

Technology Gap, Research Institutes, and the Contract Research System: The Role of Government-funded Research Institutes in Korea*

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Introduction

Nothing demonstrates the function of technology as the key element of economic growth better than the recent economic history of East Asia.¹ Korea has little in the way of natural resources, but its ability to effectively utilize its human resources for the indigenization, improvement, and commercialization of foreign technologies has been prominent. Generally, technological knowledge is transferred from industrial countries in diverse forms, such as licensing, importing of machines embodying advanced technology, inviting foreign expert engineers or consultants, foreign direct investment, and joint businesses. These transferred technologies usually required local adaptation through trial and error, collective testing, and pilot production until they could be mastered. Such an adaptation process is a duty of the recipient of technologies; however, it needs external assistance before it is able to exercise such competence. In the case of Korea, government-funded research institutes (정부출연연구기관), or GRIs, established in the 1960s and 1970s were endowed with such a mission.²

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¹ See Rudi Volti, *Technology Transfer and East Asian Economic Transformation* (The Society for the History of Technology & the American Historical Association, 2002).

² For the brief history of GRIs, see Yim Deok Soon & Kim Wang Dong, “The Evolutionary Responses of Korean Government Research Institutes in a Changing National Innovation System,” *Science, Technology & Society* 10-1 (2005), 31-55.

Though various different policies and approaches can be observed, a common factor is the processes of bridging technology gaps in East Asian countries is the significant role of the governments. Of course, the process established and carried out for it was different from other countries, and it was not easy to find a single model of success among these nations. As the Korean economy grew rapidly in the 1960s and 1970s, Korea's technological capabilities grew as well, fostered by the government's efforts to develop science and technology (S&T).³ The Korean government founded a research institute, which despite being run by government funds, was a legally independent corporation. This institute performed research on industrial technology and provided the results to industries in order to assist them in enhancing their level of technology. Furthermore, the establishment of the first GRI, the Korea Institute of Science and Technology (KIST, 한국과학기술연구소) in 1966 became a starting point of the formation of a modern S&T system in Korea, composed of research institutes, administrative agencies, and other supporting institutions. Through the 1970s, the government established over a dozen research institutes in each industrial field, modeled after KIST, which was the focus of the S&T policy. It is not incorrect to observe that the history of Korea's S&T in the 1970s was fused with the history of institution building.⁴

Why did the Korean government embark on the establishment of multiple GRIs, and what results were harvested as a result of focusing national policy on bridging technological gaps? Can this policy be evaluated as having been successful enough for other developing countries to accept it as a useful model? To answer these questions, I will trace back the early history of KIST and analyze its role in bridging the technology gap in Korea.

I have divided my essay into three main parts; first, with a focus on the contract research system, I will describe the process of the establishment of KIST. Second, by closely examining specific examples, I will illustrate the actual roles that KIST played. Lastly, I will explain the reshaping of its mission with the difficulties of the contract research system. This case study is a good example of an institutional policy, and how research institutes are established in order to bridge technology gaps and create an S&T system in a developing country.

Birth of the First Government-funded Research Institute

Since Korea's liberation from Japanese colonization in 1945, Korean scientists had constantly requested for government endeavor to promote S&T. In particular, they

³ For more information on the history of technology in contemporary Korea, see Kim Linsu, *Imitation to Innovation: The Dynamics of Korea's Technological Learning* (Boston: Harvard Business School Press, 1997); Korea Institute of S&T Evaluation and Planning (KISTEP) ed., *Dynamic History of Korean Science & Technology* (Seoul: Ministry of Education, Science and Technology, 2010) [한국과학기술기획평가원, 『한국과학기술이 걸어온 길』].

⁴ See Moon Manyong, "The Creation of Government-supported Research Institutes during the Park Chung-hee Era," *STI Policy Review* 2-2 (2011), 55-65.

requested the establishment of an advanced research institute and a central administrative agency for S&T policy. However, the government did not respond seriously to these requests until the 1960s. Following a *coup d'état* in 1961, a military regime took over the administration, and primarily seeking to promote economic growth, it took an active interest in advancing S&T. Despite touching on technical training, this initiative did not, however, contain any comprehensive planning for the development of S&T.

The Korea-US Summit Meeting in 1965 provided the momentum needed for the future development of S&T. During the Summit, the US President at the time, Lyndon B. Johnson, offered to send his science advisor as an envoy to Korea to explore the feasibility of US cooperation in establishing a Korean institute for industrial technology and applied sciences. Korean President Park Chung-hee (박정희) welcomed the offer. This news stimulated general interest in S&T amongst the Korean public, and many newspapers began to report on topics such as the terrible research environment, the poor treatment of scientists, and the issue of "brain drain." At the time, brain drain was a serious problem in Korea, the primary reason for this being the lack of job positions that required, and would accordingly compensate for those with higher education.⁵ A significant number of scientists and engineers were filled with anticipation that the new institute would provide new opportunities in the field of S&T.

