Assessment of Innovation Policy Coordination Through Korean Office of Science, Technology and Innovation (OSTI)

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Abstract

The need for designing and implementing integrated policy was further emphasized in tandem with the increase in interest concerning policy coordination and interactions. An active discussion is taking place in the field of innovation policy concerning "integrated innovation policy," which considers innovation along with financial, regional development, social, and environmental policies together in a holistic manner. In Korea since the beginning of the 2000s, there were many attempts at implementing integrated innovation policy through the restructuring of the overall S&T administration system. For the purposes of taking an integrated approach to S&T policies as well as to S&T-related human resources, industrial, and regional development policies, the Roh Administration (February 2003~February 2008) elevated the S&T Minister to the level of Deputy Prime Minister as well as launching the Office of Science, Technology, and Innovation (OSTI) (October 2004 ~ February 2008) under the Ministry of Science and Technology. This study investigates the policy coordination activities of the OSTI from the perspective of policy integration. It deals with the background of the OSTI, its roles and responsibilities, the coordination process, and its achievements and limitations while discussing the important implications for developing effective policy measures with the hope of contributing to the development of theories of integrated innovation policy.

Keywords
integrated innovation policy, Office of Science, Technology and Innovation (OSTI), policy integration, Korean innovation policy

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1. INTRODUCTION

"Integrated Innovation Policy" is now an important topic in the field of policy theory, with active discussions taking place concerning the integrated approach of linking innovation policy to other policies previously considered as separate areas of consideration. This integrated approach, also referred to as "holistic innovation policy" or "third-generation innovation policy" has grown to become a genuine innovation policy trend (Arnold & Boekholt, Boekholt, 2004; Boekholt, Arnold, Deiaco, McKkibin, Simmonds, & Stroyan, 2002; 2003; EC, 2002; 2004; Edler & Kulmann, 2003; Kivimaa & Mickwitz, 2006; OECD, 2005; Pelkonen, 2006).

The Korean government also had organizational attempts at implementing integrated innovation policy. Notably, the Roh Administration (in office February 2003~February 2008) established the Office of Science, Technology and Innovation (OSTI) (October 2004~February 2008) and undertook various coordination activities in order to take an integrated approach to S&T policy and other S&T-related industrial, human resources, and regional policies.

Using case studies, this study investigates the policy coordination activities of the OSTI in their efforts to pursue an integrated innovation policy. We review previous discussions on the background of the OSTI, its roles and responsibilities, the coordination process therein, and its achievements and limitations towards developing theories of integrated innovation policy and providing important implications for developing effective policy measures in the future.

Cases are analyzed from the perspective of policy integration. Policy integration pursues policy coordination from the early stages by establishing a common vision rather than seeking policy coordination through negotiations and compromise between different policy areas. In order for integrated innovation policy to be well implemented, the vision for policy agenda should be properly shared among all actors and individual policies should be aligned with each other for coherence.

This study is structured as follows. Chapter 2 reviews discussions on integrated innovation policy and policy integration. Chapter 3 presents the criteria for analyzing the activities of the OSTI from the perspective of policy integration. Chapter 4 discusses the background, functions, and activities of the OSTI, while Chapter 5 deals with characteristics of policy coordination by the OSTI and its limitations through case studies.

2. INTEGRAED INNOVAION POLICY AND POLICY INTEGRATION

2.1. Emergence of Integrated Innovation Policy

The third-generation in innovation policy is emerging wherein not only the supply of innovation but also socioeconomic demands are considered in the policy-making process. While past innova-

tion policy set economic growth as a key objective, the newly emerging third-generation innovation policy includes not only economic growth but also socioeconomic development considerations such as the improvement of life quality and sustainability. Additionally, the reach of innovation policy has now expanded to encompass all areas of socioeconomic policies while in the past it was confined to S&T and industry-related areas. As a result the coordination and integration of innovation and other relevant policies have emerged as a key issue in this third-generation of innovation policy, and consequently this generation is often referred to as holistic innovation policy (Arnold & Boekholt, 2003; Boekholt, 2004; Boekholt et al., 2002; EC, 2002; 2004; Edler & Kulmann, 2003; OECD, 2005).

