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Structural equation model for the evaluation of national funding on R&D project of SMEs in consideration with MBNQA criteria

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Abstract

Financial support on the R&D in Science & Technology for SMEs at the governmental level plays a crucial role on the improvement of the national competitiveness. Korea Science & Engineering Foundation (KOSEF) has supported the R&D projects of SMEs with the competitive technology ability by way of the Science and Technology Promotion Fund. In this paper, we propose a structural equation model (SEM) to evaluate the performance of such a funding program in terms of three aspects: output, outcome and impact under given funding inputs, R&D environment of a recipient company, and external evaluation programs of funding organization. We adopt Malcolm Baldrige National Quality Award (MBNQA) criteria to assess the R&D environmental factors of recipient companies. In addition, we test the effect of interim evaluation of the funded project. The proposed model is applied to the real case and is used to identify the best practices as well as to provide feedback information for the improvement of the government funding programs of the R&D projects of SMEs.

Keywords: Structural equation model; R&d funding; Performance index; MBNQA

1. Introduction

Science and technology has become one of the most critical parts for the development of a country. Thus it is necessary to set up the right direction of the national policies and corresponding financial support for R&D of SMEs. R&D funding is typically followed by the interim intervention of funding sources for the progress check up and subsequently by the final evaluation of the performances. Interim intervention is needed before the final evaluation so as to prevent potential problems and to get feedback information on the improvement of the R&D project before it is completed.

Each of the interim and final evaluations is an essential component of publicly or privately funded R&D programs for effective management and policy implementation. Evaluation is a powerful tool for decision makers, only if it is correctly structured, managed, and applied. However, in reality, many agencies struggle to implement evaluation programs. The Advanced Technology Program (ATP) of National Institute of Standards and Technology (NIST) of US Commerce Department has emerged as a leader in the effective development and application of evaluative tools. NIST funds industrial and academic research in a variety of ways, and ATP co-funds high-risk, high-payoff projects with industry. The Small Business Innovation Research Program funds R&D proposals from small businesses. NIST also offers other grants to encourage work in specific fields such as precision measurement, fire research, and materials science. NIST has been conducting economic impact studies on a regular basis since 1992, as a means to (1) provide management with information on the nature and magnitude of NIST research projects; (2) inform the policy and budget communities of the economic returns to society from NIST projects; and (3) fulfill Government Performance and Results Act (GPRA) requirements for performance evaluation data. NIST also uses these studies to evaluate completed and ongoing research and related projects, as well as to support strategic planning processes (NIST, 2003).

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In addition, various ideas for the effective management of R&D projects have been proposed.

Ojanen et al. (2002) tried to promote effective R&D management by utilizing Malcolm Baldrige National Quality Award (MBNQA) criteria at the project level. Berg, Leinonen, Leivo, and Pihlajamaa (2002) created a simple method for assessing the quality of R&D by defining the maturity level of R&D, which represents the success and effectiveness of R&D. Their model assessed how effectively the strategy process of the company supports the R&D and how the objectives of R&D are defined. This method for assessing the quality and maturity of R&D is based on six viewpoints: business strategy, product and technology strategy, strategic implementation of R&D, R&D as a business section, R&D outputs, and implementation of R&D-projects. Bizan (2003) found out that size and organizational form affect the probability of technical success and duration to commercialization of government supported collaborative research projects.

Many authors have applied Total Quality Management philosophy to R&D management (Bellary & Murthy, 1999; Chatterji & Davidson, 2001; Daniel & Amrik, 2005; Kiella & Golhar, 1997).

The existing approaches, however, have a simple structure and do not consider the hierarchical relationship among various factors affecting the performance of R&D projects. Also, there are not many studies that test the effects of both interim and final evaluation of the national funding program on the performances of R&D project.

The main objective of this study is to develop a structural equation model for the evaluation of the national funding for R&D of SMEs. We propose a model that can provide both direct and indirect effects of following factors on the performances of R&D: funding, external evaluation programs of the funding organization, R&D environmental factors of a recipient company. We also consider the R&D environmental factors affecting the effectiveness of R&D in terms of the MBNQA criteria.

With the proposed SEM, one can find various indices which can be used as barometers of the R&D performances due to funding. Therefore our study results are expected to give valuable and controllable feedback information to improve the effectiveness of R&D funding.

The organization of this paper is as follows. In Section 2, we introduce the proposed SEM. In Section 3, the proposed procedure is applied to a real case. In Section 4, findings are discussed along with feedback information.

2. Model

SEM has been increasingly seen as a useful quantitative technique for specifying, estimating, and testing hypothesized models describing relationships among a set of meaningful variables (Sohn & Moon, 2003; Yoon et al., 2001). Applying the SEM to the case of R&D funding evaluation, the causal relationships among input factors for fund, evaluation program factors, environmental factors and overall performances can be analyzed. R&D managers then can utilize the feedback information obtained from this analysis for the promotion of R&D efficiency.

The structural equation model for the evaluation of national funding on R&D project of SMEs is shown in Fig. 1. The factors used and their relationship in the proposed SEM are explained in detail in the next subsection.

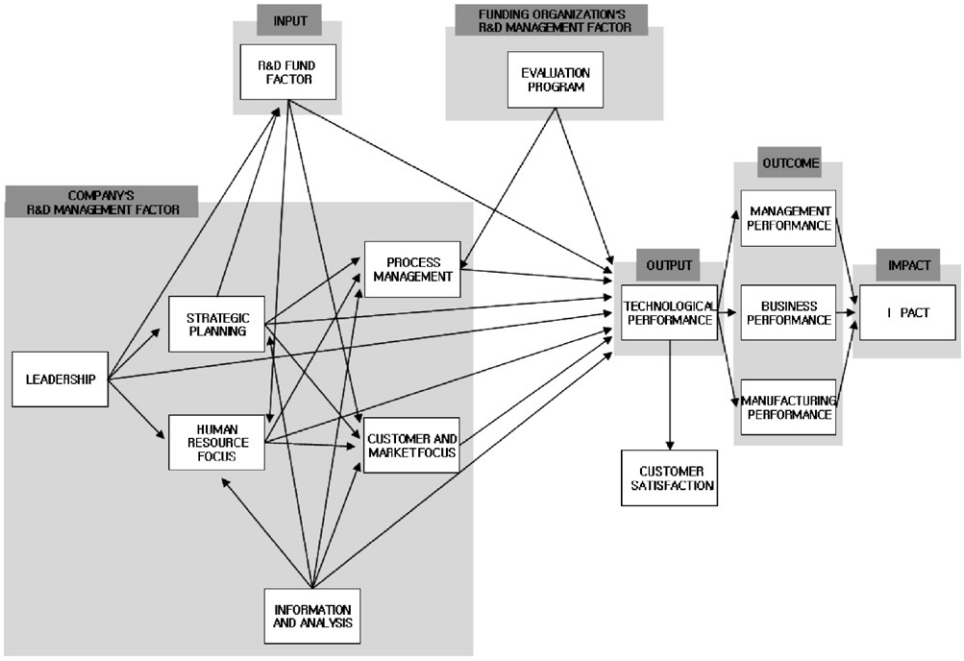

Fig. 1. Structural equation model for the evaluation of national funding on R&D project of SMEs.