Some scientists opined that improving research environments of existing institutes that faced shortage of research funds and facilities were of higher priority. However, the Korean government argued that given the limited finances, the problems of national and public research institutes could be best solved through the creation of a brand new institute that could reform the entire culture of research in Korea. Relying on US aid, the Korean government pushed ahead with the plan.

President Johnson's offer was, above all, a token of gratitude to the Korean government for its decision to dispatch Korean combat troops to Vietnam and fight as an ally to the US. It also aimed to help Korea mitigate brain drain which was a controversial issue in the international community during that era. At the same time, this offer was designed to placate Koreans' opposition to the normalization of Korean-Japanese diplomatic relations, which was in the final stages of negotiations, indicating in a way that US assistance would continue even after the restoration of diplomatic relations between the two countries.⁶

Two months after the summit, President Johnson's science advisor, Donald Hornig, visited Korea to survey the situation. He conferred with scientists, government officials, and key industrialists, and inspected laboratories in universities, industrial plants, and governmental and private research establishments. After returning to

⁵ For the brain-drain in Korea, see Yoon L. Bang-Soon, "Reverse Brain Drain in South Korea: State-led Model," *Studies in Comparative International Development* 27-1 (1992), 4-26.

⁶ Donald F. Hornig Oral History, (Lyndon Baines Johnson Library Oral History Collection Interview I, 1968. 12. 4), <http://www.lbjlib.utexas.edu/johnson/archives.hom/oralhistory.hom/Hornig-D/hornig1.PDF> (accessed December 2005); Henry Lambricht, *Presidential Management of Science and Technology: The Johnson Presidency* (Austin: Univ. of Texas Press, 1985), p. 95.

the US, Hornig presented a report in which he maintained that the proposal to set up a new institute was timely given the prospects for rapid growth of Korean industry.⁷ He advised that USAID assist with its establishment in conjunction with an American technical organization like the Battelle Memorial Institute (BMI). Accordingly, the private, non-profit BMI in Ohio was chosen as a sister institute and given the role to assist the establishment and operation of a new institute.⁸

In 1966, with the aid of the US government, KIST was established as a non-profit organization. The US government granted 7.18 million dollars to KIST, and the Korean government endowed 14.1 million dollars for its establishment and operation during its first 5 years. Although KIST was established with financial assistance from the Korean and US governments, it had the legal form of an independent corporation. Park Chung-hee became the founder of KIST in a private capacity. This was mainly because the Korean government wanted to avoid inefficiencies, such as bureaucratic regulation of recruitment and accounting, which were common to its national and public research institutes. The US government also agreed on the legal arrangements, so as to prevent excessive interference by the Korean government. KIST was able to secure stable government support through the “Promotion Act for KIST” (한국과학기술연구소 육성법), which stipulated payment of endowment funds and transfer of state-owned property. The reason why the term ‘government endowment fund’ was used instead of the more common term ‘government subsidy,’ was because they wanted to avoid arduous audits or accounting that were required under the “Subsidy Management Act” (보조금 관리법). Hence, a unique form of research organization called a “government-funded research institute” was born.

KIST recruited Korean scientists located overseas to return home to serve as its core researchers, and it took on a role as the “reverse brain drain center.” Because Korea suffered from serious brain drain, the scientists that KIST repatriated came to symbolize change in Korea.⁹ In fact, President Park considered KIST a national symbol of “the modernization of the fatherland,” which was Park’s key motto, prompting him to order active support for the institute. Under the aegis of the Korean government, the institute acquired equipment that would enable high-quality research and a distinguished staff that would carry out the research, and KIST was seen as an achievement that the Park regime could be proud of.

The goal of KIST was to contribute to the development of the Korean economy through industrial research, which meant that scientific research in Korea was be-

⁷ Donald F. Hornig, “Report to the President: Regarding the Feasibility of Establishing in Korea with US Cooperation an Institute for Industrial Technology and Applied Science” (1965). The KIST Archive owns a copy of the report.

⁸ For more information about the BMI’s role, see Battelle Memorial Institute, *Report on Battelle’s Assistance to the Korea Institute of Science and Technology* (Columbus: Battelle Memorial Institute, 1971).

