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Technology Planning-Based Management for the Dissemination of R&D Outcome of Government Supported Research Institutes

Kyungil Choe†
School of Industrial and Management Engineering
Hankuk University of Foreign Studies, Yongin 427-050, Korea
E-mail: kichoe@hufs.ac.kr

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Abstract. This study deals with technology planning-based management for Basic R&D Programs of government supported research institutes (GRIs). The Korean Research Council for Industrial Science and Technology which consists of major GRIs needs to implement new government policies which focus on the dissemination of R&D outcome, collaborative research, and performance-oriented R&D investment. The major characteristics of technology planning-based management include the hierarchy of market-oriented technology plans and the valuation of core technologies. We also suggest technology classifications and project network diagrams.

Keywords: Management of Technology, Technology Planning, Government Supported Research Institute.

1. INTRODUCTION

In Korea, the Office of the Minister for Science & Technology Innovation (OMSTI), a unit of the Ministry of Science and Technology (MOST), controls 3 research councils. One of them is the Korean Research Council for Industrial Science and Technology (KOCI) which consists of major government supported research institutes (GRIs) including the Korea Institute of Oriental Medicine (KIOM), the Korea Institute of Industrial Technology (KITECH), the Electronics and Telecommunications Research Institute (ETRI), the Korea Food Research Institute (KFRI), the Korea Institute of Machinery and Materials (KIMM), the Korea Electrotechnology Research Institute (KERI), the Korean Research Institute of Chemical Technology (KRICT), and other affiliates. The KOCI is in charge of

- planning of research programs in the area of applied science and industrial technology,
- budgeting and evaluation of member GRIs, and
- internal and international cooperation for joint research programs.

Research programs of GRIs are classified into two groups: (1) commissioned programs funded by governments and/or private companies, and (2) Basic R&D Programs (BR&DP) by general government funds. A BR&DP usually lasting for 3 to 5 years can be divided into several subprograms or projects of shorter duration. A commissioned program usually has the short-term use and objectives of its outcome, while a BR&DP may not. BR&DPs are supposed to provide basic research resources for GRIs, but their effectiveness is in question. For example, in 2004 the three research councils generated only 2.3% of their total budget by research royalties, while the Pasteur Institute did 23.0% in 2003 (MOST, 2005a). Accordingly, there have been growing concerns regarding the R&D effectiveness of GRIs. In fact, it is a common issue in most countries – see Rubenstein (2003) for the cases of the U.S and Japan. The MOST (2005a) summaries them as follows:

- Management practices of GRIs need to be improved to achieve national science and technology objectives.
- Research competence and assets of GRIs need to be better utilized.
- Newly emerging research institutes of universities and industries make GRIs less competitive.

The MOST sets up new policies to strengthen the core competence of GRIs:

- To launch Special R&D Programs for effective R&D

† : Corresponding Author

investment
- To enhance the specialty and competitiveness of GRIs
- To provide the stable research environment for raising researchers' morale
- To increase the management autonomy of research councils and GRIs

From the same point of view, BR&DPs are required not only to provide basic resources for GRIs but also to utilize their outcome for industrial benefits (MOST, 2005b). The evaluation of BR&DPs the KOCI has focused also on administrative aspects rather than R&D performance (KOCI, 2005a). Hence, the KOCI needs to develop new evaluation processes of BR&DPs for the new policies of the MOST.

This article suggests a new management framework for BR&DPs of the KOCI. We want to discuss more fundamental issues, such as demand-driven technology planning, rather than the simple enforcement of performance evaluation – see KOCI (2005a) and Choi (2005) for various performance management techniques. For the successful dissemination of R&D outcome (DR&DO), the processes need to be extended from technology planning to business development. Effective technology planning would lead to long-term research plans and post-project processes for the DR&DO. In the next section, we briefly explain the status quo of BR&DPs. A new management framework is discussed in section 3. We explain its work breakdown structure (WBS) in section 4, and then make concluding remarks.

