Multi-Criteria Partner Selection in Virtual Organizations

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INTRODUCTION

Virtual organization partner selection has recently attracted the attention of researchers from various fields. The need for partner selection arises when a broker (e.g., Katzy & Dissel, 2001) identifies a collaboration opportunity and is willing to form a virtual organization (VO). Several researchers have suggested that a pool of proactively cooperating organizations would be an efficient platform for creating VOs (Lau & Wong, 2001; Camarinha-Matos & Afsarmanesh 2003; Tølle & Bernus, 2003). Here, we follow the terminology of Camarinha-Matos and Afsarmanesh (2003), who call this pool a virtual organization breeding environment (VBE). The idea is that a VBE provides a common structure for repeated VO creation, hence decreasing the costs related to ad hoc VO creation. Such a VBE structure includes, for instance, a common ICT infrastructure, contract templates and decision-support tools for agile VO creation.

It has been commonly accepted that VO partner selection is essentially a multi-criteria decision-making problem, which involves several incommensurable and possibly conflicting factors (e.g., Talluri, Baker & Sarkis, 1999; Mikhailov, 2002; Jarimo et al. 2005). Common examples of conflicting criteria are the usual project measures, that is, cost, time and quality. Moreover, it is likely that "soft" criteria—such as corporate culture and social relations—are also employed in partner selection. Often, the decision criteria are structured in a hierarchy, which divides the general criteria into subcriteria and sub-subcriteria, and so forth.

This article studies the formation of appropriate VO configurations and the selection of the most preferred VO configuration from among the set of alternatives. In this regard, we propose a general formalization of the problem. Specifically, we employ multi-attribute value-theory (MAVT) (Keeney & Raiffa, 1976), which offers methods that cope with conflicting objectives.

The remainder of this article is structured as follows. First, we review earlier works on partner selection. Second, we present our perspective on VO partner selection based on multi-criteria decision-making theory. Third, we suggest directions for future research and conclude our article. Finally, the article gives the definitions of some key terms.

BACKGROUND

Partner selection was originally the problem of supply chain management (SCM). The research started to ex-

pand in the 1960s together with R&D project selection, which benefited greatly from the work of Markowitz (1952) on financial portfolio optimization. Throughout the history, the research lines of partner selection and R&D project selection have had many similarities. For instance, both started with cost minimizing models, accompanied shortly thereafter by multi-criteria models.

The development of the analytic hierarchy process (AHP) (Saaty, 1980) and activity based costing (ABC) (Cooper & Kaplan, 1988), respectively, boosted multi-criteria models and cost minimizing models for partner selection to growth in the 1980s. In recent SCM literature, topics such as total cost of ownership (e.g., Degraeve, Labro, & Roodhooft, 2000; Ferrin & Plank, 2002) and option contracts (e.g., Martínez-de-Albéniz & Simchi-Levi, 2005; Kamrad & Siddique, 2004) have received attention. Finally, in the 1990s the emergence of computer networks (mainly the Internet) gave birth to research on virtual organization partner selection. Although VO partner selection differs in many ways from supplier selection, the results of traditional SCM research can give some insights into the problem.

In broad terms, earlier models for VO partner selection can be categorized either as (1) cost minimization models or (2) multi-criteria models. Advanced cost-minimization models capture a large variety of costs in the objective function and are therefore reasonably good in this regard. Multi-criteria models, in turn, capture several incommensurable criteria in addition to cost considerations.

To begin with the first category, Ko, Kim and Hwang (2001), Ip, Yung, and Wang (2004), and Wu and Su (2005) present mathematical programming models where the objective is to minimize total costs, which consist of production, operation, and transportation costs, for instance. An advanced cost model is that of Feng and Yamashiro (2003), who integrate a large variety of cost factors into one "comprehensive cost function." Degraeve and Roodhooft (2000) present another extensive cost-minimizing model, which is applied to the selection of suppliers. They also develop a transparent cost-hierarchy and show the relationship between activity based costing and total cost of ownership approaches.

Extending the one-criterion models, for instance, Talluri et al. (1999), Mikhailov (2002), Boon and Sierksma (2003), Fischer, Jähn, and Teich (2004), Lin and Chen (2004), and Sha and Che (2005) present models that account for multiple criteria, such as organizational competitiveness and social relationships. In particular, Lin and Chen (2004) have collected a comprehensive list of 183 evaluation attributes for partner selection. Ip, Huang, Yung, and Wang (2003) develop a model for maximizing the probability of success of a virtual enterprise. Moreover, the recent model of Talluri et al. (2006) accommodates stochastic variability in partner performance attributes.

In conclusion, hardly any multi-criteria models have been presented for dealing with inter-organizational dependencies – including considerations such as inter-organizational trust, cultural homogeneity, and success of past collaboration – which contribute to the expected success of future collaboration (Camarinha-Matos & Afsarmanesh, 2003). Such criteria must be considered for a group of organizations (as opposed to a single organization), wherefore the resulting models are more complex (Fischer et al., 2004). As an attempt to fill that void, this paper conceptualizes the VO partner selection as a multi-criteria decision-making problem incorporating also inter-organizational dependencies.

MULTI-CRITERIA MODEL FOR VO PARTNER SELECTION

Phases of VO Partner Selection

Although VO partner selection is not a linear process, we shall identify the essential phases that are necessary to go through from the perspective of a centralized decision maker. Even though the order of the following seven phases reflects the sequential order, the true process is iterative, some phases may be parallel, and negotiations are likely to occur in between.

1. Elaboration of a work breakdown structure (WBS) for the project reflecting the needs of the customer. The WBS is a deliverable-oriented hierarchical decomposition of the work that needs to be carried out in order to fulfill the objectives (PMBOK, 2004).
2. Determination of criteria for partner selection, possibly different criteria for different needed competences. Competences are needed for executing the work defined in the WBS.
3. Gathering data of possible VO partners, for instance using data mining techniques (e.g., Wong, 2006)
4. Identification of partner candidates for each needed competence.