⁹ According to Huang, Korea’s brain-drain in 1960s was most serious among the 25 countries surveyed. Huang Wei-Chiao, “An Empirical Analysis of Foreign Student Brain Drain to the United States,” *Economics of Education Reviews* 7-2 (1988), 231-243.

ginning to be understood as being closely connected with economic development. Since KIST was founded under the initiative of the US, the US government exerted great influence during its early years. Hornig advised that KIST be run under a contract research system. According to the contract research system, an institute makes a contract with a sponsor and supplies research results and services to that sponsor. Basically, it meant that the institute earns its budget by winning research contracts. Hornig pointed out that BMI, which was well known as a contract research institute in the US, should be selected as the sister institute of KIST.

Why did Hornig recommend the contract research system to Korea? He mostly wanted KIST to show the rapid fruition of US aid to Korea. If KIST succeeded in solving problems in response to the demands of its industrial sponsors, Koreans would be able to justify the establishment of KIST. In other words, Hornig thought that the sponsor-led contract research system would be more effective in showing the value of KIST than a researcher-led research system. Additionally, he hoped that the US government could reduce the grant to KIST if it received enough contracts.

Although the contract research system was unfamiliar to Koreans, the Korean government adopted it to reform the attitude of researchers and industrialists on research and development (R&D). It would mean that researchers would have to do practical research so that industrialists would be interested in their R&D. Namely, the Korean government wanted to implant a new R&D culture. Furthermore, the Korean government also hoped to reduce its endowment for KIST if it received enough contracts.

The establishment of KIST became a launching point for development of S&T in Korea. The Korean government realized the necessity of a governmental agency for effectual administration and support for the new institute. As a result, the year after the birth of KIST, the Ministry of Science and Technology (MOST, 과학기술처), an administrative office for S&T policy was founded and the scientists' long waited requests of political endeavor to promote S&T had been answered. MOST implemented many important policies regarding S&T development, including the establishment of supporting institutions for scientists and promoting the popularization of science. One Korean newspaper termed these series of events as "the S&T boom," which was not an overstatement.¹⁰ Establishing a research institute is not a panacea for bridging the technology gap, but governmental support, including a comprehensive S&T policy, is essential and an institute could be a very effective catalyst in the process.

KIST's Role in Bridging Technology Gap

¹⁰ Moon Manyong, "'Science and Technology Boom' in 1960s: The Formation of Science and Technology System in Korea," *The Korean Journal for the History of Science* 29-1 (2007), 67-96 [문만용, "'1960년대 과학기술 붐': 한국의 현대적 과학기술정책의 형성", 『한국과학사학회지』].

There were three types of contracts that KIST undertook: governmental projects, industrial projects, and endowment projects. Governmental projects were intended to solve problems as requested by governmental ministries or agencies. Typical examples are the development of defense-related products, such as weapons and patrol ships designed by KIST in the early 1970s, and survey projects related to government policies. Second, industrial projects were requests from industrialists to solve specific problems, mostly the adaptation of transferred technologies, developing new technologies, and market research. The third type was “package deal contract research,” which was a bundle of government-funded projects under the contract but self-determined by KIST staff. KIST needed this governmental endowment until they acquired enough contracts to sustain it, but at the same time did not want to lose its autonomy. Finally the staff at KIST successfully persuaded the government and secured an endowment that only provided funds for research excluding operating expenses, which meant the government had no rights to be involved in the administration of the fund.

Since KIST was a research institute, R&D was fundamental to bridging the technology gap. However, there were more ways for KIST to contribute to the industry than just research. Firstly, KIST demonstrated to Korean companies that R&D could pay for itself, thus providing a stimulant to industrial research. When KIST was established, most Korean companies depended on simple imitation and old foreign technology. In other words, Korean industries had not yet developed to a point where they could develop a systemized R&D. They did not recognize any necessity for developing new products or processes through in-house R&D, and it was very rare for them to sign research contracts with independent research institutes. The staff at KIST was thus not sure on whether the industry was interested in paying for R&D. In order to sign a contract, they needed to advertise their R&D ability and convince industrialists of its necessity. Few companies gave favorable responses to research budget proposals presented by KIST and some businesspersons asked technical advice by treating a researcher to dinner without contracts.

However, this atmosphere began to change as more and more cases of successful contract research took place at KIST. Several companies at risk were revived by the assistance of KIST, and some companies emerged triumphant in commercialization of the technology developed by KIST. For example, a spinning company was undergoing difficulty due to the breakdown of imported machines, but the foreign company that originally manufactured the machines demanded an unreasonable sum of money and duration for fixing the mess. Fortunately, the Polymer Laboratory Team at KIST was able to solve the problem with less money in much shorter time than had been estimated by the foreign manufacturer. A pharmaceutical company was also able to overcome a severe shortage of raw materials thanks to KIST developing substitute compounds. This news provided great promotion of the achievements of KIST, and the number of contract signed with industries gradually increased. Of course, this was not the only factor for companies to recognize the value of R&D, but KIST definitely played a considerable role stimulating the change.

