

Title

What type of knowledge intermediary system will take the highest priority in the Korean science and technology policymaking process?

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Abstract

The Korean government has gradually increased support for knowledge intermediary system (KIS), but criticisms are also growing because of inefficiency in allocating limited government resources. This study aims to provide a systematic assessment of KIS in South Korea by comparing six types of KIS. We utilize the 2010 data from National Science & Technology Information Service (NTIS) and the survey result of 491 researchers/policymakers who were participated for this study. The NTIS and survey data support that technology transfer organizations will have to be more prioritized in the S&T policy process. All types of KIS will need more enhanced functions to achieve their own policy missions. This paper can contribute to better understanding of the current status of KIS in Korea and shed a light on the role of the government in developing KIS.

Keywords

Knowledge intermediary system, infrastructure, science and technology policy, South Korea.

Note

This paper is an adapted and developed version of a STEPI report—Hong et al. (2012), A systematic assessment of the government-funded research and development projects: focusing on science and technology infrastructure projects in South Korea.

Introduction

In a knowledge based society, effective use and diffusion of useful knowledge is as important as its production. When knowledge is delivered to the right user and fully utilized, it can maximize values and lead to production of another new knowledge. During last decades, many innovation studies have emphasized the importance of knowledge intermediation system (KIS), which bridges key players (e.g. universities, research institutes, and industrial corporations) involved in an innovation process (Alexander and Martin, 2013; Ankrah, Burgess, and Shaw, 2013; Bessant and Rush, 1995; Bozeman, 2000; Howells, 2006; Klerkx and Leeuwis, 2009; Wright et al., 2008; Yusuf, 2008). The role of KIS has been studied in various settings, but no one doubts that effective KIS plays a significant role in facilitating positive interactions among heterogeneous innovators and thus promoting more valuable innovation.

The Korean government has gradually increased support for KIS since 1962 when the first national science and technology (S&T) plan was established. The construction of a major research complex at Daedeok would be a representative example of KIS in Korea. Although the Daedeok project was completed in late 1980s, the government has continued to invest large amount of funding for KIS projects. Since 1990s, intermediary organizations have greatly expanded and became diverse. For example, the number of school-based enterprises has increased from 2 in 1998 to 222 in 2010. According to 2010 data, there are 127 regional innovation centers and 193 innovation clusters in Korea. The numbers show that policymakers have considered KIS as a significant factor for innovation.

However, it is unclear that KIS is performing effectively in Korea. Scholars have pointed out the weakness of KIS in Korea. Kim et al. (2010) argue that “in Korea, intermediaries are still in the early stages of development... their role is still not clearly understood” (pp. 870-871). Park (2011) also mentions that the Korean technology intermediary system remains in the beginning stage. He explains that 74.1 % of technology transfer intermediaries have less than 10 employees, and more than half organizations were newly opened since 2005. Many intermediary organizations seem still poorly-conditioned to conduct their missions.

This study attempts to assess the current status of KIS in Korea by systematically comparing six types of KIS. In so doing, it will reveal what type of KIS has been prioritized and which one has performed most successfully. Then, this study will address what type of KIS should be more supported in order to accelerate S&T innovation in Korea. This study utilized a national data system to analyze the government funding for each type of KIS. It also used data from survey that was designed for finding problems and solutions relating to KIS in Korea.

Literature Review

With holistic/systematic perspectives over an innovation process, the connectivity issue of knowledge innovators has caught great attention for last decades. This growing interest has brought in a variety of terms to deal with intermediaries, including bridging institutions (Bessant and Rush, 1995; McEvily and Zaheer, 1999; Stankiewicz, 1995), brokers (Hargadon and Sutton, 1997; Provan and Human, 1999; Winch and Courtney, 2007), third parties (Mantel and Rosegger, 1987), technology transfer infrastructures (Hassink, 1996), university-industry linkages/relations (Ankrah et al, 2013; Yusuf, 2008), and boundary organizations (Guston, 1999).

