the supply constraints, buyer supplier and suppliers profile(Vinodh et al., 2010). Sawik considered supply chain disruption and delay risks in the supplier selection of multi-period(Sawik, 2011).

Most of the vendor selection methods considering the supply chain risk focus on the AHP model and the DEA model. For example, Chan applied the fuzzy

extended AHP to select the global supplier with the different decision criteria like cost, quality, service performance and supplier's profile and risk factors(Chan and Kumar, 2007). Kull developed an integrated AHP–GP approach to assess suppliers along the risk criteria and evaluated alternative suppliers based on multiple risk goals and various hard constraints(Kull and Talluri, 2008). Azadeh presented a flexible method , which was chosen from three models, such as DEA, fuzzy DEA and chance constraint DEA, for supplier selection under certainty, uncertainty and probabilistic conditions(Azadeh and Alem, 2010). In addition, Vinodh used a fuzzy analytic network process (fuzzy ANP) approach to the supplier selection process(Vinodh et al., 2011). Sawik proposed a mixed integer programming approach and scenario analysis considering the supply chain disruption and delay risks(Sawik, 2010).

### 3. Conclusions

This study has taken a wide look at vendor selection under supply chain risk management and the existing shortage in this field. There applies a conceptual framework (Fig.1) based on the above literature review. Initially, from the perspective of the supply chain risk management, the evaluated overall risk indexes are been determined by risk identification and risk assessment. These risk indexes are subsequently considered in the vendor selection criteria and methods. Finally, supply chain risk management and monitoring process is taken into account.

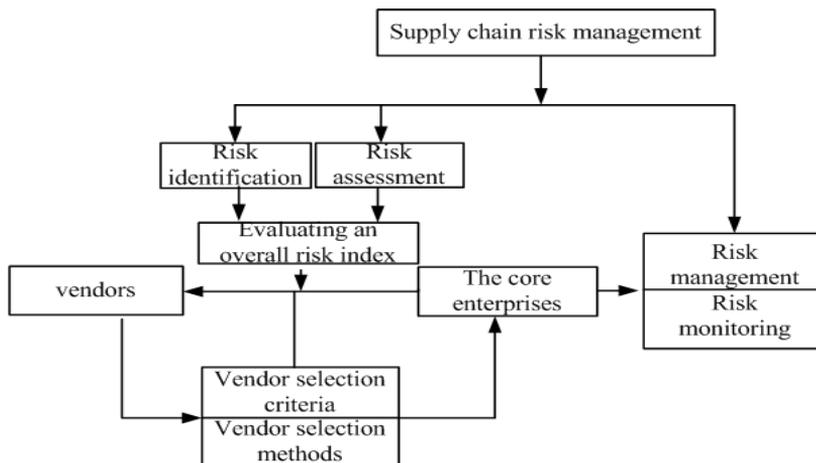


Fig. 1: vendor selection under supply chain risk

### 4. Future Work

In summary, most of the recent researchers focus on the supply chain risk management and vendor selection respectively, therefore the vendor selection under supply chain risk is a broad field in future research. The future research directions are put forward for giving the decision-making reference to researches as follows.

①The combination of other theory: The future study should extend the previous vendor selection approaches, which are applied in the deterministic situation. The vendor selection considering the supply chain risk factors, may utilize the fuzzy set theory because of the uncertainty of supply chain risk. Some stochastic risk factors could apply the uncertain programming theory, for instance, expected value model, chance-constrained programming and dependent-chance programming.

②The analysis of the application conditions and integrated approaches of the different methods: Though Azadeh applied a flexible DEA–FDEA–CCDEA approach to the vendor selection, this research only focused on the application of DEA model under certainty, uncertainty and probabilistic conditions(Azadeh and Alem, 2010). The vendor selection applying other methods like mathematical programming model is a major topic in future.

③The empirical research of managerial implications: Supply chain risk management is a systemic process, which consists of four basic steps like risk identification, risk assessment, risk management and risk monitoring. In the recent vendor selection research considering supply chain risk factors, Kull applied the AHP approach to get a risk index for each of the suppliers across multiple dimensions, then utilized these risk indexes in the GP model for vendor selection later, at last this model was tested at a mid-sized automotive supplier(Kull and Talluri, 2008). However, the implementation of risk management and risk monitoring, which are indispensable to supply chain risk management, hadn't been studied systematically in vendor selection process of this paper. So the future research should concentrate on the managerial implications of the vendor selection based on supply chain risk management comprehensively.

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