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An integrated method for collaborative R&D project selection: Supporting innovative research teams

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ABSTRACT

Collaborative R&D projects that are applied by innovative research teams (CIRT projects) are supported by government funding agencies in a number of countries due to the complexity and multidiscipline research of innovation. Government funding agencies invest heavily to CIRT projects every year. Thus, it is important to select the desired CIRT projects to avoid undesirable budget consumed. The purpose of this paper is to propose an integrated method for CIRT project selection. In this method, competitiveness and collaboration of candidate innovative research teams (IRTs) are used to assess and select projects. The criteria for competitiveness and collaboration are finalized in light of literature review as well as real situations. A formal decision procedure that aggregates competitiveness and collaboration performances of CIRTs is then presented. It integrates analytic hierarchy process (AHP), scoring method and weighted geometric averaging method. Some sample data from the National Natural Science Foundation of China (NSFC) is used to illustrate the potential application of the proposed method.

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1. Introduction

Collaborative R&D projects that are applied by innovative research teams (CIRT projects, for simplicity) are supported in a number of countries such as USA (see the National Science Foundation, NSF, http://nsf.gov), German (see The Deutsche Forschungsgemeinschaft, DFG, http://www.dfg.de/en), Japan (see Japan Society for the Promotion of Science, JSPS, http://www.jsps.go.jp/english) and China due to the complexity and cross-discipline research of innovation (Du & Ai, 2008; Kim & Park, 2009). CIRT projects play an underlying and significant role for many countries in the progresses of science and technologies (Arranz & de Arroyabe, 2006). For example, in China, CIRT projects are supported by a variety of government funding agencies (or administrations), involving the National Natural Science Foundation of China (NSFC), the Ministry of Education, province government department and local government department. Increasing financial supports from these funding agencies are provided to CIRT projects. Particularly, fiscal year 2009 budget on CIRT projects is estimated to RMB 600 million (Chinese Yuan) in China. To allocate the limited strategic resource to the candidate projects, it is very important for the government funding agencies (or administrations) to select the desired CIRT projects to avoid the undesirable budget consumed.

The CIRT project is a kind of scientific research project. It should be applied by innovative research teams (IRTs), which are leaded by outstanding young scientists and focus on exploring the natural science and technology. Ordinarily, a IRT that applies for the funds for CIRT projects should have the following qualifications. First, it naturally forms during the past collaborative research. Second, it focuses on the basic and applied research within a certain field of natural science and technology, and team members' cooperative fruits are high quality. Third, its members come from cross-disciplines and have steady and common research interests. Fourth, one or more outstanding young scientists guide the team research activities. The CIRT project selection is therefore different from the general R&D project selection with respect to some aspects such as rules, criteria and the procedure.

So far, collaborative R&D project selection has seldom addressed in the existing research, whereas an extensive body of theoretical literature on other R&D project selection can be found. In the past four decades, a variety of decision models have been developed to support R&D project selection (Huang, Chu, & Chiang, 2008; Martino, 1995; Tian, Ma, & Liu, 2002). According to a literature review by Henriksen and Traynor (Henriksen & Traynor, 1999), the current decision models and methods for R&D project selection fall into the following categories: (1) unstructured peer review; (2) scoring; (3) mathematical programming, including integer programming (IP), linear programming (LP), nonlinear

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programming (NLP), goal programming (GP), and dynamic programming (DP); (4) economic models, such as internal rate of return (IRR), net present value (NPV), return on investment (ROI), cost benefit analysis, and option pricing theory; (5) decision analysis, including multiattribute utility theory (MAUT), decision trees, risk analysis, and analytic hierarchy process (AHP); (6) interactive method, such as Delphi, sort, behavioral decision aids (BDA), and decentralized hierarchical modeling (DHM); artificial intelligence (AI), including expert system and fuzzy sets; (8) portfolio optimization. On the other hand, the criteria for R&D selection involve the following ten categories (Wang, Wang, & Hu, 2005): (1) contribution to national economy, (2) direct economic benefits, (3) creativity and advancement, (4) theoretical or technical contribution, (5) technique improvement, (6) energy and material save, (7) indirect economic benefits, (8) social impact, (9) dissemination ability, and (10) R&D project efficiency and commercialization potential. The existing decision models and methods have significantly advanced the efficiency and effectiveness of R&D project management. However, there is still limited research provides a suitable decision method for CIRT project selection.