The development of various concepts relating to intermediaries reflects interest of researchers in innovation studies, but also criticisms have pointed to existing studies, which appear theoretically too dispersed (Howells, 2006; Klerkx and Leeuwis, 2009). After the review of the concepts listed above, Howells (2006) argues that the literature of intermediaries is a “burgeoning, yet surprisingly disparate” (p. 715). Although the main idea of the literature is similar in emphasizing the knowledge connectivity issue, the variety of concepts has resulted in difficulties in synthesizing the range of research subjects and scopes. For example, some studies focus only on technology transfer offices (Bozeman, 2000; Colyvas et al., 2002) and others address intermediaries comprehensively by including range of organizations, such as “outside companies, company R&D labs, universities, university-industry consortia, public R&D institutions, government and industry support organizations, associations, groups, and technology brokers” (Kim et al., 2010).

To synthesize the fragmented literature, Howells (2006) reviewed intermediary organizations in the U.K. and provided a framework to cover the broad functions. He attempted to address even unrecognized or undervalued functions of intermediaries. For him, the intermediary role includes “foresight and diagnostics; scanning and information processing; knowledge processing and combination/recombination; gatekeeping and brokering; testing and validation; accreditation; validation and regulation; protecting the results; commercialization; and evaluation of outcomes (Howells, 2006, p. 720).” His case studies revealed that intermediary organizations have actually played more varied roles than has been expected. Howells (2006) started his research with a perception focusing on brokering role of intermediaries, but the research finding showed that the role of intermediaries are wider and difficult to make clear distinctions.

Yusuf (2008) categorizes intermediaries into four types. First, general intermediaries exist to produce and disseminate innovative knowledge. Like universities, this intermediary refers to a knowledge hub for multiple research networks to interact. Second, there are specialized

intermediaries, which is to transfer innovative products to commercial users. An example is technology licensing offices at universities or public research institutes. Many studies of intermediary are focused on this specialized one. Third, financial intermediaries are venture/angel capitalists. These intermediaries provide financial support with tacit knowledge, such as “managerial know-how, contacts, troubleshooting skills or risk assessment skills” (p. 1170). Finally, institutional intermediaries are public agencies that support knowledge transfer and interaction among academic and industry researchers.

Because of the diverged approaches, this study includes various types of KIS to assess its current status and problems. Except financial intermediaries, we covered a range of KIS, such as research associations, technology transfer offices, accreditation institutes, and global R&D collaboration organizations. This study also addresses KIS as intermediary organizations, not as processes, because we believe that specific organizations would be more observable than intermediary processes. Thus, one can more easily compare what types of KIS have performed more successfully and have been more prioritized in S&T policy processes.

Historical Background

Overall, the Korean government began to consider KIS as a part of national science and technology plans since 1960s, but the actual development of the system were closely related to the Daedeok Research Complex (DRC) project. It was planned in early 1970s, but completed in late 1980s. The DRC is currently being developed into Daedeok Special Research and Development Zone, which is expected to be a global innovation cluster by reinforcing R&D, technology industrialization, and investments. With the completion of the DRC project in 1980s, KIS became more diverse in order to meet various needs. Especially, in 1990s, new trends for democratization, globalization, and localization offered rationales for the development of KIS. KIS is widely recognized as a significant infrastructure for sustaining national competitiveness in S&T policy area, and thus the Korean government increased support for KIS. This section addresses the historical development of KIS in detail.

In 1962, the government established ‘The First Five-Year Plan for S&T Development’, which was a national initiative to advance S&T in Korea. This plan covered S&T issues comprehensively, including S&T legislation, S&T administrative structure, accreditation, institutional reform, supportive system for R&D activities, global collaboration, and S&T diffusion. The government also established Korean Institute of Science and Technology (KIST), in 1966, which is a leading public research institutes in Korea. At the same time, scientists and their groups organized an umbrella body called “the Korean Federation of Science and

Technology Societies (KOFST)” in 1966. The KOFST is one of the major scientists’ associations to support scientific and technological development. In 1960s, the government attempted to provide S&T infrastructure, but no specific and concrete plans focusing on KIS were made.

