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An evaluation model of buyer–supplier relationships in high-tech industry — The case of an electronic components manufacturer in Taiwan

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ABSTRACT

With globalize market, fast-changing technology and shortening product life cycle, businesses are becoming extremely competitive, and a cooperative buyer–supplier relationship is essential for a manufacturer, especially in technology-related industry, to survive and to acquire reasonable profit. Even though the research on various types of collaborations between firms is abundant, the research that provides a mathematical model for the selection of the most appropriate relationship form is very limited. The main objective in this study is to base on an electronic components manufacturer in Taiwan to propose an analytical approach to evaluate the forms of buyer–supplier relationship between the manufacturer and its supplier. A model, which applies the analytic network process (ANP) and the benefits, opportunities, costs and risks (BOCR) concept, is constructed to consider various aspects of buyer–supplier relationships. Multiple factors that affect the success of the relationship are analyzed by incorporating experts' opinions on their priority of importance, and a performance ranking of the buyer–supplier forms is obtained. The results shall provide guidance to select the most appropriate form of relationship between the manufacturer and its supplier. The proposed model is systematic, and it is easy to be understood and applied by the management. The model can be tailored and applied by firms in various industries that are making decisions on buyer–supplier relationship.

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1. Introduction

In Taiwan's economic development, manufacturing has been the most representative industry, which comprises five major categories: metal products industry, machinery industry, transportation industry, precision equipment industry and electronic components industry. Even though these industries once had created Taiwan's economic miracle, they are facing the most difficult situation nowadays. In recent years, under the environment of global competition and fast-changing technology, companies have entered a slim profit-margin era. In order to lower costs, raise profit and attain core technology and competitiveness in the supply chain, companies often switch from arm's length purchasing transactions into some kind of buyer–supplier partnership, such as technological cooperation, contractual purchase, cooperative relationship and strategic alliance. The underlying reasons for the relation building are to obtain sufficient material supply, reduce cost, shorten delivery time, reduce investment, acquire core technology, and reduce purchasing operation time, repetitive processes and negotiation cost, etc. A critical reason nowadays is to facilitate the process of advanced-technology product development and introduction in order to enhance a firm's competitive advantage from change.

This research focuses on the electronic component manufacturing industry in Taiwan and studies a famous hard disk component company, which is considering building a relationship with its core-technology component supplier. An interview with experts of vertical integration in the company is carried out to find the critical factors for integration. Saaty's analytical network process (ANP) with BOCR is adopted to analyze the results of questionnaire, calculate the relative importance of these critical factors, and rank the possible vertical integration forms. The result of the study can be a reference for the industry when forming a strategic relationship with the supplier with core technology. The proposed model is not only applicable to the domestic hard disk component manufacturer in assessing the most appropriate relationship with its suppliers, but also can be tailored for other manufacturers in various industries. With better allocation of resources, reduction in cost, increase in profit and concentration in core technology, the competitiveness of firms in a supply chain can be enhanced.

The rest of this paper is organized as follows. The next section reviews strategic alliances and buyer–supplier relationships, supplier selection models, and the ANP methodology. A model based

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on the ANP with benefits, opportunities, costs and risks (BOCR) to evaluate the forms of buyer–supplier relationship is developed in the following section. In the subsequent section, the model is applied on an electronics components manufacturer in Taiwan in evaluating the efficiency under different types of buyer–supplier relationships between the manufacturer and its supplier. Some concluding remarks are made in the last section.

2. Literature reviews

2.1. Strategic alliances and buyer–supplier relationships

Strategic alliances is defined as a formal agreement between two or more business organizations to pursue a set of private and common interests through the sharing of resources in contexts involving uncertainty over outcomes (Arino, de la Torro, & Ring, 2001). Strategic alliances can range from handshake agreements to licensing, mergers, outsourcing and equity joint ventures (Zineldin & Bredenlöw, 2003). Existing studies suggest many benefits that can be obtained through strategic alliances if they are implemented correctly and successfully. The primary benefits of strategic alliances are "enhanced supply chain synchronization, total cost reduction, improved quality and cycle time and a strengthened overall competitive position" (GEBN, 1995). The benefits also include improving a firm's operations and competitiveness (Brucellaria, 1997), getting access and expanding to specific markets (Elmuti & Kathawala, 2001; Lin & Chen, 2004), internationalization (Yoshino & Rangan, 1995), obtaining and securing new/critical technology and knowledge (Hagedoom, 1993; Lin & Chen, 2004; Tyler & Steensma, 1995), and achieving better quality and/or lower cost (Elmuti & Kathawala, 2001). Some other benefits are confronting environmental uncertainty (due to intensification of competition, acceleration of technology advancements, enlargement of required investment, and globalization) (Dickson & Weaver, 1997; Townsend, 2003; Yasuda & Iijima, 2005), reducing financial risk, sharing costs of research and development (Elmuti & Kathawala, 2001), reducing political risk, and various other strategic motives (Glaister & Buckley, 1996).