To secure continuous contracts with the industry, the first director, Choi Hyung Sup (최형섭), emphasized the significance of the first contract with the industry, which would create the first impression of the institute. He sincerely requested that researchers should never fail in the first contract with industry. In addition to granting tax exemption benefits and promoting KIST to support the industry, the government also encouraged businesses to work in collaboration with KIST. President Park instructed cabinet members to seek for ways to escalate the number of contracts. According to Stevan Dedijer, the concerns over scientific development of a top-leader are crucial in promoting S&T in an underdeveloped country, both practically and symbolically, for the general public are less aware of the importance of S&T in the growth of the nation.¹¹ President Park, as the founder of KIST, presented himself as a solid sponsor of the institute, mediating and solving conflicts that arose in the early stages. The president's support for KIST thus enhanced the social status of its researchers, and at the same time imposed particular responsibilities on them. In other words, President Park's patronage was a factor that helped KIST to grow stably in a short time span.

One of the most common ways to bridge technology gaps was technology transfer from foreign companies, and KIST assisted companies during this transfer process. Based on their knowledge on the technology, KIST gave professional advice on appropriate technology licensing companies, and prices for licensing contracts. After the technology transfer, KIST conducted research on how to adapt and improve the technology. For example, the Metallurgy Laboratory Team assisted the Korea Special Metal Industrial Company (한국특수금속공업) in selecting the licensing company, evaluating prices for the transferred technology and adapting it. After they recognized the efficacy of the technical assistance, the metal company underwent three additional research contracts with KIST.

Technical assistance in technology transfer and research on adapting technology were significant roles KIST played in its early years. In fact, although KIST did not underscore the importance of technical assistance, it gradually recognized the high demand for such activities from the industry. Back then, most Korean industries had to resort to foreign technology and direly needed practical assistance in the process of transferring technology. A sizable number of scholars argued that research organization in developing countries should pay attention to technology transfer as well as original research. By examining sample projects in Latin America, James Utterback argued that the most important role of applied research institutes in developing countries was in providing assistance for successfully transferring foreign technology.¹² At a seminar held at KIST in 1972, Glenn Schweitzer, the director of the S&T department of USAID, maintained that research organizations in developing countries should become "technological

¹¹ Stevan Dedijer, "Underdeveloped Science in Underdeveloped Countries," *Minerva* 2-1 (1963), 61-81.

¹² James M. Utterback, "The Role of Applied Research Institutes in the Transfer of Technology in Latin America," *World Development* 3-9 (1975), 665-673.

institutes” rather than “research institutes,” emphasizing the assisting role in technology transfer.¹³ Although the project fee for technical assistance was lower than for R&D projects, KIST became increasingly conscious of the former.

KIST’s role in establishing the Pohang Iron and Steel Company (POSCO, 포항제철) is an interesting example of technical assistance. In its construction stages, POSCO relied heavily on Japanese engineering consulting groups and needed experienced engineers to review the conclusions. POSCO wanted to hire retired Japanese engineers, but they declined the offer, concerned for the relationship with Japanese consulting groups. So KIST intervened to assist indirectly, and suggested Japanese retirees take on non-regular researcher posts, to which they agreed. Eventually, these engineers provided advice on the construction, choice of machinery, and operation tests of equipment.

KIST did not only end up becoming a center for technology transfer, but it also functioned as a center for indigenous technological development. It developed specific products and processes at the request of sponsor companies, and sought to commercialize research products resulting from government funding, called package deal contract projects. Although companies preferred foreign technology that has already been proven in the market, they did request indigenous development depending on their needs; when a licensing company was reluctant to transfer its technology, or when they had difficulties in obtaining raw materials for foreign technology, they visited KIST for contract research.

Research requests of industry sponsors were highly diverse. In 1970, a small company brought a flexible straw developed in the US and questioned the possibility of domestic production. After signing a contract, the Synthetic Resin Laboratory Team at KIST succeeded in developing an identical product and obtaining a patent in Korea. The company also asked KIST to develop a machine for making flexible straws, eventually exporting commercial products to Europe. Similarly, there were many simple items that industries wanted to develop, especially in synthetic chemistry since Korea had not adopted a product patent system until the 1970s. If they developed a new synthetic process for imported medicines and agricultural chemicals, there was a good chance for successful commercialization. Therefore, synthetic chemistry laboratories had a host of research contracts with industries.