As demands for a research region construction were growing in early 1970s, KIS were mainly developed with the DRC project during 1970s and 1980s. The DRC project was to build a research cluster in a local region called Daedeok. In 1973, the project was first discussed at the Overall Science and Technology Review Council, which was the first national authority for S&T issues. After that, public and private research institutes started to move to the region. There were 3 government agencies, 15 government-funded research institutes, 4 investment companies, 8 private research centers, and 3 higher education institutes when the opening ceremony for the DRC was held in 1992. Although the DRC project was completed in 1992, the Daedeok area has continued to actively invite researchers and public/private research facilities. Daedeok still remains a representative research area in Korea.

In 1990s, democratization, localization, and globalization became dominant in Korea. The Korean regime transitioned from a military-driven to a democratic one in 1993. With this political change, more specialized policies to meet regional demands were developed. KIS was not limited to a massive construction project (e.g., the DRC) with development of university-industry collaboration at a local level. Also, during this decade, global R&D cooperative projects have increased and the demands for KIS became more diverse.

Since 2000s, national KIS projects radically increased. The number of Regional Innovation Centers was 127 in 2011, and the number of government-funded industrial complex zones increased from 7 in 2005 to 193 in 2011. Also, there have been varied projects for promoting technology transfer and commercialization. For example, New Technology Start-Up Incubation Project (2000), University-Industry Cooperation Office (2003), Technology Licensing Office (2006), and University Holdings (2004). Currently, the university-industry collaboration is a major policy issue in S&T area, but few systematic assessments were conducted to figure out how efficiently the government has invested the KIS projects.

Concepts and Methods

In this paper, KIS is defined as an organization which supports knowledge diffusion and bridges the gaps between two or more parties in an innovation process. To address KIS comprehensively, we categorized it into 6 types. Type 1 is organizations to connect industrial researchers. An example is Korean Industrial Technology Association (KITA), which was

established in 1979. KITA has supported the establishment and management of private R&D institutes. Type 2 is organizations to connect local innovators. The success of the Daedeok project triggered to launch new regional innovation projects. The current regional innovation centers (RIC) are the good example. The number of RIC increased to 127 in 2011. ‘Techno Park’ projects and ‘Industrial Innovation Cluster’ projects are also in this type. Type 3 is testing, accrediting, and standardizing organizations. There are Korea Testing Laboratory, Korea Laboratory Accreditation Scheme, and Korea Accreditation System. Type 4 is technology transfer organizations at public research institutes (PRIs) and universities. Technology Licensing Offices are an example. Type 5 is organizations to bridge universities and industry actors. The difference with Type 2 is that Type 2 utilizes local facilities and resources while Type 5 is usually affiliated to universities. Type 6 is organizations to facilitate global R&D collaboration. An example is ‘Global Tech’ project, which support global networks between Korean and foreign scientists.

<Ⅱ 1> Types and Examples of KISs

No.	Function	Example
Type 1	Connecting industrial researchers	Korean Industrial Technology Associations;
Type 2	Linking local innovators	Regional Innovation Center
Type 3	Testing, accrediting and standardizing	Korea Testing Laboratory
Type 4	Commercializing R&D products	Technology Licensing Office
Type 5	Bridging universities and industry actors	School-based enterprise
Type 6	Facilitating global R&D collaboration	Global Tech

In order to analyze six types of KIS, we primarily used two research methods. First, we utilized a national R&D data system called National Science & Technology Information Service (NTIS). We focused on 2010 NTIS data and government-funded projects. We found that a total of 39,254 R&D projects were funded by government agencies in 2010. To select the KIS projects, we filtered by the grand titles of projects and then utilized the specific titles of them. After that, we obtained 717 projects, which were directly related to KIS. With the information of the 717 projects, we did a primary analysis on six types of KIS.

