ELSEVIER

Applying the analytic hierarchy process to evaluation of the national nuclear R&D projects: The case of Korea

Chul-Oh Shin [a,1], Seung-Hoon Yoo [b,*], Seung-Jun Kwak [c,2]

[a] *Coastal & Ocean Policy Research Department, Korea Maritime Institute, 1027-4 Bangbae-Dong, Seocho-Ku, Seoul 137-851, Republic of Korea*
[b] *School of Business and Economics, Hoseo University, 268 Anseo-Dong, Cheonan, Chungnam 330-713, Republic of Korea*
[c] *Department of Economics, Korea University, 5-1 Anam-Dong, Sungbuk-Ku, Seoul 136-701, Republic of Korea*

Abstract

Researchers, institutes, and government involved in research and development (R&D) are faced with the problem of performing R&D project evaluations. As a real-world case of evaluation, we elicited and reproduced the evaluation process of the national nuclear R&D projects, using a specific case study of Korea for the year 2001. In the methodology, the analytic hierarchy process is employed to evaluate and rank the selected nuclear R&D projects which have a wide range of evaluation objectives and characteristics. This article presents a derivation of a wide range of objectives, evaluation viewpoints from research professionals and evaluators, and evaluation criteria. To structure and quantify the criteria and research performance of some selected projects, we elicited strategic objectives, then refined and structured them into a hierarchy. The method and implications can be easily understood and applied by practitioners since they follow the standard practice of evaluation and relative comparisons of performance using evaluation procedures.
© 2007 Elsevier Ltd. All rights reserved.

Keywords: Analytic hierarchy process; Decision-making; National R&D project; Project evaluation

1. Introduction

Agencies participating in national research and development (R&D) programs have been diversified and investments also increased during the 1990s. Thus, comprehensive coordination at the government level became necessary, to include strategic investment and resource allocation, promote inter-connections among research programs, and prevent duplication of investment in national R&D sources (Ministry of Science and Technology, 2000a). Moreover, the performance evaluation of any national R&D program is considered as an imperative for a government organization. The evaluation of the research output, however, has probably had less of an impact in the literature than it deserves, in part because much of the most detailed and valuable work is not easily obtainable (Georghiou and Roessner, 2000).

* Corresponding author. Tel.: +82 41 560 8344; fax: +82 41 563 0135.
E-mail addresses: shin@kmi.re.kr (C.-O. Shin), shyoo@hoseo.edu (S.-H. Yoo), sjkwak@korea.ac.kr (S.-J. Kwak).
[1] Tel.: +82 2 2105 2819; fax: +82 2 2105 2779.
[2] Tel.: +82 2 3290 2217; fax: +82 2 3290 2535.

In general, the purpose of evaluating national R&D projects is to suggest directions and strategies of national R&D programs at government level, to make balanced investments, and strengthen national R&D. The problem of R&D project evaluation, however, requires practical and efficient decision-making tools to support reasonable investment programs. In addition, many institutions and organizations have focused on R&D and its results.

Performance evaluation and comparison of important national R&D projects are frequently based on the values of several criteria and attributes. Such evaluations are often complicated by the absence of a natural or obvious way to weigh the importance of the individual dimensions of the performance (Caporaletti et al., 1999). Moreover, the evaluation process can deal with problems such as lack of objective measurable units in evaluation factors, the need to meet multiple dimensions, and the conflicting stakeholders' needs. It is in such a situation that the analytic hierarchy process (AHP), suggested by Saaty (1980), can be considered as a basis for obtaining priorities and relative performance evaluation on national R&D projects.

The main purpose of this study is, therefore, to address the evaluating practice of Korea's national nuclear R&D (NNRD) projects, establish the basis framework for the evaluation, implement the exploratory evaluation research, and also suggest a supplementary plan based on our results in order to manage future nuclear R&D projects effectively. This purpose is achieved by using the AHP. To this end, we deal with the practical procedures for the research evaluation, policy and managerial implications of the application of the AHP to measuring and comparing NNRD projects.

The NNRD project evaluation problem is a problem of identification, weighting, interaction, and evaluation. The project evaluators must first identify all attributes which are perceived to be significant in evaluating target projects. Recently, the AHP technique has been applied to several heterogeneous decision problems, e.g. engineering, business, energy, health, and political decision areas. However, little attention has been given so far to the application of the AHP to the performance measurement and evaluation of an R&D project, although the method seems to be suitable to compare the overall results of different research and management outputs when multi-attribute performance criteria are used (Rangone, 1996).

The AHP has three important advantages in dealing with the problem of R&D project evaluation. First, the AHP has the ability to compare and rank decision alternatives based on both qualitative and quantitative factors (Poh et al., 2001). Second, this approach enables the evaluators to carry out strategic comparisons across a wide range of attributes and objectives. Third, it can elicit information from evaluation panels, or even one individual, to provide insight into different views on key value questions. With its theoretical advantages, the method has favorable potential for R&D evaluators and decision makers in the field of science and technology; the AHP only requires pairwise comparisons' enumeration of preferences for attributes. Moreover, it is adaptable to the project evaluators who are unfamiliar with assigning preference values to qualitative and quantitative factors, and it allows attributes to be evaluated separately, making the evaluation more accessible.

The remainder of the paper is organized as follows. Section 2 provides a brief overview of the current status of NNRD project evaluation in Korea. Section 3 presents an overview of the proposed methodology. Our case study is described in Section 4, drawing on required pairwise comparisons, as well as structuring important criteria and attributes; AHP elicitation procedures are concerned. Section 5 discusses the implications of the evaluation results, priority weights, and the improvement of evaluation systems. Some concluding remarks are made in the final section.

2. Current status of national nuclear R&D projects evaluation in Korea

2.1. National nuclear R&D activities in Korea

The Atomic Energy Act stipulates that the Ministry of Science and Technology (MOST) shall formulate the NNRD Program according to the sector-by-sector implementation plan. The NNRD Program, otherwise called the 'National Medium-and-Long-term Nuclear R&D Program,' is implemented mainly by the Korea Atomic Energy Research Institute, Korea Cancer Center Hospital, and Korea Institute of Nuclear Safety (MOST, 2000b).

Originally, the 'National Medium-and-Long-term Nuclear R&D Program' was launched in June 1992 as a 10-year (1992–2001) program. It was modified into a new R&D program to be implemented for the 1997–2006 term, to take account of major changes in national and international situations. There are 28 major projects that are currently being carried out and funded by both the government and the Nuclear R&D Endowment Fund. In 2001, 141.8 billion Korean won (US$10.7 million) was planned to be allocated to the program from a total of 181.6 billion Korean won (US$13.7 million) of nuclear R&D resources, which will be raised via the government budget (30 billion Korean won) and the Nuclear R&D Endowment Fund (131.6 billion Korean won).