Partnership relationship is not applicable to all of a firm's suppliers, and alliances should only be formed with some suppliers (Ganesan, 1994; McCutcheon & Stuart, 2000; Nordberg, Campbell, & Verbeke, 1996; Ramsay, 1996). Lambert, Emmelhainz, and Gardner (1996) categorized suppliers as primary and secondary, with the primary supplier being the supplier the firm purchases the majority of their products from. In addition, Welch and Nayak (1992) stated that arm's length contractual relationships should be maintained with suppliers of lower-importance components. Since non-critical or standardized inputs are widely available, there is no reason to expect that strategic alliance sourcing of them will have any significant advantage for the sourcing firm (Kotabe, 1992; Murray, Kotabe, & Zhou, 2005). Proprietary (or critical) technology components are customized, and crucial components that are technical in nature affect performance of the product (Dyer, Cho, & Chu, 1998; Kraljic, 1983). The sourcing firm may need the supplier to develop the components with the suppliers' technological expertise in order to supplement the firm's limited capabilities and to help differentiate technology/uniqueness of components from competitors. Therefore, an alliance should only be undertaken with suppliers, especially the primary suppliers, of critical technology components. Nevertheless, many managers still find it difficult to determine which suppliers should be targeted for which kind of strategic alliance.

Even though developing alliances among firms has become a trend, the failure rate of strategic alliance was reported to be as high as 70% (Das & Teng, 2000; Murray et al., 2005). With today's fast-changing technology environment, the development of a successful alliance becomes even more difficult. While the basic concept of alliances is well known, there are relatively few guidelines for implementing and developing strategic alliances. In order to achieve the eventual success of the buyer–supplier relationship, a formal purchasing strategy development process, a supplier assessment and selection process, followed by the evaluation and selection of the type of collaborations are necessary.

2.2. Works on supplier selection and buyer–supplier relationships

The works on supplier selection problem are abundant. Dickson (1966), one of the first works on supplier selection, identified over 20 supplier attributes, such as net price, quality, delivery, performance history, capacity, and service. Managers often need to make tradeoffs among these attributes, and the simplest supplier selection method is the categorical method, which assigns good, satisfactory, neutral and unsatisfactory to each supplier characteristic and sums up the total score for each supplier (Ghodsypour & O'Brien, 1998). One of the most common methods is the linear weighing method, in which different weights are given to a number of criteria and the supplier with the best weighted total score is selected (Roodhooft & Konings, 1997).

Various supplier evaluation methods are categorized by Degraeve, Labro, and Roodhooft (2000) into four major types: rating/linear weighting, total cost approaches, mathematical programming and statistical approaches. Mathematical programming models are proved more effective than the linear weighting methods because they can optimize the explicitly stated objective (Kumar, Vrat, & Shankar, 2004). Wang, Huang, and Dismukes (2004) classified supplier selection research into three categories: criteria, strategy and optimization. The *criteria* category can further be divided into identification and analysis, whereas the *strategy* category includes three-stage model and product-driven model. The *optimization* category catches most of researchers' attention, and it is further classified into linear programming, mixed integer programming, goal programming, multi-objective programming and nonlinear programming.

Four research subjects within the research field of supplier selection were identified: problem definition, formulation of criteria, pre-qualification and final selection (de Boer, Labro, & Morlacchi, 2001). The latter two are mostly studied. The pre-qualification step is the process of reducing the set of suppliers to a smaller number of acceptable suppliers, and the methods that are often applied can be categorized into four kinds: categorical methods, data envelopment analysis (DEA), clustering analysis (CA), and case-based reasoning (CBR) system (de Boer et al., 2001). The final selection step is usually solved by five types of methods: linear weighting, total cost of ownership, mathematical programming (MP), statistics, and artificial intelligence (AI) (de Boer et al., 2001; Hong, Park, Jang, & Rho, 2005). Most proposed methods belong to linear weighting and MP models (Hong et al., 2005). Earlier works by MP models were reviewed by Weber and Desai (1996) and Weber, Current, and Desai (1998). Talluri, Narasimhan, and Hair (2006) reviewed some recent multi-criteria, MP, and advanced methodologies on supplier selection.

Some recent works are reviewed here. Hong et al. (2005) proposed a MP model that considers the change in suppliers' supply capabilities and customer needs over a period in time, and the model not only can maximize revenue but also can satisfy customer needs. Talluri et al. (2006) presented a chance-constrained data envelopment analysis (CCDEA) approach that considers stochastic multiple performance measures. Analytic hierarchy process (AHP) is one of the most popular methodologies applied in supplier selection problem. The strongest features of the AHP are: it can generate numerical priorities from the subjective knowledge expressed in the estimates of paired comparison matrices; it can han-

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