Second, we conducted a survey for evaluating each type of KIS and finding solutions for better systems. A total of 491 researchers/policymakers participated in the survey. The respondents came from public research institutes (38.1%), universities (38.7%), private research institutes (14.7%), and government agencies (8.6%). It was an on-line survey, which lasted for 3

weeks in November 2012. We offered the respondents structured questionnaire, which consisted of four questions with multiple-points scales and one open-ended question.

Findings from the NTIS 2010 data

The NTIS data present that the Korean government offered the highest funding on Type 3 (organizations for testing, accrediting, and standardizing) in 2010. It was almost 37% of a total KIS funding amount (\$100 million) and 290 funded projects were Type 3 (40%). The second highest funding was given to Type 2 (organizations for linking local innovators) in 2010. 22% of a total KIS funding was allocated to Type 2 (\$ 59 million) and the number of Type 2 projects was 192 (27%). The type with lowest funding was Type 1 (organizations for connecting industrial researchers). The number of funded projects in Type 1 was 9 (only 1%) and the amount covers only 6% of the total KIS funding. This result indicates the fact that the government prioritized Type 3 and Type 2 over other types of KIS while Type 1 did not take much attention from the government.

Figure 1. The No. of Projects of Each KIS Type

Figure 2. Funding Amount of Each KIS Type

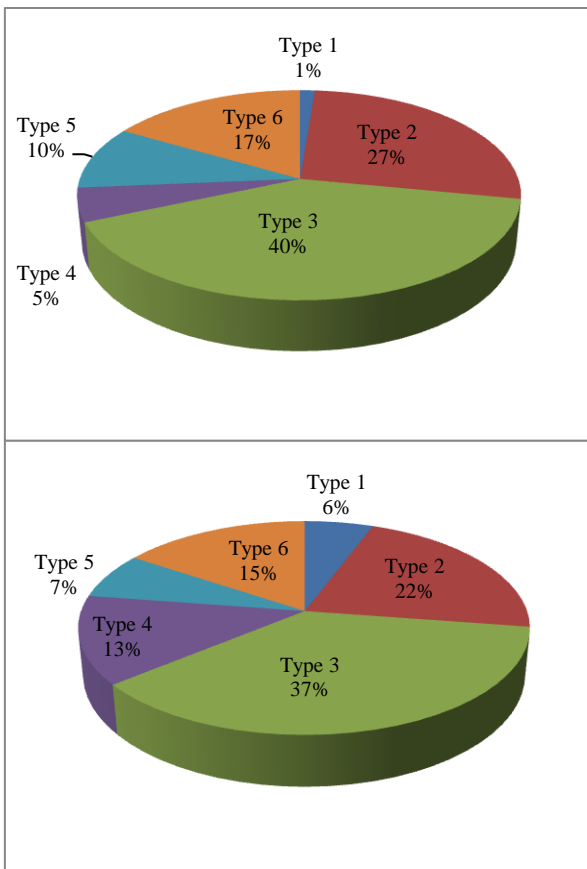


Table 1. Government Funding Status for Each Type of KIS

(Unit: million \$)

	No. of Funded Projects	Amount Funding	Average Amount per project
Type 1	9	15.48	1.72
Type 2	192	59.08	0.30
Type 3	290	100.03	0.34
Type 4	37	36.44	0.98
Type 5	70	19.10	0.27
Type 6	119	42.57	0.35
Total	717	272.73	0.38

In 2010, six governmental agencies offered funding for KIS, including MEST (Ministry of Education, Science and Technology); MLTM (Ministry of Land, Transport and Maritime Affairs); MIFAFF (Ministry for Food, Agriculture, Forestry and Fisheries); RDA (Rural Development Administration); KFDA (Korea Food & Drug Administration); and MKE (Ministry of Knowledge Economy). Among the six agencies, MKE was the biggest investor, which provided 63% of a total KIS funding amount. MKE invested all types of KIS except Type 1. The highest funding from MKE went to Type 2. This result is understandable because MKE is a department to represent industry interests. MEST offered the second highest funding (21%). MEST invested four types of KIS, including Type 1, 4, 5, and 6. These results are also predictable because MEST is the major department for S&T development with the KIS, even though the former focuses more on basic sciences than applied science or technology transfer issues.