2. BASIC R&D PRORAMS OF GRIS IN KOREA

BR&DPs are very important for GRIs to secure research resources: for a member GRI of the KOCI, they usually take about 30 to 50% of the total budget. The ratio of researchers participating in BR&DPs is much higher than the budget ratio: for most GRIs, about 80 to 100 % of researchers are involved with BR&DPs (KOCI, 2005b). It implies that BR&DPs may be diversified too much to provide research outcome in an efficient manner.

The major issues of BR&DPs include that a program may be selected not by technological demand but by organizational benefits, and that there are few procedures to manage R&D outcome in a systematic way. Most GRIs are not capable of effective technology planning. The current planning hierarchy of GRIs as shown in Table 1 implies that long- and mid-term plans are made mainly for management purposes.

There is no long-term technology plan of the KOCI. For a GRI, one with the longest time horizon is the 10-year Strategic Plan, which is more like a resource plan. The next longest plan is the 3-year Management Plan which includes quantitative measures for GRI management. The 3-year plan usually lacks of technology planning. There are also yearly management plans mainly for the performance evaluation of the management. From the technology planning point of view, there are no formal plans for both the KOCI and GRIs,

The KOCI controls the total budget of BR&DPs of member GRIs, while GRIs selects specific programs within its budget limit. A typical procedure for selecting a BR&DP by a GRI is as follows (KOCI, 2005a):

(1) Long-term research plan made for the need of the GRI
(2) Demand survey and topic selection: R&D topics are selected on the yearly basis. The demand survey covers the government and industries.
(3) Application for BR&DPs
(4) 1st selection (document reviews)
(5) Final selection (with presentation)

Table 2 summarizes the status quo of technology planning and program management of GRIs. Most GRIs have organizations under the name of technology planning or similar ones. Their activities, however, are more related to administrative work. Standard procedures for program management are in use for most GRIs, but again they focus on administration. There are few procedures for the DR&DO especially after closing down a program. It is interesting that for some GRIs the due dates of BR&DPs are clustered in certain year(s). This factor should be considered if we need to determine

Table 1. The current planning hierarchy of GRIs

Level	Plan	Description	Major Issue
0	None	long-term plan of the research council	no capability of technology planning of the KOCI
1	10-year strategic plans	long-term management plans of GRIs	not for technology planning, but mainly for resource planning
2	3-year management plans	mid-term plans for management purposes	mainly for setting up quantitative measures for GRI management
3	1-year management plans	yearly management plans with 10 key R&D programs	unclear relationships between key programs and BR&DPs
4	unit R&D programs	the average duration of 3 to 5 years	unclear relationships between the whole program and its subprograms

Table 2. Technology planning and program management of GRIs

Institute	Technology planning	Program management
KIMM	- BR&DP selection by partial technology planning - no technology valuation	- standard procedures in use - weak in dissemination and evaluation of outcome
KFRI	- BR&DP selection on the yearly basis - no technology valuation	- checkpoints enforced during a program - partial procedures for DR&DO
ETRI	- a technology planning unit in operation - selection factors based on technology, marketability, and business	- standard procedures in use - weak procedures for DR&DO
KIOM	- weak capability of technology planning - no technology valuation	- standard procedures in use - 20% weight of DR&DO during selection
KRICT	- long-term research plans in use, but unclear relationships with BR&DPs - no technology valuation	- standard procedures in use - no DR&DO factors considered during selection
KERI	- insufficient technology planning - no technology valuation	- most BR&DPs finished in 2006 and 2008
KITECH	- insufficient technology planning - no technology valuation	- most BR&DPs finished in 2007

when the new management processes take effect.

