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2012 Modularization of Korea's Development Experience:

# The Internalization of Science and Technology in the earlier stage of Economic Development in South Korea

2013

Ministry of Science, ICT and Future Planning

STEPI SCIENCE AND TECHNOLOGY POLIC INSTITUTE

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# Preface

The study of Korea's economic and social transformation offers a unique opportunity to better understand the factors that drive development. Within one generation, Korea has transformed itself from a poor agrarian society to a modern industrial nation, a feat never seen before. What makes Korea's experience so unique is that its rapid economic development was relatively broad-based, meaning that the fruits of Korea's rapid growth were shared by many. The challenge of course is unlocking the secrets behind Korea's rapid and broad-based development, which can offer invaluable insights and lessons and knowledge that can be shared with the rest of the international community.

Recognizing this, the Korean Ministry of Strategy and Finance (MOSF) and the Korea Development Institute (KDI) launched the Knowledge Sharing Program (KSP) in 2004 to share Korea's development experience and to assist its developing country partners. The body of work presented in this volume is part of a greater initiative launched in 2010 to systematically research and document Korea's development experience and to deliver standardized content as case studies. The goal of this undertaking is to offer a deeper and wider understanding of Korea's development experience with the hope that Korea's past can offer lessons for developing countries in search of sustainable and broad-based development. This is a continuation of a multi-year undertaking to study and document Korea's development experience, and it builds on the 40 case studies completed in 2011. Here, we present 41 new studies that explore various development-oriented themes such as industrialization, energy, human resource development, government administration, Information and Communication Technology (ICT), agricultural development, land development, and environment.

In presenting these new studies, I would like to take this opportunity to express my gratitude to all those involved in this great undertaking. It was through their hard work and commitment that made this possible. Foremost, I would like to thank the Ministry of Strategy and Finance for their encouragement and full support of this project. I especially would like to thank the KSP Executive Committee, composed of related ministries/departments, and the various Korean research institutes, for their involvement and the invaluable role they played in bringing this project together. I would also like to thank all the former public officials and senior practitioners for lending their time, keen insights and expertise in preparation of the case studies.

Indeed, the successful completion of the case studies was made possible by the dedication of the researchers from the public sector and academia involved in conducting the studies, which I believe will go a long way in advancing knowledge on not only Korea's own development but also development in general. Lastly, I would like to express my gratitude to Professor Joon-Kyung Kim and Professor Dong-Young Kim for his stewardship of this enterprise, and to the Development Research Team for their hard work and dedication in successfully managing and completing this project.

As always, the views and opinions expressed by the authors in the body of work presented here do not necessary represent those of the KDI School of Public Policy and Management.

**May 2013**

**Joohoon Kim**

**Acting President**

**KDI School of Public Policy and Management**

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# Summary

This report studies how science and technology emerged as one of the overriding tools in the beginning of economic development in South Korea, leading to the national institutionalization of science and technology. In the 1960s, an effort to institutionalize the nation's science and technology which had been in a very underdeveloped state was indeed ground-breaking. Such attempt was triggered by national leaders who believed self-reliance of science and technology was essential for economic development. The then President promised his full support for developing science and technology and utilizing them to economic development. Also, public officials in science and technology such as the Minister of Science and Technology decided to pour a significant amount of resources into establishing a system to promote science and technology. While STI (Science and Technology Insitutionalization) policies were formulated on a national scale, various legislations were drafted to support for the development of science and technology and the establishment of systems for STI administration, and R&D (Research and Development) were introduced for the first time in the Korean histroy. This paper looks at the process how science and technology were institutionalized, and aims to shed light on the fact that the Korean government adopted self-reliance as its main motto to realize economic development.

This study elaborates South Korea's institutionalization of science and technology in the following five chapters. Background in Chapter 1 and Chapter 2 are briefly illustrated. The next chapter deals with how national leaders came to realize the importance of science and technology for economic development and expressed their strong commitment to support the process. Chapter 3 explores the systematic formation of a legal framework to promote science and technology. Chapter 4 describes the expansion of administrative and R&D bodies in science and technology and explains how South Korea's S&T System in

the late 1970s aligned with the administrative and R&D structures. Chapter 5 discusses the qualitative and quantitative outcomes produced by promotional efforts in science and technology.

The national institutionalization of science and technology enabled South Korea to secure local supply of science and technology required for economic development. It is worth noting that at the same time, the country has become independent in science and technology at a more fundamental level. It includes a paradigm shift among the South Korean people to appreciate science and technology both culturally and socially.

The government's large-scale promotion raised public awareness of the importance of science and technology, motivating talented individuals to pursue a career in the field. The Korean people left devastated by the Korean War in 1950, living below poverty line, were given a new hope that learning skills and technology would lead to a successful life. Such point will be discussed as implications in chapter 6, or conclusion of this paper. Lastly, based on the implications, suggestions are made for policy-makers who are involved in economy,science and technology in developing countries.

# Chapter 1

## Introduction

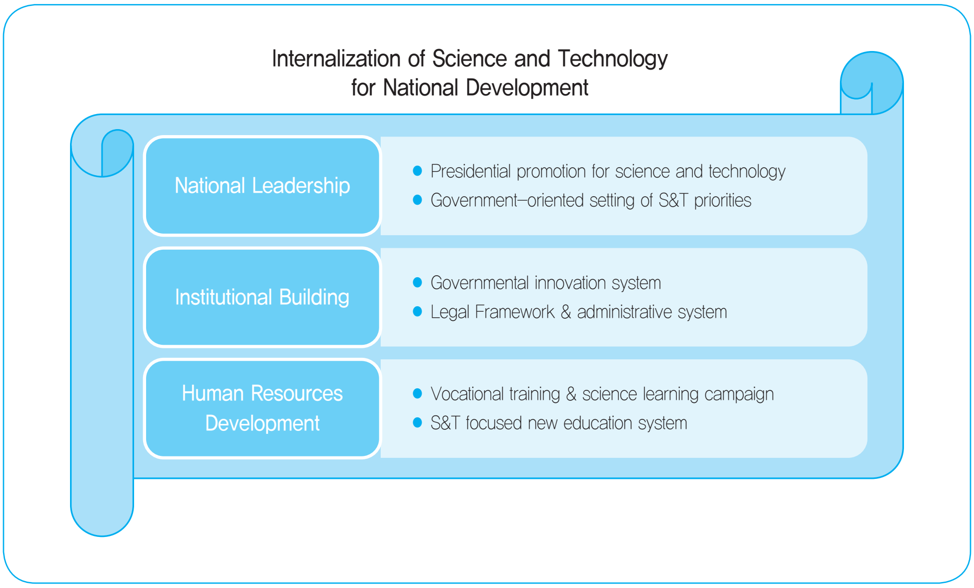
# Introduction

Amidst heightened interest in Korea's successful development by the international society, the nation's science and technology sector is noted as a core factor of its success. No more than some 50 years ago, back in the 1960s, Korea's science and technology remained in a very underdeveloped state, a stark comparison to the advances the nation has achieved today. R&D activities in science and technology, including those of public and private sectors, were extremely rudimentary. It could even be said that the theoretical science education taught in a handful of universities represented all of the science and technology activity that went on in Korea during the early 1960s. Despite such unfavorable conditions, however, Korea's science and technology sector underwent rapid growth after the 1960s, together with its economic progress.

As it is well known abroad, Korea's science and technology could undergo such astronomical growth during the latter half of the 20$^{th}$ century because it had a powerful initiative to promote the industry. In the background, lay the drive to actively utilize science and technology in achieving economic growth. In fact, science and technology contributed to national economic progress for about two decades from the 1960s to the 1970s as it educated human resources necessary for industrial development and satisfied the technological demands of the industry. Furthermore, the results of promoting science and technology enabled the country to set a foothold in cutting-edge industries, and Korea has since managed to steadily maintain the growth made in its economy. This shows that the results a country can expect from investing in science and technology are, in the short-term, satisfying factors essential to rapid economic growth, and in the long-term, acquiring the capacity with which to achieve the country's sustainable growth.

The main idea of science and technology policies in Korea could be synthesized as an "internalization" strategy. Generally, underdeveloped countries with poor scientific activities cannot easily adopt science and technology in their situations, because such decision could cost too much to their national budgets. Although 1960s Korea was at the typical condition of underdeveloped without science and technology, the then national leaders chose the internalization strategy rather than outsourcing science and technology. The below figure shows three major components to support the internalization strategy at the early stage of science and technology promotion. The first factor was national leadership guiding science and technology toward national developmental issues. Since then, science and technology in Korea have largely equated to national mission-oriented activities, not to curiosity driven ones. Institutional building was the second driver of the internalization. In condition that the private sector was immatured, the Korean government took the lead in building a legal framework to introduce the public-funded innovation system including research institutes and supporting organizations. As human resources in Korea were regarded as the only competent driver for the economic development, the government introduced various policy tools of technical training and science and technology education.

Figure 1-1 | Conceptual Framework for Internalization of Science and Technology




It was the highest leaders, under the leadership of the President, that led the promotion of science and technology during the early stages of Korea's economic development. In a country with limited resources, science and technology is the field which cannot be developed without special insights and full support of national leaders. Chapter II examines how the President pushed forward with the promotion of science and technology despite difficulties in the preliminary stages of development. Then-President Park Chung-hee always emphasized that self-reliance in science and technology was an essential factor in achieving economic growth and announced decisive support for the field on a national level. The President's promotion of this sector paved the way to the establishment of a national science and technology system.

Chapter 3 studies how the Korean government built the legal system as a way to institutionally promote science and technology. In Korea, the legal system enacted by the government acts as the foundation which justifies the duty and function of the administration and major national projects of the government. Before 1962, there were no laws related to science and technology in Korea. In accordance to science and technology promotion adopted by the government as its major policy goal since the beginning of national economic development, the laws that will be studied in this chapter were enacted, including the Professional Engineers Act, Science and Technology Promotion Act, and Technology Development Promotion Act. Though there were differences and conflicts among ministries in the process, most laws related to science and technology were swiftly institutionalized, fully backed by the President.

Chapter 4 explores the administrative structure of the national science and technology system, the government's R&D system, and national R&D projects. Since the early 1960s, the Korean government considered science and technology as the country's inherent capacity and was committed to building the foundation to cultivate the sector. This foundation was built by the establishment of a preliminary national science and technology system led by Ministry of S&T and the Korea Institute of Science and Technology (KIST) during the late 1960s. This system was further expanded with the the Daeduk Innopolis in the 1970s constructed by the government.

Chapter 5 reviews the achievements in the promotion of science and technology mainly in two aspects: quantitative and qualitative change. The quantitative indicator shows that the advancement in science and technology preceded the country's economic development. Since the early 1960s, national leaders decided that promoting science and technology was investing in the future, and thus, science and technology always led the economy. The second aspect is the change in the social and cultural dimension. The transition from a social culture which looked down on skills to one that valued them was an essential step that Korea had to take in order to transform from an agricultural society into an industrial society. The Saemeul Movement and projects to enhance the scientific system and knowledge of the people were initiatives carried out to this end. In particular, as a result of science education projects focused on the youth, many Koreans became workers for industrial sectors.

Thus, this report notes the science technology policies, legal framework and administrative systems created by the country's main actors that led the development of science and technology. Self-reliance in science and technology achieved in the 1960s-70s was developed with the installation of these systems. In an effort to examine them, this study undertook broad research on materials related to science and technology policies and administration; Beginning with a thorough study of the archives of major institutions, primarily the National Archives of Korea, National Assembly Library and legal systems, research of major articles on science and technology policies and administration in contemporary newspapers and journals, literary records, and interviews of major science technology administrators are included.

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# Chapter 2

## Presidential Leadership and Policies for Promoting Science and Technology


1. Need for Technological Self-Reliance
2. Development of the First Technology Policy (1962)
3. Presidential Initiative on Science and Technology
4. STI Policies for Heavy and Chemical Industrialization
5. Conclusion

# Presidential Leadership and Policies for Promoting Science and Technology

Leadership and decision-making of national leaders play a critical role in the development of underdeveloped countries. Types of development vary depending on what leaders opt for and what projects they initiate. Some pursue an economic development model which prioritizes labor input in a bid to combat unemployment, while others prefer industrial development based on local resources. When Korea underwent economic development after the 1960s, its national leaders selected science and technology as a core component in the process. Also, the President addressed the importance of science and technology at first hand, considered himself as a leading patron and encouraged development in the relevant fields. This chapter discusses how the 5-Year Plan for Science and Technology was adopted as a national agenda at the outset of the economic development, following the decisions made by national leaders who valued science and technology.

## 1. Need for Technological Self-Reliance

In the initial stage of economic development, Korean leaders faced a tough reality where essential elements of development, such as, funding, manpower and resources fell short. With lack of local funding, they tapped into foreign funds. Korea's working population at the time was not a small number but well-skilled industrial workers were scarce. National resources were significantly lacking and totally dependent on imports. Against this backdrop, it was extremely challenging to obtain foreign loans, build and run industrial complexes. The dire situation called for a decisive solution – a need for technological self-reliance.

First, the challenges the Korean government faced during the funding process served as a stark reminder of the importance of science and technology. Korea's main channel for funding was the United States Operations Missions to the Republic of Korea (USOM/K). A loan application submitted by the Korean government for economic development was subject to a USOM/K review and referred to Development Loan Fund (DLF) approval. During the process, USOM/K asked a technical consulting firm to study the technical feasibility of Korea's proposal. The company solely responsible for the task was Smith Hinchman & Grylls Inc. (SH&G).

However, SH&G's reviews were frequently delayed and their outcome was often negative, which caused the scrapping of the government's key projects including an early 1960 plan to build an integrated steel mill. Most of the time, USOM/K and SH&G were unsure whether Korea was capable of running factories even if it built them with the help of foreign funds. Therefore, in order for the Korean government to secure foreign funding, it had to prove to foreign loan authorities its in-house capabilities to push forward with economic development. Especially, technological capabilities were indispensable as they formed an integral part of management for large-scale factories and industrial facilities once they were built.

Being thoroughly aware of the issue, President Park Jung Hee asked about the level of local technology during a report by the Economic Planning Board (EPB) on early January in 1962. Jeon Sang Geun, former Director of the Bureau of Technology in EPB recorded the moment as follows:

"Here is a project progress report by the Economic Planning Board (EPB) for 1962."

With this, the new year inspection tour by the nation's sovereign ruler began. The First 5-year Plan for the Economic Growth, expected to take effect on January 1st, was the major part of the EPB's report on the day. The person in charge of briefing was Ahn Jong Jik, Director of Planning Bureau who was temporarily transferred from the Bank of Korea.

Standing in front of President Park, Ahn carefully explained the 5-year plan, from its objectives and investment plans to mobilize domestic and foreign capital. It might have been a serious setting. Beads of sweat formed on his forehead. Minister Kim Yoo Taek's face turned stern. Nonetheless, Ahn completed his hour-long briefing without losing control.

A complete silence fell over the room. Minister Kim studied Chairman Park's face, looking uneasy. Chairman Park lit up his cigarette and drew a deep breath of the smoke without uttering a word. After a while, he opened his lips.

"I'm not sure if we have not so many difficulties on the technology front. We are about to build new factories but can we do that with existing technology and a current pool of engineers? If not, please tell me how we can tackle this."

He politely spoke in a deep voice. But the question took everyone present in the meeting totally off guard. (Jeon Sang Geun, 1982: 8-9)

The reason President's remarks caught everyone off guard was that up until then, EPB officials had no previous experience in mapping out technological strategies on a national scale. At the time, most technology was introduced from overseas, which was made based on decisions by loan authorities.

The First 5-year Plan for the Economic Growth, slated for 1962, mainly listed production goals and investment plans by industry within a 5-year period. The plan was not sufficient enough to easily pass a technical feasibility review by loan authorities. Eventually, the president's unexpected question led to the development of nationwide technology policies.

## 2. Development of the First Technology Policy (1962)[1]

Since the President's inquiry, the EPB looked to produce measures for the supply and demand of technology. During the process, EPB officials not only considered how to obtain science and technology required for economic development in the short term but also mulled over how to overcome widespread open disdain for technology in the long haul. This awareness is described in the preface of the First 5-year Technology Plan formulated in 1962 where EPB Minister Kim Yoo Taek shed light on two main pillars of the plan. First, he underlined the need to build local technological capabilities for Korea's economic independence. Kim said the successful implementation of the First 5-year Plan for the Economic Growth required engineering workforce and innovative technological advances. Second, he pointed out Korean society should do away with stereotypes against science and technology. Confucian tradition still remained in the society back then, which often looked down on technology. Also, the Koreans had a limited understanding about science and technology. In this respect, equipping people with technological abilities was more than just a reformative policy but a cultural transition from a traditional world-view to a modern one.

Development of technology policy began with identifying the current status and challenges. The First 5-year Technology Plan assessed the level of Korea's science and technology as "lagging behind" based on the following nine reasons.

1. This verse mainly discusses the specifics of the First 5-year Technology Plan.

(1) Basic technology for industrial activities is mostly dependent on foreign countries.

(2) There are no industrial products that are competitive in the global market.

(3) A comprehensive system which allows for efficient technology administration is not in place.

(4) R&D efforts to develop science and technology in national and public institutions are lacking. Private institutes are rare and there is no agency responsible for raising awareness about the importance of science and technology and distribute them.

(5) A lack of R&D systems hinders creative and self-driven research activities.

(6) No policy and systems are put in place to foster future top engineers and supply them with education, research and production facilities.

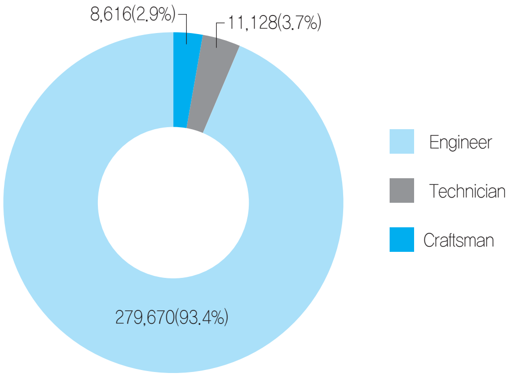
(7) A serious imbalance exists between the number of engineers, technicians and craftsmen. In an ideal situation, the ratio would be 1:5:25 but currently, Korea shows the ratio of 1:1.3:33.

(8) The level of knowledge and education about science and technology among ordinary citizens is fairly low. Businessmen, for their parts, lack commitment to streamlining the management through technological innovation. Overall, Korea lacks the foundation on which to build high-quality science and technological activities.

(9) There is no comprehensive and major policy to promote science and technology.

According to the assessment of the First 5-year Technology Plan, Korea's science and technology ranked the lowest in the world. Particularly, technological manpower lacked engineers who can lead science and technology education and research and technicians who can instruct on the shop floor. It is worth noting that the English word "craftsmen" used in the Plan actually stands for a group of semi-skilled or unskilled laborers. Generally, craftsmen are seen as highly-skilled artisans and it appears that semi-skilled or unskilled laborers are mistranslated as craftsmen.

**Figure 2-1 | Numbers of Technological Manpower According to Vocational Capabilities**




Source: The First 5-year Technology Plan p. 11

In response to the above issues, the First 5-year Technology Plan outlined two missions. One was to procure the engineering manpower needed for the implementation of the plan. The other was to ratchet up technology for industrial growth and a productivity boost. Strategies to accomplish the aforementioned two missions were broken down into the following seven aspects. (1), (2) and (3) apply to the first mission and the others to the second.

(1) The supply and demand for technical manpower should be idientified. To this end, the number of technical professionals required for economic development is estimated. Compare the figure with the current local supply of manpower, and design measures to foster talent to meet future needs.

(2) Capitalize on the existing engineering talent pool to take part in economic development as much as possible and establish a plan to enhance its effectiveness.

(3) Cultivate technical talents by classifying them into engineers, technicians and craftsmen, with a strong focus on technicians.

(4) Provide practical education in the fields of science and technology to promote technology and relevant R&D activities.

(5) Introduce foreign technologies at an adequate level to meet the demands for economic development, and manage funding in a rational manner.

(6) Encourage dissemination of technologies to renew public awareness of technology.

(7) These missions and objectives call for a system to promote science and technology. To this end, introduce relevant regulations and create an administrative body and an agency.