Figure 3. No. of Projects Funded by Each Agency Figure 4. Funding Amount of Each Agency

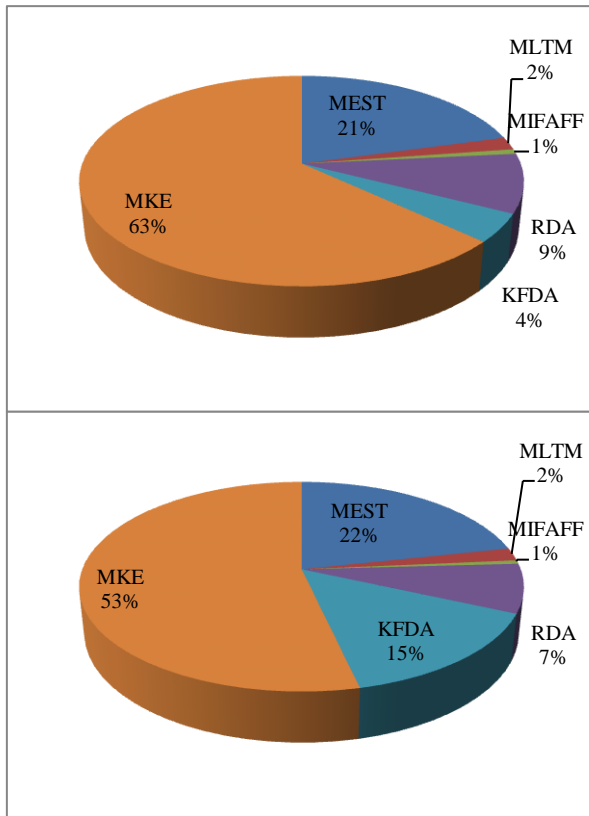


Table 2. Government Agency Funding Status for Each Type of KIS

(Unit: million \$)

	Total Amount (Total No. of Projects)	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6
MEST	56.59 (155)	15.49 (9)			0.87 (6)	19.11 (70)	21.13 (70)
MLTM	5.33 (14)		4.15 (9)				1.17 (5)
MIFAFF	2.04 (4)				2.04 (4)		
RDA	24.61(54)		9.47 (2)	6.70 (42)			8.43 (10)
KFDA	11.97 (106)			11.97 (106)			
MKE	172.20 (384)		45.46 (181)	81.36 (142)	33.53 (27)		11.85 (34)

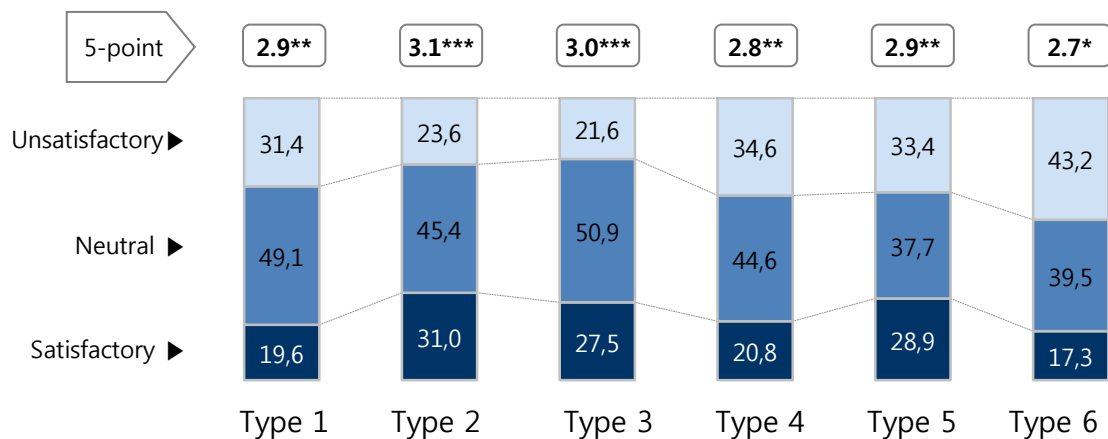
Findings from the survey

The survey respondents answered four questions, including how much they perceive the certain type of KIS achieve policy goals; how much they perceive the certain type of KIS take policy priority in future investment; whether they agree with the increase of KIS; and whether they agree with the function enhancement of each KIS type. Except the second question, all questions have 5-point scale.