3. A NEW MANAGEMENT FRAMEWORK FOR BR&DPS

A new management framework needs to be designed based on the following purposes:

- Strategic use of BR&DPs for implementing new government policies
- Effective technology planning for demand-oriented performance management
- Increased support and evaluation for the DR&DO

In the past, the selection of BR&DPs programs was a bit biased for the short-term need of GRIs. Under new policies, however, BR&DPs should be chosen from strategic and market-oriented purposes. For example, the criteria have to reflect the focuses of new policies such as joint research initiatives among institutes. In addition, BR&DPs need to increase direct support for program-based research units rather than for the entire GRI.

For demand-oriented performance management, a BR&DP needs to be managed not as an isolated project but as a member of a group identified by market-oriented technology planning. For example, a GRI may identify core technology groups which consist of sub-technologies with the hierarchy of 2 to 3 levels. Then a long-term research plan needs to be made for each core technology group. From the demand-oriented point of view, long-term plans have to include well-defined target markets and technology valuation.

For each BR&DP, the substantial efforts for technology planning should be made so that we can properly address its objectives, strategic importance, relationship with other programs, and so on. For the efficient DR&DO, we need to carefully prepare technology transfer and business development as early as at its planning phase. After closing a BR&DP, the selection of subsequent programs should be related to the DR&DO of predecessor programs. Hence a planning hierarchy as shown in Table 3 is required to make BR&DPs interrelated, and to manage the life cycle of a program from technology planning to the DR&DO. Technology classification at the highest level of the hierarchy has to be aligned with the mission and vision of a GRI. The classification can be developed by various tools such as technology trees and knowledge maps (Yoon, 2004).

Table 3. A planning hierarchy of the new management framework

Level	Management Purposes	Research Purposes
0	10-year Strategic Plan of the research council	Technology classification of the council
1	10-year Strategic Plan of a GRI	Technology classification of a GRI
2	3-year Management Objectives	Long-term research plan for each core technology group (LPCT)
3	Yearly Performance Objectives	Yearly update of LPCTs
4	-	Selection and execution of a BR&DP

One of the important characteristics of out new framework is the long-term research plan for each core technology group (LPCT) for a period of 3 to 10 years. The LPCT has to be made for each core technology

group at the highest level of technology classification. From a demand-oriented point of view, it includes technology planning and technology valuation. The LPCT identifies all BR&DPs that belong to the same technology. Any changes in programs have to be made in the yearly update phase of the LPCT, before selecting specific BR&DPs.

Technology planning defines target markets, products, and the program network diagram (PND) as shown in Figure 1. The PND is similar to an extended technology roadmap (TRM) – see EIRMA (1997), Kostoff and Schaller (2001), and Phaal *et al*. (2003) for details of TRM. For a core technology group, our PND shows the precedence relationship among programs as well as among technologies and markets.

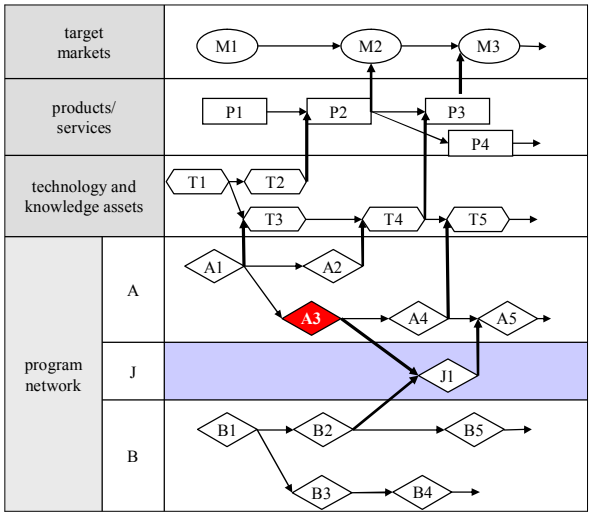

Figure 1. A Program Network Diagram

We can value each program, if we can estimate the value of the whole core technology and the contribution of each program. Issues here are that technology valuation is not a simple task, and that GRIs are not capable of valueing every core technologies. See Neely and de Neufville (2001) for various valuation techniques and related issues. Technology valuation can be temporarily replaced with a simplified economic analysis, when our framework is introduced. It would make the implementation of our framework less painful.