TABLE 1. Evolution of Innovation Policy and Key Policy Areas

	1st-generation innovation policy	2nd-generation innovation policy	3rd-generation innovation policy
Perspective looking at innovation	Linear perspective	System-wise perspective	System-wise perspective
Policy objectives	Economic growth	Economic growth	Economic growth, life quality, and sustainable development
Scope of innovation policy	Policy of a single discipline	Interdisciplinary policy	Interdisciplinary policy
Key areas of interest	Policy for science	· Policy for innovation · Innovation-friendly employment policy and financial policy	· Innovation for policy problem · Integration of environmental policy and innovation policy
Key stakeholders participating in innovation policy	S&T community	S&T community and business community	S&T community, business community, and civil society

Source: OECD (2005), partially modified from the study by Seong & Song (2007)

Integrated innovation policy focuses on system-wide characteristics. Key variables affecting innovation activities include not only network relations between innovation players but also the interaction between educational, labor, financial, and legal systems. As a result, the areas of innovation policy surpass science, education, and technology development to cover industrial, environmental, labor, and social policies, making the linkage and integration between innovation policy and labor, industrial, and welfare policies a key agenda.

In this context, changes have taken place in the governance of innovation. Key players engaged in innovation activities go beyond scientists and engineers and enterprises to include other actors and stakeholders, raising the need for changes in the traditional decision-making structure in technology innovation. In adopting the perspective of the third-generation innovation policy, innovation players from non-S&T fields now join in the decision-making process that used to be led by innovation players of the S&T field (Arnold & Boekholt, 2003; Boekholt, 2004; Boekholt et al, 2002; OECD, 2005).

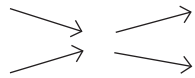
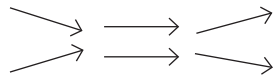
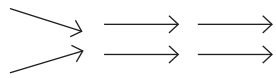
2.2. Definition and Characteristics of Policy Integration

A theory on policy integration is needed in order to approach policies that span across various fields

from a holistic point of view. Policy integration refers to the effort of aligning individual policies with the overarching objectives by harmonizing policies or developing complimentary policies that still maintain the autonomy and independence of the sub-policies that happen to be the components of a system. This means sharing the development direction of the policy system and leading individual component policies toward that direction (Anja & Ewald; 2007Kivimaa & Mickwitz, 2006; Meijers & Stead, 2004; Stead, 2007).

Interactions between different policies have long been discussed from the perspectives of policy cooperation and policy coordination. These perspectives refer to activities that attempt to resolve policy conflict or overlap through negotiation or compromise if there are any. As a result, policy cooperation or policy coordination tends to be a one-time event with no guarantee that the relevant policies are developed in the same direction or would be compatible in the future.

TABLE 2. Policy Integration and the Gap Between Policy Coordination and Cooperation

	Degree of policy interactions	**Alignment of policies**
Policy cooperation	· Information sharing and communication between different sectors	
Policy coordination	· Policy cooperation between different sectors is accompanied by efforts to overcome policy conflicts. · Policies of each sector do not need to have common goals	
Policy integration	· Efforts are made to avoid policy conflicts. · Efforts are made to create synergies through interactions between different policy areas. · Common policy goals and visions are used for forming policies.	

Source: Modification of Meijers & Stead (2004)

Policy integration refers to the coordination of otherwise different policies that follow different directions through presenting joint goals and a joint knowledge base that is acceptable to different ministries and other governing institutions (Meijers & Stead, 2004; Stead, 2007). Consequently, policy integration tends to define a common policy direction prior to agenda setting or policy planning. Policy integration also means policy coordination through a network structure between different policies or organizations while maintaining the individuality of different policies. It is also a sustained process of achieving integration, not a one-time event.

Since within the policy integration paradigm various players are involved in the policy planning and execution process, innovative ideas are developed into cost-effective policies that are enhanced by strengthening policy alignment and avoiding policy overlap (the National Audit Office, 2001). However, for effective policy integration, a consensus should be reached among participating stakeholders on principles for measuring policy performance, allocating resources, operating joint programs, deciding leadership, and coordinating budget planning between different ministries.

However, policy integration can neither be universally applied to nor be effective in all areas. Integration processes call for immense effort and resources, and there are many areas that do not re-

quire the policy integration approach. Policy integration itself cannot be an objective. The objective of policy integration is to improve policy impact. Policy integration is merely a means to resolve the so-called "wicked problems" that cannot be solved with the existing silo approach taken by individual ministries.

