

# Development of Logic Model for R&D Program Plan Analysis in Preliminary Feasibility Study

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**Abstract**—The Korean Government has applied the preliminary feasibility study to new government R&D program plans as a part of an evaluation system for R&D programs. The preliminary feasibility study for the R&D program is composed of 3 major criteria such as technological, policy and economic analysis. The program logic model approach is used as a part of the technological analysis in the preliminary feasibility study. We have developed and improved the R&D program logic model. The logic model is a very useful tool for evaluating R&D program plans. Using a logic model, we can generally identify important factors of the R&D program plan, analyze its logic flow and find the disconnection or jump in the logic flow among components of the logic model.

**Keywords**—Preliminary feasibility study, R&D program logic model, technological analysis.

## I. INTRODUCTION

THE Korean Government has increased the research and development(R&D) budget drastically and supported the expansion of the private sector's expenditures on R&D. The R&D budget of the Korean Government has expanded from 4.2 trillion Korean won in 2000 to 16.9 trillion Korean won (equivalent to about 14.7 billion dollar) in 2013. However, the quantitative increase of R&D investment could not lead the qualitative improvement of the performance of R&D. So, the Korean Government wanted to enhance the efficiency of R&D investment.

Due to the huge budget size and complex characteristic of the R&D programs, the government has a burden of decision making for the investment of a new R&D program. In Korea, the preliminary feasibility study is applied to demonstrate the feasibility of large-scale, long-term public investment R&D programs and also to enhance fiscal efficiency and their productivity since 2008. In 2008, under the President's executive order, it is carried out as preliminary feasibility study for the newly proposed government program plans on R&D whose budget is over about \$50 million and whose government subsidy is over about \$30 Million. The preliminary feasibility studies have been performed to predict the potential results of implementations of planned R&D programs [1]. This system is conducted to raise the effectiveness of government R&D investments by selecting R&D programs that has high viability, by analyzing previously R&D program plans before carrying forward them.

The preliminary feasibility study is positioned between a

national science & technology plan and periodical evaluation in the lifecycle of R&D programs. Once a national plan for a specific science & technology area is set up, a government department makes a program proposal for carrying out the plan. Only for the programs which get through the preliminary feasibility study system acquire a qualification of a budget investment.

In the preliminary feasibility study on new government R&D program plans, 3 major criteria are applied to measure not only economic effects but also effects in aspects of technology and policy [2]. Technological analysis, policy analysis and economic analysis are performed independently and results of these analyses are reviewed and combined to deliver the final results. AHP (Analytic Hierarchy Process) method has been utilized as a means of collecting the decision-making information for R&D programs in the preliminary feasibility study [3].

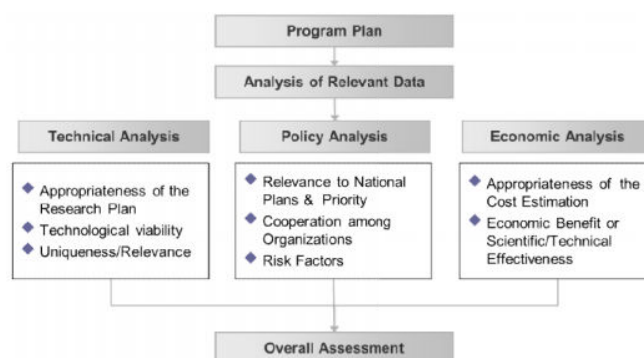


Fig. 1 The general procedure of the preliminary feasibility study

The fundamental purpose of the preliminary feasibility study is to produce important information to help the Ministry of Strategy and Finance decide that the government will either do or do not invest in a specific R&D Program proposed by any government department. The Ministry of Strategy and Finance can do an informed decision due to the preliminary feasibility study. In addition, this study can contribute the improvement of an R&D program plan by complementing its small drawbacks during the preliminary feasibility study process [4].

KISTEP (Korea Institute of Science & Technology Evaluation and Planning) has played the main role in the preliminary feasibility study on R&D programs with the Ministry of Strategy and Finance and has developed the standard guideline of the preliminary feasibility study.

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## II. LOGIC MODEL OF PROGRAM

Program is a series of works to produce desired outputs and outcomes by doing certain activities to achieve specific objective, investing various resources under a specific background. In general, a program consists of a lot of projects.

R&D program plans have issues/problems, objectives and targets, inputs, activities and strategies, systems for management and evaluation, output and outcome. A good program plan provides the good understanding of what the program intends to achieve, how it will be achieved, and how performance will be measured and evaluated.

A program plan itself is a big hypothesis: if a program is implemented as planned, then expected results are accomplished. Evaluator can use a logic model to unpack the hypothesis for understanding the program plan. By building the logic model of a program plan, evaluator can catch how the program staffs or relevant stakeholders believe the program works.

The program logic model is defined as a picture of how organizations do their work and links outputs/outcomes with relevant issues/problems, program objective, and program activities/processes. Therefore, a logic model is a systematic and visual way to present and share the understanding of the relationships among the resources to operate a program, the activities, and changes or results to achieve.

