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Factors Influencing the Performance of the National R&D Projects in the Field of Science and Technology

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Abstract

This study focuses on projects subjected to higher-level evaluation that have been checked and inspected by the higher-level evaluation committee. Therefore, for the national R&D projects that do not meet the adequacy criteria for the results of self-evaluation by department, this study will determine the characteristics of the project that influence the evaluation results.

The results of the analysis can be summarized as follows. First, the project duration has a negative influence on the research performance. Second, the sunset project has a negative (-) influence on the two performances compared to other projects. Third, the greater the investment, the more positive the effect on the total performance. Fourth, the goal achievement level of the project has a positive influence on the total performance. Next, policy implications based on the analysis results can be discussed. First, in relation to the project duration, the longer the project duration, the more the research performance declines. Therefore, for the research-centered project, it is necessary to seek plans to achieve short-term and long-term research performance simultaneously through follow-up and extended project.

Keywords: National R&D Projects, Performance, Science, Technology

I. INTRODUCTION

The level of science and technology in national competitiveness is critical to the national competitiveness. in 2017 S.Korea has injected KRW19,392.7 billion budget in R&D, and carried out 568 projects and 61,280 programs [1] .The budget and number of programs have been steadily increasing over the last five years, and this trend is expected to continue for the time being. [Figure 1] below shows the budget scale and national R&D projects of S. Korea in 2013-2017, indicating that about 5% of the national budget is spent on an annual basis and a lot of national projects are supported by the government budget [2].

On the other hand, with the prospect that the economically active population will decrease sharply, the concern about this is getting attention in Korea and East Asian countries, which in turn increases the importance of the efficiency of government's fiscal spending. The flow of recent studies on budget has focused on how to design and operate the system related to budget management to solve both the master-agent problems and the tragedy of the commons. This may eventually be considered as various attempts to achieve efficiency of government fiscal spending [3]. This eventually aims to mitigate budget constraints by achieving the same results at the level of low spending, or by achieving better results at the same level of spending [4].

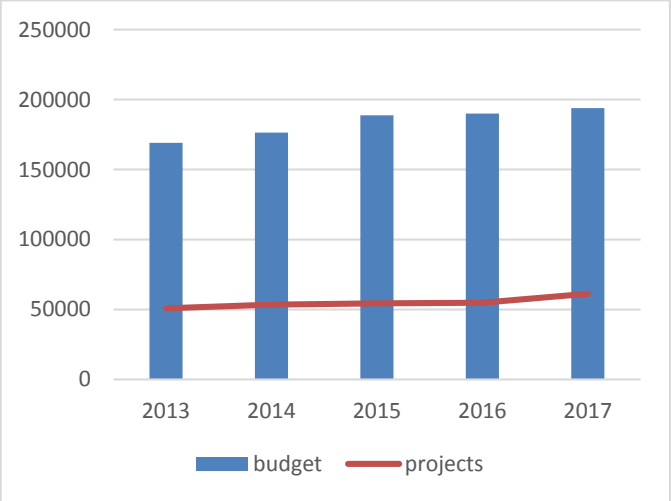

Fig. 1. Budget scale and number of programs in the national R&D projects of S.Korea in 2013-2017

Therefore, the government has introduced a performance evaluation system for all projects, in which finance is injected, and provided an institutional system to feedback the evaluation results to the budget allocation. National R&D projects are also subjected to the performance evaluation system. It is promoted in a three-year cycle according to the 「Frame Act of Science and Technology」 and 「Act on Performance Evaluation and Performance Management of National R&D Projects」. The evaluation steps consist of: (1) reviewing performance goals and indicators of each project, (2) delivering evaluation guidelines to each department, (3) conducting self-evaluation by each department, and (4) conducting higher-level evaluation and determining results by the Ministry of Science and ICT. In the higher-level evaluation, if the criteria of 3 items of adequacy check - evaluation process, basis and result, are met, the result of self-evaluation of each department is acknowledged as it is. Whereas if the result fails to meet the criteria for adequacy, the higher-level evaluation committee checks and inspect each project [5].