For the first question, the survey showed that Type 2 organizations performed the best in terms of its policy goal achievement and Type 3 was the second best. When the lowest two points are combined to ‘unsatisfactory’ and the highest two scores are converged to ‘satisfactory’, only Type 2 and 3 organizations have more satisfactory responses than unsatisfactory ones. These results indicate that the government spending for Type 2 and 3 are considered effective in achieving their policy goals. On the other hand, Type 6 received the lowest grade in terms of the policy goal question. Although the government has recently emphasized the importance of global R&D collaboration, most respondents have negative opinions about the performance of Type 6 organizations. Interestingly, Type 4 also was poorly graded. This result shows that organizations for technology transfer (Type 4) are perceived unsuccessful to obtain its policy goal.

Figure 5. Perceived Degree of Policy Goal Achievement of Each KIS Type

(Unit - point and %)

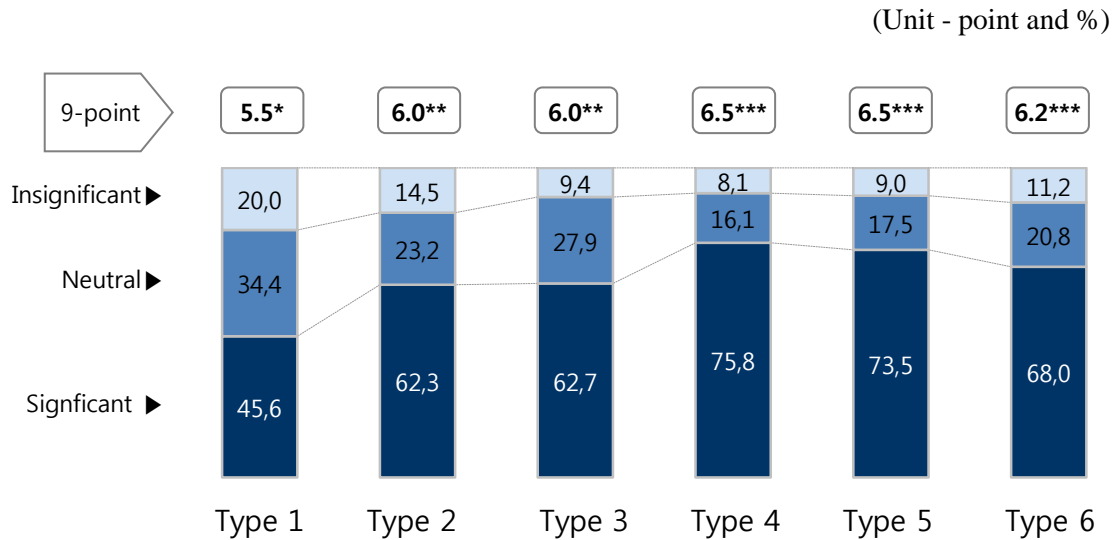


Note - *, **, and *** are significant at the .1, .05, and .01 levels, respectively.

The survey respondents also presented their opinions about how important each type of KIS is in allocating the government funding in the future. In a 9-point scale, the highest score indicates that the type is perceived the most important by the respondent, while the lowest score means the opposite. Overall, all types of KIS were perceived worthy to receive government funding. Especially, Type 4 and 5 organizations obtained the highest scores (6.5). If the responses are divided into insignificant, neutral, and significant, Type 4 and 5 have the highest percentages of ‘significant’ responses. Most respondents seem to believe that organizations for technology transfer and university-industry collaboration should be supported in the future. The type with the lowest score was Type 1. The associations for industrial researchers (Type 1) have

received more negative responses than the other types. Type 1 also has more positive responses than the negative ones, though. When the government has to allocate its financial resource, Type 1 may not be more prioritized than the other types of KIS.