4. THE WBS OF THE NEW FRAMEWORK

The WBS of our new management framework is depicted in Figure 2. It has 4 phases such as technology planning, program planning, program management, and post-program management. Each phase consisting of 3 tasks finishes as deliverables planned are accepted by the program management office.

One of the most important changes in our framework is the LPCT. It includes the PND, and assigns technology values to BR&DPs. The PND in Figure 1 defines the precedence relationship among BR&DPs, target markets, and products/services in a systematic manner. Using the PND, we can determine how a BR&DP contributes to the whole value of the core technology group. For example, at first we estimate the value of the core technology, and determine the contribution weight of each BR&DP. Then the value assigned to a BR&DP equals to the amount of the whole value multiplied by its contribution weight.

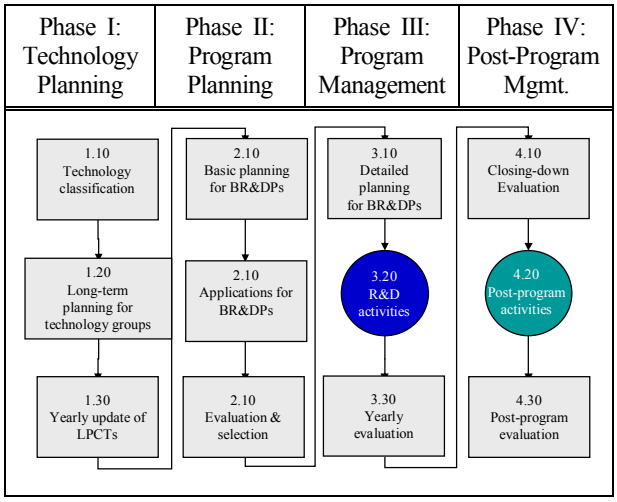

Figure 2. The standard WBS of the new BR&DP management framework

Our valuation method for a BR&DP is easy to use, although it depends on subjective judgment. The valuation of an individual BR&DP may be a very hard problem, because its major objective is to provide basic research resources for GRIs. Target markets and products defined in the PND of a technology group, however, can make the valuation of the whole group relatively easy. Hence, under our framework a BR&DP is managed not as an isolated one but as one of the group interrelated sharing the same target markets and technologies.

Applying for a BR&DP requires the statement of technology planning (STP), the plan of work (POW), and the plan of use (POU). The STP includes the definition and strategic importance of technological objectives, and the value assigned by the LPCT. The POW specifies the objectives and quantitative performance measures. It also consists of yearly work plans, resource plans, and budget statements. The POU deals with how to utilize and disseminate its outcome, after main R&D activities are complete. It also needs to define major milestones and quantitative measures for the DR&DO.

The evaluation and selection procedure for BR&DPs shall depend on the role and responsibility of the KOCI and GRIs. In general, a GRI screens out BR&DP proposals, and then the KOCI chooses BR&DPs sent from member GRIs. Selection by the KOCI should be affected by various factors such as the types of technol-

Table 4. Evaluation weights of the KOCI (Kim and Yang, 2005)

Evaluation Factor	Basic Technology			Industrial Technology		
	New	On-going	Final	New	On-Going	Final
effectiveness of technology. Planning	30	20	10	40	20	10
efficiency of program activities	40	50	50	30	50	40
likelihood of successful use of outcome	30	30	40	30	30	50
Total	100	100	100	100	100	100

ogy (e.g., basic technologies or industrial technologies) and the status of programs (e.g, new, on-going or final). Table 4 shows an example of evaluation weights that the KOCI can use for selection.