In an effort to accomplish the fist mission, the status of technoical manpower was assessed and projections of supply and demand were made. The number of technical professionals in Korea was estimated at approximately 300,000. Engineers were defined as university graduates from science and engineering schools, technicians as those who had field experience after graduating from high school, and craftsmen as unskilled laborers. An in-depth look at the manpower by industrial sector produces interesting findings. Engineers were highly likely to work at public offices or schools and not many of them pursued a career in industry aside from construction. On the contrary, technicians and craftsmen were relatively evenly distributed across different industrial sectors. With the rise of the textile industry, many technical professionals were gathered in the area. Considering the industrial environment of the time, workers who had received vocational training played a more important role in the field, compared to those who had had higher education.

Table 2-1 | Technical Manpower by Fields

(Unit: people)

| Fields | Engineers | | Technician | | craftsman | | Total | |
|---|---|---|---|---|---|---|---|---|
| | head count | % | head count | % | head count | % | head count | % |
| Government offices | 1,273 | 14.8 | 742 | 6.7 | 14,335 | 5.1 | 16,350 | 5.5 |
| Science and engineering schools | 1,022 | 11.9 | 10 | 01 | 179 | 0.1 | 1,211 | 0.4 |
| Mining industry | 464 | 5.4 | 1,456 | 13.1 | 26,422 | 9.4 | 28,342 | 9.5 |
| Textile industry | 529 | 6.1 | 2,174 | 19.5 | 81,802 | 29.2 | 84,505 | 28.2 |
| Metalworking and machinery industry | 515 | 6.0 | 1,404 | 12.6 | 34,430 | 12.3 | 36,349 | 12.1 |
| Chemical industry | 743 | 8.6 | 1,424 | 12.8 | 41,005 | 14.7 | 43,172 | 14.4 |
| Other industries | 441 | 5.1 | 1,781 | 16.0 | 51,101 | 18.3 | 53,323 | 17.8 |
| Construction and service industries | 3,629 | 42.1 | 2,137 | 19.2 | 30,396 | 10.9 | 36,162 | 12.1 |
| Total | 8,616 | 100.0 | 11,128 | 100.0 | 279,670 | 100.0 | 299,414 | 100.0 |

Source: The First 5-year Technology Plan p. 12

The First 5-year Technology Plan estimated that the 600,000-strong manpower was in demand for the next five years. In 1961, the number of technical professionals was about 300,000, meaning it had to double in five years. The demand was especially higher in metalworking, machinery and chemical industries. Accordingly, subsidiary programs to expand technology training and industrial education were offered.

Table 2-2 | Projections for Technical Manpower (1961-1966)

(Unit: people)

| | Initial year (1961) | 1st year | 2nd year | 3rd year | 4th year | Target year (1966) |
|---|---|---|---|---|---|---|
| Mining | 28,342 | 39,449 | 43,845 | 50,130 | 56,355 | 61,902 |
| Textile | 84,505 | 90,710 | 108,434 | 131,393 | 133,005 | 134,938 |
| Metalworking and machinery | 36,349 | 59,722 | 61,343 | 77,631 | 100,993 | 120,836 |
| Chemical | 43,172 | 48,387 | 56,507 | 66,743 | 70,549 | 72,918 |
| Other manufacturing | 53,323 | 60,840 | 67,733 | 75,193 | 82,199 | 87,421 |
| tertiary industry | 53,723 | 70,328 | 80,302 | 93,542 | 10,667 | 123,748 |
| Total | 299,414 | 349,436 | 418,164 | 495,632 | 549,768 | 601,763 |

Source: The First 5-year Technology Plan p. 25

It is worth noting that the strategies placed high priority on training of technicians. Carrying out the Plan for the Economic Growth meant building grand-scale industrial facilities, introducing much machinery from overseas and running them. To this end, capabilities to build factories and operate facilities were considered essential. Therefore, the First 5-year Technology Plan specifically addressed people who were superior in skills and defined them as "technicians." Korea was in need of scores of technicians who had "more than two-year experience in the field after graduating from vocational high school," in order to build and manage factories on its own, backed by foreign capital.

On the other hand, the strategy to foster technical professionals in the First 5-year Technology Plan was necessary for earning the trust of foreign loan authorities. The government's strong commitment to incubating talent to build capacity of future workers in charge of constructing and managing industrial facilities could resolve doubts that USOM/K or DLF had in terms of Korea's technological abilities.

Education and training programs for future engineering talent yielded desirable results in 1966, a target completion year. Thanks to a particular success in running vocational night high schools, more than 600,000 technical personnel were estimated to work in the industry in 1966.

Beside the talent growth policy, another element worth looking at is that the Park Jung Hee administration drew up a blueprint for establishing a system to promote local technology in the First 5-year Technology Plan. Back then, Korea had no regulations in relation to science and technology and no bureau-level offices existed to address relevant issues within the government organizations. Enacting regulations and introducing an administrative system to promote technology called for an important national-scale decision. This was realized through the creation of the Bureau of Technology in EPB, the introduction of the 1963 Professional Engineers Act, the 1967 Science and Technology Promotion Act, and the establishment of the Ministry of Science and Technology in the same year (See Chapter 3, 4). The goals of the First 5-year Technology Plan were actually accomplished.

## 3. Presidential Initiative on Science and Technology[2]

A state-driven initiative on promoting science and technology in the initial stage of economic development was possible mainly due to the President's interest and support for the matter. In fact, President Park addressed pending issues regarding science and technology which were at a standstill as a result of interministerial disputes and provided his full support to science and technology. He spoke on numerous occasions in support of science and technology. The following remarks are an excerpt from the 2nd 5-year Science and Technology Plan.

2. This verse refers to the 2nd 5-year Science and Technology Plan. See ⟨Science President Park Jung Hee and Leadership⟩ (MSD Media), 2010, Co-authored by Kim Yeong Seop and 15 others.

Preface to the 2nd 5-year Science and Technology Plan

The history of civilization is the history of science and technology. Advances made in the field become a barometer in national strength. Needless to say, science and technology have led economic, social and cultural growth in many parts of the world and served as the foundation for developing national power. However, given that science and technology are about creativity and will that are exclusively found in mankind, science and technology should be advanced with the help of more specific individual commitment to providing back-up for the national development drive.

Now, we should fully tap into smart human resources to reform a backward system by promoting science and technology first and foremost.

To this end, it is imperative that the government consciously set and fulfill its goals. **This is why the 2nd 5-year Science and Technology Plan should be adopted as a national plan along with the economic growth plan.**

As you know, science and technology are genuine potential resources unlike natural resources that are limited by amount and location. They can be continuously developed as far as our wisdom and endurance allow.

I hope the following Science and Technology Plan will provide an opportunity to build on our legacy while serving as a driving force behind our national competitiveness and development of science and technology.

July 1966

President Park Jung Hee

From this excerpt, President Park indicates that he did not view science and technology simply as a means to an end. This is in stark contrast to many leaders today who consider science and technology as a tool to achieve economic development. In other words, Park regarded science and technology as the heart of cultural and historical progress. He was confident that science and technology will modernize Korea's backward culture.

His insight influenced high-ranking officials at EPB in charge of developing the 2nd 5-year Science and Technology Plan. In the preface of the plan, then EPB Minister Jang Ki Yeong stated "Science is a yardstick of national wealth." and "Advanced countries are those with science, but underdeveloped countries are those without." Jang added that the plan is designed not only to meet the demand for science and technology necessary for economic development, but also to pursue the development of science and technology themselves. In this context, the science and technology plan played a crucial role as a part of national development plan in the early stage of economic development.

President’s strong commitment to supporting science and technology gave great momentum to the plan for promoting science and technology. While the first round of the plan mainly focused on fostering human resources, the 2nd 5-year Science and Technology Plan emphasized expanding investment in science and technology. There are four goals that the Korean government sought to achieve through the investment in science and technology.

First, the government planned to build a self-sufficient economy based on the advancement of science and technology during the period from 1966 to 1980. To put it another way, it pinpointed science and technology as an internal factor in economic development while forecasting the economy for the next 15 years. The government predicted that if the level of national science and technology reached self-sufficiency, the South Korean economy would be able to thrive on its own without any technical assistance from overseas. In this context, the government appropriated 10 billion won a year for investment in science and technology. By today’s standard, the amount would barely cover a single large-scale research project. At the time, however, investing $20 million in science and technology required a make-or-break decision at the national level considering GNI per capita was only around $100.

Second, the government was eager to encourage inventions and make the most of achievements from research on science and technology to foster the industry. To this end, the government set a goal for each technology required to develop major industries and selected R&D projects. These projects were led by KIST established in 1996. Recognizing that it would take considerable amount of time for research achievements to drive the development of the industry, the government pointed out the need to make investment decisions from the long-term perspective. Under such long-term view, R&D investments increased dramatically afterwards. In fact, the total R&D investments exceeded 60 billion won in 1976 and reached 210 billion won in 1980.

Third, the government was keen to secure the nation’s best and brightest in the field of science and technology. Although there were a sufficient number of educated people within the country, Korea was struggling to stem brain drain due to a poor local R&D environment. To make the problem worse, even those within the country were not utilized at the right place at the right time. In a bid to tackle this problem, the government aimed at nurturing human resources at the national level by enhancing education and vocational training for science and technology. Two state projects were carried out to improve capabilities of human resources necessary to develop the industry. One was to support middle and high schools to build engineering laboratories, and the other was to help science and technology universities to establish laboratories. As in the first plan, the government also strived to increase the number of engineers. It laid out a plan to expand the number of engineers from 600,000 in 1965 to 1 million in 1971 and started to found more schools and increase education courses to produce the next generation of engineers.

Fourth, the government was determined to promote the outcome of technological cooperation with other countries. Under this goal, in particular, the emphasis was put on strategic and selective policies in adopting technologies. Until the beginning of 1960s, the adoption of overseas technologies depended on the decision of aid donors. In this regard, the fact that the Korean government rolled out the policy to introduce foreign technologies that meet the demand of the local industries meant that the government started to take control in technological cooperation. This would obviously result in rapid learning of technologies in the adoption and utilization of advanced ones.

Figure 2-2 | President Park Jung Hee Appoints Choi Hyeong Seop as the First President of the KIST

Source: Choi Hyeong Seop(1995), p. 57

One of the noteworthy state-led projects under such goals was inviting expert Korean engineers overseas to South Korea. Fostering talents in the field of science and technology required significant amount of time. The most effective measure to shorten the time was to invite Koreans who received high quality education in science and technology from abroad to their homeland. Accordingly, the government started a project to attract overseas talents with a Korean ethinic background. The invited scientists and engineers primarily carried out their R&D activities at KIST. The total number of invitees was only around 20 to 30 annually. Despite small numbers, they made a crucial contribution to strengthening the capacity of national science and technology by taking science and technology of the nation to the next level in a short period of time.

However, tapping into Korean scientists and engineers abroad was not an easy task. Park appointed Choi Hyeong Seop as the first president of KIST in 1966. Choi was a scientist who specialized in metal engineering. Park put Choi in charge of the project aimed at attracting overseas Korean talents who were willing to work at KIST. After putting such hard work, Choi finally came up with an idea to invite competent Koreans among those who went to study abroad in the 1950s. However, inviting Korean scientists and engineers living in the U.S. or other advanced countries at the time was very challenging. Above all, there was a significant gap between developed countries and Korea in terms of income of scientists and engineers as well as living standards. In order to overcome such challenges and attract talents, unprecedented favorable treatment was a necessity.

Choi laid out four plans to attract overseas Korean experts. The first plan was providing accommodations for scientists and engineers from abroad. The second was offering the U.S. health insurance for the invitees as there was no local health insurance plan in Korea at the time. The third was creating an educational environment for the children of the invited experts and providing supports to help them settle in the country. The last plan was paying a quarter of what they earned in the U.S. in Korean won since there were many who came from the U.S. Though the promised salary was far less than what they received in the U.S., it was still approximately three times higher than what professors at the national universities earned at the time.

As words spread out, his plan faced opposition from universities professors and public servants at home. Vested interests protested against his plan to give favorable treatment to scientists and engineers at KIST. Their opposition subsided with the decision made by President Park. Backed by the President, KIST researchers were able to receive special treatment as planned by Choi. The following box describes the related anecdote. The anecdote shows how much importance the President had put on the project to invite overseas talents.

Many Earn More Than the President

Dispute over salary did not end with this (protest from university professors). Complaints were submitted even to the President, and the Ministry of Science and Technology (MOST) seemed to have reported that the salary was too high. One day, the Blue House requested to bring salary schedule of KIST. After looking at the schedule, the President said "Well, certainly there are many who make more money than me" and laughed. So I said "Sir, if you believe it is unfair, you can reduce mine but not anyone else's". After examining the schedule for quite a while, the President said "Do as you please" and left.

(Choi Hyeong Seop, 1995: 58)

President Park emphasized not only scientists and engineers at KIST, but also skilled manpower. He encouraged engineers to put an effort to create a culture that values technology. In the picture below, President Park is shaking hands with a young engineer who entered the International Vocational Training Competition (IVTC). It was not just a political gesture. By publicly recognizing the importance of technology and skills, the head of the state delivered a message to people that a desirable image of Koreans in the future was a diligent engineer. This engineering-centered strategy under the economic development plan was spearheaded by technology and engineers.

President Park's investment in technological manpower led Korea to winning the first place at the IVTC in the 1970s. When Korean engineers received the top honor at the IVTC in 1977, President Park congratulated them, saying "Your top score at this critical juncture where we pursue an industry-driven economy has certainly boosted our morale in the hope of joining the ranks of advanced industrialized nations in near future." "In the past, there were times when our athletes took home medals from international sports competitions such as the Olympics. But I think the fact that young Koreans showcased their talent and ability in the heavy chemical industry sector at the IVTC bears major significance", he added (MK Business News, July 19, 1977).

Figure 2-3 | President Park Greets Korean Engineers Who Took Part in the IVTC

Source : e-video history (http://ehistory.korea.kr/)

Thanks to the President's renewed commitment to backing science and technology, the Ministry of Science and Technology, an exclusive body for promoting science and technology was founded in 1967. At the inauguration ceremony, the President vowed that the Ministry would play a critical role in developing science and technology with "great administrative power". As a "vehicle ushering in the era of science and technology", the Ministry received much expectation and concerns from the industry and science circles. The President appointed Kim Ki Hyeong as the first Minister of Science and Technology. Kim was a rising star in science, holding more than 40 patents in electronics and materials.

The nation's first Minister of Science and Technology, Kim Ki Hyeong demonstrated his leadership by bridging local industries and science circles. In 1968, he announced the Science Promotion and Investment Plan which prioritized the growth of the electronic and precision industries and the local development of core technologies required. The Plan proposed to provide technical support to industries while fostering self-reliance in Korea's science circles.[3] At the outset, one of the key functions of the Ministry of Science and Technology was to study demand for science and technology from each Ministry and coordinate relevant policies. To this end, Minister Kim worked closely with the EPB and the

3. "Electronic and Precision Industry-Centered Science Promotion and Investment Plan", ⟨Donga Daily⟩, June 5, 1968; "Focus on Localization", ⟨MK Business News⟩, July 19, 1968. However, the plan did not seem to turn out as intended, which may be attributed to trial and error made by the Ministry of Science and Technology on its initial stage of planning and implementing policies.

Ministry of Commerce and Industry to map out the specifics, serving his role as a mediator within Ministries.

On the one hand, President's leadership to promote science and technology reinforced the government's role as policy maker in the relevant area, stimulating science and technology. At a much broader level, his leadership changed public attitudes and behaviors. Demonstrating his leadership, President Park shared his national vision - to build a prosperous country through technology - with the Korean people. The result was scores of talented individuals pursuing careers in science and technology and a cultural revolution that recognized skills as important vocational ability.

## 4. STI Policies for Heavy and Chemical Industrialization

Presidential leadership to promote science and technology on a large scale increased public awareness that science and technology were national capabilities. A culture of poverty-ridden failure and looking down on technology gradually disappeared. Once many Koreans carried a positive attitude towards science and technology, rapid industrialization took place which prioritized technology and skills. Such change even triggered a shift in the structure of the industry. In the early 1970s, the Korean government announced its plan to shift from the light industry-centered structure to the heavy chemical industry-centered structure. This was marked by President Park Jung Hee's 1971 declaration on heavy chemical industrialization. The following is part of the excerpt.

(...) I will usher in an era of heavy chemical industrialization, revive the Miracle on the Han River on four rivers, have Korean exports reach the five oceans and modernize farming and fishing villages, making Korea join the ranks of the developed countries (...) (MK Business News, July 1, 1971).

After the goal of economic development was set as heavy chemical industrialization, the government's science and technology policies were drafted in line with the initiative. The 3$^{rd}$ 5-year Science and Technology Plan announced in 1971 advocated "technological innovation" and targeted on accomplishing heavy chemical industrialization.

Demand for the Development of Science and Technology

In order to achieve ambitious economic development in 1970s, there is a pressing need to develop new technology in line with a groundbreaking development in Korea's science and technology sector.

Up until now, businesses heavily relied on importing production facilities from overseas and receiving foreign aid. Now, they should produce new technology and products that can compete with other nations' products in global markets. To this end, major business strategy should focus on technology development. In 1970s, the introduction and learning of advanced technology and in-house R&D activities will become of great importance.

All these issues hint at the advent of the era which calls for technological innovation. In a response to this phenomenon, strategic growth in science and technology is in high demand. Under the constraint of limited natural resources, we should strongly pursue innovation-led industrialization. In particular, to compete with advanced nations and meet the current of the times in the world export markets, the nation's export structure is required to pivot on heavy chemical products such as machinery, ships and electronic goods. This can be done only through rapid progress in science and technology and technological innovation. Therefore, Korea should continuously keep its momentum for economic development by building up science and technology capabilities.

The 3rd 5-year Science and Technology Plan, 1971, p.9

President Park named Choi Hyeong Seop, former director of the Korea Institute of Science and Technology (KIST) to take the helm of the Ministry of Science and Technology to lead technological innovation initiatives for heavy chemical industrialization. As a trailblazer for Korea's science and technology in the 1970s, Choi expanded the nation's science and technology system and stepped up R&D efforts in the field. Since the early 1960s, Choi had built his expertise as a STI policymaker for science and technology while holding several key positions in the administration. He served as Minister of Science and Technology from 1971 to 1979, going down as the longest serving Minister in Korea's history of administration.

Behind his reputation as a respected advocate of science and technology was President Park's unsparing support. Under the auspices from the President, Choi designed a framework for STI policies and built the country's science and technology system with deep conviction. The following story illustrates how he became the longest-serving minister.

Talk with Park Jung Hee

After receiving a letter of appointment, I (Minister Choi) said "I have something to tell you" and the President said "Okay, have a seat". Even before listening to what I have to say, he said "It's difficult for us but you can always go back to the lab after serving in an administrative post. So keep it up for two or three years and go back to KIST". "That's what I was about to tell you. I see what you mean" I said and stepped out.

It has passed four years, being in the 5th year since I was in the Minister post but still there was no word from high-up. As I became a little bit anxious, I went to the Blue House, just in time for a progress report completed in my 4th year around December. I couldn't let go of the chance, I brought up the subject saying "It's been almost 4 years since I became the Science and Technology minister. I was hoping to go back to KIST". The President didn't say a word but stared into empty space. I had no choice but to back off.