This study focuses on projects subjected to higher-level evaluation that have been checked and inspected by the higher-level evaluation committee. Therefore, for the national R&D projects that do not meet the adequacy criteria for the results of self-evaluation by department, this study will determine the characteristics of the project that influence the evaluation results. It is anticipated that the results of this study will serve to establish a standard for the national R&D project to achieve higher performance.

II. THEORETICAL DISCUSSION

1) Performance Management in the Public Sector

In relation to the performance management, some scholars have emphasized comprehensive performance, whereas some others have focused on measuring and managing performance. However, in the discussion on the performance of the public sector centered on the government, this study could not help considering the responsive aspects to consumers(customers) from the viewpoint of the government that executes policies or delivers the service. Therefore, for concept of performance, democratic aspect that can be expressed as political accountability has been emphasized, and conceptual definition that is comprehensive and able to meet the needs of various stakeholders becomes necessary. In conclusion, the concept of public sector performance may be considered to include the conceptual elements, that is administrative effectiveness, and political accountability [6].

Form the perspective of tradition, the goods and services produced and provided by the government sector have the characteristics of public good. Therefore, the production and supply of them have mainly been operated in the form of government monopoly. Therefore, the government has little inducement to consider the efficiency or the crisis of organization survival according to the competition principle. However, the new public management theory in the 1980s emphasized that the performance management of the public sector can contribute to enhancing the competitiveness of society and the nation, playing an important role in the public sector as part of government innovation in each country in the 2000s [7]. The performance management is a generic term for various management models. Drucker (1954) saw it as the management of goals [8], Moynihan (2008), on the other hand, saw it as the management of results [9], and Christensen, Lægreid, & Stigen (2006) defined it as the management of goals and results from a comprehensive perspective [10]. Furthermore, Swiss (2005) explained it as the result-based management [11].

In relation to the policy process that uses performance information and the characteristics of performance management that is goal-oriented management system, Gong, DS, et al. (2013) defined the performance management in the public sector as a series of process where 'planning – execution, check - evaluation – feedback' are organically linked and operated cyclically [12]. In addition, the Article 2 of 'Framework Act on the Evaluation of the Government Services', defines it as a series of activities such as 'establishing the mission, mid-and long-term goals, annual goals and performance indicators of agency and managing the execution process and results from the perspective of economic feasibility, efficiency, and effectiveness'.

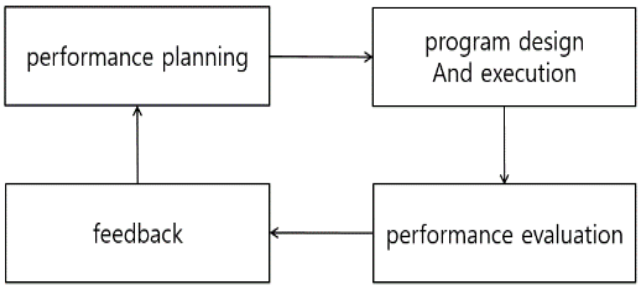

Fig. 2. General procedure for performance management

2) Review of Prior Studies

In prior studies of the factors influencing the results of the performance evaluation for the projects that have been conducted by the central government, there may be controversies related to the establishment of the analytical model because the empirical analysis is somewhat insufficient.

Nevertheless, the study that can be considered to be related to the analysis model of this study that will be designed later is the study by Heinrich (2012) [13]. He verified the factors that influenced PART scores (result score and total score) from 2002 to 2007 in 95 programs of the Department of Health and Human Services in the USA (DHHS) by multiple regression analysis (OLS). As a result of the analysis, it was found that the project that suggested no evidence results for PART evaluation and the project that suggested qualitative evidence only results showed negative (-) influence, and the political characteristics (interest of the parliament) and the program manager's responsibility had a positive (+) influence. On the other hand, the variable of 'the direct project of the federal government' or the variable of 'regulatory project type' that can be viewed as institutional aspects did not show statistical significance, and variable of 'the age of agency' and the variable of 'performance-oriented budget' showed negative(-) influence and positive(+) influence respectively in some models.