The Ethambutol Project was an interesting case of synthetic chemistry and showed difficulties that KIST researchers had to experience during the project. In 1970, the Organic Synthetic Chemistry Laboratory Team was asked by the Handok Pharmaceuticals Company (한독약품) to develop a novel process to produce ethambutol. Ethambutol was an anti-TB drug, monopolized by an American Cyanamid that was not in production despite having a registered patent in Korea. The team worked out a process different from that of American Cyanamid’s patent, but the reaction required 1-nitroporpane as the first precursor, a compound produced by

¹³ Glenn Schweitzer, “Recent Programs Related to Technology Transfer,” *Proceedings of the International Seminar on Dissemination of Technology* (Seoul: KIST/IITRI/USAID, 1972), pp. 126-132.

another American company, Commercial Solvents Company. After learning about KIST's project, however, Commercial Solvents refused sales of the substance due to its exclusive contract with American Cyanamid. So the team had to work out another complicated series of reactions that mainly utilized domestic substances, but eventually was able to obtain a patent for the process. When they built a pilot plant to produce ethambutol from raw materials, American Cyanamid tried to establish a joint venture for ethambutol with another Korean company. KIST and the sponsor company made sure that the government became aware of the injustice of the joint venture plan, and was granted a one-and-a-half-year grace period. American Cyanamid then decided to reduce the selling price of ethambutol reducing the gains of Handok Pharmaceuticals in comparison to their huge investment.¹⁴

The ethambutol case clearly shows Korea's inexperience in R&D and typical interference of a foreign company that owns the original technology. When a domestic company tries to commercialize new technology, the foreign company attempts to interfere through a licensing contract, a joint venture, and by dumping prices. After the controversy, the Korean government revised the "Technology Development Promotion Act" (기술개발촉진법) and secured a way to protect domestically developed technology.¹⁵

Thanks to the four-year protection period guaranteed by this law, the polyester films (PET films) developed by KIST were able to succeed in being commercialized, and the sponsor company became the leader of the videotape industry. The PET films were developed in late 1977 and became the representative accomplishment of industrial R&D of that period. At the time, major PET films had been developed more than 20 years ago, and the patents to these technologies had been expired. Because licensed companies strictly protected the manufacturing know-hows, the Sunkyong Chemicals (선경화학) commissioned the Polymer Laboratory Team to develop PET films. Team succeeded in developing film-grade PET chips and polymerization catalysts for industrial use, and obtained competent results in optimum processing tests as well. Based on this achievement, the sponsor company started embarked on building a factory, but controversies arose as another domestic company pushed forward with the production of PET films by importing technology by the turnkey method from a Japanese firm. This was a very similar situation to the ethambutol case. Whereas officials at economy-related ministries or conservative businesspersons were in favor of technology introduction, the S&T sector showed favorable attitudes toward domestically developed technology. After ten months of dispute, the Committee on Technology Development Review (기술개발심사위원회), where representatives of several ministries gathered, recognized the product of KIST's research as a new domestic technology that is worthy of protection.. Thus, other companies were prohibited from importing foreign tech-

¹⁴ About the ethambutol project, see Moon Manyong, *Formation of a Modern Research System in Korea*, pp. 263-266.

¹⁵ 'Technology Development Act' was enacted in 1972 with the purpose of promoting R&D in industry. Yet, the act did not contain the provision for protecting newly developed technology.

nology for the next four years, in accordance to the revised Technology Development Promotion Act.¹⁶

KIST's development of new technology requested by industry sponsor was the most powerful way to bridge the technology gap, yet development projects did not always constitute successful industrialization. For a happy ending of a research project, the government needs to devise varied political support, including a protection period and tax benefits. Such improvements in policy for R&D were the indirect function of KIST in bridging technology gaps.

Another way for KIST to contribute to bridging the technology gap was transfer of researchers to the industrial sector. KIST possessed much excellent manpower with practical R&D experience, and they spread out to the industrial circle, effectively distributing high levels of S&T. Sometimes the researchers who conducted the contract research would move to the sponsor company for effective technology transfer. Some researchers were headhunted by the industry sector, with proposals of better benefits. In other words, KIST played a role of nurturing skilled scientists and engineers and supplying them to various fields of the economy, and this can also be considered as one of the biggest accomplishments of KIST. Although this would, in turn, be brain drain on the part of KIST, it had significant positive value in that it promoted diffusion of advanced technology at the national level.

KIST assisted the industry in bridging the technology gap through diverse methods, including development of new technology, assistance of technology transfer, and manpower transfer. In order for a newly established research institute to deliver the results that is expected of it, the government should provide unwavering support to the institute and its major clients, namely in this case, industries. The government's efforts for the institute would naturally be linked to the comprehensive policy for promoting S&T. In other words, the new institute can function as a catalyst and a departure point for the development of an S&T system in developing countries.

