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Comprehensive and configurable metrics for supplier selection

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Abstract

As firms are increasingly becoming outsourcing oriented, supplier selection has become a major strategic decision for original equipment manufacturers (OEMs). Hundreds of publications can be found in the literature that deal with supplier selection. Researchers from business school often emphasize philosophical issues and focus on developing qualitative principles to guide management decision making. On the other hand, engineering researchers mostly treat supplier selection as an optimization problem. While strategic thinking cannot provide quantitative solutions, a mathematically optimal solution has no meaning if it does not match a firm's business strategy. Therefore, there is a need to integrate strategic thinking with quantitative optimization in order to make sound and effective decisions on supplier selection. This paper presents an integration mechanism in terms of a set of comprehensive and configurable metrics arranged hierarchically that takes into account product type, supplier type, and OEM/supplier integration level. Based on a firm's business strategy, the management configures an appropriate set of metrics used to measure supplier performance. An optimal supplier selection decision is then made based on this chosen set of metrics, achieving a strategic fit between the firm's business model and its supply chain strategy.

Keywords: Supplier selection; Decision making; Metrics; Multi-attribute utility theory

1. Introduction

Due to global competition, original equipment manufacturers (OEMs) are increasingly becoming outsourcing-oriented in order to lower manufacturing costs. According to Krajewski and Ritzman (2001), the percentage of sales revenues spent on purchased materials varies from more than 80 percent in the petroleum refining industry to 25 percent in the pharmaceutical industry. Therefore, the selection of appropriate suppliers has become an important decision for OEMs. OEMs must choose those suppliers that can deliver required raw materials and components at a high-quality level with low cost to satisfy customer demand. In addition, because of shortened product life cycle, OEMs and suppliers need to develop strategic partnerships so they can quickly adapt to a rapidly changing market. Furthermore, with rising consumerism and the concern about the environment, more and more OEMs are consciously building a consumer and environment friendly image.

Partnering with the right suppliers has become a key factor to the success of an OEM (Ellram et al., 2002).

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As such, many researchers devoted their efforts to developing supplier selection methodologies. Researchers form business school often emphasize philosophical issues and focus on developing qualitative principles to guide management decision making. This is typified by the philosophy of matching business strategy with supply chain strategy, first articulated by Fisher (1997) and later formalized by Chopra and Meindl (2003). On the other hand, engineering researchers mostly treat supplier selection as an optimization problem and attempt to develop mathematical models to generate optimal solutions. We believe these two paradigms are complementary rather than competitive. While strategic thinking cannot provide quantitative solutions, a mathematically optimal solution has no meaning if it does not match a firm's business strategy. The missing link is a set of comprehensive metrics that can be configured based on a firm's business strategy to serve as a basis for formulating an objective function to be optimized quantitatively.

Although some metrics have been proposed in the literature to measure supplier performance, they are not developed specifically to integrate strategic decision making with quantitative optimization. The number of metrics also varies, ranging from 13 to 60 in different publications. The issue of configurability is often ignored. In this paper, we present a comprehensive set of metrics that are configurable based on a firm's business strategy. These metrics are arranged hierarchically to take into account product type (i.e., make to stock, make to order, or engineer to order), supplier type (i.e., local or global), and OEM/supplier integration level (i.e., no integration, operational integration, or strategic partnership). After briefly reviewing relevant literature in Section 2, the metrics development methodology is presented in Section 3. Section 4 discusses how the metrics can be configured for supplier selection. This is followed by an illustrative example in Section 5. Section 6 concludes the paper.

2. Literature review

2.1. Supplier selection

Research on supplier selection can be traced back to the early 1960s when it was called vendor selection. These early research activities are summarized in a literature review by Weber et al. (1991). Ghodsypour and O'Brien (1998) also provided a short but insightful overview of supplier selection research. Supplier selection is a decision-making problem. While some researchers emphasize strategic decision making (Davidrajuh, 2003; Huang et al., 2002; Fisher, 1997), the majority treat it as an optimization problem. Different solution methodologies have been proposed, ranging from linear programming to non-linear programming. Table 1 lists a few representative methodologies.

Treating supplier selection as an optimization problem requires the formulation of an objective function, typically cost minimization. Some researchers focus on overall purchasing costs (Roodhooft and Konings, 1996); others consider total inventory costs that take into account quality, flexibility and responsiveness (Youssef et al., 1996). Ghodsypour and O'Brien (1998) argued that an optimization approach can only handle quantitative criteria, but qualitative considerations are abundant in real-world supplier selection. They proposed an integrated method that uses the Analytical Hierarchy Process (AHP) and linear programming to deal with both qualitative and quantitative criteria. This philosophy was adopted by Wang et al. (2004), where strategic fit between product characteristics and supplier performance is emphasized. Fuzzy set theory has also been used to deal with real-world supplier selection problems

Table 1
Optimization methodologies for supplier selection

Method	References
Linear Programming	Pan (1989), Kingsman (1986), Anthony and Buffa (1977) and Moore and Fearon (1973)
Mixed Integer Programming	Kasilingam (1996), Rosenthal et al. (1995), Chaudhry et al. (1993), Turner (1988), Narasimhan and Stoynoff (1986), Bender et al. (1985) and Gaballa (1974)
Goal Programming	Karpak et al. (1999), Sharma et al. (1989) and Buffa and Jackson (1983)
Multi-objective Programming	Liu et al. (2000) and Weber and Current (1993)
Non-linear Programming	Hong and Hayya (1992) and Benton (1991)