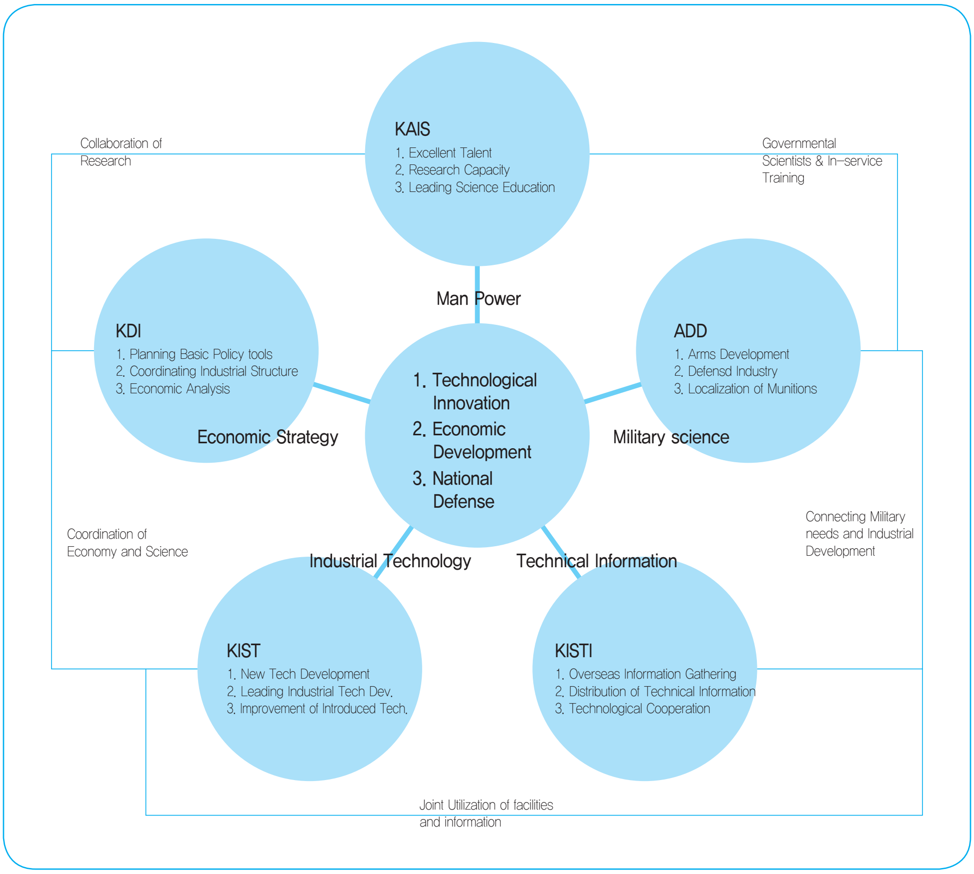
In the following January, the President made his annual tour to government departments. Sipping tea after a briefing, the President asked "Minister Choi, I have a question. You've always said we should make plans and carry out policies in science and technology in a consistent manner from a long-term perspective. Do you still stand by that conviction?" When I answered "Yes", he said "Then you should stay where you are and push your agenda without a second thought" and left. It was his answer for my remarks made in the year before.

〈The Institute Where Light Never Goes Out〉, pp. 218-219.

Minister Choi outlined STI policies with emphasis on the development of industrial technology to achieve the goal of heavy chemical industrialization. Under the policy agenda, the government was to focus on its R&D investment in developing industrial technology which was expected to utilize the national STI system built in Hongneung. The following diagram illustrates the structure of the Hongneung Research Park appeared in the 3rd Plan. At the time, Hongneung was home to the Korea Advanced Institute of Science (KAIS), the Agency for Defense Development (ADD), the Korea Institute of Science and Technology Information (KISTI), the Korea Institute of Science and Technology (KIST), and the Korea Development Institute (KDI). Minister Choi believed the five organizations should collaborate with one another to achieve technological innovation, economic development and the nation's self-defense capabilities.

As shown in the diagram, a cooperative system in the Hongneung Research Park was designed by function. KAIS fostered excellent STI talent, boosted research capacity and led science education. It supplied top-notch talent needed for the development of economy, technology and defense capabilities. ADD was in charge of arms development, defense industry research and localization of munitions. KISTI gathered information from overseas, distributed it to local think-tanks and facilitated international technological cooperation. KIST was responsible for developing new technology, leading industrial technology development, enhancing and improving introduced technology. Under this research structure, KDI mapped out economic strategies that aligned the goals for economic and science development. As described above, Minister Choi clarified the roles of key state agencies and facilitated interagency working, thereby integrating economic growth and the STI promotion.

Figure 2-4 | Structure of the Hongneung Research Park




Source: The 3rd 5-year Science and Technology Plan p. 29

Minister Choi sought to concentrate on STI policies to benefit the country's economic growth, a principle further elaborated in his theses "Industrial Study for a Developing

Country" (I) to (X) first published in 1973.[4] In the opening of his first paper, he expressed his view as follows.

"To achieve technological development needed for nation's economic growth, its growth goals, resources and capabilities should be taken into account in identifying key industries and strategic technologies. The ever-present problem is the balanced development of urban and rural areas in terms of industry and agriculture. Cutting-edge, specialized industrial technology for industrial growth should be accompanied by generic technology for income and employment growth in farming and fishing communities. Generally, specialized industrial technology is already developed and currently in use in advanced nations. It is challenging to produce such technology in a developing country with limited technical capabilities. This calls for a state vehicle to select and introduce advanced technology after fully considering local conditions and transfer its findings to the private sector."

The Hongneung Research Park was an early form of the state vehicle that Choi had illustrated. It connected the government and the private sector by elaborating on the country's economic and technology policies and providing the markets with a vision and future directions for industrial growth. Also, under KIST's initiative, the complex selectively introduced advanced technology from overseas, and provided private companies with technology required for industrial development, serving as a lead-in to foreign technology.

Looking to go further beyond the Hongneung Research Park, Minister Choi drafted a plan to construct an larger vehicle in charge of technological development. This was none other than the Daedeok Science Town, the future home to clusters of research institutes studying diverse industrial technologies. He planned to build ship research facilities in a bid to support the shipping industry, the core sector in the Plan for the Economic Growth, and to establish oceanography institutes for marine development. However, as the Hongneung Research Park lacked space to accommodate such facilities, Choi ended up mapping out a plan to construct the 2nd research complex, larger than Hongneung. The idea was proposed to President Park Jung Hee on January 17th, 1973. During a briefing attended by the President, Prime Minister, Deputy Prime Minister, ministers, presidential staff and Republican Party leadership, Minister Choi stressed a need to found and integrate research organizations to assist Korea's private sector that lacked technological development capabilities. Following Choi's remarks, President Park ordered Choi to elaborate on his plan to build another research complex.

4. Yeom Jae Ho, "Choi Hyeong Seop: A Trailblazer in Science and Technology", 〈Policymaker in a Transitional Period: Korea's Leadership〉 (Nanam, 1994) p. 103-134. Kang Mi Hwa, "Choi Hyeong Seop's STI Policies: 〈Analysis on STI Strategies of a Developing Country〉", 〈The Korean Journal for the History of Science〉 28(2) (2006), p. 297-328. referred for Choi Hyeong Seop's STI policy leadership.

Four months later, a draft plan for the construction of the 2nd research complex was delivered to the Blue House. The President, Prime Minister, Minister of Commerce and Industry, Minister of Construction, Chief Presidential Secretary, Senior Secretary to the President for Economy, Minister of Science and Technology and department heads were present at the briefing. The President approved the construction plan to establish the Daedeok Science Town during the meeting. The following is an excerpt from the construction plan reported to the President.

The Construction Plan for the 2nd Research Complex (draft)

Background and Need

A. To found research facilities specific to each industry technology of strategic importance in order to provide technical assistance to the heavy chemical industry.

B. To facilitate the public use of facilities by having a cluster of research institutes and to increase the effectiveness of investment

C. To form an intellectual think tank to allow for interaction among researchers and sharing technology information

D. To streamline research activities by having existing national testing labs and research institutes previously clustered in Seoul moved to the new research complex

E. To fully capitalize on management experience from the 1st research complex (Hongneung)

Roles of the Research Complex

A. Functions

(1) Vehicle for technological development

(2) R&D (Selective modification of imported technology)

(3) Provision of technical training and information

(4) Technical assistance for private companies

(5) Agency for technology introduction and distribution

B. Outcomes

(1) Preventing foreign dependence on technology

(2) Saving foreign currency by streamlining technology import channels

(3) Improving global competitiveness of domestic products through high-quality technology imported at low cost

(4) Securing and training a pool of engineers in science and technology to better cope with the era of heavy chemical industry.

(5) Building technology potential and capabilities for new product development

Ministry of Science and Technology, "The Construction Plan for the 2nd Research Complex (draft)", May 18, 1973.

Despite the President's approval, the efforts to build the 2nd research park in Daejeon met with opposition from other ministries. In the process of introducing the Support for Specific Research Institutes Act to back up the plan, some lawmakers and public officials in other ministries stood against several clauses in the bill, particularly tax break. The bill mandated tax incentives but during deliberation, many called for imposing local and state taxes on land, buildings and facilities of specialized research institutes. Also, some insisted on slapping tariffs on research equipment imported from outside the country. Against all the odds, the bill for Support for Specific Research Institutes Act was passed in its original form under the condition that in case of state secrets, local situations and circumstances should be taken into account.[5]

In this way, the contribution made by the Hongneung Research Park in economic and technological growth led to the construction of the 2nd research complex in Daejeon. Indeed, in the 1970s, a great number of government officials had some doubt about an urgent need for the Daedeok Science Town to promote industrial growth in the short term. In addition, they had to watch closely the Minister of Science and Technology gaining clout, as he got strong backing from the President. In fact, investing in science and technology at the time was a bold and far-sighted move which was well beyond addressing pending issues that lay ahead. Such insight created momentum for the high-tech industry in the 1980s.

5. 『Minutes from the 88th Meeting of the 14th Economy and Science Committee』, (December 12, 1973).

## 5. Conclusion

This chapter illustrates that Korea pursued the promotion of science and technology at the outset of economic development. It also highlighted the importance of the President's initiative as well as strategies and planning undertaken by leaders who contributed to STI development.

It is common knowledge that in a country with limited resources, the government selects a key sector to develop. However, as shown in this chapter, carrying out selective development is far from easy. STI promotion in Korea took place despite opposition from various stakeholders. The President and science leaders saw it as investing in the nation's future. But others who emphasized limited resources and put first priority on addressing pending issues believed that the idea of investing in science and technology was far-fetched. Without the strong support from the President, the promotion of science and technology in Korea may not have taken place. Whenever a new project was unveiled as per the Science and Technology Plan, and whenever the influence of the Minister of Science and Technology increased, so did opposition forces seeking to diminish the effect.

Nonetheless, a far-sighted approach to promoting science and technology consequently made a significant contribution to Korea's economic development. The fact that science and technology were tapped in line with needs of economic growth would be an understatement. It is true that science and technology met the technological demand of the time in terms of economic development. However, most of promotional projects in science and technology in the 1960s and 70s dealt with establishing a national science and technology system in the long haul, rather than fulfilling the economic demand of the time. The nationwide promotion sparked a cultural turn in the Korean society, which was a paradigm shift in the public perception of science and technology; people reconized science and technology may help them out of poverty. This fundamental change was a decisive factor that facilitated Korea's transformation from agricultural society to industrial society.

2012 Modularization of Korea's Development Experience
The Internalization of Science and Technology
in the earlier stage of Economic Development
in South Korea

# Chapter 3

## Establishment of Science and Technology Legal System


1. Professional Engineers Act
2. Science and Technology Promotion Act
3. Technology Development Promotion Act
4. Support of Specific Research Institute Act
5. National Technical Qualifications Act
6. Korea Science Foundation Act
7. Conclusion

# Establishment of Science and Technology Legal System

Since the 1960s, the Korean government tried to devise a legal framework on building national policies and systems that would serve as a foundation for the development of science and technology. As a result, more than ten laws were enacted over 15 years that primarily aimed at establishing a system to vitalize national R&D activities and industrial technology, and to nurture and utilize science and technology manpower. This required the Korean government at the time to clarify the national duty towards achieving self-reliance in science and technology and to establish an administrative and financial system for promoting science and technology.

**Table 3-1 | A Table of Laws on Science and Technology Enacted in Korea (1963-1976)**

| Law | Enact | Abolition | Enforcement Decree | Enforcement Regulations | Existing Law |
|---|---|---|---|---|---|
| Professional Engineers Act (Act No. 1442) | 63.11.11 | - | ○ | ○ | Professional Engineers Act |
| Act on the Support of the KIST (Act No. 1857) | 66.12.27 | 80.12.30 | ○ | × | Korea Advanced Institute of Science and Technology Act |
| Science and Technology Promotion Act (Act No. 1864) | 67.1.16 | 01.1.16 | ○ | × | Framework Act on Science and Technology |
| Act on the Support of Korea Scientific and Technological Intelligence Center(Act No. 2109) | 69.5.19 | 81.12.31 | ○ | × | Act on the Establishment, Operation and Support of Government-Funded Science and Technology Research Institutes |
| Korea Advanced Institute of Science Act(Act No. 2220) | 70.8.7 | 80.12.31 | ○ | × | Korea Advanced Institute of Science and Technology Act |
| Technology Development Promotion (Act No.2339) | 72.12.28 | 11.5.24 | ○ | ○ | Industrial Technology Innovation Promotion Act |
| Korea Atomic Energy Research Institute Act (Act No. 2443) | 73.1.15 | 06.12.26 | ○ | × | Act on the Establishment, Operation and Support of Government -Funded Science and Technology Research Institutes |
| Technical Services Support Act (Act No. 2474) | 73.2.5 | 92.11.25 | ○ | ○ | Engineering Industry Promotion Act |
| Support of Specific Research Institute Act(Act No. 2671) | 73.12.31 | - | ○ | × | Support of Specific research Institute Act |
| National Technical Qualification Act (Act No. 2672) | 73.12.31 | - | ○ | ○ | National Technical Qualification Act |
| Korea Science and Engineering Foundation Act (Act No. 2943) | 76.12.22 | 09.3.25 | ○ | × | Korea National Research Foundation Act |

Source : Korea Ministry of Government Legislation (www.law.go.kr)

This chapter focuses on six laws that were pivotal in the establishment of Korea's science technology system among the laws that were enacted during this period, and examines the process of their enactment. The study aims to consider the significance of each law in the establishment of Korea's national science technology system.

## 1. Professional Engineers Act

It was in February 1962 when the Korean government first publicly announced its determination to develop a legal framwork for science and technology. The Economic Planning Board (EPB) proposed the first Five-year Plan for Technology Promotion as a way to efficiently achieve the goal of the first Five-year Economic Development Plan. According to the first Five-year Plan for Technology Promotion announced at the time, securing human resources in engineering and qualitative enhancement of technology standards were the most pressing challenge in carrying out the Economic Development Plan. Accordingly, the EPB considered revising laws and systems related to promotion of technology, and installing institutions as an essential step towards achieving the long-term goals of economic growth and technology promotion.[6]

The idea that promotion of science and technology would provide the foundation for economic independence was supported widely by not only science and technology experts, but the entire Korean people, and this enabled the plan to be passed at the National Assembly Standing Committee in a relatively short period of time. In particular, President Park Chung-hee, the Chair of the Supreme Council for National Reconstruction ordered all necessary legal matters related to projects included in the first Five-year Plan for Technology Promotion to be completed by December 31 of 1962.[7] As a result, the EPB pursued the enactment of the Professional Engineers Act, Science and Technology Promotion Act, and the Vocational Training Act by launching the Drafting Committee on Acts Related to Science and Technology Promotion, composed of 26 persons led by Lee Bong-in, to carry out the first Five-year Plan for Technology Promotion in September of the same year.[8]

Considering the Korean government at the time relied more than 40 percent of national finances on counterpart funds, the Professional Engineers Act was an indispensible legal action in achieving self-reliance in science and technology. In particular, the AID project which was accountable for more than 30 percent of external aid projects for Korea in the 1960s provided momentum for such laws. In order to continuously receive benefits

6. Announcement of the Five-year Plan for Technologyx Promotion, Donga Ilbo, 1962.2.6.

7. First Five-year Plan for Technology Promotion, pp. 9-10, Minutes of the Supreme Council for National Reconstruction, 1962.5.31.

8. Establishment of the Professional Engineers Act, p. 4, The Kyunghyang Shinmun, 1962.10.8.

from AID projects, an economic and technological validity report had to be written and submitted by a team of technicians that AID recognized. Unfortunately, as there were not many engineers who could write and submit such a report in Korea at the time, the government had no choice but to employ mostly American technicians for this task. The commission costs that were paid to American technicians took up a considerable amount of the Aid budget. Therefore, the EBP came up with the Professional Engineers Act not only to efficiently operate AID projects, but also to build a system which certified the qualifications of home-grown technicians to avoid the strict technological inspection procedures of the American technicians team.[9]

The bill for the Professional Engineers Act, which began with the composition of the Drafting Committee on Act Related to Science and Technology, was completed at the end of November of the same year. The initial bill was composed of eight chapters and 41 articles, among which the most important were the provisions set out in “Chapter 3. Examination”, “Chapter 4. Tasks”, and “Chapter 5. Professional Engineers Management Board”.[10] The initial bill required applicants to take the Engineers Examination to have completed a bachelors-degree program in a relevant science technology field and to have professional knowledge in the field. Additionally, they had to have at least seven years of practical field experience in relevant professional fields based on such knowledge and learning. The examinations were composed of a written exam for each different field, a test to design and write a proposal, and an interview. Special emphasis was placed on the oral interview as it would be an assessment of the applicants’ experience and characteristic qualities that could not be evaluated through written tests.

Next, in order to efficiently utilize professional engineers in government’s policy projects, their responsibilities were regulated by law. Pursuant to the bill, professional engineers could undertake technological tasks of technical service projects operated by a government-managed company, in relation to long-term economic development or attracting foreign investment and trading, and other important public good projects under the order of the Minister of the EPB. By identifying the 14 professional areas subject to the law (agriculture, marine, forestry, electric, machinery, chemical, textile, metal, mining, shipping, aircraft, civil engineering, production management, and applied science), the bill tried to fully utilize technicians in each industrial sector. The Drafting Committee on Act Related to Science and Technology Promotion also included a provision to install the Professional

9. Lee Bong-in, My Brief History in Technology, p. 89 out of pages 31(6), 83-90, Korean Society of Civil Engineers.

10. Economic Planning Board (EPB), Professional Engineers’ Bill, June, 1963. The bill is composed of “Chapter 1. General Provisions”, “Chapter 2. Registration”, “Chapter 3. Examinations”, “Chapter 4. Responsibilities”, “Chapter 5. Engineers Management Committee”, “Chapter 6. Korea Engineers’ Society”, “Chapter 7. Penalty”, and “Chapter 8. Supplementary Provisions”.

Engineers Management Board in the EPB to effectively operate a system for examinations and managing talent. The Professional Engineers Management Board was entrusted with examination management, registration of applicants, and suspension of qualifications of professional engineers.

But in the process of coordinating diverse opinions of related government departments to make the bill into a law, the EPB faced an unexpected problem. Jeon Sang-geun, government official of the EPB at the time, reflects: "When we were devising the law, we intended to integrate qualification laws on technologies and functions independently conducted by different ministries and to enact a comprehensive act that would provide the criteria for engineers qualifications."[11] The idea that aimed to unilaterally manage the qualification examinations for an extremely broad technology field at a time when each ministry already had its own unique system to acknowledge the qualifications of engineers triggered a criticism of the EPB. Ministries, such as the Ministry of Education, Ministry of Commerce and Industry, Ministry of Agriculture and Forestry, and Ministry of Communication claimed that the vested interests of telegraphic and fixed-line engineers, telephone and fixed-line engineers, publishing and fixed-line communications companies had to be respected.

In particular, the Ministry of Construction believed the Professional Engineers Bill infringed on the Certified Architects Bill that the Ministry was trying to enact at the time. Architects also opposed to the new bill, claiming that construction was an area which required not only elaborate design skills, but also administrative capabilities that could deal with various regulations to acquire construction approvals. They also claimed that a design itself was an aesthetic concept while construction was a creative activity that went beyond applied skills. But underneath such claims lay concerns that the level of qualifications required by the Professional Engineers Bill was so high that the architects certified by the Certified Architects Bill would hardly be qualified under the new bill, which could have negative effects on construction design service and authorization process that had been monopolized thus far by architects. On the other hand, the EPB adamantly adhered to the idea that as civil engineering and construction took up a large share of technical services at the time, the the new law would have limited impact and the original intent of the bill would not be fully fulfilled, in case that the new bill were to exclude the construction field.