President Park offered a handwritten message for the commemoration of the 10th anniversary of KIST in 1976, which read "nation-building through science, self-reliance in technology." As a token of "modernizing Korea," KIST had to undertake the mission of nation building and act as a leading institute enhancing the level of technology. That was the reason why the Korean government decided to invest huge funds in KIST and adopt the unfamiliar contract research system.

Reshaping its Mission and Contract Research System

During the 1970s, KIST became the institute that represented Korean S&T advancement, and a landmark to be visited by honored foreign guests. In 1971, the

¹⁶ About the PET film project, see Choi Nam Sok, "A Case Study – Development of Polyester Film," *Proceedings of the 7th ASCA Conference Pre-Seminar I on the Role of Local R&D for Industrialization* (Seoul: KIST, 1979), pp. 173-182.

first director of KIST, Choi Hyung Sup, was appointed the Minister of Science and Technology in recognition of his distinguished service at KIST. He served as the minister for seven and a half years, which was the longest term for any minister in Korean history. During his tenure, he drew up a plan to build a science research complex in Daedeok (대덕) that would provide the groundwork for R&D in Korea.¹⁷ With the construction of the Daedeok Science Town (대덕연구단지), the Korean government, encouraged by the initial success of KIST, began to establish a series of GRIs modeled after KIST. While KIST was a multi-disciplinary institute, newly established GRIs were to be institutes that are specialized in areas such as shipbuilding, communication technology, electronics, and chemical technology. Some of these GRIs were originally established as affiliates of KIST, but later became separate institutes. Eventually, more than a dozen GRIs modeled on KIST were founded by the mid-1970s. This is why KIST is often referred to as “the mother institute of GRIs.”

Under the change in milieu, KIST tried to redefine its identity and mission to distinguish itself from the new institutes. As new GRIs chose the contract research system modeled after KIST, competition between KIST and the new institutes over research contracts and recruitment of researchers was unavoidable. KIST maintained that it would hand over short-term industrial projects to the new specialized GRIs, while KIST would take on long-term and large-scale projects that industries could not afford to develop. According to their logic, since KIST was the only multi-disciplinary institute in Korea, it would be better for KIST to focus on national projects that specialized but smaller institutes could not carry out.

Consequently, after having a long conference with the government in 1978, KIST announced that it would focus on long-termed endowment research projects or package deal contract research. This meant that KIST would transform into a national institute that was mainly dependent on governmental funding even though it did not formally abandon its contract research system. Why did this change arise? The official reason had been to differentiate its mission from the newly established GRIs. However, there are some backdrops behind the decision; some of them were the common factors in GRIs and others resulted from KIST's own situation.

Firstly, as a leading research institute in Korea, KIST had to comply with governmental requests including assisting in the process of S&T policymaking. Although sometimes KIST had to perform such services for the government without signing any contracts, finding government sponsors was generally easier than finding industrial sponsors. Then, KIST was not just an industrial research institute, but it functioned as an adjudicating institute whenever controversial issues of S&T arose, and it also acted as a think tank for the Park regime. For example, KIST unwillingly established an affiliate, the Institute of Regional Development (지역개발연구소) in 1977, dedicated to the planning and construction of relocating the capital under the supervision of President Park. Because the aim of the institute

¹⁷ For the brief history of Daedeok Science Town, see KISTEP, *Dynamic History of Korean Science & Technology*, pp. 242-258.

was significantly different from the initial role of KIST, the establishment of the affiliate institute demonstrated that KIST was a quasi-governmental organization during that period. KIST's mission could not help being closely related to governmental affairs.

Another fundamental reason behind KIST's modification was the burden of the contract research system. KIST had to adhere to the contract research system and sum allocated to the projects gradually increased. However, researchers disliked the system because they found great difficulty in maintaining contract research. Most new GRIs had similar problems since they also adopted the contract research system modeled after KIST. Why did they dislike the system?

Above all, even though industrial projects increased steadily, it was still difficult to make sufficient research contracts with industry. Since the heads of the laboratories at KIST took responsibility for searching for sponsors in addition to carrying out research and managing the laboratory, they sometimes had to spend more of their time finding sponsors. And the smooth running of the laboratories depended on the number of contracts they could secure. The top executives of KIST also had to make an effort to secure financial stability of the institute in light of the uncertainty surrounding how much funding could be obtained by contracts. Since it was difficult to predict the amount of funds, executives had to find an alternative source that would guarantee secure budgets.