3. KEY ISSUES IN POLICY INTEGRATION AND PERSPECIVE OF ANALYSIS

The following is a review of the key ways of examining the policy coordination activities of the OSTI from the policy integration perspective. Policy integration can be discussed through different aspects such as agenda setting, policy planning, policy evaluation, and policy learning.

3.1. Levels and Types of Policy Integration

The levels at which policy integration is made are varied. In general, policy integration can be categorized into either cross-ministerial and ministerial. Cross-ministerial policy integration means more than two different ministries set a shared vision and objective and pursue complementary policy direction and content, whereas ministerial policy integration refers to a process of integrating policy directions and content through existing ministries accepting new values. The latter could also mean a process of integrating policies of different areas within the same ministry.

Cross-ministerial policy integration can further be divided into i) integration of policies pursuing different policy goals (e.g. integration of innovation policy and environmental policy, integration of transportation policy and environmental policy) and ii) integration of certain policies being pursued by multiple ministries (e.g. R&D policy).

In summary, policy integration can be categorized into i) the integration of policies for different areas at the ministry level, ii) cross-ministerial integration of policies for a certain area, and iii) cross-ministerial integration of policies for different areas (e.g. regional development policy and innovation policy, green growth policy).

3. 2. Catalysts for Policy Integration

There have been various discussions on the organization and means of facilitating policy integration. It is a key topic for the British government (the National Audit Office, 2001) and the OECD is also discussing policy means that have been generated from the experiences of member economies (OECD, 2005). Discussion by Stead (2007) and Schwedler (2007) is the most comprehensive to this date. The following are the elements that promote integrated policy decision.

3.2.1. Setting the Agenda and Shared Vision

According to Stead (2007), for effective policy integration, the most important thing is to set an agenda that is meaningful to each ministry. Though policy integration is important in resolving difficult issues, relevant ministries need to be persuaded to think that way else they would not actively

participate in the coordination activities.

Once a common agenda is set, the next important step is to set a vision that can be shared by different sectors and different interest groups. Under the theory of policy integration, vision is not presented through a top-down approach based on bureaucratic authority but is formed through discussions and joint deliberations by stakeholders. This takes the form of coordination activities that take place prior to policy integration.

3.2.2. Coordinating Organization

In facilitating policy integration, organizational aspects also play an important role. Cross-ministerial committees or working groups, where people from different ministries participate, can help overcome the differences in their perspectives or languages and deepen mutual understanding. Moreover, the role of a central body that manages policy integration is also crucial. If the National Science and Technology Council (NSTC) is a cross-ministerial consultation body that different ministries participate in, the OSTI is a central body supporting coordination activity between different ministries.

3.2.3. Institutions Facilitating Policy Integration

A budget system that sets separate budget accounts for integrated policies or projects would help strengthen accountability of different ministries and facilitate the development and implementation of integrated policies. At the same time, activities to set integrated indices reflecting multiple policy objectives (for example environmental goals and innovation) and to evaluate policies can promote policy integration (environmental policy and innovation policy). Improving accountability through the participation of NGOs or civil groups can also strengthen policy integration since these groups tend to perceive policies from a broader perspective than experts who often present their opinions focused on certain areas.

3.2.4. Common Knowledge Base

Sharing a knowledge base between civil servants or interest groups in different sectors is also important in facilitating policy integration. Activities required for policy integration include i) presenting example cases of policy integration and sharing experiences, ii) operating workshops and training programs on policy integration to teach the processes and methods of policy integration and to share expertise in each different field, and iii) enhancing the understanding of activities and expertise in different sectors through manpower exchange. At the same time, providing objective information on the current status of relevant projects is also an important means to promote policy integration.

3. 3. Perspective of Analysis

The characteristics of policy coordination activities by the OSTI are now reviewed based on the aforementioned discussions on policy integration. Here, the OSTI is considered as a secretariat supporting consultation bodies such as the NSTC or the S&T Ministerial Meeting that coordinates science, technology, and innovation policies. The OSTI is a mediator that supports and monitors players of innovation with different orientations. However, the OSTI is not simply a supporting

organization. It plays an active role in discovering agenda, leading vision-setting, and presenting options for policy coordination. The following addresses the role of the OSTI in facilitating policy integration as a central body of policy coordination and its characteristics.

For this purpose, the OSTI's activities in supporting policy coordination are reviewed in two aspects.