It was only during the Cabinet Meeting held on August 23, 1963 that the two government departments were finally able to break away from the deadlock and reached an agreement. The EPB partially accepted opinions of the Ministry of Construction, thus initiating the legislative progress for the Professional Engineers Bill. The amended bill included the structural design of buildings, but other construction designs were overseen by the Certified

11. Jeong Sang-geun, Korea's Science and Technology Policies : A Policymaker's Testimony, p. 139, Jeongwoosa, 1982.

Architects Bill, thereby partially acknowledging the service range and vested interests of existing architects. Meanwhile, the Professional Engineers Bill stipulated the areas that it would be applicable to, such as determining that plant engineering services, which was expected to increase in line with the sophistication of the industry, would be under its jurisdiction rather than the Certified Architects Bill.

The Bill was passed at the Supreme Council for National Reconstruction on October 31 and announced as Law No. 1442 on November 11. This was 14 months after the Drafting Committee on Act Related to Science and Technology Promotion first devised the bill. The bill that was proclaimed into law on this day did not differ significantly with its original draft. However, with classifying “civil engineering” into the categry of “construction” among the 14 professional areas, the scope of the subcategories were reduced. Production management, which was set out separately in the original draft, was transferred under “Applied Sciences”, and “Mining” was deleted, culminating in the following 12 professional fields that would be subject to the Professional Engineers Act.[12]

**Table 3-2 |** A Table of Science and Technology Professional Fields Pursuant to the Professional Engineers Act

| Science and Technology | Professional Fields |
|---|---|
| Agriculture | Animal Husbandry, Agricultural Chemistry, Agricultural Engineering, Sericulture, Plant Protection |
| Fishery | Fishing, Fishery Processing |
| Forestry | Forestry, Forestry Product |
| Electric | Generation, Transmission & Distribution, Electric Equipment, Electric Application, Electronic Communication, Electronic Application. Electronics Stuff |
| Machinery | Workshop Practice, Motor, Precision Instrument, Vehicle, Fluid Machinery, Air Conditioning and Heating Equipment, Refrigerating Machine |
| Chemical Engineering | Chemical Fertilizer, Ceramic Industry, Medicine, Chemicals, Fuel and Lubricant, Plastic, Electrochemical Industry |
| Textile | Spinning, Weaving&Braiding, Dyeing&Textile Finishing |
| Metal Work | Ferrous Metallurgy, Nonferrous Metallurgy, Metallic Material, Metalworking Process, Surface Treatment, Metal Mold Casting, Mineral Dressing |

12. Asterisk 1. A Table on the Professional Fields in the Science and Technology Sector, Enforcement Decree of the Professional Engineers Act, Presidential Decree No. 1819, 1964. 5. 27.

| Science and Technology | Professional Fields |
|---|---|
| Ship | Shipbuilding, Vessel Engineering |
| Aircraft | Airframe, Power Unit, Air Equipment |
| Construction | Soil Analysis&Foundation Work, structure, Harbor Construction, Road Building, Railroad Work, Erosion and Torrent Control, Water Pollution Control, Wastewater Treatment, City Planning, Regional Planning |
| Applied Science | Mathematics, Physics, chemistry, Geophysics, Geology, Biology, Production Management |

Source: Professional Engineers Act

With the enactment of the new Act, the Professional Engineers System created opportunities for domestic engineers to participate in national economic development projects. The Park Chung-hee administration launched the Engineers Management Committee and conducted the first Engineers Examinations in 1964. The Committee nominated 115 figures from a technical community as members of the examination board to prepare for the exams. A total of 557 persons applied for the exams with a concentration on fields with high social demands, such as 200 applicants for construction, 103 for electricity, 75 for machinery out of 13 science and technology fields. There were 67 successful candidates with 20 in the construction sector, 15 in electricity, 7 in agriculture and 4 in mining. At a time when the Park administration was pursuing the economic development of Korea, a system to enable the active participation of domestic quality engineers was institutionally set in place.

## 2. Science and Technology Promotion Act

In accordance to the first Five-year Plan for Technological Promotion passed at the 39th Supreme Council for National Reconstruction on May 21, 1962, the Technology Management Division was elevated to the Technology Management Bureau as the administrative body that would be entrusted with the implementation of this plan. Its first task as a Bureau was to devise a legal framework on science and technology that would be a unified guide to dramatically promote science and technology. Based on the agreement reached with the Drafting Committee on Act Related to Science and Technology Promotion, the Bureau devised a Science and Technology Promotion Bill composed of 24 provisions in April 1966. This bill established an administrative system that covered three sectors of Human Resources Development, Research and Development (R&D) and Technical Cooperation, installed the Science and Technology Promotion Committee, and allocated more than 0.1 percent of the government's total budget to the Science and Technology Promotion Fund.

With the implementation of the Professional Engineers Act, the Korea Industrial Development Center, a juridical foundation for technical services, was set up, and Republican Member of the Korean National Assembly Lee Jae-man was inaugurated as its Chairman. As one of the representative figures to welcome the enactment of the Science and Technology Promotion Act, he emphasized that this was a long-term aspiration of the science and technology community in “Industrial Technology”, a journal published by the Korea Industrial Development Center.[13] Upon hearing that the EPB was proceeding hastily with the legislative process of the bill, Lee proposed to the EPB that as a legislative member, he would motion the bill and proceed with deliberation of the bill. Given that procedures for government-motioned bills were much stricter than member-motioned bills, the EPB decided to accept his proposal, and as a result, the bill was introduced to the National Assembly Committee on Finance and Economy jointly by Lee Jae-man and 12 other legislators in 1966.[14]

Lee explained the proposal for the Science and Technology Promotion Bill during the fifth meeting of the 57$^{th}$ Committee on Finance and Economy on June 30, 1966, and Lee Jinsu, Chief Counsel, was the rapporteur for deliberation of the bill. Claiming that science and technology could make a greater contribution to economic development than capital, Lee appealed that “the acquisition of technology is a short-cut to national economic development”. He further stressed that “without mentioning various foreign cases where the country is fully committed to science and technology promotion or R&D investments whose volume is more than hundreds of times greater than our total national budget, Korea is in a wretched state without even a basic act on science and technology promotion.” Korea could not be compared to advanced countries where the Science and Technology Promotion Committee within the legislative body and the Ministry of Science and Technology within the administrative body were working hard to establish a national science and technology system. This was why he believed that the country needed more this Act than an institutional or administrative procedure.[15]

Lee Jinsu, the Chief Council responsible for deliberation of this bill, said, “Considering that science and technology promotion is not effectively carried out in Korea, there is a need to slightly push the development of this field through laws such as the Science and Technology Promotion Act” and basically agreed to the need to establish a legal framework to promote science and technology. But he pointed out that the draft bill had some problems. First, the

13. Lee Jae-man, A Word to the Reader, p. 1, Industrial Technology, 1 (1), Korea Industrial Technology Development Center, 1966.

14. A Study and Analysis of Major Factors that Influenced the Enactment Process of Korea's Science and Technology Policies, p. 5, Ministry of Science and Technology, 2005.

15. Lee Jae-man, Explanations on the Science and Technology Promotion Bill, Minutes of the fifth meeting of the 57th Committee of Finance and Economy, 1966.6.

biggest problem was that the new bill was excessively binding on administrative policies and would likely infringe on other acts already in effect. The second was the lack of detailed regulations regarding a comprehensive research institute. At the time, the establishment of the Korea Institute of Science and Technology (KIST) was underway with assistance from the U.S. government, but the fact that the draft bill did not have any specific provisions on its relation with KIST had potential risk of further disputes regarding the future application of the bill. Lastly, he pointed out the matter of fixing figures as the provision regarding the allocation of 0.1% of the country's budget for science and technology funds in Article 15 could create future administrative problems in the budget and should be amended.[16]

In the end, the EPB reflected Lee's report and amended the bill, which was comprised of 18 provisions in total. Provisions such as "Article 3. Policy and Encouragement", "Article 5. Installation of a Committee", "Article 8. HR Development Council", "Article 12. Installation of a Science and Technology Foundation", and "Article 13. Guidance of Technology Dissemination" were either partially or entirely deleted. The Subcommittee on the Deliberation of the Science and Technology Promotion Bill re-deliberated the revised bill. National Assembly Members Lee Nam-jun, Kim Woo-kyoung, Kim Nam-hong, and Kang Seon-gyu were appointed as Members of the Subcommittee ,and the deliberation was concluded chaired by Kim In-sik.

Noting that Lee Jae-man had originally motioned the bill, and Lee Jin-su deliberated it, Kim In-sik acknowledged that "Despite the fact that enhancement of science and technology is of utmost importance in achieving national economic development, Korea has weak policies in promoting science and technology, and therefore it is essential that we come up with related policies through this legislative process." The Subcommittee then recommended that all Members of the Committee on Finance and Economy accept and actively support the amended bill. Kim, however, did point out that several issues such as permitting subsidies and tax exemptions regarding research activities were incomplete in legislative terms, and recommended that the bill be recognized as an alternative plan in progress and later be complemented.[17] As such, despite various problems that emerged in the process of legislation, the fact that this bill could be passed shows not only the comprehensive understanding, both socially and politically, of the need for a Science and Technology Promotion Act, but also that it was the most important bill to build Korea's national science and technology system.

16. Lee Jin-su, Senior Counsel's Deliberation Report on the Science and Technology Promotion Act, Minutes of the fifth meeting of the 57$^{th}$ Committee of Finance and Economy, 1966.6.

17. Kim In-sik, Deliberation Report to the Subcommittee on Science and Technology Promotion Act, Minutes of the thirteenth meeting of the 57$^{th}$ Committee of Finance and Economy, 1966.

As a result, the Science and Technology Promotion Act came into effect on January 17, 1967 after being passed at the National Assembly Committee on Judiciary and Legal Affairs and the Plenary. The Act that was proclaimed into law was comprised of 15 provisions. It integrated two provisions of installing and organizing the Science and Technology Promotion Committee into one, deleted the provisions on the installation of research institutes and capital that could create confusion with the establishment of KIST, and removed provisions on tax measures. It can largely be summarized into the following four sections: First, the Science and Technology Promotion Act aimed to add consistency to the policies that had been dispersed and pursued unsystematically before then. Second, it provided matters regarding the establishment of an administrative system for the design and implementation of comprehensive basic policies and plans. Third, it installed the Science and Technology Promotion Committee to provide the Minister of Science and Technology Agency advice on basic policies, budget planning, and promotion of science and technology. Lastly, it provided legal grounds for setting up policies and administrative systems that aimed to efficiently develop human resources in the science and technology fields. In consequence, Korea's first legal framework to build the science and technology system was born.

## 3. Technology Development Promotion Act

In the 1970s, domestic companies neither engaged in active research and development nor had proper facilities to do so. Most of them were fully dependant on advanced technology imported from abroad. One of the support policies to facilitate private technology development was the Technology Development Promotion Act.[18] This was the first law proposed by Ministry of S&T in the advent of the 1970s, and it was as a result of demands from the Office of the Prime Minister in April 1971, prior to the inauguration of Minister Choi Hyeong-seop. Kim Jong-pil, then Prime Minister, urged the EPB and Ministry of S&T to create detailed provisions to achieve the goal of "maintenance of high growth and take-off as an export-importing country through technological innovation", which supplied a background to the Technology Development Promotion Act.[19]

An examination of reasons for the proposal of such act reveals how the government assessed domestic conditions for technological development. In the early 1970s, the government's policy projects for technology introduction were operated inefficiently due to its pluralistic and dispersed system. Additionally, as the global economy progressed towards an integrated system, the country was not only mired in difficulties as a least developed

18. Kim Jeong-sik, Explanations on the Technology Development Promotion Act, Journal of the Korea Society of Mechanical Engineers, 14 (2) p. 106-108, 1974.

19. From Patent Bureau to Patent Service, Plans for the Science and Technology Promotion Act, Maeil Economy, p. 3, 1971.04.09.

industrialized country, but development in various industrial technologies were meager as a result of limited funds. In a bid to address the situation, the Ministry of S&T came to devise the Technology Development Promotion Act in order to "facilitate independent development of all kinds of industrial technologies and the introduction, absorption and improvement of appropriate advanced technologies to reinforce the international competitiveness of the industry and enhance peoples' lives."

What were the problems that were directly related to the Technology Development Promotion Act? According to the Technology Development Promotion Bill, the technological gap between advanced countries and Korea was increasing continuously due to the lack of a system to induce industrial technological development. Second, although there was almost no accumulation of technology, little effort was made in adopting advanced technologies, and even if a few did attempt to introduce technology with great difficulty, they mostly failed to absorb and improve them, thus making little difference. Third, laws related to the introduction of technology were pluralized and certification procedures complicated, which also caused any expectations for the adoption of technology to be very low. Fourth, the Foreign Capital Inducement Act, which regulated all matters regarding technological introduction, gave prominence to the management of foreign currency and did not have any policies or follow-up management to promote the appropriate adoption of technology. In contrast to other countries, Korea's Foreign Capital Inducement Act acknowledged the introduction of capital goods on a turn-key basis and authorized technical services as capital goods. Therefore, there were many cases that used this previous government's policy to facilitate foreign capital investments to their advantage and acquired authorization for technical services that could be carried out locally. This impaired fostering of domestic technical services and nationalization of technical services, and created a huge waste of foreign capital. Furthermore, the Foreign Capital Inducement Act had been enacted prior to the installation of the Ministry of S&T, and thus, in order to efficiently pursue introduction of technology to Korea after the commencement of the Ministry of S&T, a new law had to be made.[20]

Not long after work began on the writing of a new bill in cooperation with the EPB, Choi Hyeong-seop, Minister of the Ministry of S&T, managed to designate the Ministry of S&T as a major institution to implement the Technology Development Promotion Act. In the Technology Development Promotion Bill that was completed on September 20, 1971, the S&T made it clear that the Ministry intended to expand its position and unilaterally manage the pluralistic introduction of technology. A close examination of the detailed provisions revealed two items that could potentially become critical problems. First, it tried to place overall industrial property rights, the rights regarding introduced technology, under the

20. Technology Development Promotion Bill, p. 1-6, Ministry of S&T, 1971.9.20.

management of the Ministry of S&T. There was also a provision to transfer the Patent Office, which was installed as an external agency of the Ministry of Commerce, under the authority of the Ministry of S&T. At the time, companies wanting to bring in foreign capital were required by law to acquire authorization from relevant ministries. But the new bill stipulated the Minister of S&T as the highest decision-maker in all foreign capital investments. In other words, through the bill, the Ministry of S&T tried to transfer every function related to the introduction of technology in other ministries to the Ministry of S&T, and thereby, create a new science and technology policy system.

Two days after the bill was submitted, a deliberation council was held in the Ministry of Commerce on September 22, where they discussed these two issues in great depth. Deciding that trademarks were not a type of technology and that the introduction of designs did not have the sophistication potential to adopt the technology itself, the Ministry of Commerce requested to include "with an exception of designs and trademarks" after the word "industrial property rights" in one of the provisions which defined introduction of technology as a "transfer of industrial property rights and other technologies" under Article 2. This was applicable to the rest of the bill. In addition, in the provision of Article 12 regarding the authorization of a contract to introduce technology, the Ministry of Commerce wanted to include the requirement of acquiring opinions of related ministers not only for the authorization, but also for the conclusion, renewal and amendment of the contract in order to keep the Ministry of S&T Minister's exclusive authority in check.[21] As such, the Ministry of Commerce opposed strongly against its intention to transfer the Patent Office as an affiliated agency of the Ministry of S&T, and separated industrial property rights from designs and trademarks since they were cautious about granting the Ministry of S&T the right to intervene in all matters regarding new technology and utility models. This was an example of conflicts between the Ministry of Commerce and the Ministry of S&T regarding which ministry should be entrusted with the government's policies regarding the introduction and development of technology and industrialization.

This conflict continued until May 1972, about one year after the bill was completed. On May 22, 1972, the Ministry of S&T finally acceded to the Ministry of Commerce and submitted a revised bill, amending the definition and the provision regarding the participation of related ministers in the authorization of technology introduction. But this time, another problem came up: the provision which stipulated support in terms of tax and financial assistance to technology developing companies in order to encourage the absorption of foreign technology and self development of technology. Besides, the matter of transferring the Patent Office remained unresolved. In the end, there was a re-coordination

21. Kim Hee-so, Opinions on the Technology Development Promotion Bill, 1971.9.27.

among related ministries when the bill was tabled in the Economic Deputy Ministers' Meeting held at the end of May.[22]

Facing strong opposition from the Ministry of Commerce, Choi removed the matter of transferring the Patent Office and drastically reduced the provision of support for investments. The revised bill was finally submitted to the Cabinet Ministers' Meeting and passed on July 11, 1972.[23] The Ministry of S&T had no choice but to reduce its original plan, but it was still significant as they had agreed to install the Technology Development Deliberation Committee. Despite opposition from related ministries, the Ministry of S&T could install the core agency that would support the introduction of technology of domestic companies while deciding on major matters regarding technological development and introduction of appropriate technology.

Immediately after the enactment of the Technology Development Promotion Act, however, on July 21, 1972, the Korea-Japan Cabinet Ministers' Meeting on the signing of a treaty to protect the two countries' industrial property rights was held, and the entire Korean economy, industry and science and technology community in Korea paid close attention. This was a critical matter regarding the payment of royalty by Korea to Japan for introducing Japanese technology to Korea and developing domestic technology. In particular, the Japanese government's efforts to protect their industrial technology was well known in Korea, and there was great concern that as a result of the treaty, it would swamped by Japanese patent applications which would cause a huge loss to the Korean government.[24] The meeting resulted in a grace period until 1974 when both countries would start to protect industrial property rights with mutual patent applications. With this, the government complemented related laws and in particular, ordered the Ministry of S&T to come up with measures to support facilitation of technological development.[25]

This lead to a revision of the provisions on financial assistance to the adoption of technology, which had been previously reduced due to the opposition of related ministries. More specifically, the arbitrary provisions on the installation of a Technology Development Fund was made mandatory, and tariff discounts, product tax breaks, and depreciation on test research equipment were proposed.[26] At the time, there were even discussions at the National Assembly claiming that "given the current situation, the obligatory provision

22. Delay in the Technology Development Promotion Act, p. 5, Maeil Economy, 1972. 05. 22.

23. Decisions to Enact the Technology Development Promotion Act, p.2 Khyunghyang Shinmun, 1972.7.12.

24. Proposal of Economy Sectors: Too Early for Korea-Japan Industrial Property Rights, p. 3, Donga Daily, 1972.07.10.

25. Haste in Technology Development according to year-end signing of Korea-Japan Industrial Property Rights, p. 3, Kyunghyang Shinmun, 1972.09.07.

26. Stronger Support in Tax and Finance, p.1, Maeil Economy, 1972.09.11.

should be drastically increased",[27] which clearly demonstrated the concern policy makers had regarding the economic and technological impact of the Korea-Japan Industrial Property Rights Protection Treaty.

The Technology Development Promotion Act was finally proclaimed into law in December 1972, after numerous changes were made to the original version. The media evaluated the bill as "the science community's harvest for 1972" and "establishing the foundation for technological development". Industry expectations on government technological development assistance peaked.[28] This achievement reflected Choi's determination to establish the Ministry of S&T as the administrative institute in charge of comprehensive coordination of such matters, in a situation where all sectors believed huge changes in the international industrial society regarding industrial property rights could act as a risk for the domestic industrial community. Through this Act, which was the first bill that he managed to pass after coming into office, Choi managed to ensure that the Ministry of S&T could standardize and coordinate all matters regarding the introduction of technology and thereby build the foundation for the enactment of related bills led by the Ministry of S&T.

## 4. Support of Specific Research Institute Act

Choi Hyeong-seop tried to overhaul Korea's national R&D system so that KIST, where modern R&D was underway, could lead the system. During the early 1970s, the government believed it needed a more specified, specialized research institute in order to focus on fostering the heavy-chemical industry. This led to proposals to build a new research complex, and upon assuming office as Minister of the Ministry of S&T, Choi began to devise plans for a new complex. This idea soon took shape as the construction of the Daeduk Innopolis, and the enactment of the Support of Specific Research Institute Act was discussed to provide institutional support to research institutes that would move in to the research complex.