Secondly, the requests of the industry sponsors for research were so varied that KIST could not fully satisfy them. Clearly, multifarious research topics created a serious burden for KIST researchers. Most researchers occasionally had to carry out research on topics that were not in their specialty. Particularly, they had difficulties in development studies, such as projects for commercialization or mass production. These kinds of projects required know-how in engineering and a close relationship with technical experts in the factories, which was not easy for researchers outside of the industry.

The 'flexible straw' project mentioned above is the most successful example of an integrated research from initial study to the development of a machine for mass production. Yet, it was not so easy for KIST to conduct all kinds of research in each stage for every project. Although the PET film research was satisfactory in the laboratory phase, the sponsor company had to overcome serious technical and economic obstacles through additional R&D before successful mass production. Setting aside the risk of failure, the company usually needs to invest large amounts of money and time for the prosperous commercialization of a new technology. Sunkyoung Chemicals, the sponsor of the PET film project was a large company and was able to deal with these difficulties. However, because of the hardship, most small and medium enterprises preferred fully packaged technology, which in turn was a large burden to KIST.

In the early 20th century, there were many independent contract research organizations in the US. Those contract institutes did not become substitutes for in-house

institutes but functioned as complements.¹⁸ The process of basic research in the laboratory transforming into a final product was not linear, and successful innovation needed exchange of experiences and information. However, contract institutes did not have adequate information, especially when related to production sites; they could not conduct all kinds of research on behalf of the in-house institutes. As Pilar Beneito argued, unless contract research is combined with in-house research, fundamental innovation is impossible.¹⁹ The finding that the best results arise when two kinds of research are combined also implies the limitations of a contract research institute.²⁰ Principally, the company had to lead the commercialization research, which should proceed with close relation to the production site. The case of the PET film shows that the significance and difficulty of commercialization research.

As we have seen, Korean companies expected KIST to function as an in-house institutes as well as a contract research institute. KIST had to conduct the entire process, from initial research to commercialization study to a plant layout, which was a condition unique to Korea that KIST had no choice but to deal with. The contract research institute in developed countries hands commercialization research over the sponsor company that possesses R&D capability up to a point. Thus the contract organization was described as a bridging institution between academic research and production research.²¹ However, many Korean businesses did not have such research capabilities and had to depend entirely on KIST, which imposed heavy tasks on the institute.

Some sponsor companies complained about KIST's research capability and some critics said its researchers were not suited for industrial research, for most of them had only worked in universities or research institutes outside of the industrial circles. That criticism seems to be reasonable, but even the researchers who came from the industry sector expressed difficulties in satisfying the diverse demands of industrial projects. One mechanical engineer at KIST who had worked for over 10 years at an American metal factory said that although he took great pride in his wide experiences as a mechanical designer, it was very tough to comply with the various requests from sponsors. And thereby, a considerable number of researchers did not like contract research with the industry, and preferred self-initiated research or package deal contracts. This situation prompted the readjustment of KIST's identity.

¹⁸ David C. Mowery, "The Relationship between Intrafirm and Contractual Forms of Industrial Research in American Manufacturing, 1900-1940," *Explorations in Economic History* 20 (1983), 351-374.

¹⁹ Pilar Beneito, "Fecundity of In-House and Contracted R&D in Terms of Radical vs. Incremental Innovation," <http://www.ucd.ie/economic/staff/achevalier/web/aew/pilar2.pdf> (accessed November 2005).

²⁰ Alan D. MacPherson, "A Comparison of Within-Firm and External Sources of Product Innovation," *Growth and Change* 28 (1997), 289-308.

²¹ Andrew Webster, "Bridging Institutions: The Role of Contract Research Organisations in Technology Transfer," *Science and Public Policy* 21 (1994), 89-97.

After the readjustment, the mission of KIST was to aim for indirect and long-term projects, although there was no change in its ultimate goal - contributing to the economic development of Korea through industrial research. KIST called its research “national project,” which demanded full governmental support, for there was the necessity for research at the state level. On the other hand, it was also a strategy to upgrade its status and social image. In fact BMI, the sister institute of KIST, advised against the reshaping of the mission. However, the chairman of Board of Director of KIST replied that they were different from BMI. He said that BMI was just one of many private research institutes in the US, but KIST, as a representative institute of Korea, had to mainly carry out national projects. As a result, although KIST formally maintained contract research system, there were substantial differences between the contract research system of KIST and BMI.

The contract research system was introduced from the US to KIST in the 1960s, and in ten years, the institute modified this US-style research system. An underdeveloped Korean research environment, a series of establishment of GRIs, and the rise of KIST’s national status conditioned the modification in the 1970s, and the result was a Korea-styled contract research system, focusing on package deal contract research funded by the government. At first the package deal contract research were invented to cover the insufficient contract amount by KIST, yet the invented contract projects became a major research contract due to the readjustment of its mission. Experience tells us that foreign technology should be indigenized and modified during its adaptation to a new environment. The same point can be made for a transferred foreign research system.