The logic model could make the program more efficient and contribute to the effective dissemination of its results. To complete a program logic model is to draw a map with possible paths. If researchers have this map in hand, they will be more confident to carry out a program and its possibility will be getting higher.

The logic model is a useful tool for conceptualizing, planning, managing, evaluating, and communicating with others about a program. Also, the logic model can be the basis for convincing the working mechanism and the expected performance of a program to others: why the program is necessary, how the program will work, when the program will produce expected performances, who will carry out the program, what will be needed to implement the program, what kind of and how much results will be produced, where the program will be implemented in, and so on [5].

It is a good management and evaluation tool that can be used throughout a program's life (planning, implementation, and evaluation) [6]. Therefore, the program logic model approach could be used as an important part of the technical analysis of the preliminary feasibility study.

## III. DEVELOPMENT OF LOGIC MODEL FOR ANALYZING R&D PROGRAM PLANS

For the good evaluation of R&D program plans in the preliminary feasibility study, we have needed a proper logic model for analyzing the R&D programs. Once the logic model of a specific program is established, we can develop evaluation questions for evaluating the program.

In the ex-post evaluation conducted after the end of the program, the outcome structure related to outcomes and

impacts is evaluated mainly. However because the preliminary feasibility study is the ex-ante evaluation, the program structure related to issues/problems, objectives, working mechanism, R&D activities, inputs and outputs is evaluated intensively.

The logic model is a very useful tool for evaluating R&D program plans. Until now, almost R&D program plans that are applied by government departments don't have their logic model. Therefore the professional group that evaluates an R&D program plan composes its logic model and analyses it.

We had developed and improved the R&D program logic model and Fig. 2 shows its recent version. Meanings of components of the logic model are shown in figures component by component. Arrows in the logic model illustrate the relationship and the direction of an effect between components. We tried to form the simplified logic model to apply it easily in practice. However, the logic model presented is a general form and it could be modified, depending on the characteristics of the program. The detailed meaning of each component in the logic model is as follows.

### 1. Issue / Problem

Issues or problems are the starting point to explain why to plan a specific R&D program. In this component, it should be explained what issues or problems in areas related the R&D program make the program necessary indeed to address them. Contextual factors, such as scientific, technological, industrial, social, national, economic, environmental needs or challenges that can represent the necessity of the R&D program could be described in this component. If the issue or problem to be addressed by the program is complex, resulting from a number of contextual factors, important factors highly related to the program should be selected. Policies, other R&D programs or projects, future forecasting, statistics or survey data related to the area of the program could be described in this component.

### 2. Objective

The objective is the core performance that will be achieved by carrying out a specific R&D program. The objective should be very highly related to issues or problems to be addressed by the program. Although the objective itself could be suggested qualitatively, quantitative performance indices of the objective should be suggested to measure how to solve the issue or problem by the R&D program. The objective should be specific, measurable, achievable, relevant, and time-bound. The Objective should be analyzed in conjunction with the outcome/impact.

### 3. Beneficiary

The beneficiaries in the preliminary feasibility study are not agents funded through a R&D program. They mean main agents to directly obtain economic benefits by the achievement of the objective or outputs of a program. They must be closely connected with the program objective.

### 4. Input

Input means all of resources required to support R&D program activities. Basic elements of input are financial and human resources. R&D facilities and equipment, R&D

agencies, knowledge are also contained in input. Outputs and outcomes of existing R&D programs to be utilized in the R&D program could be also included in input. If the R&D program was planned faithfully, proper minimum resources for producing expected results could be computed quantitatively.

#### 5. Activity

The activity means all R&D activities conducted to achieve the program objective and to produce outputs. Generally, large scaled R&D activities are classified as the development of technology, the construction of facilities and the introduction of equipment. The development of a big scaled technology could be subdivided into several R&D activities like developments of elementary technologies.

#### 6. Output

Outputs are direct results of R&D program activities. They

are technologies, information, data, products, services developed by R&D activities in the R&D program. Also they should be described in terms of amount and/or size and/or scope of results. Academic papers and patents produced in basic research program are also contained in outputs.

#### 7. Outcome/Impact

Outcomes are short-term and intermediate-term results expected to be achieved in several years after the end of the R&D program.

Impacts are the direct and indirect changes and ripple effects expected to occur in social system or country in the future as long-term outcomes of R&D activities.

The economic analysis in the preliminary feasibility study is to estimate direct economic outcomes of an R&D program.