The first involves the selecting of agenda for policy coordination, in other words the reviewing of agenda selected for policy coordination as well as the roles of the OSTI in the process of agenda setting. Whether the OSTI has presented a shared vision for those selected agenda by compromising different interests of different ministries and, if so, how the OSTI did this will be examined.

The second aspect reviewed is how organizations and systems were introduced for effective policy integration. It is examined as to whether a committee was established for effective polity integration, whether new budget accounts were set for integrated policy, and whether indices like environmental impact evaluation or health impact analyses that reflect integrated policy objectives were introduced. Whether and how knowledge and information required for building mutual understanding and trust between different players of policy coordination were formed, acquired, diffused, and utilized will also be examined.

4. ORGANIZAIONAL STRUCURE AND FUNCTIONS OF THE OSTI

4.1. Background of the Establishment of the OSTI

The OSTI was launched as part of administrative reform of the Roh administration, which was the first administration in the postwar history of the Korean government to present science, technology, and innovation policy as a key national agenda and take action towards strengthening STI policy, under the slogan of "a science and technology-oriented society." Though the importance of science and technology was repeatedly emphasized before the advent of the Roh administration, it was the first occasion since the establishment of the postwar Korean government that S&T-related policy was emphasized as a central national agenda. This promotion of S&T policy coupled with economic policy led to the conception of an "innovation-led economy," heralding innovation's emergence to the center of economic policy.

Along with this, the scope of innovation policy was expanded from science and technology to a wider spectrum of policies required for resolving social issues. Innovation activities are no longer confined to strengthening the competitiveness of science and technology and private companies, but are connected to efforts to improve quality of life and balance regional development.

As result of these efforts, a foundation was laid for STI policies, long considered as a minor facet in economic policy, to emerge as the core of economic policy. For this purpose, the Minister of

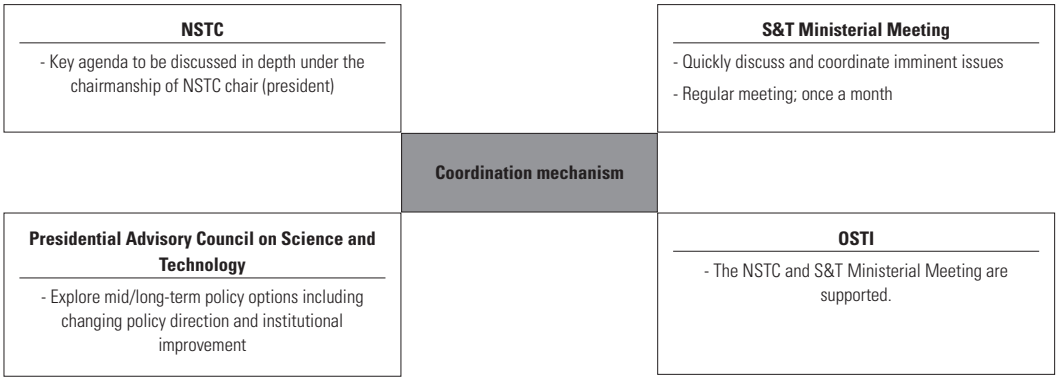
Science and Technology was elevated to the position of Deputy Prime Minister and the OSTI was launched under the Ministry of Science and Technology to plan, coordinate, and evaluate S&T-related policies and budget.

4. 2. Structure and Functions of the OSTI

Established in October 2004, the OSTI carried out pan-ministerial coordination of policies by supporting the National Science and Technology Council (NSTC) and the S&T Ministerial Meeting, until being closed down in February 2008 as a result of government restructuring.

Chaired by the president, the NSTC is the highest ranked decision-making organization in S&T policy. The NSTC is in charge of evaluating R&D projects of individual ministries, making preliminary coordination activities, and deliberating on key policies. The S&T-related Ministerial Meeting meanwhile is held regularly and chaired by the S&T Deputy Prime Minister, coordinating relevant issues facing different ministries.

FIGURE 1. STI Policy Coordination Mechanism of the Roh Administration



Source: Partial modification of data from the Ministry of Science and Technology (2008:59)

Policies coordinated by the OSTI included S&T policy, S&T-related industrial and HR policies, and regional innovation policy as deliberated by the NSTC. In addition, current issues in science and technology with significant social implications were also the subject of coordination and adjustment.

