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A fuzzy decision support system for strategic portfolio management

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Abstract

Portfolio selection for strategic management is a crucial activity in many organizations, and it is concerned with a complex process that involves many decision-making situations. In order to decide which of the proposed projects should be retained in the final project portfolio, numerous conflicting criteria must be considered. They include economic, personnel development, and corporate image. Although there are many studies available to assist decision-makers in doing the process of portfolio selection, there are no integrated frameworks that one can use to systematically do the portfolio selection. In addition, in most decision-making situations, decision-makers have to make decisions with incomplete information and under uncertain circumstances. These situations have been recognized by many researchers as a suitable field to use fuzzy set theory. Therefore, based on the concepts of decision support system (DSS), we developed an integrated framework that incorporates fuzzy theory into strategic portfolio selection. This framework provides managers with a flexible, expandable and interactive DSS to select projects for portfolio management. We used a real-world case to demonstrate the proposed approach.

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1. Introduction

The selection of a strategic portfolio, which requires the consideration of corporation goals, resources, and constraints, is an important and challenging task. Usually, there are more projects available for selection than can be undertaken within the physical and financial constraints of a firm, so

choices must be made in creating a suitable project portfolio [13]. In order to decide which of the proposed projects should be retained in the final project portfolio, a number of conflicting criteria must be taken into account. They include environmental advantages and disadvantages, tangible and intangible benefits, and risk level of the project portfolio. Several studies have been proposed to help organizations make good project selection decisions. Most of these studies have focused on the fields of R&D [3,6,23,28,33,34], information technology [21,22,24,27] and marketing [8,35]. In these studies, the methods of Analytic Hierarchy Procedure (AHP), scoring model, and portfolio

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matrices used in conjunction with optimization models are popular among decision makers to consider a broad range of quantitative and qualitative characteristics, as well as multiple objectives. The evaluation models found in present portfolio selection methods are mainly numerical, e.g., expressed with numbers between 0 to 100. The drawback of these studies is that decision makers generally have vague perceptions instead of clear knowledge about the evaluation criteria and are unable to provide exact numbers. To overcome the problem, some prior studies employed fuzzy theory to do the evaluation [7,23,27,31]. Of these, Coffin and Taylor [7] and Machacha and Bhattacharya [27] applied fuzzy logic to software product selection and R&D project selection, respectively; Kuchta [23] used fuzzy numbers to present the net present value and the resource utilization of individual projects; and Rasmy [31] constructed a fuzzy expert system to solve the multiobjective linear programming problem. However, in order to sustain a company's competitive advantage in today's increasingly challenging and turbulent environment, a leader must change his perspective from product-orientation or market-orientation to strategy-orientation when making project selection decisions. Existing studies generally concentrate on evaluating projects for their functional level, e.g., R&D or information technology, and neglect the demands of making the evaluation at a corporate level. Hence, a project selection method constructed with complete strategy-oriented evaluation and selection process will meet many firms' practical needs.

In diversified, multibusiness organizations, the evaluation and selection of the appropriate strategic plans that the firm will pursue involve the business strength/industry attractiveness analysis of the SBUs and the feasibility analysis of the strategic plans that are submitted by the SBUs. The process, from identifying the competitive position of SBUs and the feasibility of strategic plans to determining the suitable strategic plans, is a very complicated task that requires a structured evaluation procedure and experienced evaluators. However, in the evaluation process, evaluators must confirm that all the information available or needed is brought to bear on the problem or issue at hand. As previous cases indicated [1,5,21], the identification of all relevant information for a decision does not mean that the decision-makers

have complete information; in most cases, information is incomplete. In addition, many decisions that have far-reaching effects on the organizational activities and personnel are made in groups. One problem of group decision-making is that every member has different amounts of information on the problems. This means that the situation where different decision-maker possesses different confidence level for the problem will occur. Therefore, the field of strategic management has been recognized as an appropriate field for the application of the fuzzy set theory, because of the fuzziness of the main concepts and terms, and the contexts of strategic management belong to the area of uncertainty and vagueness [30].

In this study, we have developed an integrated framework for strategic formulation to improve the process of project portfolio selection. The proposed approach takes advantage of the characteristics of some existing methods, which include portfolio matrix model, 3Cs model [15], fuzzy weighted average [10,25,26] and fuzzy integer linear programming [17,18]. These methods have sound theoretical bases and are commonly used because of their good decision support characteristics. In order to increase the user acceptability, we use a computer-based group decision support approach to project strategic formulation. According to Turban [36], "A decision support system is an interactive, flexible, and adaptable computer-based information system, specially developed for supporting the solution of a non-structured management problem in improving decision making. It utilizes data, provides an easy-to-use interface, and allows for the decision-maker's own insights." Based on Turban's key concepts of DSS [36], a Fuzzy Portfolio Selection System (FPSS) is developed in this paper to help managers systematically and scientifically make decision for strategic project portfolio.

2. The conceptual framework

Conceptually, our approach for project portfolio selection in the group decision support system is a three phase process: (1) pre-evaluation, (2) preference elicitation, and (3) data analysis and reporting. The pre-evaluation phase encompasses four basic activities: (1) discussing and selecting the alterna-

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