

A dynamic model for strategic supplier selection

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Abstract. Supplier selection decisions at the strategic level are focused on strategic items with both a high supply risk and a high profit impact. Therefore, strategic supplier selection decisions have to be long-term orientated considering (i) mutual commitments between the partners involved, (ii) fixed costs upon selection of a new supplier in the form of investment in training, and technology, as well as (iii) significant costs of switching from one supplier to another. Existing approaches of supplier selection neglect the interdependencies in time arising from investment costs of selecting a new supplier and costs of switching from one supplier to another. Moreover, it is assumed that the set of employed suppliers can be changed each period without cost. These shortcomings of current approaches motivates the research presented in this paper. A stochastic dynamic model for supplier selection based on hierarchical planning approaches will be presented. This model enables the evaluation of alternative dynamic supplier selection strategies.

1 Introduction

A supply chain (SC) can be considered as a network of different geographically dispersed facilities, where products are transformed and stored, and transportation links that connect these facilities. The major task of supply chain configuration (SCC) – the strategic level of supply chain management (SCM) – is the design of the SC in such a way, that a given set of objectives is achieved. SCC decisions concern the entire SC process. On the production side decisions about the location and capacity of plants are the typical tasks of SCC. On the distribution side, in general, the locations of warehouses have to be determined. This paper focuses on the major task on the procurement side: strategic supplier selection. Each potential supplier is equipped with his own production facilities and warehouses. Therefore, by selecting suppliers the network's structure will be influenced.

Supplier selection decisions are complicated by the fact that multiple criteria must be considered in the decision making process [12]. Supplier selection decisions are further complicated by the fact that some suppliers may have different performances in regard to the different criteria. For example, the supplier who has the best quality performance may not have the best delivery performance [13]. Since the 1960's when *Dickson* [2] suggested 23 different selection criteria, the analysis of these criteria has been the focus of a large number of publications. Quantitative approaches supporting supplier selection range from simple linear

weighting models to complex mathematical programming models. Extensive literature overviews on available approaches to supplier evaluation and selection are given by *De Boer/Labro/Morlacchi* [1] and *Weber/Current/Benton* [12].

Supplier selection decisions at the strategic level of SCM are focused on strategic items with both a high supply risk and a high profit impact. Here, the buyer aspires to a long-term orientated strategic partnership type relationship with his suppliers [3]. The considered long-term planning environment is characterized by only a few suppliers, long-term contracts and substantial switching costs, either because of a high unique specification or because of the scarcity of the material [1]. Therefore, strategic supplier selection decisions have to be long-term orientated considering (i) mutual commitments between the partners involved, (ii) fixed costs upon selection of a new supplier in the form of investment in training, and technology [6], as well as (iii) significant costs of switching from one supplier to another. Besides the price, the quality, and the delivery time of the supplier's products, these switching and investment costs have to be taken into account selecting one or more alternative suppliers for a strategic item.

Existing approaches of supplier selection neglect these interdependencies in time arising from investment costs of selecting a new supplier and costs of switching from one supplier to another. Moreover, it is assumed that the set of employed suppliers can be changed each period without cost. These shortcomings of current approaches motivates the research presented in this paper. We propose a stochastic dynamic model for supplier selection based on hierarchical planning approaches. Our model enables the evaluation of alternative dynamic supplier selection strategies. The remainder of this paper is organized as follows: In section 2 we first present a generic single-period supplier selection model. With it the impacts of the supplier selection decisions on medium-term supply chain performance can be evaluated. Using this model we generate the base-level of our hierarchical approach, presented in section 3. On the top-level of the proposed hierarchical approach we model supplier selection alternatives and the corresponding investment and switching costs. In section 4, we show, how this hierarchical approach can provide valuable decision support for strategic supplier selection decisions.

2 A deterministic one-period supplier selection model

In this paper, we utilize a modified version of the deterministic single-period supplier selection model presented by *Jayaraman/Srivastava/Benton* [5]. The model simultaneously determines the set of suppliers and allocates the demand of the buyer's plants among them. For a more detailed formulation, which splits the regarded period in multi sub-periods, considering time-varying prices dictated by time-varying quantity discounts, and the possibility of carrying forward products to a future sub-period, incurring holding costs, see *Tempelmeier* [11] and *Reith-Ahlemeier* [8]. In our model, the buyer of a specific product selects one or more