Wang & Biedermann (2012) analyzed the influence of US PART score on budget decisions from 2004 to 2008 by establishment of various control variables [14]. The control variables that they set are divided into project scale, project type, the amount of lobbing, the number of persons involved in the project, whether the government is a branch government, partnership (whether it is the ruling party), and budget subjected to specified usage. In addition, Gilmour & Lewis (2006) also verified the influence of political factors on the increase and decrease of budget in 2004 fiscal year based on 2003 during the Bush administration [15]. A total of 234 programs were used for the study and they were analyzed by using OLS and 2SLS (two-step least square) model.

III. ANALYTIC MODEL DESIGN

1) Establishment of Analytic Framework

The primary purpose of this study is to estimate the factors influencing the performance of national R&D projects. More specifically, the performance of national R&D projects are divided into two categories- R&D performance and the total performance indicator, which is the total score recognized as the final result in the higher-level evaluation system.

Next, this study distinguishes the characteristics of each R&D project as an independent variable to achieve the purpose of study.

The first is the project type, which is divided into technology development project, R&D project, and others. The second is the duration of the project and the presence of sunset system. The third is whether of not the project implementation body is a government-funded institution in relation to the use of specialized agencies for promoting R&D projects. The fourth, this study distinguishes the amount of investment until 2017, budget in 2017, and the presence of matching fund in relation to the budget of the project. Finally, the study selects the achievement level of the project and uses it as an independent variable for analytical model. The analysis framework of this study is shown in the following [Fig. 3].

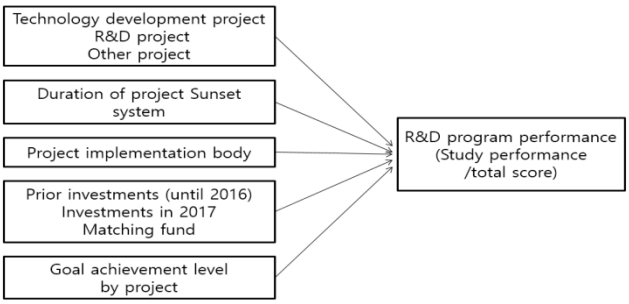

Fig. 3. Analytical framework in this study

2) Data Collection and Establishment of Variables

The data used for the empirical analysis in this study were collected from "2018 National R&D Project Higher-level Evaluation Report" published by the Ministry of Science and ICT. KISTEP in 2018.

For the establishment of variables, the project duration, project type, sunset system, implementation body, budget and the goal achievement level were used as independent variables for the analytical model as shown in the analytical framework summarized in the figure above. Among these, project type, sunset system, and project implementation body are in the form of dummy variables. For the variables related to the budget amount, the total budget of the previous years (t-1) are used as variables considering the time lag approach and they take the form of natural logarithm (ln) to prevent the occurrence of bias.

On the other hand, there are two dependent variables. The research performance and the total score will be established and OLS analysis will be conducted two times for each dependent variable to estimate the influencing factors. Finally, the heteroskedasticity for the ineffective final model in estimating the influential factors of the variables will be verified and if the heteroskedasticity is detected, the robust estimation method will be additionally used.

IV. ANALYSIS RESULTS

1) Factors Influencing Research Results

The results of analysis of the factors influencing research performance were analyzed as shown in [table 1] below. For the detection of heteroskedasticity for the analysis model, Breusch-Pagan analysis was conducted. The results showed that the value of chi (2) was 34.03, and the p value for this was .0000, indicating the presence of heteroskedasticity. This will be analyzed using robust estimation method.

Looking at the analysis results, the research performance decreased by about 0.1 point as the first project duration increased by one year, which suggested that the level of R&D has already been achieved in long-term projects, showing marginal increment phenomena (B = -. 096, p = .034).