It was natural for KIST to reshape its mission in order to adapt itself to the changing environment. Every research institute has to interact with its surroundings and attempt to reform its identity as time passes. However, many companies, especially small- and medium-sized companies still need the assistance of contract research institutes, from simple technical advice to short-termed R&D for new products and manufacturing processes. In the early 1980s, most GRIs, like KIST, also changed their missions; they aimed to conduct national projects funded by the government. Eventually, the government had to establish another institute, the Korea Institute of Industrial Technology (한국생산기술연구원), for technical service for small and medium enterprises in 1989. Although a specific research system is proved efficacious, diversity is more appropriate than uniformity to adapt to variety of environments.

Conclusion

KIST and other GRIs led Korean R&D during the 1970s, when industries and universities did not possess the capability and will for it. According to a report in 2004, KIST profits since its establishment recorded a multiple of 33.1 on a cost-benefit

analysis.²² KIST's way of bridging the technology gap was diverse. It is possible that its most significant contribution was in demonstrating to Korean companies that R&D could pay for itself, thus providing a catalyst for industrial research. Some scholars argue that the transfer of researchers from KIST to the industry was the most important role KIST had played to enhance the level of technology in Korea.

The early history of KIST demonstrates the effectiveness of the establishment of a research institute in bridging the technology gap in a developing country where its research system is bleak. However, establishment of an institute does not always mean improving technological capabilities of the country. To yield desirable results, governmental support is essential, which would expand into the implementation of a comprehensive S&T policy. We need to remind ourselves that the Korean government founded MOST and carried out various supporting policies for S&T immediately after the establishment of KIST. In the 1970s, a couple of newly established GRIs also became good examples of governmental endeavors for promoting S&T and bridging the technology gap. Ultimately, KIST functioned as a trigger for industrial research as well as formation of the S&T system in Korea. In the early stages, it is necessary to set roles for each research institutes in a way that suits the actual domestic environment. Above all, they should be helpful to the domestic industrial circle in a practical manner so that the general society is able to recognize the value of the institutes. Rather than conducting the high-level frontier research that foreign scientists aspire for, local research organizations should focus on practical studies that are in demand at home, and the effects of which can be fully witnessed by society. In that sense, the contract research system at KIST could be deemed an effectual option for developing countries. KIST did localize the contract research system in the 1970s, but all in all, the system would had been necessary for a period of time, for conducting research that is in demand had a very significant value in reforming Korea's R&D culture. It was the key in proving the need for R&D to industrialists, and illustrating the significance of sponsor-led research to the scientists and researchers. Considering these symbolic meanings and practical effects, especially the first GRI needs to accept the contract research system in spite of its difficulties. Yet, I do not believe that all GRIs should adopt the contract research system in the same way. As an S&T system is formed, a diverse research system is necessary, depending on the area of research and the goal of the institutes. While some institutes take on long-term projects or basic research, other institutes have to comply with various requests from the industry. Although sponsor-led research definitely has its worth, absolute conformity is not desirable for the development of S&T at the national level.

²² Seol Sung Soo et. al., *Research on the Performance Analysis and Socioeconomic Contribution Strategy of Research Institutes* (Seoul: Korea Research Council of Fundamental Science & Technology, 2004), pp. 39-99 [설성수 외, 『소관연구기관 성과분석 및 경제사회적 기여전략 연구』].

Abstract

The Korea Institute of Science and Technology (KIST) was established by the aid of the US in 1966. By examining the early history of KIST, the first government-funded research institute (GRI), I analyze the role of KIST in bridging the technology gap in Korea. KIST assisted the industry in bridging the technology gap through diverse methods, including development of new technology, assistance of technology transfer, and manpower transfer. Through the 1970s, the Korean government, encouraged by the initial success of KIST, established over a dozen research institutes in each industrial field, modeled after KIST. To differentiate its mission from the newly established GRIs, KIST decided to focus on long-termed package deal contract research projects that were fully funded by the government. KIST and other GRIs led Korean R&D during the 1970s, when industries and universities did not possess the capability and will for it. The early history of KIST demonstrates the effectiveness of the establishment of a research institute in bridging the technology gap in a developing country where its research system is bleak. In the early stages, it is necessary to set roles for the research institutes in a way that suits the actual domestic environment and the contract research system can be an effectual option for the institute.

Key Words: Korea Institute of Science and Technology (KIST), technology gap, Government-funded research institutes (GRIs), contract research system, Choi Hyung Sup, package deal contract research