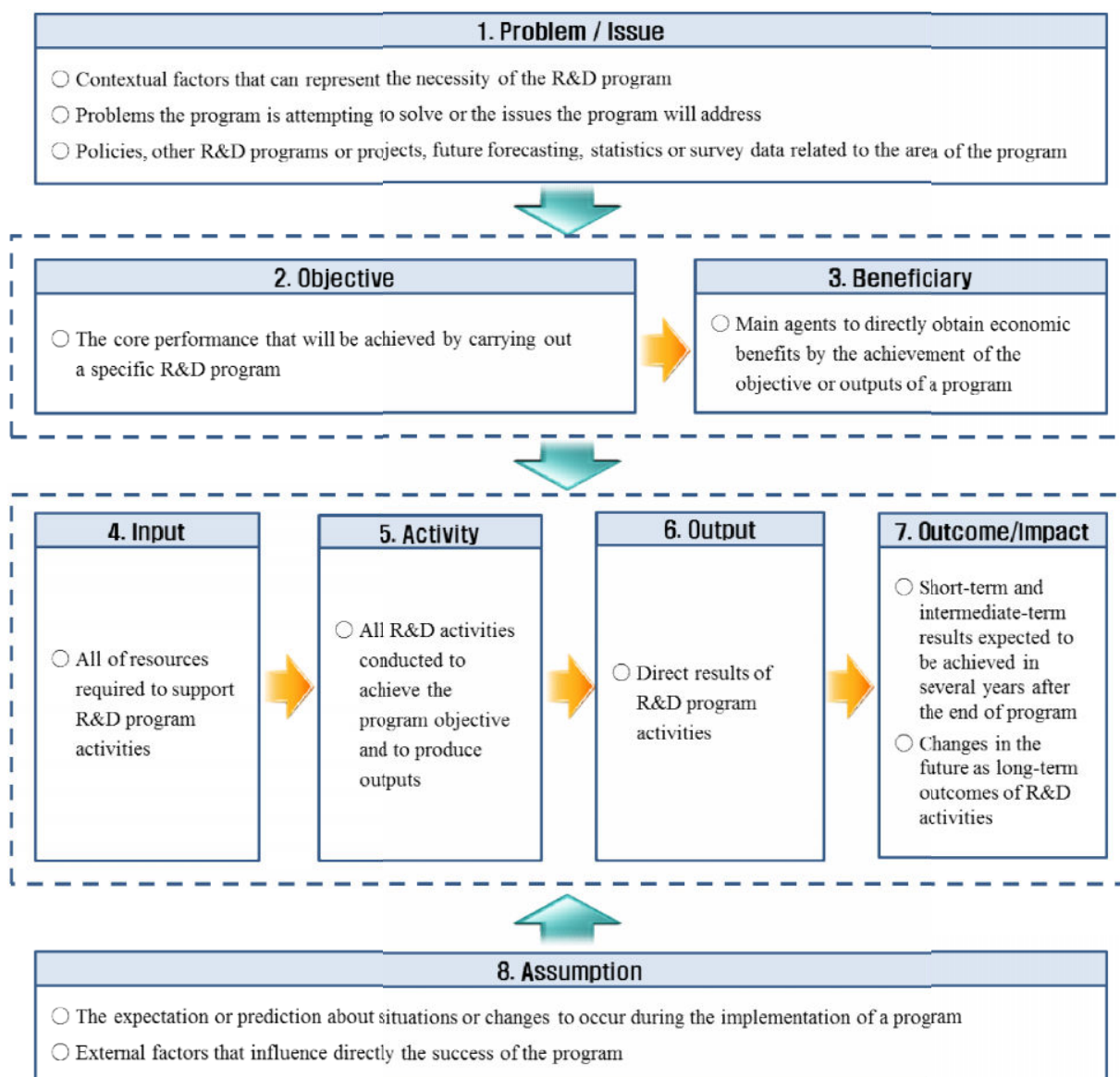


Fig. 2 Logic model for R&D program analysis in the preliminary feasibility study

## 8. Assumption

A program plan itself is a hypothesis: if a program is carried out as planned, then expected results will be produced. The assumption is a belief in the validity of the program. If we disassemble the program according to the logic model, almost components have their assumptions.

Assumptions are the expectation or prediction about situations or changes to occur in components of a logic model during the implementation of a program. 'If~, then~.' expression is usually used. They should be directly related to the implementation of the program.

Also, external factors (such as environmental condition, legislation, regulation, principle, belief, risk) that influence directly the success of the program could be included in assumptions.

Using this logic model, we can generally identify important factors of the R&D program plan by examining the its contents component by component - why this R&D program is needed, how this R&D program plan was made, what objectives are, who beneficiaries will be, what kinds of input will be necessary, what R&D activities will be conducted, what kinds of and when output will be produced, what outcomes and impacts will occur, etc.

Also we can analyze the logic flow of the R&D program plan and find the disconnection or jump/gap in the logic flow among components.

## IV. CONCLUSIONS

Actually, logic models have not used widely in the planning process of a new government R&D program in Korea. However, because the logic model analysis is dealt as an important part of the preliminary feasibility study, we are looking forward the logic model to be diffused to R&D program planning. As a further study, we will improve steadily the logic model for the better evaluation of R&D program plans. By doing this, the preliminary feasibility study will contribute to raise R&D program planning abilities of government departments.

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