The Ministry of Science and Technology introduced a dual deputy minister system by launching the position of the OSTI head and creating a new organizational framework differing from the existing one. In addition, the OSTI's staff were recruited from the Ministry of Science and Technology, other ministries, and the private sector following a ratio of 4:4:2. It also attempted to account for specialization by using private sector experts. The total head count of personnel numbered 106.

The key responsibilities of the OSTI were two-fold. First, the OSTI allocated roles between ministries for conducting cross-ministerial R&D projects and building large-scale research facilities,

equipment, and infrastructure. For R&D projects that involved multiple ministries such as for new drug development, climate change conventions, and disaster prevention, the OSTI not only defined roles between ministries but also built a pan-ministerial implementation mechanism. For example, with nano infrastructure-related projects and R&D projects led by the Ministry of Agriculture and Forestry and the Rural Development Administration, it was the OSTI that adjusted the R&D budget.

Second, the OSTI conducted activities that improved investment efficiency by aligning the evaluation results of R&D projects with budget allocation and adjustment. The OSTI increased the R&D budget for high-performing projects while decreasing the budget for projects with poor performance by taking into account the results of R&D project evaluation by the NSTC.

TABLE 3. Changes in R&D Budget Allocation with the Launching of the OSTI

Classification of changes	Before launching the OSTI	After launching the OSTI
Adjustment of R&D budget	Feedback presented to the Budget Office after evaluation and adjustment of R&D projects	Results of R&D project evaluation and budget adjustment/allocation factored into budgeting.
Setting limits in R&D spending	The Budget Office sets total amount of budget while the NSTC presents its opinion on the spending limit by ministry	The NSTC and the Budget Office jointly set the total amount and the NSTC notifies individual ministries and the Budget Office of the spending limit by ministry after it sets the limit
Focus of investment direction	The NSTC defines the direction and presents it to the Budget Office	The NSTC decides the direction and factors it into the budget proposal by ministry
Organizational structure of R&D budget deliberation	Temporary committee led by the private sector	Standing evaluation system utilizing evaluators of the OSTI and private sector experts
Aligning performance evaluation with budget	Performance evaluation results are poorly reflected in the budget	Budget allocation/adjustment based on performance evaluation results

Source: OSTI (2005. 2),「Operational Direction of New S &T Administrative System」

5. CHARACTERISTICS OF POLICY COORDINAION OF THE OSTI: CASE ANALYSIS

This section reviews cases of policy coordination conducted by the OSTI from the policy integration perspective. Featured cases are "Measures to Improve Efficiency of Investment in Nano-infrastructure (Agenda for the 13th S&T Ministerial Meeting, February 16, 2006)" and "Redefining Roles in Disaster Prevention Research by Ministry (Agenda for the 14th S&T Ministerial Meeting, March 23, 2006)." Policy coordination for nano-infrastructure was judged as successful within the OSTI. Policy coordination for disaster prevention R&D was also considered as meaningful work in defining R&D roles between ministries.

5. 1. Cases

5.1.1. Measures to Improve Efficiency of Investment in Nano-infrastructure

When measures to improve efficiency of investment in nano-infrastructure began to be discussed,

there were nineteen key facilities including five large-scale infrastructure facilities under relevant ministries that included the Ministry of Science and Technology and the Ministry of Commerce, Industry and Energy. However, as individual ministries pursued infrastructure projects without much coordination, functional differentiation between facilities was lacking and utilization was low due to overcapacity in some facilities. This was because the mechanism of direction-setting and coordination was not properly functioning from a mid/long-term perspective. Such unintended results occurred despite a "Nano-Technology Master Plan" having been developed in 2001 and R&D projects carried out accordingly. Because of this, surveillance institutions outside of the S&T community began raising issues related to nano-infrastructure.

Since the relevant ministries were limited to only the Ministry of Science and Technology and the Ministry of Commerce, Industry and Energy, a special committee for coordination was not formed. However, during the process of agenda adjustment by the OSTI, the opinions of relevant ministries and external expert groups were taken into account. After the analysis of activities and issues with each facility, discussions took place on differentiation measures for each facility, the establishment of a new nano-technology coordination committee, and the introduction of a new evaluation system.

The "Nano-Technology Coordination Committee" was launched under the OSTI as an organization in charge of the comprehensive management of nano-infrastructure at the pan-ministerial level. A total of fourteen experts (government officials from the relevant ministries attending as standing members) from industry, universities, and research institutions were appointed and assigned to different working-level sub-committees of R&D, HR Development and System, Infrastructure-building, and Industrialization depending on their area of expertise. In addition, a specialized information agency was established to provide information on research and industries home and abroad. This agency analyzed newly emerging nano-policy and nano-technology trends, presented improvement ideas, and reported on public and expert opinions to the NSTC.