Early ideas on building a huge research and education complex can be found in the Science and Technology Development Master Plan that was established in 1968, immediately after the commencement of the Ministry of S&T. This idea originated from the belief that allocating numerous research institutes in a certain area to enable the joint use of personnel and facilities would lead to the maximization of research results and efficiency in

27. Huge Revision by National Assembly, p. 5, Maeil Economy, 1972.09.22.

28. (Photo) Technology Development Promotion Act, A Harvest of the Science Community for 1972, p. 5, Maeil Economy, 1972.12.22).

nurturing research personnel.[29] The Master Plan claimed to review the creation of a research and education institute with a long-term vision of building a country with scientific prowess in the 1980s, but it was criticized as a simple list of science and technology policies of advanced countries without detailed policy goals and in the end, came to nothing.[30]

In October 1970, the Ministry of S&T consigned a study and research project entitled a "Master Plan for the Development of Research & Education Park" to the Economy Science Council. In the introduction of this report, Lee Deok-seon, research project manager, reveals the reality the Korean industrial community faced and the understanding of policy makers at the time. He wrote, "the labor-intensive Korean industry is now at a turning point where fundamental change is inevitable", and stressed the need to conduct R&D to evolve into a technology-intensive industry and educate and train personnel.[31] After this report was submitted to the Ministry of S&T in July 1971, it had an enormous impact on designing a concept for the Daeduk Innopolis and shaping of a basic framework to construct the complex.

This report was a kind of a policy research in order to draw up a basic plan to create a large-scale research and education complex. Lee revealed that the creation of a research and education complex where joint research and sharing of facilities would be possible would enable the efficient promotion of R&D projects. He also evaluated that building a complex and transferring or newly installing national and public test research institutes, universities and other science and technology agencies in a location well-distanced from densely populated cities would enable rational investments in research and education facilities. The report was largely composed of four sectors: the first was a research to benchmark the location and environment of education or science cities of advanced countries, and the second was a study on the environment of Korean research and education facilities near metropolitan areas. Then, he wrote about the master plan for the research and education complex and lastly, proposed measures to construct such complex.

The most important part of this report was his conclusion on the study of the location and environment of domestic research and education facilities. Based on this report, he claimed it would be more advantageous to the country to build the complex in a location that was outside metropolitan areas. The fact that a majority of domestic national and public research institutes were already dispersed around Seoul and its surrounding regions and that their sites were small and most of their facilities run-down formed the basis of his claim.

29. 1973-2003, Thirty Years of Daeduk Innopolis - the Cradle of Science and Technology, p. 62, Daeduk Science Town, 2003.

30. Groundwork for Science and Technology in the 1980s: A Glance at the plan which took two years in the making, p. 5, Kyunghyang Shinmun, 1968.12.28.

31. Lee Deok-sun, Master Plan for the Development of Research & Education Park, 1971.

Furthermore, the fact that the research environment was aggravated due to city pollution, including noise, vibration and air pollution, because they were located within city centers could not be ignored. They were also restricted from expanding their sites because of nearby residential and commercial areas, and the lands the institutes were built on were expensive, more than 40,000 Korean Won per pyeong (3.3 square meters) on average. As a result, the report concluded that selling the lands they were built on and moving to a cheaper, better environment would not only improve the research environment, but also be more reasonable in terms of acquiring funding. The writer called for the immediate installation of the Research and Education Park Construction Committee and the Research and Education Park Construction Center, chaired by the Prime Minister, to pursue the construction of this complex if the government agreed on his proposal. He also proposed the enactment of a Research and Education Park Construction Act and special accounting procedures for the complex, and the installation and operation of an integrated contact office for national and public test research institutes in Seoul to support this project.

After Choi was inaugurated as the Minister of Ministry of S&T in June 1971, this Master Plan was selected as one of the most important policy measures implemented by the Ministry of S&T in the early 1970s. Building upon this research, Choi brought the “Draft Proposal to Construct the Second Research Park” to President Park Chung-hee’s attention during his new year inspection tour on January 17, 1973. In addition to the President, the Prime Minister, Deputy Prime Minister, ministers, secretaries of the Blue House and executives of the Republican Party were present. In his report, Choi stressed that Korea was a developing country where its companies had little technology development capacity, emphasized the need for a vehicle to promote technological development and claimed that it was essential to geographically concentrate research institutes in one place.

Upon hearing this, President Park ordered that he devise a more concrete plan to construct the Research and Education Park, and four months later, a meeting on the “Plan to Construct the Second Research Park” was held at the Blue House on May 18. The meeting was attended by Prime Minister Kim Jong-pil representing the President, Minister of Commerce Lee Nak-seon, Minister of Construction Chang Ye-jun, Presidential Chief of Staff Kim Jeong-ryeom, and First Senior Secretary for Economy Jeong So-young. From the Ministry of S&T, Minister Choi Hyeong-seop, Head of Planning Jeon Sang-geun, and Planning officer Gwon Won-gi were present. Jeon, Head of Planning at Ministry of S&T, gave the briefing. The plan to construct the Daeduk Innopolis was authorized by the President during this meeting, and it became a national project.

The Plan to Construct the Second Research Park contained various advantages, such as the concentration of specialized research institutes according to strategy industry technologies in order to provide future technological support to the heavy-chemical industry, shared use of facilities and efficiency in investments, and the creation of a think tank to increase mutual exchange of researchers and technology information. Furthermore, it could also actively utilize the operational experience of the first research park.[32] The newly constructed research complex was expected to act as a mediator for technological development and be in charge of conducting R&D and absorbing and improving adopted technologies. It would also act as an agent and distributor of adopted technology by providing technical training and information, and offering technological guidance to private companies. If the second research complex could successfully carry out its functions, it would result in the prevention of the country's technological dependency on other countries, save foreign currency by installing a unified window for the introduction of technology, strengthen international competitiveness of products produced with high quality technology adopted at lower cost, train science and technology manpower in strategic industries to respond to the rise of the heavy-chemical industry, accumulate technological capacity, and build the capability to develop new products.

Within ten days after acquiring the President's authorization, the first Science and Technology Council meeting was held in the Cabinet meeting room to discuss the "Plan to Construct the Daeduk Research and Education Park" and the "Long-term Plan for Manpower Supply and Demand and Policy Direction". The Council invited Professor Kim Hyeong-man, city planning expert, to revise and complement the construction draft proposal in order to devise a detailed basic plan to construct the second research complex and connect it with city planning. About a month later on June 25, Kim submitted the "Research on the validity of the construction of a research and education city and establishment of planning standards", thereby setting the overall direction of the construction. The report was based on the recognition of the reality facing Korea's industries that was similar to the discussions by Lee Deok-sun in 1971.

In the introduction of this report, Kim wrote, "The transfer of various research institutes in a single complex will produce tangible results on collaboration and information exchange among research institutes and savings in capital investments thanks to the shared use of facilities. Also, adding education facilities, such as universities, to the research complex was expected to lead to various positive effects, including industry-academia cooperation and facilitation of science and technology promotion. Meanwhile, a research and living environment that meet international standards was required to attract highly educated science engineers with prominent research records and maximize their capabilities. This report aimed to offer a way to establish a science and technology system to attain continuous high economic growth and thereby achieve the goals of the country's economic development of reaching 10 billion dollars in exports, elevating the GNI per capita to 1,000 dollars by the

32. Plan to Construct the Second Research Park, Science and Technology Agency, 1973. 5. 18.

1980s. More specifically, the first goal of this research is to verify the validity of planning and constructing a new town concentrated on research and education institutes near Daejon, far away from the capital city of Seoul, and to draw up the concept and planning criteria to this end. The construction of a new research complex will lead to various positive effects, such as the dramatic promotion of science and technology and a distribution of population."

As plans to construct the Daeduk Innopolis grew more concrete, the Ministry of S&T felt the need to build a systematic legal system that would provide for its construction, ranging from determining the nature and goals of research institutes that would move into the research complex to devising support policies for the institutes. In a bid to come up with a bill, the Ministry of S&T submitted the Support of Specific Research Institute Bill to the National Assembly in November 1973. The main objective of the bill was to do away with the complicated matter of enacting and applying an individual law for each of the research institutes in various fields that would move into the complex according to the plan. The bill identified the Ministry of S&T as the administrative body with the highest authority in order to build a consistent and comprehensive management system for different research institutes.[33]

The Support of Specific Research Institute Bill, aiming to support and coordinate various research institutes to be constructed within the Daeduk Innopolis, was referred to the thirteenth meeting of the 88th Economy and Science Committee for review. Former Ministry of S&T Minister Kim Ki-hyeong pointed out several problems and revealed his negative position on the construction of a research and education city. He pointed out that the bill was submitted in haste by the Ministry of S&T without undergoing sufficient discussions with related ministries, which had the potential of creating future conflict. He also indicated that the provision granting the Ministry of S&T the authority to arbitrarily coordinate and evaluate support projects for various research institutes based on this bill was problematic.

In the process of enacting this bill, not only Kim, but many government agencies and notable industry figures showed their displeasure. As a matter of fact, it was mostly an opposition against the formation of a legal system with the Ministry of S&T at its center. But, exhibiting powerful leadership in science and technology policy with the full support of President Park, Choi established a science and technology system that was directly linked to the development of national economy and technology industry. Against this backdrop, various laws motioned by the Ministry of S&T were often passed in their original form despite controversy at the National Assembly. It was the same for this bill. It was decided that the bill would be "enacted according to the government's original proposal considering

33. Support of Specific Research Institute Bill, 1973.11.

the current state and conditions of national secrets", thereby dampening any dissatisfaction of Kim and other key figures. The Support of Specific Research Institute Bill that was passed at the Economy and Science Committee was soon tabled and passed at the National Assembly Plenary, and proclaimed into Law No. 2671 on December 31, 1973.

The most critical provision in the Support of Specific Research Institute Act as the legal and institutional foundation to build the Daeduk Innopolis was the provision on tax breaks. In particular, specific research institutes that were established in the form of juridical foundations were imposed with huge local and national taxes on their research sites and building facilities in contrast to national research institutes. They also had to pay tariffs on research equipment and materials imported from overseas. Given the financial difficulties of research institutes during the early stages of establishment, they would obviously face difficulties in operation without the tax breaks provided for in the Act. The Ministry of S&T actively proposed the matter of tax cuts by proposing the Act in order to enhance operational efficiency of research institutes and to foster R&D capacity.

Han Gy-ik, Deputy Director of the Ministry of S&T at the time, reflects as follows: "The controversy over the Support of Specific Research Institute Act was due to the provision stipulating specific research institutes as subject to tax breaks under all tax laws, including the Regulation Law on Tax Reduction and Exemption. It is a general requirement that the legal entities subject to tax reduction benefits must be identified in related tax laws, yet the Ministry of S&T tried to come up with a package solution to the tax problem for all specialized research institutes and make it into a system pursuant to Article 2 of the Support of Specific Research Institutes Act. There were many conflicts between the tax authorities under the Ministry of Finance during the enactment of this bill. The Ministry of Finance claimed that it was impossible to offer tax support to paper research institutes that could be established every year according to the new Act but were not acknowledged as a legal entity under the current Tax Law. Yet the Ministry of S&T tried to persuade the Ministry that it was essential to set up a system which offered automatic support to research institutes designated as specific research institutes for it would make establishment and operation of research institutes much easier. In the end, the determination of the Ministry of S&T won through, and amendments were made to the Tax Law. Research institutes established and designated as specific research institutes from then onwards were now subject to tax benefits."[34]

Such changes were ground breaking at the time, and signaled the establishment of a Korean-style R&D system. The Support of Specific Research Institutes Act was a law which

34. Han Gy-ik, A Study and Analysis of Major Science and Technology Policies of the 1970s-90s that Contributed to the Development of Science and Technology and Industry, p. 191-192, Ministry of Science and Technology, 2007.

incorporated an increased demand for more segmented, specialized research institutes as part of the policy to nurture the heavy- chemical industry, together with KIST. As a result, the research institutes designated under this Act could play a pivotal role in Korea's R&D activities during the 1970s.

## 5. National Technical Qualifications Act

During President Park Chung-hee's new year inspection tour in January 1973, Minister of S&T Choi Hyeong-seop proposed founding of the Daeduk research and education city, adoption of a skills proficiency initiative, and the establishment of a science foundation as major projects of the Ministry of S&T. Among his ideas to pursue the skills proficiency initiative was to improve the existing technical qualifications system, and he announced that he would develop a new system based on Germany's technical qualifications system.[35] In order to carry out this project, Jeon Sang-geun formed a working group with HR Planning Director Bang Seok-mok, fourth-grade official Choi Young-hwan and fifth-grade official Jin Hae-sul. At the time, there were 26 qualifications systems related to engineering and skills under different ministries, and they contained many problems. The titles for technical qualifications, their responsibilities and eligibility to apply for the exams were needlessly complicated and many technical qualifications did not fit the then domestic situation. Such sporadic technical qualifications not only led to a lack of special treatment to persons with technical qualifications, but there was also a huge build-up of a variety of problems, such as sporadic technical education and vocational training, inconsistency with policy situations, and a lack of a responsible institution.[36]

In August 1972, the Ministry of S&T decided to integrate and coordinate technical qualifications based on the report "Study for the Improvement of Science and Technology Qualifications Systems" submitted by the Korea Industrial Development Institute. The introduction of the report briefly touched on problems inherent in the existing qualification systems. In order to search for a way to efficiently manage science and technology qualification systems, this report conducted a study on the current status and operation of the systems under each ministry, and comprehensively analyzed differences between them and problems in their operation. Additionally, it conducted a case study on the qualification

35. Jeon Sang-geun, Development of Korea's Science and Technology: A Policy Maker's Testimony (Revised Edition), pp. 188-189, Seoul: Life and Dreams, 2010.

36. Jeon Sang-geun, Development of Korea's Science and Technology: A Policy Maker's Testimony (Revised Edition), pp. 191-193, Seoul: Life and Dreams, 2010.

systems and their operation in major advanced countries, and included an analysis comparing them with that of Korea and their differences.[37]

As for Korea's science and technology qualifications system, the Korea Industrial Development Institute concluded as the following: "A total of eleven ministries, including the Ministry of S&T, issue and operate 53 different types of licenses in science and technology, including those of technicians. These qualifications are based on academic background and little consideration is given to practical experience. There are as many as 23 departments that manage the qualification systems verifying that there is an excessive dispersion of management agencies and many problems exist in the qualification systems themselves, such as various criteria among different ministries. Furthermore, 35 types of licenses in 16 areas are similar to each other, showing that the qualifications criteria and responsibilities overlap. These points impair the society's credibility of such qualifications systems and their utilization." As such, problems regarding the distribution and diversity of qualifications were well revealed in an actual survey conducted by this report where a staggering 63.2 percent of respondents answered that qualification systems themselves should be revised.

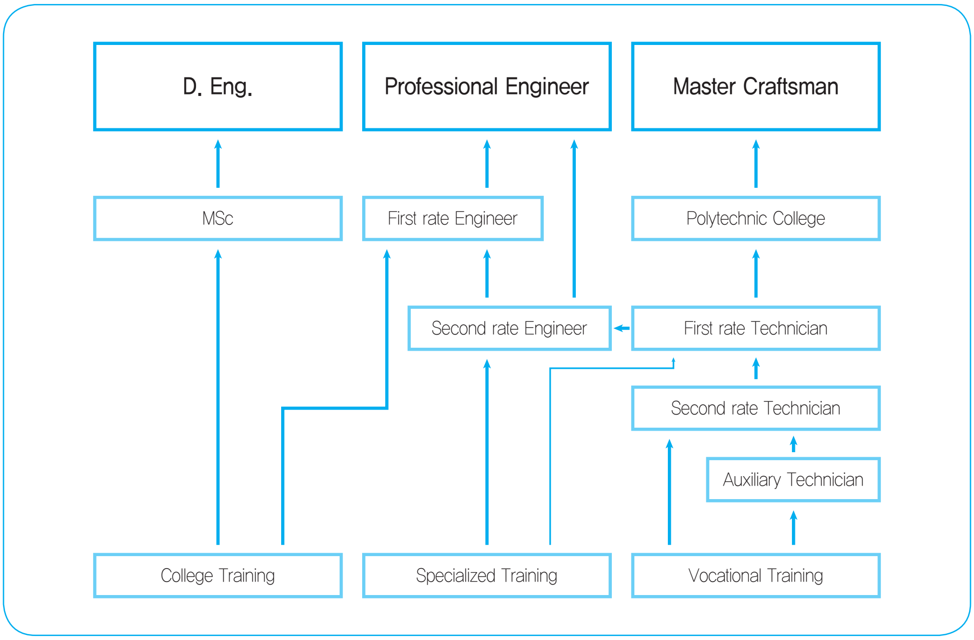
This report exposed problems inherent in human resources development architecture related to qualification systems. Upon examining the education system, the author of the report pointed out the following problems: a lack of skills education for primary school graduates who did not move on to secondary education; a lack of a practical way to utilize secondary school graduates as professional technicians; the unclear function and role of vocational high schools; and lastly, the need to revise the system to allow practical education and field experience in tertiary educational institutions and acquisition of facilities. In terms of vocational training, the need to complement the system to provide job placement support and assurance for vocational trainees and to increase the rate of those taking and passing the qualifications exams were also called to attention. This helped to organize in detail problems of domestic science and technology qualification systems at the time. Based on such analysis, the report came to the conclusion that phase-by-phase measures should be set up to revise and systemize irrational, similar qualification systems, and that after implementing the first phase, a long-term plan must be adopted to unify the system.

Immediately after this report was submitted, the Ministry of S&T systemized all industrial sectors and devised an economic and social preferential treatment to those who acquired qualifications, and at the same time, it tried to establish a national technical qualification system which could mutually link to foster and utilize technical talent. The most notable feature of this system was that it changed a deeply rooted disdain the Korean society held

37. Korea Industrial Development Institute, A Study for the Improvement of the Science and Technology Qualifications System, p. 3-5, Science and Technology Agency, 1972.

upon technicians and skilled labor to create a social landscape where they would receive better treatment. As a result, the National Technical Qualifications System categorized technical sectors into engineers and technicians, and all graduates of specialized colleges and industrial high schools and vocational trainees had to mandatorily take qualification exams. Those who passed were offered employment first, and if engineers and technicians acquired one of the highest qualifications as a professional engineer or master craftsman, they would be socially treated equally as PhDs.

Figure 3-1 | Basic Relations Between Professional Engineers and Master Craftsman Pursuant to the National Technical Qualifications Act




Source: National Technical Qualifications Act

As illustrated above, the National Technical Qualifications Act categorized technical qualifications into engineers and technicians, and those who acquired the qualifications were defined as those who passed the technical examinations. Additionally, graduates of vocational and technical schools designated by the Presidential Decree and those who completed vocational training according to the Vocational Training Act were obligated to take the technical examinations held by the Minister of Education or the Minister of a related ministry. Two career paths were primarily established according to this Act. First, one could attain qualifications of an engineer or a technician by acquiring education at a specialized school. Second, those with field experience through vocational education or training could acquire qualifications as an auxiliary technician, first or second rate technicians, and master craftsman. The unique feature of this bill was that in order to offer a preferential treatment to qualified technicians, it required the identical social treatment between masters and doctoral program graduates and between technicians and engineers.

Similar to the Technology Development Promotion Act, the Ministry of S&T claimed the need to unify and systemize the National Technical Qualifications Act for the efficient fostering of technical manpower. This bill was immediately met with objections from other ministries. The bill transferred independent technical examinations held by each ministry to the Ministry of S&T, which caused a conflict between related ministries. The Ministry of S&T convened, a number of times, a working group meeting with various ministries, but meetings could not be held since most of the related ministries, including the Ministry of Commerce, Ministry of Construction and Railway Service refused to attend. These ministries claimed that there was no need to unify existing qualification systems as they had already been well established with appropriate criteria according to different natures of each qualification. In the end, the Ministry of S&T personally contacted Jeong So-young and Oh Won-cheol, Senior Secretaries at the Blue House, to request that the National Technical Qualifications System be included as a national project.[38] Because Minister Choi Hyeong-seop had the full support of the President, this system was immediately selected as a national project. As a result, the National Technical Qualifications Bill was introduced at the National Assembly with objections of related ministries only partially withdrawn.