Table 1. OLS analysis results of the factors influencing research results (robust)

RES_Perf	Coef.	Std. Err.	t	P>t	Beta
Type_Dev(D)	6.212173	8.240055	0.75	.453	.188784
Type_Res(D)	7.941862	9.14309	0.87	.387	.188829
age	-.09613	.044768	-2.15	.034	-.25994
sunset(D)	-10.8639	3.49569	-3.11	.003	-.35864
QCA(D)	4.576208	4.693427	0.98	.332	.125374
match_bud(D)	-3.04097	3.568063	-0.85	.396	-.10039
ln_t_bud	2.064515	1.769647	1.17	.246	.214969
ln_17	-2.27034	3.017458	-0.75	.454	-.15893
GOAL	.059494	.125047	0.48	.635	.036018
_cons	49.44453	16.44486	3.01	.003	.

Dependent variable : Research performance
R2: .1359, F: 2.39, p: .0179
Number of obs: 99, Root MSE: 14.368

In relation to the model adequacy, F value was 2.39 and p value for this was .0179, rejecting the null hypothesis (H0). On the other hand, t2 value was.1359, which was lightly low, requiring attention in interpreting results.

Second, it was found that the research performance was lower by 10.9 points in the sunset R&D project in comparison with other projects. In the case of the sunset project, the project that requires clear results within a short period of time becomes the subject. Therefore, it can be interpreted that projects such as technology development and proliferation of performance take larger proportion compared to the project that requires long-term research.

Third, the negative (-) influence of sunset project was greater than that of the project duration based on standardized coefficient β.

2) Factors Influencing Total Performance

The results of analyzing the factors influencing total performance are listed in the [table 2] below. For the detection of the heteroscedasticity of analytical model, Breusch-Pagan analysis was conducted. The value of chi (2) was 2.31 and p value was .1289, indicating the presence of homoscedasticity in the following analytical model. Therefore, OLS analysis will be conducted.

In relation to model adequacy, F value is 6.04 and the p value for this was .0000, rejecting the null hypothesis that all independent variables have no influence on dependent variables. Next, R2 was .3166, indicating that there is no big problem in interpreting the analysis results.

Looking at the analysis results, first. the sunset project showed a total performance of 4.4 points lower than that of other project, which is similar to the analysis results for the influences on the research performance previously analyzed.

Second, as the prior investment amount increased by 1%, the total performance improved by 0.013 points. Since the national R&D project is not an area where the distribution / redistribution policy is not the main stream, the influence of capital is closely associated with the performance, In addition, Heinrich (2012) found in his research that capital has a positive influence on the PART score [16] and GAO (2004a, 2004b) found a significant relationship between the PART score and the President's proposed budget increase for 234 fiscal projects evaluated in 2004 fiscal year [17][18].

Third, it was found that as the goal achievement level is improved by one point, the total score of the project improved by about 0.3. This result confirmed that in the institutional aspect, the higher-level evaluation system of the national R&D project in Korea has established the goal achievement level as one of the key indicators.

V. CONCLUSION

In this study, the performance of national R&D projects were defined in two categories - R&D performance and the total score of the project(total performance). And OLS analysis model, in which these performances were established as dependent variables, was designed to verify the factors influencing the national R&D project.

The results of the analysis can be summarized as follows.

First, the project duration has a negative influence on the research performance.

Second, the sunset project has a negative (-) influence on the two performances compared to other projects.

Third, the greater the investment, the more positive the effect on the total performance.

Fourth, the goal achievement level of the project has a positive influence on the total performance.

Table 2. OLS analysis results of the factors influencing total performance

Total_Perf	Coef.	Std. Err.	t	P>t	Beta
Type_Dev(D)	-1.16401	1.665658	-.7	.486	-.08194
Type_Res(D)	2.385354	2.158207	1.11	.272	.131376
age	-.0093	.016478	-.56	.574	-.05828
sunset(D)	-4.3891	1.397517	-3.14	.002	-.33563
QCA(D)	-1.56172	1.51618	-1.03	.306	-.09911
match_bud(D)	1.255065	1.34532	.93	.353	.095974
ln_t_bud	1.306804	.575456	2.27	.026	.315199
ln_17	.377714	.847954	.45	.657	.06125
GOAL	.331001	.061738	5.36	.000	.464178
_cons	36.45963	7.051944	5.17	.000	.