The OSTI also readjusted overlapping areas, defined specialties by facility, promoted linkage between facilities, and allocated functions by facility. At the same time in order to improve the efficiency of these facilities, measures to improve capacity utilization as well as service quality were also presented. They also presented measures to introduce a new evaluation system and aligned them with budget allocation and adjustment.

5.1.2. Measures to Redefine the Roles of Disaster Prevention R&D

An agenda for "redefining roles in preventive research by ministry" emerged as a result of the establishment of the National Emergency Management Agency (NEMA) (June 2004). With the inception of an organization in charge of coordinating all preventive functions of the nation, the different roles in disaster prevention research needed to be newly defined. Before the NEMA was restructured, R&D activities were conducted in a sporadic manner by relevant individual organizations, which resulted in overlapping R&D activity and a non-systematic approach to the issue of disaster prevention.

Regarding this issue, the OSTI set the division of roles in disaster prevention R&D as an agenda

for policy coordination by holding working-level meetings that relevant ministries would participate in. For effective implementation of coordination activities, a special committee on disaster prevention was formed and operated with twelve experts in the field of disaster prevention research recommended by R&D players in the Ministry of Commerce, Industry and Energy, the Ministry of Construction and Transportation, and the NEMA. This special committee developed an adjustment plan for defining roles in disaster prevention R&D by ministry. Support provided by government-funded research institutes in disaster prevention included the analysis of relevant laws and projects of seven relevant ministries and the development of an adjustment plan (September~December, 2005).

Working-level officials from relevant ministries reviewed and discussed the adjustment plan developed by the special committee (November 2005) and received final feedback from individual ministries (December 2005). The finalized plan through this feedback process was sent to the S&T-related Ministerial Meeting and was deliberated and approved, the results notified to relevant ministries and reflected in the budget deliberation form for the next year. The content of this final plan included i) background and necessity of redefining roles, ii) analysis of the current status of disaster prevention R&D, iii) rationale, criteria, and direction of adjusting roles in disaster prevention research by ministry, and iv) expected impact and future plan.

The adjustment of roles in disaster prevention R&D further developed into the establishing the "Master Plan for Developing Disaster and Safety Management Technology" (2008~2012). This master plan was deliberated and approved by the NSTC, and the cross-ministerial coordination and adjustment system was further elaborated as well as technology development strategy and investment plans presented.

5. 2. Characteristics of the Policy Coordination Process

5.2.1. Setting Agenda and Vision

Agenda Limited to Coordination in R&D

The OSTI's coordination-related agenda almost exclusively dealt with pan-ministerial coordination in R&D. For example, it was limited to issues within the R&D process such as the coordination of overlapping nano R&D infrastructure and role-splitting in disaster prevention research. However, considerations for coordinating technology demand as well as supply such as aligning R&D activities with disaster prevention projects or linking nano R&D activities to industrialization were excluded from policy coordination. This was because innovation policy in Korea was focused on the suppliers, and consequently did not form close linkage with problem-solving activities on the demand side. The R&D side operated in accordance with the logic processes of R&D while the demand side was driven by business logic, and policy coordination activities tended to focus on R&D side. Integrated coordination between R&D and business requires significant amounts of knowledge, operational know-how, and policy measures. However, securing such capability was difficult for the OSTI as the institution was in its early stages. Even coordination between the ministries involved in R&D was difficult, as when coordination between sectors was pursued, it was hard going

to define the scope of policies and budget to be harmonized.

In order to commercialize the outcome of national R&D projects and utilize it for resolving larger social issues, an intensive effort is required to coordinate R&D and business. Going beyond the framework of coordination within the R&D process, which tends to be the current focus of discussions, requires coordination between R&D and issues such as safety, environment, health, welfare, employment, and regional development. For effective implementation of this idea, priority should be to secure alignment and integration between R&D and project implementation within ministries (for example, as in the industrial technology development and energy-saving project led by the Ministry of Knowledge and Economy). In fact, most of the ministries have been pursuing their own R&D projects. Now more then ever it is necessary to take an integrated approach to cover both these projects and cross-ministerial projects.