Figure 6. Perceived Relative Importance of Each KIS Type for Future Investment

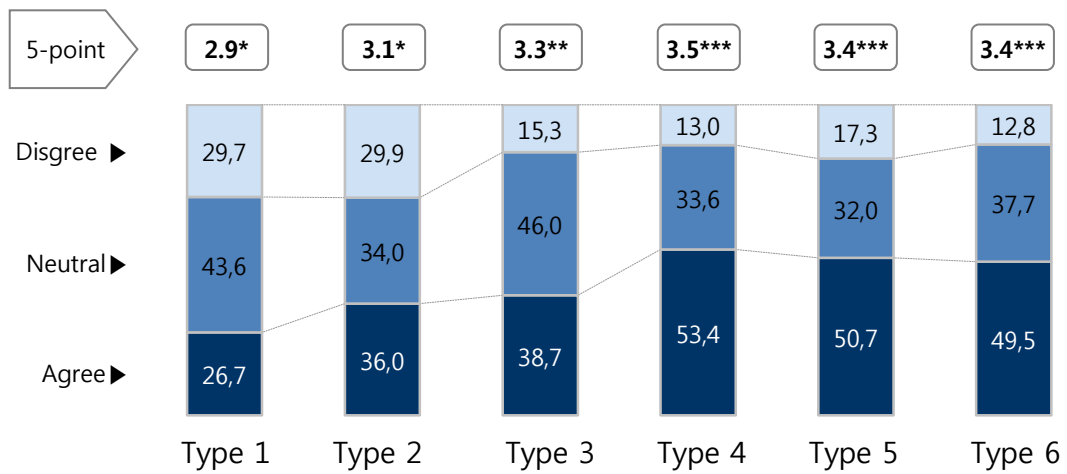


Note - *, **, and *** are significant at the .1, .05, and .01 levels, respectively.

In terms of policy options, most respondents answered that all types of KIS except Type 1 will have to increase the number of organizations/institutions. Type 4, especially, received the most positive responses to this option. This result also implies that Type 4 cannot be successful to achieve their policy goal because of the lack of absolute numbers. Although the number of Type 4 has radically increased, the respondents perceived that the increased Type 4 organizations are still insufficient. Type 5 and 6 also have absolutely large portion of positive responses than negative ones. The organizations for university-industry collaboration and global R&D networking would need to increase. Respondents were slightly more negative on the increase of Type 1 organizations than positive. This result seems to show that the associations/organizations for connecting industrial researchers would be large enough.

Figure 7. Opinions for Increase of Each Type of KIS

(Unit - point and %)

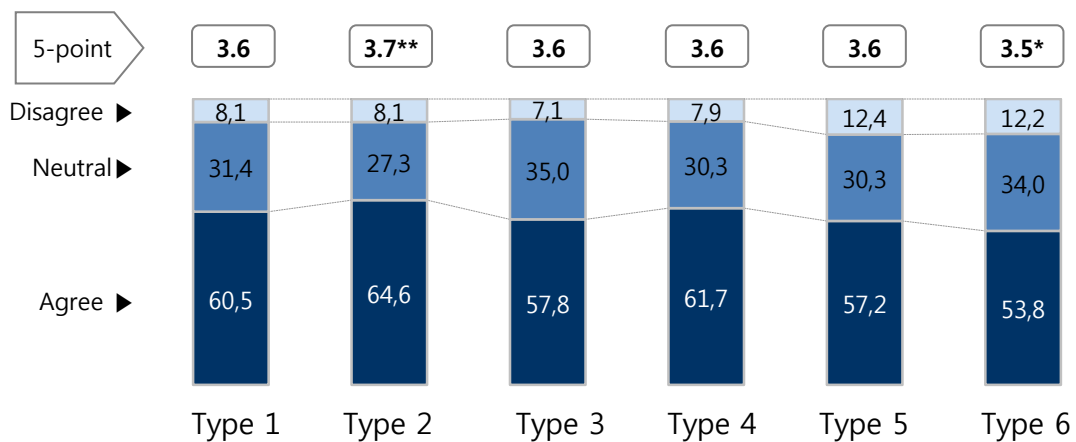


Note - *, **, and *** are significant at the .1, .05, and .01 levels, respectively.

