

# A hybrid approach to supplier selection for the maintenance of a competitive supply chain

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## Abstract

This article outlines a hybrid method, incorporating multiple techniques into an evaluation process, in order to select competitive suppliers in a supply chain. It enables a purchaser to do single sourcing and multiple sourcing by calculating a combined supplier score (CSS), which accounts for both qualitative and quantitative factors that impact on supply chain performance. By performing a cluster analysis, it draws a supplier map (SM) so as to position suppliers within the qualitative and quantitative dimensions of performance efficiency, and to select a portfolio of suppliers from supplier segments, which are different in performance with regard to key factors.

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## 1. Introduction

The value of win–win strategies, which enable businesses to achieve success, increases as the world is becoming highly complex and specialized. Such strategies make it possible to interconnect organizations and for people to get involved in business transactions businesses and companies can share maximum benefits, at acceptable levels under circumstances, pursuing either cooperative goals or conflicting goals. The win–win strategies are more important to strategically-related firms, which conduct direct commercial transactions in an industrial network.

Manufacturing firms, which face a competitive environment, should seriously consider win–win strategies, as customer needs vary over time and technology changes rapidly. Firms begin to focus on strategic business partners in the production process and recognize the significance of a supply chain and supply chain management, in order to actively cope with such environmental changes.

In order to gain competitive advantages in markets, manufacturers must collaborate, not only with component or raw material suppliers, but also with wholesalers/distributors, retailers, and customers, who all participate in a supply chain, directly or indirectly, in order to fulfill customer requests. Supply chain management (SCM) involves the management of transaction flows among players in a supply chain so as to maximize total supply chain profitability.

SCM aims to minimize overall costs across the supply chain and to maximize the revenue generated from the customer in cooperation with business partners. Firms within a supply chain can achieve sustainable competitive advantages through developing much closer relationships with all companies, and they can significantly reduce time and costs depending on the appropriate management of the supply chain, while serving customer needs at the same time. In a competitive environment, successful SCM is much helpful in strengthening the competitive edge of firms (Kumar, Vrat, & Shankar, 2004).

In general, SCM arises from several corporations that build their own supply chain. They must find more efficient partners to make the chain competitive. Among a variety of available suppliers, manufacturers must choose more collaborative ones who are able to develop long-term

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relationships. Especially, as purchasing activities within a supply chain play a more strategic role and trends include the movement from spot purchasing to long-term contractual relationships, sound supplier selection has become a strategic decision, meaning that it has become a vital source for adding strength to value proposition and for improving the competitiveness of manufacturers (Wise & Morrison, 2000).

This paper, therefore, focuses on the selection of competitive suppliers in order to develop an efficient supply chain. The organization of this paper is as follows. The second section provides the various performance categories that are considered while evaluating and selecting the supplier, and it provides an overview of existing methods. The next section presents a hybrid method, incorporating analytic hierarchy process (AHP), data envelopment analysis (DEA), and neural network (NN) into the evaluation process. The fourth section exhibits the results from the new method by using actual data. Finally, concluding remarks and discussions follow.

## 2. Literature review

Manufactures usually evaluate potential suppliers across multiple performance categories, using their own selection criteria with assigned weights. These evaluation factors are mainly classified into qualitative and quantifiable measures.

### 2.1. Supplier selection criteria

Incorporating multi-dimensional information into vendor evaluation is important and well established in both academic and practitioner's literature. Over the years, several multi-criteria techniques have been proposed for the effective evaluation and selection of vendors. According to literature, some supplier selection criteria are found to vary in different situations, and experts agree that there is no one best way to evaluate, select suppliers and that organizations use a variety of different approaches in their evaluating processes.

A study carried out by Dickson (1966) surveyed buyers in order to identify factors they considered in awarding contracts to suppliers. Out of the 23 factors considered, he concluded that quality, delivery, and performance history are the three most important criteria. Traditional vendor evaluation methods, however, mainly considered financial measures in the decision making process.