Post-coordination Without Sharing Vision

Policy coordination processes at the OSTI were geared toward post-coordination, in other words to resolve issues after they surfaced, rather than pre-coordination, or implementing policies by sharing vision and defining roles between stakeholders. In the case of nano-infrastructure (before the OSTI was established) there was a master plan for nano-technology developed by the NSTC. However, nano-infrastructure building activities were not coordinated through this master plan but were pursued by individual ministries in a competitive manner. The coordination of R&D roles in disaster prevention was also focused on reallocating R&D activities performed by individual ministries rather than on developing and sharing a vision for a comprehensive disaster prevention system. This was because coordination activities were not performed through the process of generating an agenda for policy coordination based on pre-discussions and developing and sharing the vision with relevant ministries, but were simply pursued as a way of immediately resolving issues that arose in the policy implementation process.

Though activities to develop and share vision were not sufficient, there were coordination activities that gave a voice to the opinions of stakeholders and generated an agenda every ministry could agree to. In this process, with the participation of government officials and external experts, different positions of different ministries were successfully coordinated. In the case of nano-infrastructure, while coordination was mainly led by the OSTI, the opinions of external experts were carefully referenced. In the case of disaster prevention R&D, a coordinated agenda was generated through expert committee.

This post-coordination was often conducted in the form of re-allocation of resources after resources had already allocated. As result, two different groups, one that benefited and the other that was harmed, started to pursue political activities, making the policy coordination process more political. Under these circumstances, budget allocation and coordination rights often become strong measures for coordination. During its early stages, the OSTI had the right to allocate and adjust the R&D budget so it could conduct coordination activities by leveraging the budget. However, as time went by, the OSTI's right to allocate and adjust the R&D budget weakened, resulting in weak policy coordination activities.

5.2.2. System for Coordination

Professional Research and Investigation

The OSTI did research and investigation on information related to coordinating agenda in their process of coordinating policy. This research involved organizations including various government-funded research institutes in the concerned fields (the Korea Institute of Science and Technology Information, the Korea Research Institute of Standards and Science, the Korea Institute of Geosciences and Mineral Resources) and the Korea Institute of S&T Evaluation and Planning and government officials from the OSTI in the relevant technology fields who used to work in the private sector. The outcome of this research and investigation was used as basic data for coordination activities. This implies that intelligence activities on policy information were conducted to a certain degree.

These activities are all understood as infrastructure activities for pursuing policy coordination based on expertise and data. During the early stages, infrastructure building activities and policy coordination activities were conducted in parallel. It required some time in order for coordination activities to be more compelling based on knowledge, information, and expertise.

System to Enforce the Outcome of Coordination: Ad-hoc Committee, Planning and Project Evaluation

Various systems were introduced to help enforce the outcome of policy coordination. First, a coordination committee was launched to monitor the outcome of coordination on an ongoing basis and carry out coordination when issues arose (e.g. Nano-Technology Coordination Committee, Safety Technology Deliberation Committee). These ad-hoc committees monitored whether the outcome of coordination was regularly enforced and coordinated issues arising from the implementation process following the direction set by the OSTI during the coordination process.

In addition, the OSTI made sure that the outcome of coordination was reflected in the master plans of the relevant fields (e.g. the Master Plan for Disaster and Safety Management). Moreover, when the NSTC carried out research, investigation, and evaluation of national R&D projects, the OSTI tried to enforce the outcome of coordination by reflecting the implementation results of policy coordination in the evaluation indices.

Authority to Coordinate Budget Allocation

Even though coordination activities were carried out based on data and information from expertise and intelligence functions, coordination was not easy for individual ministries had their own laws with their unique objectives and independent budget items. Also, there were particular forces driving independent implementation of projects in each ministry. Because of this, and to help smooth coordination, the OSTI was given the authority of budget allocation and coordination.

During the early stage of the OSTI, as the president considered the deliberation process of the NSTC as high priority and endowed budget allocation and coordination authority to the OSTI, the OSTI was able to exert significant influence. Moreover, as the first director of the OSTI was appointed from the Budget Planning Office, decisions on budget allocation and coordination approved

by the NSTC were easily effectuated.

In fact, this mode of coordination was based on a centralized policy coordination approach pursued by the Economic Planning Board (EPB) during the past development-oriented period. The only difference was that the subject of policy coordination was S&T innovation policy instead of economic policy. The OSTI hoped to play the role of a control tower with comprehensive planning, coordination, and evaluation functions based on budget allocation authority following the EPB model.