In the second policy option was about whether to reinforce KIS functions. All types of KIS obtained positive answers for this option. Type 2 received the most positive responses for this issue. Although Type 2 obtained the highest score in the policy goal achievement question (the first survey question), the respondents still perceive that the functions of Type 2 organizations need to be stronger. Type 1 had negative responses in increasing the number of organizations, but it also had positive responses to this question.

Figure 8. Opinions for Function Reinforcement of Each KIS Type

(Unit - point and %)



Note - *, **, and *** are significant at the .1, .05, and .01 levels, respectively.

Discussion

The findings from the NTIS and the survey provide several implications. First, Type 4 would take highest priority in allocating the government funding. The 2010 NTIS data showed that the government funding for Type 4 was only 13% of a total funding amount and 5% of a total number of KIS projects. On the other hand, the survey respondents strongly expressed that Type 4 organizations have to obtain government funding in the future. Also, they answered that Type 4 organizations should be increased in terms of numbers and reinforced in their functions. This result indicates that technology transfer organizations would become more dominant in Korea.

KIS performs a variety of roles, but a major function would be technology transfer from academic to industrial areas so that the R&D products can have maximized financial values. Howells (2006) emphasizes technology transfer as “the first real interest in intermediaries in relation to innovation” (p. 716). The relatively lower investment for Type 4 in 2010 reflects the fact that the government did not consider the role of Type 4 organizations as the most significant, but at the same time, the survey results show that the role of Type 4 would be more expanded as the core type of KIS.

Second, Type 1 organizations remained relatively least significant in offering the government funding. The number of national projects for Type 1 in 2010 was only 9 (1%) and the funding amount was \$ 15 million (6%). This funding data show that Type 1 took the lowest attention from policymakers. The survey result also supports this idea. The questions of future investment for Type 1 have relatively high negative responses than other types. Also, the negative responses for increase of Type 1 organizations were more than the positive responses. The respondents seem to believe that Type 1 should not be prioritized in the funding allocations. If so, the policymakers would consider relocating the funding for Type 1 organizations into other types of institutes, such as technology transfer centers of Type 4.

Finally, the policy option of function reinforcement should be considered more seriously with further investigation because most survey respondents perceived it necessary regardless of the type of KIS. However, the question of ‘how to do that’ remains unresolved because the specific ways could vary. Colyvas et al.(2002) argues that technology transfer from universities occurs through informal networks between academics and industrial actors, not through formal institutions, such as technology transfer offices. Their in-depth study of six invention cases shows that the technology transfer offices do not significantly affect the collaboration between universities and other players. If it can be applied to this Korean context, the most significant policy options would be the support of informal networks rather than quantitative increase of

Type 4 organizations. To develop policy solutions for more effective KIS, more case studies would be required.

Conclusion

This paper addressed the current status, problems, and solutions of KIS in Korea. Overall, the survey respondents seem to believe that KIS should be more supported for achieving their policy goals, such as bridging major innovators (e.g. universities, industrial corporations, and research institutes) for promoting S&T innovation. More budget allocations, more organizations, and enhanced functions would be necessary. Type 4 could be more prioritized because the policy goal for technology transfer will become more significant.

This study can contribute to better understanding of the current status of KIS in Korea because few studies have dealt with KIS comprehensively and comparatively. Policymakers who allocate limited government resources would have more systematic view about what types of KIS should be prioritized. This study also can shed a light on the role of the government in developing KIS because the findings indicate that the increase of KIS organizations would not be the only option. Although this study did not fully discuss how to enhance the functions of KIS organizations, the government officials would need to consider more diverse ways to support KIS, not only through the increase of formal organizations.

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