The National Technical Qualifications Bill submitted by the Ministry of S&T was significant in that it improved the treatment for engineers and technicians, but there were various problems in the statutory provisions. Senior Counsel Seon Seok-chang's deliberation report to the Economy and Science Deliberation Committee held on December 7, 1973 not only expressed concern over the possibility of the bill infringing upon the enhancement of the quality of technical manpower pursued by the policies of the Ministry of Education, but also claimed it could not be a proper assessment of the qualifications of engineers. Some legislators also expressed doubt over whether it was appropriate to unify the legal system for technical qualifications, which was the issue at the very heart of the conflict between related ministries. Furthermore, not only the active utilization of people who acquired technical qualifications, but also the treatment of engineers produced under the existing Professional Engineers Act were also indicated as matters for consideration.

Shin Hyeon-hwak stated, "Everyone is well aware of the importance of engineers in the supply and demand of science and technology, and we understand the objective the Ministry of S&T is trying to achieve by improving efficiency in administration and management

38. Korea Industrial Development Institute, A Study for the Improvement of the Science and Technology Qualifications System, p. 264, Science and Technology Agency, 1972.

and by enacting a law on the qualification systems of engineering manpower." However, he pointed out that the uniformity of the technical qualification laws could violate the autonomous development of education.[39] In the meeting, Kim Gi-hyoung said that although he agreed to the bill itself, it was difficult to assess the demand of domestic industries for qualified technicians, and the engineers already produced by the existing Professional Engineers Act were not effectively utilized.[40]

In the end, a Deliberation Subcommittee was formulated to revise and resolve on the National Technical Qualifications Bill. The Ministry of S&T deleted the provision of mandatory employment for those who acquired qualifications, and resubmitted the bill on the condition that it would later submit a bill to amend or abolish the existing Professional Engineers Act. The bill was passed at the National Assembly Plenary on December 31, 1973 and announced into Law No. 2672. With this law, the Ministry of S&T could integrate and operate the multitude of technical qualification examinations that had previously been held and managed by each administrative agency. Based on this Act, the Ministry of S&T oversaw qualification examinations for 19 technical sectors for engineers and 12 sectors for technicians.

The implementation of this Act held great significance in that it built a National Technical Qualifications System with a consistent qualifications criteria necessary for major industrial technology fields, such as the heavy-chemical industry, offered momentum to enhance the quality and social position of technical manpower, and devised an improved technical education system.[41]

## 6. Korea Science Foundation Act

The transition in the government's industrial policy from heavy and light industries toward heavy-chemical industry during the 1970s created an accelerated increase in demand for highly skilled science technology manpower. But at the time, the science engineering universities and graduate schools in Korea provided a destitute educational environment with little capacity to produce such high quality graduates, and far from the cultivation of human resources, and worse, brain drain was a frequent phenomenon. This was why the government came to devise a policy focused on heightening the quality of domestic tertiary education, producing more graduates, and encouraging research activities of universities. The Science Foundation was founded as part of the government's initiative to boost university-based basic research.

39. Minutes of the thirteenth meeting of the 88th Committee on Economy and Science, p. 5-7, 1973. 12. 10.

40. Minutes of the thirteenth meeting of the 88th Committee on Economy and Science, p. 5-7, 1973. 12. 10.

41. National Technical Qualifications Bill, p. 123, Science and Technology Agency, 1972.

The Ministry of S&T sought the advice of the U.S. Science Foundation, which had a wealth of experience in founding science foundations, and tried to attract foreign investments to partially fund the project. The issue of establishing a science foundation in Korea was tabled as an agenda in the Korea-U.S. Permanent Joint Committee of Science and Technology Cooperation held from November 13 to 16, 1973, and Professor Kim Jeong-heum of Korea University emphasized the role of and need for a science foundation in Korea. "First, we need to foster human resources and support research activities of talented university scientists and engineers; second, we need a research foundation to enhance the quality of university education in science and technology fields; third, basic and applied science research supported by the research foundation are not only beneficial on their own, but can act as the window to researchers around the world; fourth, continuous research is needed on similar foundations, benchmarking their objectives and priorities."[42] He urged the Korea Research Foundation to contribute to qualitative enhancement of university education and to act as a groundwork for greater basic research and international exchange. This is almost identical to the nature of the science foundation discussed in the Science Foundation Bill that was proposed by the Ministry of S&T.

At the time, Choi Hyeong-seop stood at the center of the idea to set up the science foundation and manage Korea-U.S. collaboration in this project. He reflects that he decided to establish the science foundation because he felt the need to formulate measures to facilitate research, especially basic research in universities. During his service as Minister of S&T, he put up the proposal every year when the President undertook his first round of inspections, but he did not receive a confirmative response. In the end, in order to persuade the President, he asked U.S. Ambassador Richard L. Snider to propose that the two countries collaborate to install a science foundation in Korea. Ambassador Snider immediately proposed to conduct a validity study of such an institution, and as a result, the Ministry of S&T and U.S. National Academy of Sciences jointly conducted the study from May 30 to June 5 in 1976. The Ministry of S&T announced that this study identified the current status of Korea's education and research patterns of fostering science and technology human resources. Based on these results, Choi informed then Minister of Education Min Gwan-sik of the announcement, and with the cooperation of the Ministry of Education, tried to secure the budget for building the science foundation. Unfortunately, due to a lack of shared understanding at the time, the establishment of the science foundation was put behind other more important projects of the Ministry and its budget was cut. When Choi would not raise funds, he knew that could hamper his plan to establish the science foundation during his term in office. So, he decides

42. Ten Years' History of the Korea Science Foundation: 1977-1986, p. 26. Daejeon: Korea Science Foundation 1987.

to set up legal grounds to enable the Ministry of S&T to pursue the establishment of the science foundation as a major policy.[43]

The Science Foundation Bill was first motioned at the twelfth meeting of the 96th Economy and Science Committee held in November 1976. Senior Counsel Seon Seok-chang, who was entrusted with deliberation of the bill, emphasized that government support for basic research in universities was imperative. He supported the bill by claiming that compared to advanced countries that invest from 10 to30 percent of total R&D cost in basic science research of universities, whereas Korea only invests 2.7 percent. He also said that the number of researchers per population of 10,000 in 1975 was one fifth of that in Japan and that experiment equipment and facilities in science and engineering universities did not even meet the half of the legal requirements.[44]

The legislative members at the time shared the belief that the installation of a science foundation would contribute to the promotion of science and technology, but the problems regarding the legislative process was set aside as a task for the Ministry of S&T. In particular, Choi remembers that his determination to establish a science foundation instead of a science and technology foundation was met with strong oppositions, and it was also pointed out as problematic by the National Assembly.

In turn, Kim Gi-hyoung raised the question whether the government's policies to support the development of technology thus far could face challenges if a science foundation, instead of a science and technology foundation, was established. Furthermore, he pointed out that if the Ministry of S&T participated in university R&D, instead of the Ministry of Education, it could also conflict with the educational policies of the Ministry of Education.[45] This led to lively discussions on various provisions that could amplify the Ministry of S&T Minister's authority over plans for R&D project and authorization.

During the 96$^{th}$ Economy and Science Committee Meeting that was continued on November 8 in 1976, the bill was amended to grant authorization to all project plans submitted by a researcher, from the original provision which required the authorization of the Ministry of S&T Minister. However, the discussion on the title of the institution was concluded without reflecting the legislators' opinions and was changed from the "Science Foundation Bill" to the "Korea Science Foundation Bill". This demonstrates that Choi's determination to underline the importance of fostering basic research in order to facilitate advancement in industrial technology was accepted by other legislators. The amended Korea

43. A Research Institute where the Light Never Goes Out, p. 240-241, Chosun Ilno, 1995.

44. Minutes of the twelfth meeting of the 96$^{th}$ Committee on Economy and Science, 1976.11.4.

45. Kim Gi-hyeoung, Minutes of the thirteenth meeting of the 96$^{th}$ Committee on Economy and Science, 1976.11.5.

Science Foundation Bill was referred to the National Assembly Plenary in November 1976 and was immediately resolved. On December 22 in 1976, the Korea Science Foundation Act was proclaimed into Law No. 2943.

The Korea Science Foundation Act aimed to establish a science foundation in the form of a judicial foundation to cultivate science and technology research capacity and to promote science education and international exchange in science and technology. Pursuant to this act, the Science Foundation was launched on May 18, 1977 and engaged in the support of science and technology research activities, research scholarship, projects to enhance science and technology education, hold conferences, and encourage domestic academic activities, projects to promote international exchange in science and technology, and other projects necessary for the development of science and technology. The Korea Science Foundation Act provided momentum to expand the coverage of support for research, from industrial technology fields to basic research sectors, by utilizing government funds. With the intervention by the Ministry of S&T in university R&D projects, the government could steer the direction of the research to be consistent with its policy objectives.

## 7. Conclusion

This chapter aimed to show that laws on science and technology enacted in the 1960s and 1970s had a close relationship with the establishment and expansion of the national science and technology system. As a matter of fact, the 1960s was when Korea first devised such a national system, and therefore, related laws were enacted in step with changes in government policies. A prime example was that the Economic Planning Board (EPB) considered the cultivation of science and technology manpower as a top priority in pursuing the first Five-year Plan for Technology Promotion, and thus enacted the Professional Engineers Act, thereby actively proposing an efficient way to utilize human resources in science and technology. Furthermore, with the establishment of the Ministry of S&T as the administrative institution responsible for science and technology and the implementation of the second Five-year Plan for Science Technology Promotion, this chapter described the process of how the Science and Technology Promotion Act was enacted to provide legal grounds for the Plan.

After the 1970s, there was an increase in the enactment of related laws according to the expansion of the national science and technology system. In particular, the expansion of an R&D system focused on government research institutes and the enactment of the Support of Specific Research Institute Act, the Technology Development Promotion Act to support the development of industrial technology, the National Technical Qualifications Act to utilize science and technology manpower on a national level, and the Korea Science Foundation

Act were notable achievements in terms of the establishment of the national science and technology system. More than a dozen laws on science and technology enacted during this time demonstrate the nature of Korea's science and technology system in three aspects: the establishment of an R&D system, a system to nurture strategic technology, and a system to develop human resources.

# Chapter 4

## National Administration and Research Systems for Science and Technology

1. The S&T Ministry and Shaping the Foundation for Science and Technology Administration
2. Development in Science and Technology Administration
3. Expansion of GRIs and the Construction of the Daedeok Science Town
4. Major R&D Projects
5. Conclusion

# National Administration and Research Systems for Science and Technology

A country's development can be identified through a number of economic indicators, but the underlying factors that enable such progress are often integral and created through the enhancement of capacities invisible to the eye. Since the early 1960s, the Korean government considered science and technology as the country's inherent capacity and decided to build a foundation for cultivating this field. The foundation was built with the establishment of a national science and technology system during its early stage where the Ministry of S&T and the Korea Institute of Science and Technology (KIST) were set up in the late 1960s. The system was further expanded when the government built the Daedeok Science Town in the 1970s. This paper first examines the Korean government's expansion of the science and technology administration system as part of its organization during the 1960-70s. Secondly, it looks over the further expansion of the Governmental Research Institutes (GRIs) system, which was launched with KIST in the 1970s. Thirdly, it studies science and technology projects conducted mainly by GRIs and led by the government.

Table 4-1 | Chronology of S&T Administrational Events in Korea (1967-1980)

| Year | Events |
|---|---|
| 1967 | • Establishment of Ministry of Science and Technology<br>• Fulfill the Second Five-year Science and Technology Promotion Plan |
| 1968 | • Formulate the Science and Technology Development Masterplan |
| 1969 | • Legislate the Science Based Industry Promotion Act |
| 1970 | • Establishment of the Korea Foundation for the Promotion of Science and Technology |
| 1971 | • Construction of KAIS |

| Year | Events |
|---|---|
| 1972 | • Fulfill the Third Five-year Science and Technology Development Plan<br>• Install of Science and Technology Council |
| 1973 | • Adopt the National Engineering Quilification System<br>• Plan for the Construction of the Daedeok Science Town |
| 1974 | • Fulfill the Project for Creation of Science and Technology Climate |
| 1975 | • Establishment of the Korea Research Institute of Standards |
| 1976 | • Establishment of the Research Institute of Strategy Technology |
| 1977 | • Establishment of the National science Foundation |
| 1978 | • Attempt to Liberalize the Introduction of Technology |
| 1979 | • Reopen the Science and Technology Council |
| 1980 | • Install of the National Science and Technology Council |

Major efforts by the Korean government to promote science and technology were listed up in the <Table 4-1>. This table shows that the Korean government had adopted new administrational and institutional tools almost every year since 1967.

In terms of administration and research, Korea's national science and technology system has undergone phenomenal growth over a short period of time. Changes brought on by the government's decision to adopt science and technology as the capacity which would grant the country economic independence will be introduced in the following paragraphs.

## 1. The S&T Ministry and Shaping the Foundation for Science and Technology Administration

Science and technology began to be recognized as a critical asset for the country's development under the First Five-year Technology Plan (1962-1966). Accordingly, an environment to develop science and technology was created through a long-term national plan. Once the plan was announced, the Korean science community proposed the installation of the National Institute of Science and Technology to the National Reconstruction Committee. The community prescribed that this body should oversee science and technology administration and be headed by a cabinet minister such as the Deputy Prime Minister. It also proposed that the function of the Ministry of Culture and Education, which was entrusted with education in the fields of science and technology, and public research institutes in each ministry be transferred to the Institute.

Rather than immediately setting up the National Institute of Science and Technology, however, the Korean government decided to take a more gradual approach. Instead, the governement decided to install a bureau in charge of science and technology within the

EPB during the first Five-year Technology Plan. Accordingly, the Bureau of Technology was established under the EPB in June 1962. This heralded the birth of Korea's first administrative department in the fields of science and technology.

During the first Five-year Economic Development Plan in 1966, Korea brought in many production facilities from abroad and adopted foreign technology. The government had to train technical workers to operate the facilities and develop the capacity for research and development (R&D) to be able to absorb newly adopted technologies. In order to address these issues and achieve significant economic growth over a short period a time, it had to actively introduce advanced science and technology.

At the time, science and technology administration was undertaken in parallel by the EPB and the Atomic Energy Board. But since they were not institutionally connected with the various science and technology research institutes under each ministry, it was difficult for the government to coordinate the budget, manage personnel and facilities in the fields of science and technology. Thus, the government launched a comprehensive administrative body to carry out this task. Demand for a legal framework to promote technology grew again.

Recognizing the need to coordinate science and technology in a comprehensive manner, President Park Jung-hee ordered the launch of the administrative body which would be put in sole charge of science and technology in January 1967. The Minister and the EPB worked together to map out the administrative agency for science and technology. The EPB Bureau of Technology was responsible for carrying out related working-level tasks, and it devised a proposal to create the "Science and Technology Board (tentative)" after internal discussions.

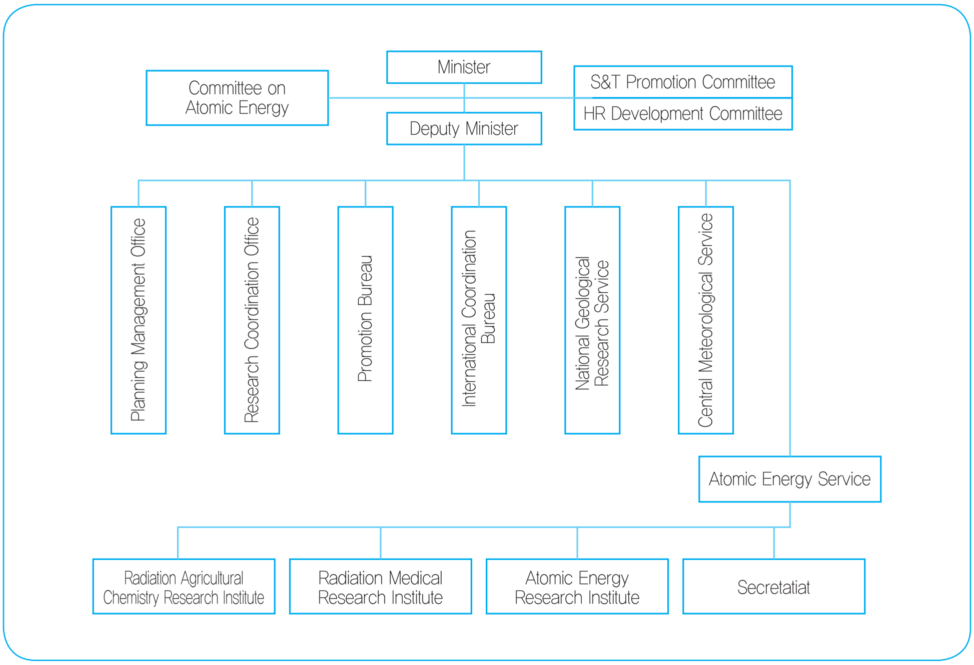
The Bureau of Technology decided that the science and technology administrative agency would be created as an "Board". Reasons were that (1) it was inappropriate to name it a "ministry" as it did not have tasks unique to the organization, in contrast to the Ministry of Commerce or Ministry of Internal Affairs; and (2) because it had to possess deputy prime minister-level authority in order to promote science and technology nationwide. After the Office of the Minister received this proposal and gathered opinions of the academia and experts in science and technology, it submitted the proposal to the President in February. The academia and experts proposed that the new science and technology administrative agency should (1) be formulated with the Bureau of Technology acting as its center, and (2) undertake the role as a coordinating and planning department similar to the EPB. Additionally, they suggested that (3) the work of science and technology administrators currently dispersed across different ministries should be gathered under the direct command of the prime minister. In order to mitigate resistance from the ministries, the new agency absorbed only research institutes and laboratories that had little relation to the unique work of related ministries. Furthermore, the Atomic Energy Board was downgraded to Atomic Energy Service and transferred under the authority of the Minister of S&T.

Figure 4-1 | President Park Jung-hee Attending the Opening Ceremony of the Ministry of S&T on April 21, 1967


Source: eHistory Korea (http://ehistory.korea.kr)

The Blue House reviewed and sent the proposal to the Ministry of Government Administration, which was its main department for establshing administrative organizations and government agencies. Then, the Ministry conducted an internal study and gathered external advice to finalize the proposal. But in the finalized version, the title of the organization was changed from “Science and Technology Board” to “Science and Technology Agency”. The reason behind this was because the term “board” was already used for the likes of the “Board of Education, Board of Research and Board of Health”, and “Agency” was normally applied to the chief coordinating office. As such, this became one of the greatest issues in the establishment of the science and technology administrative body. Though the Bureau of Technology and most of the science and technology community claimed that a deputy prime minister-level ‘Science Technology Board’ was essential to promote science and technology, there was strong opposition from within the government. With an initiative to pursue economic development, the government appointed the Minister of Economic Planning Board to the rank of a deputy prime minister not stipulated under the Constitution. However, appointing another deputy prime minister in science and technology could trigger conflicts with other ministries. As a result, establishing the agency, "Ministry of Science and Technology," was reviewed, but as 'ministries' did not have the authority for administrative coordination, it was amended to "Agency."

**Figure 4-2 |** Organization of the Science and Technology Agency (Final draft)




Source: p. 71, Twenty Years' History of Science and Technology Administration

The Ministry of Government Administration granted the Ministry of S&T (1) the authority to establish an integrated basic policy for the promotion of science and technology, and (2) the function to comprehensively coordinate tests, investigations, research and business operation. The Ministry of S&T was also allowed to (3) coordinate the operation of test and research facilities, (4) pursue international cooperation for the promotion of science and technology, and (5) set up and implement measures to conduct research and utilize atomic energy.

Based on the final draft of the Ministry of Government Administration, the Cabinet Council submitted a bill to amend the Government Organization Act, which mainly included the establishment of the Science and Technology Agency, in February 1967. Two months later, the new agency was officially launched on April 21. With this, Korea became the first underdeveloped country at the time to have a department exclusively for science and technology headed by a cabinet minister-level figure. The Science and Technology

Agency commenced as an organization composed of the Planning and Management Office, two offices under the Research Coordination Office, two bureaus under the International Cooperation Bureau, and three affiliated organizations - Atomic Energy Service, National Geological Research Service and Central Meteorological Service. The Agency was entrusted with overseeing the formulation of comprehensive basic policies, coordination of plans for supporting science and technology, technological cooperation and administration related to the promotion of science and technology.