In addition, the selection of CIRT projects is a task full of complexity and challenges. First, the selection of CIRT projects dose not focus on project prospect, but team strength. Second, not only the competitiveness, but also the collaboration of candidate teams should be considered in CIRT project selection. Third, the criteria for measuring competitiveness and collaboration of research teams are not addressed in the existing literature on R&D projects selection. Fourth, the equilibrium between performances of competitiveness and collaboration should be considered in the aggregation operation process. Due to the above challenges, the existing model and methods are incapable to solve the problem of CIRT project selection. We therefore attempt to propose a straightforward and pragmatic decision method for solving the problem of CIRT project selection. The study of this paper is motivated by a research project supported by NSFC.

The structure of the rest paper is: In Section 2, the background of CIRT project selection is introduced. Section 3 proposes an integrated decision method using competitiveness and collaboration of candidate teams for CIRT project selection. The proposed method is demonstrated using some sample data from NSFC in Section 4. Finally, Section 5 contains some conclusions and the suggested future work.

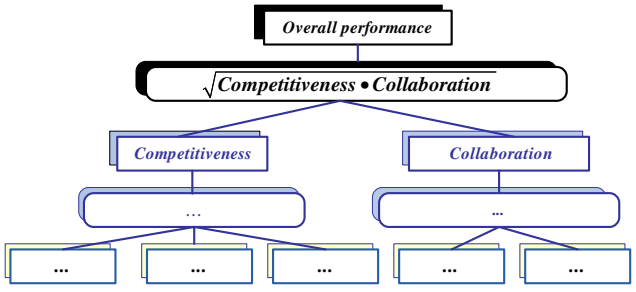

Fig. 1. Hierarchy structure for CIRT project selection.

2. Background: CIRT project selection in china

In China, Large-scope CIRT science funds are set up to continuously support the advanced research of fundamental science and cultivate innovative talents and teams. The funds for CIRT projects could be applied from different government funding agencies (or administrations), including NSFC (http://www.nsfc.gov.cn), the Ministry of Education (http://www.dost.moe.edu.cn), the province government department (see, for example, http://www.lnein.gov.cn/kj/zweb/index.asp) and the local government department (see, for example, http://pro.gdstc.gov.cn/pro). The development of CIRT funds in China is striding forward with great efforts of government.

- From 2000 to 2007, NSFC totally supports 168 CIRT projects and financial support for each project is roughly to RMB 5 million. If the research teams could achieve the research goals listed in their proposals within three years, they could gain a subsequent support as the same as the original one in the following three years.

Table 1
Criteria for measuring the competitiveness of teams.

Criteria	Sub-criteria	Definitions
Publications	Quality	How about the quality of team members' publications? It is often measured by the grade of journals, in which papers are published.
	Quantity	How many papers have the team members published in different grades of journals?
Research projects	Quality	How about the quality of R&D projects that team members have undertaken? It is often measured by the grades of projects.
	Quantity	How many R&D projects have team members undertaken with different grades?
Experts' opinions	Influence power	How about the domestic and international influence of a team? Are there Nobel winners, academicians or editor-in-chief of top-tier international journals in the team? Is the team leader a notable one? How about the citation situation of the team's publications?
	Research environment	Are the hard equipments and the culture convenient for the team members to communicate and collaborate? Is the team in a famous university or in a famous national key lab?
	Research direction	Are the research detections of the team members convergent and advanced?

Table 2
Criteria for measuring the collaboration of teams.

Criteria	Sub-criteria	Definitions
Coauthored publications	Quantity	How many publications has one member published with another in different grades of journals?
	Quality	It is often measured by the grade of journals, in which publications are issued.
Collaborative research projects	Quantity	How many times dose one member collaborates with another who is a sponsor in the finished R&D projects?
	Quality	How about the quality of R&D projects that one member collaborates with another? It is often measured by the grades of projects.

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