Another study conducted by Weber, Current, and Benton (1991) derived key factors that were thought to affect supplier selection decisions. These were taken from 74 related articles which have appeared since Dickson's well-known study. Based on a comprehensive review of vendor evaluation methods, they summarized that price was the highest-ranked factor, followed by delivery and quality. These empirical researches revealed that the relative importance of various selection criteria such as price, quality, and delivery performance is similar. More emphasis on just-in-

Table 1  
Various selection criteria that have emerged in literature

| Selection criteria                  | A | B | C | D | E | F | G | H | I | J |
|-------------------------------------|---|---|---|---|---|---|---|---|---|---|
| Price                               | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |   | ✓ | ✓ |
| Quality                             | ✓ | ✓ |   | ✓ |   | ✓ | ✓ |   | ✓ |   |
| Delivery                            | ✓ | ✓ | ✓ | ✓ |   | ✓ | ✓ |   | ✓ |   |
| Warranties and claims               | ✓ |   | ✓ |   |   |   |   |   |   |   |
| After sales service                 | ✓ |   | ✓ |   | ✓ |   | ✓ |   |   |   |
| Technical support                   |   |   | ✓ |   | ✓ | ✓ |   |   |   |   |
| Training aids                       | ✓ |   | ✓ |   |   |   | ✓ |   |   |   |
| Attitude                            | ✓ |   |   |   | ✓ |   |   |   |   |   |
| Performance history                 | ✓ |   |   |   |   |   | ✓ |   |   |   |
| Financial position                  | ✓ |   | ✓ |   |   |   | ✓ |   |   |   |
| Geographical location               | ✓ | ✓ |   | ✓ |   |   | ✓ |   |   |   |
| Management and organization         | ✓ |   |   | ✓ |   |   | ✓ |   |   |   |
| Labor relations                     | ✓ |   |   |   |   |   | ✓ |   |   |   |
| Communication system                | ✓ |   |   |   |   |   |   | ✓ |   |   |
| Response to customer request        |   |   | ✓ |   |   | ✓ |   |   |   |   |
| E-commerce capability               |   |   |   |   |   |   |   |   | ✓ | ✓ |
| JIT capability                      |   |   |   |   |   | ✓ |   | ✓ |   | ✓ |
| Technical capability                | ✓ | ✓ |   |   |   |   | ✓ | ✓ |   |   |
| Production facilities and capacity  | ✓ |   |   |   |   |   | ✓ |   |   |   |
| Packaging ability                   | ✓ |   |   |   |   |   | ✓ |   |   |   |
| Operational controls                | ✓ |   |   |   |   |   | ✓ |   |   |   |
| Ease-of-use                         |   |   | ✓ |   | ✓ |   |   |   |   |   |
| Maintainability                     |   |   | ✓ |   | ✓ |   |   |   |   |   |
| Amount of past business             | ✓ | ✓ | ✓ |   |   |   | ✓ |   |   |   |
| Reputation and position in industry | ✓ | ✓ | ✓ |   | ✓ |   | ✓ |   |   |   |
| Reciprocal arrangements             | ✓ | ✓ |   | ✓ |   |   | ✓ |   |   |   |
| Impression                          | ✓ |   | ✓ |   | ✓ |   | ✓ |   |   |   |
| Environmentally friendly products   |   |   |   |   |   |   |   |   | ✓ |   |
| Product appearance                  |   |   |   |   |   |   |   |   |   | ✓ |
| Catalog technology                  |   |   |   |   |   |   |   |   |   | ✓ |

A, Dickson (1966); B, Wind et al. (1968); C, Lehmann and O'Shaughnessy (1974); D, Perreault and Russ (1976); E, Abratt (1986); F, Billesbach et al. (1991); G, Weber et al. (1991); H, Segev et al. (1998); I, Min and Galle (1999); J, Stavropoulos (2000).

time manufacturing strategies since the 1980's has placed an increasing importance on strategic vendor evaluation and multiple vendor criteria. For example, the study of Weber, Current, and Desai (1998) considered factors, including geographical location, which he regarded as being more important than Dickson's.

After Weber's work, most researchers focused on supplier-selection criteria in either specific industries or specific countries. Especially, since Internet-based businesses have grown rapidly since 1995, vendor criteria have changed a great deal, thus corresponding to the business environmental changes (Sonmez, 2006). Table 1 summarizes some of these criteria which have appeared in literature since 1966.

### 2.2. Analytical methods used in the vendor selection process

De Boer, Labro, and Morlacchi (2001) performed an extensive review of decision methods, reported in literature,

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