One of the most important projects of the Ministry of S&T during the early years was to set the direction of the development of science and technology in Korea. The Ministry established a long-term outlook for the next two decades and set a goal for developing Korea's science and technology. to achieve this goal, the Ministry devised the Science and Technology Development Long-term Master plan. This Master plan aimed to strengthen the country's self-development capacity in science and technology to become one of the leading medium-level industrial countries in this field. To this end, a development strategy was set up to (1) facilitate and absorb advanced technology, (2) develop and utilize science and technology manpower, (3) strengthen private technology development activities, and (4) develop specialized technology that took into consideration the international division of labor.

No later was it founded, the Ministry of S&T began to revise its basic system to pursue more systemized development administration. First, it worked on building the basic foundation for the enactment of laws which would be a basis for administration, and set up the Enforcement Decree of the Science and Technology Promotion Act. In addition, it enacted as many as 50 laws, including Acts for fostering the Korea Institute of Science and Technology (KIST) and the Korea Science and Technology Information Center. Furthermore, it installed 14 committees, such as the Science and Technology Promotion Committee, the Human Resources Development Committee, and the Atomic Energy Committee, to offer advice on policy decisions of the S&T Minister.

Unfortunately, the Ministry of S&T failed to meet its intended goal in the area of comprehensive coordination of national science and technology investment, one of the most critical purposes for its establishment. From the beginning, the government tried to (1) set the direction for the development and investment of the nation's science and technology, (2) maintain consistency and smooth interactions of science and technology development activities, and (3) enhance efficiency by reducing any squandering in science and technology development and investment.

The Ministry of S&T, however, was pushed over by the EPB and other organizations which weakened its function for comprehensive coordination. The EPB comprehensively coordinated the entire country's economic development plan, which included the planning of projects related to science and technology, and the Planning and Coordination Office under the direct leadership of the Prime Minister coordinated the basic operational plans of each ministry. The greater authority of such higher bodies limited the Ministry of S&T's authority to coordinate the budget, among others, and it was not realistic to expect the Ministry fo S&T to fulfill its coordinating role. Thus, there was a growing possibility that investments in science and technology of each ministry would be implemented regardless of priorities that were set forth in the Master plan.

Nevertheless, there was the need for comprehensive coordination of national science and technology investments. At the time, the science and technology projects of ministries were mostly to provide simple administrative support for passive research activities in testing, analysis and verification that were carried out by 81 national and public research institutes under each ministry. While research personnel, investments, and equipment and facilities of such research institutes were seriously lacking, demand for building a joint cooperative system between the research institutes to utilize personnel and facilities resources continued to grow day by day.

The Ministry of S&T led the country's research and development activities during the 1960s. In 1968, it conducted a nationwide survey on science and technology research activities as a means to gather basic data for the Science and Technology Promotion Long-term Plan and Comprehensive Basic Policy. This survey was conducted on 223 research institutes, and the results revealed that the number of research manpower was 6,698, amounting to an average of 30 people per research institute, and total research and investment in the field reached 5,357,000,000 Korean Won. This was a mere 0.43 percent of GNP.

In order to vitalize the underdeveloped research environment, the Ministry of S&T devoted efforts to expand investments in R&D nationwide. It began to provide study and research grants of 130 million Korean Won to major domestic research institutes every year through service contracts. Over a period of five years since 1967, a total of 818.8 million Korean Won funded 536 projects. The focus of such funding was on the development of industrial technology, and 70 percent of R&D investments were made in research projects related to industrial sectors. More than 3,000 researchers in the academia, industry and research participated in such projects. This move revitalized Korea's science and technology research, which had until then, suffered from depression and a lack of investment.

The Ministry of S&T then founded the Korea Institute of Science and Technology (KIST) to undertake industrial R&D on a full scale. Completed in October 1969, KIST was equipped with modern research equipment and facilities, and a research team composed of prominent researchers from advanced countries. From 1968 to1969, the Institute had already signed 91 research contracts and applied for 31 patents home and abroad before its completion. Then in 1970, after being launched, it increased the number of research contracts to 160 with a value of a total 47million Korean Won, and applied for 30 patents.

In contrast to existing national and public research institutes, KIST received government funding in the form of a contribution fund, rather than as a subsidy. This ensured freedom of research as it could limit government intervention in R&D, and enabled long-term, continuous research. Meanwhile, it established a new philosophy in the operation of research institutes by attracting companies to participate in technology development through a research consignment policy in collaboration with the industry.

## 2. Development in Science and Technology Administration

Korea provided a basis for economic development through its second Five-year Economic Development Plan. The government began to build a basis for industrial technology development that would support its third Five-year Economic Development Plan. In particular, it concentrated on the fostering of steel, electronic, shipbuilding and petro-chemicals to make a transition to move the pivot of its export industry from light industries to heavy chemicals. The development of the heavy chemicals industry required astronomical technological advancement, which called for new initiatives in pursuing related projects.

The government research institutes (GRIs) that played a main role in promoting domestic science and technology activities at the time, however, did not have the capacity to meet such demands. The basic research activities of universities were stagnant due to a lack of facilities and research funding. Meanwhile, companies, that should have been the main leaders of industrial technology development, were not enthusiastic at all. They did not conduct their own R&D activities since they were dependent on technologies imported from abroad.

Science and technology administration gradually developed to address this issue. In 1971, Choi Hyeong-seop, former Director of the Korea Institute of Science and Technology (KIST), was inaugurated as the second Minister of S&T, and he actively responded to this situation. In the 1970s, the Ministry of S&T pursued (1) shaping and strengthening of the foundation of science and technology, (2) strategic development of industrial technology, and (3) creation of a science and technology landscape.

In the 1980s, Korea adopted “Technological Advantage (technological drive)” as its national policy. Advanced countries were introducing protectionist trade policies, which resulted in a contraction in exports, while domestic labor costs increased, and the competition intensified against the least developed among developing countries with lower labor costs. Furthermore, the increasingly fierce international competition in cutting-edge technologies placed heavy pressure on technology transfers from advanced countries. Korea was exporting products manufactured based on simple imitation of foreign technologies based on its low labor cost, but these changes hampered the country's export-driven policies. In response, Korea tried to achieve economic development by maximizing investment in available resources and elevating its technology level to meet the standards of advanced countries. In a move to support such efforts of the government, the Ministry of S&T tried to maximize efficiency in R&D investments and research capabilities.

We shall examine the science and technology administration of the 1970s - 1980s by categorizing it into the following sectors: (1) coordination of science and technology policies, (2) development of science and technology manpower, and (3) introduction of technology and international cooperation in science and technology.

## 2.1. Coordination of Science and Technology Policies

In a bid to comprehensively coordinate science and technology policies, the Ministry of S&T installed the Science and Technology Council by revising the Science and Technology Promotion Act in 1972. The Science and Technology Council was the highest policy coordinating body in science and technology chaired by the Prime Minister. In 1973, it devised plans to build the Daedeok Science Town and deliberated and resolved on a long-term manpower supply and demand plan and policy. In 1979, it deliberated and decided on the Nationwide Scientific Movement Plan and plans for national research programs.

In 1980, the government installed the National Science and Technology Council chaired by the President. The National Science and Technology Council set up goals for the country's science and technology and decided the size and allocation of long and short-term investments. Meanwhile, the R&D Council was further installed to set priorities for policies for the promotion of science and technology. It was entrusted with comprehensively coordinating the government's R&D projects. It also established and coordinated policies to promote and enhance efficiency in R&D and formulated policies for collaboration with research institutes. In addition, it revised the Civil Service Act in 1973 to install a system on contract-based public servants. This set out provisions for the treatment of science engineers and experts home abroad who were unable to participate in government-led R&D programs before then.

In 1981, the Ministry of S&T drew up plans to implement plans for the science and technology sector in Korea's fifth Five-year Economic and Social Development Plan. This led to the installation and operation of the Technology Promotion Conference with Enlarged Membership chaired by the President and attended by about 250 representatives of the government, industry, academia, research, media and finance in 1982. Discussions were held on technological development measures to meet the country's national development goals, fostering technological manpower, and measures to enhance productivity, while reports were made on trends of cutting-edge overseas technologies and cases of technological development. These efforts enabled the country to remove obstacles in domestic technological development and identify the direction to respond swiftly to competition in international technological development. Furthermore, based on technological development cases that were reported to the Conference, people of merit were awarded for their contribution which further encouraged science and technology personnel to pursue R&D.

The Technology Promotion Council was also founded under the President. The cabinet minister (Minister of Ministry of S&T) appointed by the President assumed the role of its Chairman, and the Council was composed of 17 standing members from related government agencies and research institutes, and related non-standing members. The Council (1) conducted assessment and analysis of technology standards in major industry sectors and came up with measures according to their results, (2) discussed and coordinated major policy matters for technological innovation, such as human resources development, facilitation of investment, and improvement of systems, and (3) provided support to the operation of the Technology Promotion Conference with Enlarged Membership by deliberating on items to be reported to the Conference and monitoring the implementation of reports made to the Conference.

## 2.2. Development of Science and Technology Manpower

The Ministry of S&T fostered science and technology manpower to strengthen the foundation of science and technology and realign the science and technology promotion system. It focused on implementing policies to strengthen basic research and increase international technological collaboration. It placed a special emphasis on the fostering and recruit of high quality science and technology manpower.

Until the 1960s, the main source of high quality workers in science and technology were mostly those who had studied abroad. But there was an urgent, growing demand for domestically fostering high quality manpower with skills that could be utilized on the field according to the progress in industrial development. Korean-American scientist, Jeong Geun-mo proposed the establishment of a specialized graduate school in science and engineering and implied that USAID would provide the necessary funds.

Figure 4-3 | Dr. Terman, the Father of Silicon Valley, on his Visit to Korea to Conduct a Validity Test for the Establishment of the Korea Advanced Institute of Science (KAIS)

Source: KAIST

In March 1970, President Park Chung-hee ordered the review of the proposal to set up such a graduate school in the Economic Trends Report Meeting. Accordingly, the Ministry of S&T devised concrete plans to found the school. Though some government departments opposed to the idea, the proposal was passed in the Meeting of Related Ministries in the same year. A U.S. delegation led by Frederic E. Terman, former Vice President of Stanford University, was dispatched to Korea in order to establish a new science and engineering graduate school and offer advice. The delegation submitted a report which strongly recommended the establishment of a science institute.

According to the results of the report, the construction of the Korea Advanced Institute of Science (KAIS) within the Seoul Research Development Park in Hongneung commenced in April 1971. KAIS hired 40 professors and officially opened in September 1973. In 1975, it produced 92 masters in science and engineering, creating the main stream of high quality manpower in Korea's science and engineering field.

The existing Education Act and Education Civil Servants Act were not applied to KAIS, which enabled the Institute to exercise greater freedom in operating school affairs and building its own educational system. The government provided a contribution to KAIS but refrained from intervening in its operation to promote its autonomy and encourage stable operation. Students were offered various benefits, including exemption from military duties, and received high quality education. Additionally, the formulation of an industry-academia system where industrial workers were re-educated served as a basis for industry-academia cooperation.

The Terman Report estimated that the appropriate number of graduates of the KAIS masters program was 100 by 1978. But domestic demand for high quality manpower surpassed the assumptions made in the Report and the school produced 142 graduates in 1978 and 4,038 in total including 299 doctors by 1986.

**Table 4-2 |** Number of Graduates of KAIS

(Unit: Persons)

| Year | '75 | '76 | '77 | '78 | '79 | '80 | '81 | '82 | '83 | '84 | '85 | '86 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Masters | 92 | 145 | 139 | 142 | 181 | 219 | 297 | 294 | 317 | 356 | 604 | 548 | 3,334 |
| PhDs | - | - | - | 2 | 17 | 13 | 21 | 18 | 49 | 43 | 64 | 72 | 299 |
| Special Masters | - | - | - | - | 44 | 87 | 89 | 75 | 54 | 56 | - | - | 405 |

Source: p. 90, Twenty Years' History of Science and Technology Administration

In January 1981, KAIS was integrated with KIST to become KAIST (Korea Advanced Institute in Science and Technology), but KIST was again separated in 1989. KAIST only had a Master's program, but when it moved to the Daedeok campus in 1989, it consolidated with the Korea Institute of Technology which operated specialized bachelor-degree programs, and has since offered both bachelor and masters programs.

**Figure 4-4 |** Joint Ground-breaking Ceremony for KAIS, Korea Development Institute (KDI) and Agency for Defense Development (ADD) on April 14, 1971


Source: KAIST

From its foundation until February 2006, KIST produced a total of 31,292 science and engineering talents composed of 7,931 bachelors, 16,979 masters and 6,382 PhDs. Among its graduates, 2,144 are professors in 306 domestic universities, which accounts for 9.54% of the total 22,463 science and engineering professors in Korea (educational statistics of 2005). 2,235 KAIST graduates are leading science and technology development by undertaking research in 150 governmental and private research institutes. 7,400 graduates are working as major actors in Korea's economic development by working in more than 2,000 companies in highly advanced science and technology fields, such as electric and electronic industries.[46]

With the successful development of KAIS, Korea no longer had to depend on advanced countries to foster high quality science and technology manpower and could nurture its own skilled human resources. Furthermore, it played a significant role in improving the Korean science and engineering masters-level education, thereby providing high quality manpower in a timely manner to contribute to the promotion of national science and technology.

In 1973, the Ministry of S&T adopted the National Engineering Qualification System to nurture and protect people in technological engineering. The National Engineer Qualification

46. National Archives of Korea(http://www.archives.go.kr), an item of 'Korea Advanced Institute in Science and Technology'.

System (1) enhanced the social status of engineers by institutionally ensuring their positions, and (2) ensured smooth supply of science and engineering manpower required for national development. Through this System, Korea established a unified engineering qualification system and raised social credibility with people who have technical skills.

Even in the 1980s, the Korean government tried to satisfy the demand for science engineers that increased with the country's progress in economic development. Pursuant to the fifth Five-year Economic and Social Development Plan, demands for master-level scientists were expected to reach 83,000 by 1991. Given the pool of technical talent was small at the time, there was a lack of about 30,000 scientists. In order to supply more professionals, it tried to produce 1,060 PhDs and 2,250 masters by 1986 and 2,310 PhDs and 4,500 masters by 1991, respectively, through KAIS and governmental research institutes. Additionally, the government decided to permanently attract 750 prominent Korean research personnel working overseas and 1,500 research personnel for a shorter term. It also expanded the government's overseas research technology training program to foster 7,200 research professionals with state scholarships and loans. Furthermore, it established science high schools and science and technology universities in the early 1980s to identify and educate prominent students who were skilled in science and technology.

Table 4-3 | Securing R&D Personnel

(Unit: persons)

| Year | 1969 | 1976 | 1980 | 1986 | 1996 | 2006 | 2011 |
|---|---|---|---|---|---|---|---|
| Total R&D Personnel | 12,145 | 27,051 | 30,473 | 87,430 | 202,347 | 365,794 | 531,131 |
| PhDs | - | 2,700 | 3,400 | 9,000 | 36,106 | 60,013 | 84,674 |
| Per 10,000 population | 1.4 | 3.3 | 4.8 | 12.5 | 21.8 | 41.4 | 54.0(2010) |

Source: 'Total R&D Personnel' NTIS Science Technology Statistics System, surveyed on November 19, 2012

## 2.3. Introduction of Technology and International Cooperation in Science and Technology

Once the country's heavy-chemical industry policy was on track, there was an increasing need to swiftly introduce advanced science and technology. In 1978, the government revised the Enforcement Decree of the Law Concerning Foreign Investment as the first attempt to liberalize the introduction of technology. This transformed the previous individual deliberation method into three procedures according to a pre-established standard:

automatic authorization, semi-automatic authorization and individual deliberation. In 1979, the second phase of liberalization of the introduction of technology was implemented. In parallel with such measures, the Ministry of S&T set up the Technology Introduction Center to assist companies in selecting appropriate technologies for adoption.

In addition, it enacted the Technology Development Promotion Act in 1972 and the Technical Services Support Act in 1973. In 1979, 136 companies deposited about 25 billion Korean Won in the Technology Development Reserve System that was established pursuant to the Technology Development Promotion Act.

As the conditions for introducing technology deteriorated, the demand for international cooperation in technology increased. Korea received technical aid equivalent to approximately 160 million US dollars from the 1950s to the 1960s. But the aid itself was not tailored to domestic conditions and was not very effective. Factories constructed with foreign investments were made on a turn-key basis from design to construction, which limited the participation of domestic engineers and service companies, hence making little contribution to the enhancement of domestic technology. But with the initiation of the third Five-year Economic Plan in the 1970s, the level and diversity of necessary technology continued to grow. In order to respond to such rapid changes, the need to actively and independently introduce, absorb and improve technology increased.

In 1972, the Ministry of S&T adopted the Five-year International Technological Cooperation Plan, which included technological collaboration and exchange of scientists to promote the introduction and development of new technologies. It also planned to nurture the capacity for selecting, amending and improving necessary technologies. Meanwhile, it formulated a system to permanently locate science centers overseas to attract Korean science engineers living abroad. It also actively supported the participation of domestic scientists in related international conferences and amended and strengthened the follow-up management system of technological cooperation. Furthermore, the Ministry of S&T installed the Technological Cooperation Coordinating Committee composed of science senior counsels and experts.

In the 1970s, the technological cooperation policies of major advanced countries began to focus on health, education, environment and population issues rather than the industrialization of developing countries. This drastically reduced technology grant-aid from advanced countries to Korea. Thus, the government set the major direction for policy in technological cooperation during its fourth Five-year Economic Development Plan that began in 1977: (1) Cooperation with advanced countries should be focused on the establishment of research institutes or on fostering of personnel for foundation building rather than tdirect introduction of technology; (2) cooperation with developing countries should be funded by advanced countries or international organizations while Korea transfers its own experience and technology; and (3) science diplomacy should be intensified by increasing the number of overseas resident officials, conducting joint research, exchanging information, and engaging in mutual exchange of science engineers with advanced countries. Meanwhile, cooperation with developing countries was defined by building a basis for donation of technology with the conclusion of the Science Technology Cooperation Agreement.

In the 1980s, research in hi-tech areas gradually expanded to a scale that resulted in creating new fields for which research could not be funded by a single country alone. In terms of the supply of researchers, a time lag between the fostering of new talent and R&D to be conducted was expected to increase, and the imbalance between supply and demand of manpower in each field was expected to intensify.

In a bid to address such international trends, the Ministry of S&T pursued the “Internationalization Strategy for Technological Sophistication” as part of its Technology Drive in 1982. This aimed to acquire new growth engines through the sophistication of technology. To this end, it built local research centers in advanced countries in the fields of electronic, precision chemistry, machinery sophistication, and genetics. It also built technology-intensive local small-and-medium enterprises (SMEs) that were in the form of joint ventures, and adopted uncompleted technologies in their development and basic application stages.

**Table 4-4 | Trends in Technical Aid by Channel**

(Unit: USD1,000)

| | | Subtotal | 51~56 | 57~61 | 62~66 | 67~71 | 72~76 | 77~81 | 82~85 |
|---|---|---|---|---|---|---|---|---|---|
| Total | | 362,565 | 6,383 | 49,477 | 46,613 | 77,160 | 68,960 | 81,773 | 41,224 |
| Funds | AID | 126,285 | 6,180 | 46,942 | 28,272 | 34,177 | 10,593 | 120.5 | - |
| | UN | 113,878 | 204 | 2,059 | 13,206 | 28,998 | 25,483 | 28,138 | 15,734 |
| | Colombo | 50,141 | - | - | 2,456 | 4,625 | 16,590 | 8,606 | 7,286 |
| | Others | 151,440 | - | 475 | 2,678 | 9360 | 16,294 | 44,908 | 18,185 |
| Type | Invitation of experts | 105,939 | 56.9 | 13,658 | 12,556 | 16,470 | 18,576 | 13,046 | 14,938 |
| | (No. of persons) | (4,643) | (6) | (786) | (612) | (935) | (1,071) | (625) | (607) |
| | Dispatch of trainees | 86,804 | 1,809 | 6,744 | 7,691 | 13,771 | 16,457 | 22,676 | 14,985 |
| | (No. of persons) | (20,877) | (514) | (1,796) | (2,409) | (4,640) | (4,505) | (4,211) | (2,708) |
| | Service contracts | 82,832 | 3,550 | 25,438 | 17,582 | 20,622 | 10,062 | 3,193 | 2,385 |
| | Introduction of resources | 115,326 | 968 | 3,636 | 8,785 | 26,297 | 23,866 | 42,857 | 8,917 |

Source : p. 249, Twenty Years' History of Science and Technology Administration

## 3. Expansion of GRIs and the Construction of the Daedeok Science Town

It was only after the 1960s that R&D activities in the modern sense began in Korea. Although there were national and public research institutes prior to the 1960s, such as the Central Industrial Research Institute and Central Geology and Minerals Research Institute, they were mostly test organizations to provide administrative support rather than conduct research.

