Supplier Selection using NSGA-II Technique

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ABSTRACT

In modern manufacturing industries, supplier selection is increasingly recognized as a critical decision in supply chain management. Supplier selection problem is a typical multiple criteria decision making problem involving a number of different and usually conflicting objectives. Because of that, modern supplier selection techniques imply solving of multi-objective optimization problems. In this paper supplier selection using evolutionary algorithm (NSGA-II method) is presented. Recent investigations show that quality and costs are among the most important selection factors. In this paper the authors used variance of quality and total costs as criteria for selection optimization. Results show that described methodology can be applicable for the practical purposes.

Keywords: Costs, Evolutionary Algorithms, Multi-Objective Optimization, NSGA-II Method, Quality, Supplier Selection

INTRODUCTION

An effective supplier selection process is very important for the success of any manufacturing organization (Liu & Hai, 2005). As an example, in many companies, the cost of the purchased goods and services accounts for more than 60% of the cost of goods sold. Also, over 50% of all quality defects can be traced back to purchase

material (Gencer & Gurpinar, 2007). Because of that, for last five decades, supplier selection criteria and suppliers performance have been a focal point of many researchers.

In modern practice, supplier selection problem is considered a complex problem in literature because it contains multiple alternatives, multiple criteria (qualitative and quantitative that may have conflict among them) and restrictions imposed by the purchasing process (Sonmez, 2006). Generally, supplier selection

consists of three phase: identifying, evaluating and contracting with suppliers. Supplier evaluation and selection is the most sensitive activity because the identified suppliers have different weaknesses and strengths. This requires precise assessment of suppliers' characteristics that are relevant for following selection.

After suppliers' performance assessment is made, the next step is making selection decision. This process would be simple if only one criterion was used. However, there are, usually, a number of relevant criteria that must be satisfied for final vendor acceptance. In that case it is necessary to determine importance of each criterion for decision making process, i.e. to determine weight parameter that have to be assigned to each criterion before final vendors evaluation (Yahya & Kingsman, 1999).

Defining of criteria for supplier evaluation and selection is the major aspect of the purchasing function (Farzad et al., 2008). There are a number of studies addressed to this research field. One of the first studies was made by Dickson (1966) who performed an extensive identification and analysis of criteria that were used in the selection of a firm as a supplier. His study was based on a questionnaire sent to 273 purchasing agents and managers selected from the membership list of the National Association of Purchasing Managers. Respondents had to assess the importance of each criterion on a five point scale from extreme to no importance value. Based on respondents' reply "quality" was selected as the most important criterion. Classification presented by Weber et al. (1991) based on analysis of all the articles published since 1966 showed that price, delivery, quality and production capacity and location were the most often treated criteria. On the other hand, study by Tullous and Munson (1991) discovered that quality, price, technical service, delivery, reliability, and lead time were among the most important selection factors. This study was performed by analysis of eighty manufacturing firms.

More recently, Zhang et al. (2003) presented study based on 49 articles published between 1991 and 2003 which confirmed that net price quality and delivery were the most important supplier selection criteria. Finally, the review performed by Bross and Zhao (2004) study concluded that the most valuable supplier selection criteria were cost, quality, service, relationship, and organization.

SUPPLIER SELECTION

Modern supplier selection techniques require consideration of both quantitative criteria (for example, quality, cost, delivery) and qualitative criteria (for example, flexibility, service, culture).

Existing methods differ in criteria evaluation and assessment and can be classified into three major categories.

First category contains methods based on elimination of suppliers which do not satisfy defined selection rule. For each chosen criterion must be defined minimal mark. Applying "conjunctive" rule (Wright, 1975), suppliers whose mark is lower than minimal mark are eliminated. Suppliers whose marks satisfy minimal marks of all chosen criteria go in next phase. Next phase is usually application of "lexicographic" rule (Wright, 1975) which implies selection of the most significant criterion for suppliers' assessment. Supplier who satisfies chosen criterion much better than other supplier is selected.

Second category of supplier selection methods are probabilistic methods. One of the most famous methods is "Payoff Matrix" (Soukup, 1987) which implies defining several scenarios of the suppliers' future behavior. Then, for each scenario and each criterion we associate mark to supplier. Finally, for each supplier the total mark is computed. Supplier with stable total mark according to various scenarios is selected.

Third category refers optimization methods. In the optimization method we optimize an objective function by varying potential suppliers. Objective function can include only one criterion or a set of criteria. Also, each criterion can involve a set of constraints on its value.

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