5. CONCLUDING REMARKS

We discuss technology planning-based management for Basic R&D Programs (BR&DP) of government supported research institutes (GRI) to implement new government R&D policies. The major characteristics of our management framework include

- strategic use of BR&DPs for implementing new government policies,
- effective technology planning for demand-oriented performance management, and
- increased support and evaluation for the dissemination of R&D outcome (DR&DO)

In the past, BR&DPs were supposed to provide research resources of GRIs, and were selected mainly by the short-term need of individual GRIs. Now, BR&DPs need to be changed to meet new policies such as the DR&DO, collaborative research, and performance-oriented investment.

One of the changes required is technology planning derived from target markets and technology assets. The KOCI and GRIs have to develop their technology classifications based on their mission and vision statements, and to make the long-term plan for core technology groups (LPCT). The LPCT identifies every BR&DPs, and justifies their strategic importance and use for the effective DR&DO. The LPCT defines the program network diagram (PND), and estimates the value of core technologies. Then they are used for assigning the technology value to each BR&DP. The actual results of post-program activities should be considered during the selection of succeeding programs. Hence, each BR&DP is managed not as isolated one but as one of a program group.

It is impractical that we ignore the contribution of BR&DPs to the research infrastructure of GRIs. We need to carefully examine how many BR&DPs shall be selected by the KOCI. An issue closely related with this is whether on-going BR&DPs are changed to be managed by our new framework. There might be some confusion, because on-going programs do not have the corresponding LPCT, PND, and so on. If the new system applies only new BR&DPs, however, its effectiveness can be delayed for some GRIs of which the finish periods of BR&DPs are clustered in certain year(s). An alternative is that new processes are applied to all BR&DPs, but GRIs are still allowed to control a certain portion. It can minimize confusion as well as a surge in administrative work. Finally, further research is required to evaluate the effect of our framework after it is fully implemented.

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REFERENCES

Choi, J. C. (2005), A Study on Designing and Implementing the R&D Performance Evaluation System for GRIs Institutional Program as an Engine of Improving R&D Productivity, Policy Study 2004-18, Science & Technology Policy Institute, *www.stepi.re.kr.*

EIRMA (1997), Technology Roadmapping: Delivering Business Vision, Working Group Report No.52, European Industrial Research Association, *www.eirma.asso.fr.*

Kim, W. J. and Yang, T. Y. (2005), A Study on the Selection Criteria of Basic R&D Programs, research report, The Entrepreneurship Center, KAIST.

KOCI (2005a), The 2004 Institute Evaluation Report, unpublished report, KOCI, *www.koci.re.kr.*

KOCI (2005b), Plan for Pilot Programs of Special R&D of Government Supported Research Institutes, internal document.

Kostoff, R. and Schaller, R. (2001), Science and Technology Roadmaps, *IEEE Transactions on Engineering Management*, **48**, 132-143.

Lee, M. H. (2001), An Analysis of Performance Evalua-

tion Indexes of Government Supported Research Institutes, research report, Science & Technology Policy Institute, *www.stepi.re.kr*.

MOST (2005a), Action Plan for the Effective R&D of Government Supported Research Institutes, internal report, *www.most.go.kr*.

MOST (2005b), The 2005 Work Plan, internal document, *www.most.go.kr*.

Neely, J. E. and de Neufville, R. (2001), Hybrid Real Options Valuation of Risky Product Development Projects, *International Journal of Technology Policy and Management*, **1**(1), 29-46.

Phaal, R., Farrukh, C. J. P., Mills, J. F., and Probert, D. R. (2003), Customizing the Technology Roadmapping Approach, *Proceedings of the Portland International Conference on Management of Engineering and Technology*, Portland, 361-369.

Rubenstein, A. H. (2003), Payoffs from Government-Sponsored R&D in the U.S. and Japan, *Proceedings of the Portland International Conference on Management of Engineering and Technology*, Portland, 133-139.

Yoon, M. (2004), Strategic Planning Methodology for National R&D Projects of Engineering Technology: Integrated Procedure of TRM and KM, Policy Study 2004-10, Science & Technology Policy Institute, *www.stepi.re.kr*.