

# A fuzzy supplier selection model with the consideration of benefits, opportunities, costs and risks

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## Abstract

Even though the research on supplier selection is abundant, the works usually only consider the critical success factors in the buyer–supplier relationship. However, the negative aspects of the buyer–supplier relationship must also be considered simultaneously. The main objective in this study is to propose an analytical approach to select suppliers under a fuzzy environment. A fuzzy analytic hierarchy process (FAHP) model, which incorporates the benefits, opportunities, costs and risks (BOCR) concept, is constructed to evaluate various aspects of suppliers. Multiple factors that are positively or negatively affecting the success of the relationship are analyzed by taking into account experts' opinion on their importance, and a performance ranking of the suppliers is obtained. TFT-LCD manufacturers in Taiwan, which is the largest TFT-LCD producer country in the world, are facing increasing competition nowadays, and the selection of the most appropriate suppliers for cooperation is essential for firms to achieve competitive advantage. A case study of backlight unit supplier selection for a TFT-LCD manufacturer is presented, and the proposed model is applied to facilitate the decision process. The model is a general form that can be tailored and applied by firms that are making decisions on supplier selection.

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## 1. Introduction

Outsourcing has become an important business approach since a competitive advantage may be gained by the cooperation with suppliers to provide products/services more effectively and efficiently (McCarthy & Anagnostou, 2004). Under the domain of inter-organizational linkage, the relationship between purchasing organizations and their suppliers has been of particular interest. Many of today's buyer–supplier relationships are operating well beyond the traditional arm's length mode, with different degrees of alliance. Closer buyer–supplier relationships can be effective ways to guarantee good quality materials, diffuse new technologies rapidly, enter a new market, overcome financial constraints, bypass governmental restrictions, and learn quickly from the leading firms in a given

field (Elmuti & Kathawala, 2001; Monczka, Petersen, Handfield, & Ragatz, 1998). With strategic alliances ranging from nontraditional contracts to the creation of a new equity, many firms develop supplier linkages that fell somewhere between these two extremes (Achrol, 1997; Argyres, 1996; McCutcheon & Stuart, 2000; Sinclair, Hunter, & Beaumont, 1996). Firms develop mutually beneficial, longer-term relationships with the best of their key suppliers so that the suppliers are more willing to invest in skills or technologies specific to the partner firm (McCutcheon & Stuart, 2000). Buyers and suppliers may broaden their contact and share business and technology information. Suppliers may expand their roles to provide services beyond traditional purchasing transactions, such as participating in the buyer's design and development work or providing advice, assistance or training from their areas of expertise (McCutcheon & Stuart, 2000). In the past two decades, a surge in the formation of a longer-term relationship that fosters cooperation among suppliers and customers has been witnessed. However, many managers find it difficult

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to determine which suppliers should be targeted for long-term relationships.

While there are many supplier selection models in literature, most studies only concern with the benefits that can be gained from selecting a supplier. In fact, various aspects of costs and risks should be considered extensively too. Therefore, in this research, we adopt the analytic hierarchy process (AHP) with benefits, opportunities, costs and risks (BOCR) for constructing the supplier selection model. In addition, fuzziness and vagueness are usually present in the decision-making process, and thus, the fuzzy set theory is incorporated into the model.

The global TFT-LCD industry is becoming extremely competitive, and a cooperative buyer–supplier relationship is essential for a TFT-LCD manufacturer to survive and to acquire reasonable profit. Since backlight units (BLU) comprise the largest portion of raw material in TFT-LCD modules and are essential for the final quality of the units, the selection of the most appropriate backlight unit supplier is very important. The main objectives in this study are to propose a fuzzy AHP with BOCR model for supplier selection and to apply the model to the backlight unit supplier selection for TFT-LCD manufacturer in Taiwan. This paper is organized as follows. Section 2 reviews the supplier selection literatures. Section 3 goes over the key concepts of analytic hierarchy process (AHP), fuzzy set theory, and benefits, opportunities, costs and risks (BOCR) methods. A fuzzy analytic hierarchy process (FAHP) model will be constructed to evaluate the suppliers in Section 4. Section 5 provides a case study of TFT-LCD manufacturer in evaluating backlight unit suppliers. Some concluding remarks are made in the last section.

## 2. Supplier selection

The selection of a supplier for partnership is perhaps the most important step in creating a successful alliance. A careful screening of potential partners is a time-consuming process, in addition to developing an understanding of partners' expectations and objectives (Dacin & Hitt, 1997). Observations of the candidate partner in direct transactions or in other interactions are highly valued. A relatively long period of relationship is recommended to gather valuable information about the candidate partner's resources, capabilities and reliability and to assess its motives and quality of management (Balakrishnan & Koza, 1993; Dacin & Hitt, 1997; Gulati, 1995, 1998; Vanhaverbeke, Duysters, & Noorderhaven, 2002). Otherwise, rushing into buyer–supplier relationship without adequate preparation or understanding of partners' needs often lead to the failure of relationships.

The selection of an appropriate supplier is an important factor affecting eventual buyer–supplier relationship. If the process is done correctly, a higher quality, longer lasting relationship is more attainable. The selection of the type of relationship is related to a firm's market positions (leader versus follower) and the strategic importance of collab-

orations within each firm's portfolios (core versus peripheral business) (Lorange & Roos, 1993; Todeva & Knoke, 2005). In order to maintain its competitive edge, the firm must protect its core businesses. Yet the firm must be willing to enter buyer–supplier relationships in peripheral activities so that wider scope for organizational learning is obtained and less confidential information is shared (Todeva & Knoke, 2005).

Partner selection is an integral component of relationship success, and research has been done to find the critical success factors and partner selection criteria. Geringer (1988) was one of the first to systematically conduct an in-depth study of partner selection criteria. Geringer found that a partner's task-related criteria, such as partners' technical know-how, financial assets, managerial experience and access to markets, and the partner's national culture, past experience, size and structure are all important criteria. Lin and Chen (2004) did a comprehensive review of literature and identified 183 decision attributes for evaluating candidate supply chain alliances for general industries. These attributes are further categorized into eight aspects: (1) finance, (2) human resource management, (3) industrial characteristics, (4) knowledge/technology acquiring and management, (5) marketing, (6) organizational competitiveness, (7) product development, production, and logistics management, and (8) relationship building and coordination; and over 50% of the evaluation attributes are focused on the last two categories (Lin & Chen, 2004).

Until recent years, the literature on partnership selection had been mainly qualitative and focused primarily on methodological aspects. Lewis (1990) proposed a qualitative approach to model the supply chain partner selection problem. Several criteria were suggested, such as value added to products, operations and technologies strengthening, and improvement in market access, to measure the appropriateness of a particular strategic alliance for a firm. Lorange, Roos, and Bronn (1992) developed a two-stage supply chain selection approach. The first stage is to evaluate the matching degree with candidate partners. The second stage is to analyze the market potential, main competitors and the worst-case scenarios simulation after the relationship formation. Dacin and Hitt (1997) examined partner selection criteria employed by managers from US and Korean firms, and found some significant differences and similarities in the characteristics sought for alliance partners between US and Korean managers. McCutcheon and Stuart (2000), through a combination of extensive literature reviews and a series of interviews with managers, developed a model of important factors that define which suppliers offer the best choice for pursuing alliance relationships. Some of these factors relate to the technology of goods or services being sourced and the ability to develop mutual goodwill trust with the targeted supplier. Cravens, Piercy, and Cravens (2000) proposed the use of the balanced scorecard to develop a formal assessment approach that linked performance evaluation

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