However, the vertical coordination approach pursued by the EPB in the past was not effective for policies, such as innovation policy, that aimed to create new things. The uncertainties and complexity of policies have increased significantly compared to that of the past, and needs for innovations are not easy to quantify. Moreover, the OSTI was endowed with far more limited authority and functions compared to those of the EPB, so the OSTI lacked the capability to effectively deal with policy agenda that went beyond science and technology and generate genuinely integrated innovation policy. As result, the OSTI failed to draw buy-in from the key ministries of innovation policy including the Ministry of Commerce, Industry and Energy, the Ministry of Information and Communication, and the Planning and Budget Office.

After some time the Planning and Budget Office resumed the authority of coordinating the S&T-related budget that had been coordinated by the OSTI in the process of supporting the NSTC, and the OSTI's budget coordination authority became reduced. The coordination activities of the OSTI started to rapidly diminish.

Taking it a step further, the newly inaugurated administration launched a restructuring of the government's organization and in this process, over the authority of budget allocation and coordination, the Planning and Budget Office and other ministries petitioned to have authority over the OSTI. Though the budget allocation and coordination power was the source of the OSTI's authority, it was also a factor that made the environment surrounding the OSTI unfavorable to it. Because of this check, the new government closed down the OSTI and the policy coordination function of the NSTC was reduced.

6. CONCLUSION

Though the OSTI operated for a relatively short period of time, it still offers many important lessons. Despite its limitations, challenges, and criticism, the OSTI has significant implications for the development of Korean innovation policy.

First, the OSTI explicitly suggested an integrated perspective on innovation policy by declaring that innovation policy should go beyond S&T and reach out to other fields. In its everyday operation, although the OSTI's coordination activities were confined to the R&D sphere, the OSTI managed to

demonstrate some aspects of an integrated policy with other fields in its orientation. This suggests a new prospect on the development of future innovation policy.

While carrying out various coordination activities, the OSTI accumulated various knowledge and experience required for implementing policy coordination, training the OSTI staff in policy coordination in the process. In the Korean government administration system, where heated competition between ministries is commonplace, the experience of having pursued cross-ministerial cooperation and integration could be used as an important asset in the future. Policy integration is not a phenomenon confined to the field of innovation policy. Policy integration can be understood as a new trend emerging from the pursuit of a new administrative system and policy process as a result of the advent of new public management theory. In this context, the OSTI experience offers many important implications.

However, the OSTI failed to build the appropriate governance for integrated innovation policy. Due to its orientation towards the future and uncertainty as well as its interdisciplinary nature, improving the effectiveness of innovation policy involves the participation and discussion of many different stakeholders as well as a thorough review of various options. In the case of Korea moreover, the country now has to pursue post-catch-up innovation that goes beyond the previous developmental era's catch-up innovation, and policies promoting the exploration and experimenting of new directions are more important than the effective achievement of defined targets.

The governance adopted by the OSTI in contrast was closer to the top-down approach often adopted in catch-up innovation. The OSTI seems to have copied the EPB model that was once effective during the development period and makes them seem wanting to play the role of a control tower leading policy coordination instead of making their organization operate through knowledge, capabilities, and a neutral position that can draw effective policy coordination and consensus. This is in line with the tendency for newly incepted organizations struggling to obtain a strong power base in order to survive. In the meantime it served as a hindrance as it made other ministries challenge the authority of the OSTI. No ministry welcomed the idea of submitting to the OSTI in its coordination activities based on budget authority when its agenda-setting capability or political influence was weak. This is why there were attempts to nullify the OSTI.

Korea seems to face a situation where new policy elements are conflicting and competing with the legacy of the past. At the same time, Korea recognizes the need for change and thus tries to achieve a paradigm shift for building a new vision for change. As the catch-up strategy based largely on imitation begins to reveal its limitations and weaknesses, a sense of crisis that the old way of doing things did not work anymore was generated, thus stimulating a search for new development path.
In order for the newly initiated innovation policy to be effective, the relevant institutional framework should be properly re-established and be able to be continuously improved. A successful design and implementation of new innovation policy demands not only changes in the "hardware" elements of the system, but also includes the shaping of a new cultural and institutional environment that supports innovation in a sustainable way. This will in turn encompass changes in both the way of doing things and organizational culture, which is not easy to achieve (Seong & Song, 2007).

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