Dependent variable: total performance value
R2: .3793, Adj R2: .3166, F: 6.04, p: ..0000
Number of obs: 99, Root MSE: 5.2569

Next, policy implications based on the analysis results can be discussed. First, in relation to the project duration, the longer the project duration, the more the research performance declines. Therefore, for the research-centered project, it is necessary to seek plans to achieve short-term and long-term research performance simultaneously through follow-up and extended project. In addition, to achieve high total performance in the R&D project in Korea, it is necessary to reduce the proportion of the sunset project.

Finally, since the analysis data of this study is limited to 2017 national R&D projects in Korea, there are some limitations to the generalization of research results. Therefore, follow-up studies that will complement these limitations based on subsequent years of panel data will be needed.

REFERENCES

[1] Yonhap News. Government R&D investment amounted to about KRW19.4 trillion last year. Jun 25, 2018.

[2] Ministry of Science and IC · KISTEP. 2017 National R&D Project Survey and Analysis Report. 2018:1.

[3] Lim, IS, HA, YS. Analysis of the factors influencing the national financial performance. "Journal of parliamentary politics" 2016;11(1):99.

[4] Ulrike, M., Adriaan, D. & Fabienne, I. The Effectiveness and Efficiency of Public Spending, Economic and Financial Affairs, Brussels: European Commission. 2018:2.

[5] Ministry of Science and ICT· KISTEP. Higher-level evaluation report on 2018 National R&D Project 2018:3-4.

[6] Lim,SG, Jeong, HC. A Study on the difference between perceptions of local and centeral government officials on the performance. Korean Administration Research. 2012;21(3):208-209.

[7] Andrews, R. & Van de Walle, S. New Public Management and Citizens' Perceptions of Local Services Effectiveness, Efficiency, and Equity, Journal of Public Management Review, 2013;15(11):762-763.

[8] Drucker, P. F. The Practice of Management, N.Y.: Harper Collins. 1954.

[9] Moynihan, D. P. The Dynamics of Performance Management: Constructing Information and Reform, Washington, D.C.: Georgetown University Press. 2018.

[10] Christensen, T., Per L. & Inger M. S. Performance Management and Public Sector Reform: The Norwegian Hospital Reform, International Public Management Journal, 2006:9.

[11] Swiss, J. E. A Framework for Assessing Incentives in Results-based Management, PAR, 2005;65.

[12] Gong, DS, Go, GG, Kim MJ et al. Performance Management: The Korean System. Daeyoung Co. 2013.

[13] Heinrich, C. J. How Credible is the Evidence, and Does it Matter? An Analysis of the Program Assessment Rating Tool, PAR, 2012;72(1).

[14] Wang, T. & Biedermann, S. PART: An Attempt in Federal Performance-Based Budgeting, The Innovation Journal: The Public Sector Innovation Journal, 2012;17(2).

[15] Gilmour, J. B. & Lewis, D. E. Does Performance Budgeting Work? An Examination of the Office of Management and Budget`s PART Scores, PAR, 2006;66(5).

[16] Heinrich, C. J. How Credible is the Evidence, and Does it Matter? An Analysis of the Program Assessment Rating Tool, PAR, 2012;72(1).

[17] GAO. Performance Budgeting: Observations on the Use of OMB's Program Assessment Rating Tool for the Fiscal Year 2004 Budget, GAO-04-174, Washington, D.C.: General Accounting Office. 2004a.

[18] GAO. Performance Budgeting: OMB's Performance Rating Tool Presents Opportunities and Challenges for Evaluating Program Performance, GAO-04-55T, Washington, D.C.: General Accounting Office. 2004b.