Supplier Selection in Business-to-Business Markets: Scope For Applying Artificial Intelligence Systems

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Abstract
This paper presents the result of a study into how organizations choose their supply partners and the extent to which they apply information technology-based systems to co-ordinate and harness potentially diverse sources of knowledge within the organization in carrying out this task. The results revealed that managers have abysmally low awareness of expert systems’ capabilities to revolutionize supply partner selection process and alter the dynamics of competitive advantage. This is worrying because many businesses are becoming vulnerable to growing strategic information-related actions and sophisticated competitive intelligence network of their competitors.

Introduction
In today’s global, dynamic business environment, trends toward outsourcing and vertical integration are revealing the critical importance of partner-ship sourcing in maintaining and/or improving competitive positions. This paper aims to (a) review organizational approaches to selecting supply-partners and identify the problems inherent in the conventional approaches, (b) identify the factors which organizations take into consideration in evaluating and selecting suppliers and how those factors are weighted, and (c) assess the relevance of Expert Systems technology in developing an effective supplier strategy. There is nothing revolutionary in ‘a’ and ‘b’ above as the literature is replete with studies addressing supplier selection processes and problems (Dickson, 1966; Weber, Current and Benton, 1991). However, the third strand will probably open up a new vista on firm competitiveness in a way that is not hitherto known. In the area of supply-partner selection, it makes sense to speculate on the potential role of Expert Systems in enhancing mutually rewarding relationships linking supplier value-adding activities to organizational competencies, which, in turn, may lead to sustained competitive advantage.

The Process For Selecting Supply-Partners
Since the seminal work by Dickson (1966), there have been incremental additions to knowledge relating to supplier selection and problems appertaining thereto. Some of the changes have encompassed an accelerated interest in quality issues, technical capabilities and improved computer communication (Weber, Current and Benton, 1991). However, very little empirical research exists which addresses the actual selection stage involving the utilization of artificial intelligence-based information in making the choice of which vendor to select (Patton, 1996). Often, subjective measures are applied. As a result of the shortcomings associated with traditional techniques (Thompson, 1996), several authors have applied quantitative techniques to provide what are intended as more objective approaches. Examples include the data envelopment analysis (DEA) (Weber, 1996), analytical hierarchy process (AHP) (Al-Faraj, Alidi and Al-Zayer, 1993), activity based costing approach, (Roodhooft and Koning, 1997), and mixed-integer programming model (Kasilingam and Lee, 1996).

Expert Systems Technology
Expert systems (ES) is a knowledge-based system within the field of artificial intelligence that focuses on leveraging human experts within organizations to gain competitive advantage. It does so by capturing the problem-solving knowledge of experts and making this information available to everyone in the organization. Once this knowledge is captured, ES can provide information on demand, 24 hours a day, to improve the effectiveness and efficiency of organizational decision-making processes of non-experts (Motiwalla and Fairfield-Sonn, 1998. Sometimes called ‘knowledge management’ or ‘diagnostic systems’, these hardware and software systems are designed using highly systematic, rules-based algorithms to approximate human knowledge and expertise in specialized areas. An expert system deals with problems the way a human expert does. Unlike conventional computer programmes, but quite like human experts, an Expert System has the ability to justify its own line of reasoning in a manner directly intelligible to the inquirer. A method used to attain this reasoning characteristic is known as rule-based programming. The rules
are in the form of: IF ... THEN ..., i.e. IF <condition> and <condition> and ... THEN <conclusion> and <conclusion> etc. Where all conditions and conclusions are statements with a truth-value, the condition is called antecedent while the conclusion is the consequent, that is, IF<antecedent> THEN <consequent>. These rules can be used to construct powerful inference systems by being combined into networks in which the consequents of some rules (or parts of the consequent) are antecedents of other rules (or parts of those consequents); see, for example, Grandon (1996), Liker and Sindi (1997), Owrang and Grupe (1997).

ES is being widely applied in the world of business, with positive impacts, in areas such accounting and risk management, insurance, logistics management and business process reengineering, total quality management, human resources management, and public sector contexts (Berry, Berry, and Foster, 1998). Although there have been studies of the use of ES by businesses in the UK (Coakes and Merchant, 1996), no study, to the best of our knowledge, has related ES technology to supplier selection decisions, either in the UK or anywhere else. While the larger project from where this paper is extracted partially developed an ES technology for supplier selection (only the financial attribute assessments have been successfully modeled so far), empirical information provided here relate to usage assessment.

Methodology

There were three approaches to the research process. The first involved an extensive search of the literature to determine the extent and limits of Expert Systems application to supplier selection decision-making. In spite of the evident interest in this technology in other spheres of business activities, no published research exists which suggests that it has been applied for partnership sourcing purposes. This lacuna necessitated the second approach which involved a series of unstructured and informal one-to-one interviews with professionals in marketing (especially, the purchasing and supply functions). These interviews, which usually took place at social gatherings, private homes and over the telephone, were conducted with 8 senior managers from a range of organizations in both manufacturing and service industries. Interviewees were chosen on discretionary grounds because of the knowledge and privileged information they possess based on their practical experience. Information obtained from the interviews afforded novel insights into a wide range of issues relating to supplier selection processes and problems and, very importantly, the scope for applying a branch of artificial intelligence, a computer-based system, to facilitate the process.

The third approach involved distribution, through the postal system, of questionnaires to 500 UK organizations randomly selected from the COMPASS business directory. Questionnaires were addressed to named individuals (where known), otherwise to the purchasing manager. The questionnaire was intended to capture data on: how managers in purchasing and supply functions perform the task of supplier selection; the factors they consider in evaluating and selecting suppliers; the weight they allocate to those factors; the general usage level of computer technology/artificial intelligence in purchasing functions; and the attitude towards the idea of using expert systems technologies to improve supplier selection tasks.

Out of the 500 questionnaires sent, only 66 were duly completed and returned over a period of three months, achieving a response rate of 13.2 per cent. The response rate achieved is typical of this type of research (i.e. postal surveys addressed to senior management positions with no pre-notification or follow up calls) and compares favorably with those of similar population and data collection methodologies both in the UK (Caruana, 1995) and USA (Dorsch, Swanson and Kelly, 1998). For this reason, no follow-up measures were undertaken to improve the response rate. However, the possible effect of non-response bias was investigated by comparing the response data from the early and late respondents (first and last quartile). This method is based on the assumption that late respondents are more similar to non-respondents (Armstrong and Overton, 1977). No significant differences were observed, thus indicating that non-response bias may not be a significant problem in this study.

Results

Organizations that completed and returned the questionnaires were of different sizes and types. As a result, two sets of analysis were performed. The first was to determine whether the size of an organization influenced the way it solved the problem of supplier selection. The second was to find out whether the type of organization affected its approach to solving the same problem. Respondents were required to rank the factors, which they considered during the process of supplier selection. Ranks 1 to 20 were to be awarded, reflecting the importance they attached to each