R&D activities began in full scale with the construction of the Daedeok under the Atomic Energy Board in 1959. The Daedeok undertook its original objective of conducting research on peaceful use of nuclear energy. At the same time, it played a central role in the Korean science and technology community, while significantly contributing to the attraction and fostering of science engineers.

Korea's first industrial development activities can be tracked back to the Korea Institute of Science and Technology (KIST) which was founded in 1966. This research institute, which initially began as a joint project between the Korean and the U.S. government, holds great significance as the following: It was Korea's first modern comprehensive research institute in the area of industrial technology and later became a model for various research institutes in Korea; it introduced a contract-based research system for the first time in Korea; and it played a critical role in attracting Korean science engineers abroad.

In addition, the government began constructing a town of research institutes in Daedeok, Choongnam Province in 1974 to accommodate various research and educational institutes, including future government research institutes. The goal of this town was to create a system of seamless collaboration among research institutes with different natures and functions. It aimed at enhancing work efficiency by enabling various research institutes to share manpower and facilities and to increase exchange.

## 3.1. Government Research Institutes (GRIs)

"... President Park Chung-hee welcomed the proposal by President Johnson to dispatch his own science advisor to Korea in order to review the possibility of building a research institute of industrial technology and applied science in Korea. This research institute and laboratory shall provide technological services and research to develop Korea's manufacturing industry. It was President Johnson's idea to grant high quality engineers trained in the U.S. the opportunity to continue their research (in Korea)."

The above is Clause 12 of the Joint Communique announced by U.S. President Lyndon Johnson and President Park Chung-hee. According to this statement, Donald F. Hornic, the presidential science advisor to the U.S. President, led a team of six to conduct a study on the establishment of KIST. According to the results of the Hornic Report in August the same year, President Johnson ordered the establishment of KIST with aid funds, and the provision of 10 million dollars over a period of ten years. In February 1966, the two governments signed an agreement on a joint project between Korea and the U.S. to establish and operate a research institute. As a result, KIST was officially inaugurated on February 10, 1966. It was completed in January 1969. It was the first research institute in Korea with modern research equipment and facilities that met the level of advanced countries, and prominent researchers attracted from advanced countries were in the line-up.

KIST's basic ideology was the guarantee of research freedom, assurance of financial stability, and creation of a reasonable and liberal atmosphere. It received government funding in the form of contribution rather than subsidy. This limited the government's intervention in R&D, enabling autonomy in research. This was set out in the "Act to Promote the Korea Institute of Science and Technology (KIST)". It became an important precedent in the enactment of acts to promote the establishment of KAIS, KDI, Agency for Defense Development (ADD), and the Korea Atomic Energy Research Institute (KAERI).

Before the construction of the institute was completed, KIST was committed to molding the research environment and establishing a research system. At the same time, it conducted a total of 144 consignment projects, including 32 study projects, 84 R&D projects, and 28 computer device based projects, of which it completed 91 projects.

KIST began to conduct R&D activities full-fledgedly since the 1970s. In the initial stage, it absorbed and improved newly introduced technologies and conducted simple product R&D. Gradually, it moved on to conducting pilot research and larger research tasks that accompanied middle-sized industrial pilot research. Out of 599 application and development research projects consigned to KIST by the end of 1975, 261 cases were commercialized. Among the technologies that were created in the process, 15 cases acquired overseas patents and 157 cases acquired patents domestically.

Based on the precedent set by KIST, the government decided to establish research institutes in strategic industries with the same organizational form and operational system as KIST. It enacted the Specialized Research Institute Promotion Act which ensured the payment of government contributions, free transfers of national property, and autonomous operation. As a result, the Korea Shipbuilding Research Institute, the Korea Electronic Technology Research Institute, the Korea Machine and Metal Research Institute, and the Korea Chemical Research Institute were founded in 1976, and the Maritime Development Research Institute was founded in 1978 as an affiliated institute of KIST.

Meanwhile, in 1976, the Korea Nuclear Fuel Corporation, the Resources Development Research Institute, and the Korea Electric Device Test Research Institute were installed in 1976, while in 1977, the Korea Telecommunications Research Institute and the Korea Institute of Energy Research were established. In 1978, the Ginseng Research Institute and the Korea Tobacco Research Institute were established in the form of special legal entities. Before this, in 1973, three research institutes under the Atomic Energy Service were integrated to establish a special legal entity, the Korea Atomic Energy Research Institute (KAERI). In 1975, pursuant to the Act to Promote Specialized Research Institutes, the Korea Research Institute of Standards was set up. As such, Korea's R&D system made a transition from a focus on national and public research institutes to GRIs with juridical foundation.

In a move to resolve the problems regarding GRIs, which stood at the heart of the R&D system, the Korean government decided to integrate and coordinate the research institutes in 1980. The major issues regarding GRIs were (1) there were too many research institutes compared to the total research personnel, facility and investment size of the country; (2) there were a excessive number of management officials compared to researchers, thus deteriorating research capability; (3) similar research institutes conducted overlapping research; and (4) cooperation among institutes and government coordination were ineffective. As a consequence, the Ministry of S&T announced the “Plan to Overhaul the R&D System and Improve its Operation” in November 1980, and integrated and coordinate the 16 government-funded research institutes into eight larger research institutes.

Simultaneously, in order to enhance the efficiency of GRIs, it implemented various policies such as (1) development of mid-long term R&D plans, (2) computerization of research tasks, (3) integrated operation of overlapping administrative support, (4) flexible operation of organization based on research tasks, and (5) improvement of reimbursement for researchers and creation of a research environment.

**Figure 4-5 |** Completion Ceremony of the Construction of KIST on October 23, 1969


Source: KIST

Furthermore, the government devised plans so that hi-tech industries could take root in Korea through joint research between GRIs and companies through specialized R&D projects. In those specialized R&D projects, the government directed GRIs to concentrate on basic R&D projects which required long-term research. Meanwhile, the government developed public welfare technologies, an area which had to be led by the government, and ordered companies to jointly develop with the GRIs mid-long term hi-tech industrial projects on a large scale that had to be nurtured under protection, rather than market competition.

## 3.2. Daedeok Science Town[47]

The Ministry of S&T cradled the idea of building a research complex to efficiently operate the country's R&D system. Before the Daedeok Science Town came to be, the Seoul Research Development Park was established by the collection of various research institutes in Hongneung, Seoul, in April 1941. This complex included KIST and the Korea Institute of Science and Technology Information (KORSTIC) that had been established at the end of the 1960s, and Korea Development Institute (KDI), KAIS, Agency for Defense Development (ADD), and the Atomic Energy Research Institute had moved in during the early 1970s. Once the Seoul Research Development Park was completed, there was a significant increase in the shared use of research facilities, primarily KIST's large electronic calculator and the science and technology information material of the Director of KORSTIC.

Deciding to build on the experience of establishing and operating the Seoul Research Development Park, the Ministry of S&T began to formulate the idea of building a town of research institutes on a larger scale. This town would accommodate not only research institutes in future strategic industry technologies, but also a number of national and public research institutes that were located in Seoul. This idea benchmarked Japan's Tsukuba Science City. The basic goals of the Daedeok Science Town was the formation of a cluster of research brains, construction of a world-class science park, and establishment of a collaboration-based research system. The complex itself was built in the form of a research and university town in the country. It became a collection of R&D functions supporting heavy-chemical industries. The proposal to set up the Daedeok Science Town acquired authorization from the Blue House in May 1973 and construction for the complex covering over 2,977 hectares in Ilwon, Daedeok-gun in Choongnam Province began in 1974.

The construction of the research and university town, however, suffered a decrease in investments due to financial difficulties caused by the oil crisis, and in particular, this led to a reduction in the plans to build shared facilities and residences for researchers. By the end of the 1970s, five public research institutes, the Korea Shipbuilding Research Institute, the Korea Research Institute of Standards and Science, the Korea Nuclear Fuel Development Corporation, the Korea Chemical Research Institute and the Korea Institute of Energy Research, three private research institutes, Ssangyong Central Research Institute, Lucky Central Research Institute and Hanyang Petrochemical Research Institute, and Choongnam University moved into Daedeok Science Town, while the Korea Ginseng Research Institute and the Korea Telecommunications Research Institute were established within the complex.

47. "Daedeok Science Town", Twenty Years' History of Science and Technology Administration, National Archives of Korea (http://www.archives.go.kr).

Figure 4-6 | President Park Chung-hee Encouraging Researchers on his Visit to the Daedeok Science Town on February 22, 1979

Source: National Archives of Korea

It was in the 1980s when the Daedeok Science Town's foundation in research was expanded in full scale as part of the government's initiative to pursue national R&D projects. Daedeok was established pursuant to the Act on Industrial Sites and Development. Immediately after the site was constructed in December 1993, the Daedeok Science Town Management Act was enacted, which enabled its more systematic development. Many private research institutes began moving into Daedeok and in 1998, their number jumped to 25 from 3 in 1990. Since then, the Daedeok Science Town has evolved into a complex of collaboration among industry, academia and research through commercialization of research results. In December 2005, the Special Act on the Promotion of the Daedeok Science Town was enacted.

## 4. Major R&D Projects

### 4.1. R&D in Atomic Energy

On February 3, 1956, Korea and the United States signed a cooperation agreement on non-military use of atomic energy. This led to the introduction of cutting-edge technology to utilize atomic energy in Korea. In March 1956, the government installed the Atomic Energy Department in the Bureau of Technology Education under the Ministry of Culture and Education. This would nurture research personnel prior to the adoption of atomic energy facilities and technologies. For seven years since 1956, 189 employees were trained overseas. Pursuant to the Atomic Energy Act, the Atomic Energy Board was officially set up as the first government agency exclusively entrusted with science and technology, and the Committee on Atomic Energy was installed under the direct authority of the President as the first policy making body in science administration. The Atomic Energy Research Institute, an affiliate of the Atomic Energy Institute, opened in March in the same year.

**Figure 4-7 |** Opening Ceremony of the Atomic Energy Research Institute in the Fifth Building of Seoul National University College of Engineering


(Located in Gongdeokri, Nohaemyeon, Yangjugun, Gyeongi Province on March 1, 1959)
Source: National Archives of Korea

According to the Plan for the Peaceful Use of Atomic Energy, the U.S. provided the research reactor TRIGA Mark II to Korea. At the time, the government set up the reactor near the College of Engineering at the Seoul National University. It went into operation in March 1962, paving the way for the era of atomic energy in Korea.

The Atomic Energy Research Institute played a significant role in the promotion of science and technology in the early stages of its development in Korea. It offered modern research facilities to science engineering manpower that had been dispersed before then due to a lack of research facilities. The Atomic Energy Research Institute and Atomic Energy Board were the windows for international collaboration with advanced countries and the International Atomic Energy Agency (IAEA). They were the channel for science and technology information from advanced countries, and enabled domestic science engineering graduates to study and train overseas.

The Atomic Energy Board was later incorporated under the Ministry of S&T, which was launched in April 1967, and reorganized as the Atomic Energy Service. After it was reorganized, the Atomic Energy Research Institute tried to increase the output of the research reactor TRIGA Mark II on its own in the short term. In the mid-term, it tried to build the 2MW research reactor TRIGA Mark III. In the long-term, it aimed to lead the construction of nuclear power plants.

In 1969, the Atomic Energy Research Institute more than doubled the generation capacity of 100MW TRIGA Mark II (by 2.5 times) by using self-developed technology. Additionally, it introduced and designed the TRIGA III of General Atomics, thus going into operation in March 1972. The Atomic Energy Research Institute participated in the atomic energy development project. In 1965, it worked with the IAEA study group to select a site for a nuclear power plant. The Committee on the Development and Research in Atomic Energy, a working-level body composed by the Atomic Energy Research Institute in December 1965, devised the validity study report on the construction of Korea's first nuclear power plant through plans for long-term supply and demand of energy and power, and on analysis of the technology and economy of atomic energy development. As a result, in March 1971, the 60,000KW PWR (pressurized water reactor) Atomic Energy Plant 1 of Westinghouse was set up in Gori. With the completion of Atomic Energy Plant 1, Korea became the second country in Northeast Asia, and the 21$^{st}$ in the world as a country developing atomic energy.

**Figure 4-8 |** Construction of Atomic Power Plant 1 which was Launched for the First Time in Korea in 1978

Source: National Archives of Korea

## 4.2. Specialized R&D Projects[48]

Specialized R&D projects originated from national R&D projects that were carried out in the 1960s. They were undertaken by national and public research institutes under each government department, including the Atomic Energy Research Institute. National R&D grants were installed with the establishment of a science and technology administrative system led by the Ministry of S&T, which was launched in 1967.

During its economic development during the 1960s and 1970s, Korea had to depend on the production facilities and operation technology imported from advanced countries on a turn-key basis. As a result, the actual introduction of technology was insignificant. During this period, science and technology policies focused on enhancing R&D capacity of the private sector, which was in its early stages, and expanded the foundation to provide science and technology. Government R&D activities that were carried out to create the basis for science and technology were primarily led by government research institutes (GRIs). GRIs attempted to expand technology to industries by adopting, absorbing and improving foreign technology and by developing their own technologies.

48. Forty Years of Korean Science and Technology History.

But from the beginning of the 1980s, protectionist movements against technology in advanced countries spread out, and mutual cooperation among them emerged as a new barrier for Korea in acquiring technology. The rapid growth of emerging developing countries was also a huge threat to Korea's export strategy. Recognizing that Korea urgently needed measures to independently develop its own technology on a national-level in order to acquire international competitiveness and achieve continuous economic growth began gathering wide support. Consequently, the government overhauled GRIs and launched strategic R&D projects.

In 1982, the government consolidated R&D resources it was providing to each GRI, and launched Specialized R&D Projects. These projects were the first national R&D projects that pursued the fostering of science and technology capacity and development of core industrial technology on a national strategic level. They first began with two R&D projects led by the government and companies. Electronic projects, such as the development of future cutting-edge technology and public technology, were fully funded by the government as they were the field with high uncertainties, investment risks, and huge public interests. The latter were projects to develop industrial core technologies that could not be fully entrusted with the capabilities of the private sector and were jointly funded by the government and companies.

Until the 1980s, Specialized R&D projects focused on projects that could effectively support economic development. They were pursued with the initiative to expand the foundation for the development of future cutting-edge technology and creation of an environment to support strategic R&D. These efforts contributed to building a system where both the government and companies could invest in R&D, and compile and utilize limited R&D resources, such as manpower.

After the mid-1980s, there was a heightened interest in R&D of ministries where technology was in high demand, such as the Ministry of Industrial Resources. This led to a diversity of national R&D projects to satisfy demand for technology development in various industrial sectors, such as industry-based technology development projects and projects to develop alternative energy and energy saving technology. In 1988, the role of Specialized R&D projects further expanded, thereby re-establishing the direction for the projects.

Since the commencement of Specialized R&D Projects until the late 1980s, new projects were launched, such as the Industry-based Technology Development Project, Alternative Energy Technology Development Project and Basic Research Support Project. During the mid 1990s, R&D projects were initiated by governement department, including the Atomic Technology Development Project, Advanced Technology Development Project, Telecommunications R&D Project, Environment Technology Development Project, Health and Medical Technology Development Project, Construction Technology Development

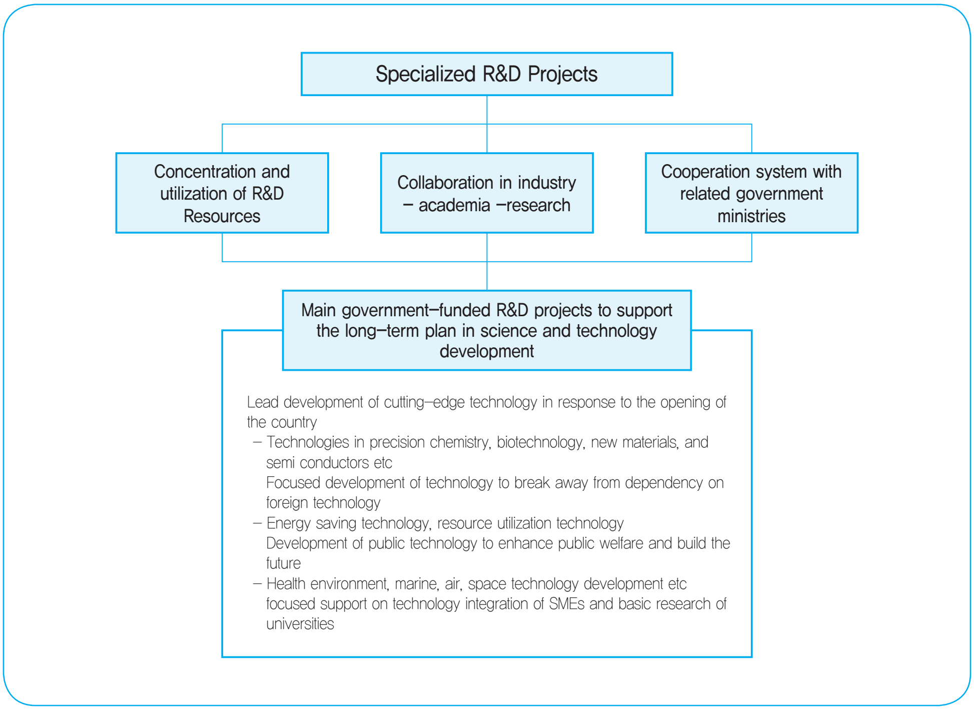
Project, and Agricultural Technology Development Project. Such Specialized R&D Projects not only shaped the foundation for domestic R&D, but also served as a catalyst for the birth of R&D projects in other ministries. It also created an important momentum for more active research by GRIs.

**Table 4-5 |** Early Developments in Specialized R&D Projects

| | Projects |
|---|---|
| 1982 | (1) Government-led R&D Projects<br>(2) Business-led R&D Projects |
| 1983 | (1) Government-led R&D Projects<br>(2) Business-led R&D Projects<br>(3) Targeted Basic Research Projects (added) |
| 1984 | (1) Government-funded R&D Projects (change of title)<br>(2) Corporate Technology Development Support Projects (change of title)<br>(3) Targeted Basic Research Projects<br>(4) New Technology Commercialization Development and Research Project (abolished after 1985) |
| 1985~1986 | (1) Industrial and Public Technology Development Projects<br>Government-led Research Projects<br>Public-Private Joint Research Projects<br>(2) Targeted Basic Research Projects<br>(3) Technology Support Projects for Promising SMEs (installed independently in 1985)<br>(4) International Joint Research Projects (installed in 1985)<br>(5) R&D Assessment Projects (installed in 1985) |

Source : Twenty Years' History of Science and Technology Administration, p. 113

Figure 4-9 | Position and Role of Specialized R&D Projects




Source: Twenty Years' History of Science and Technology Administration, p. 113

## 4.3. Incubation of Basic Research

After the mid-1970s, there was an increasing need to break away from existing technology development policies that depended on the introduction or imitation of foreign technologies. Though the importance of basic research was recognized long before, it was neglected due to limited national finances and other priorities in industrial technology development. The Ministry of S&T believed that conditions for technology development in industries were now mature enough for the government to provide national support to basic science research activities, and established the Korea Science Foundation in 1977. The Korea Science Foundation mainly supported basic research activities of universities and played a pivotal role in the incubation of R&D capacity of domestic scientists.

In the 1980s, the Basic Sciences Promotion Policy was incorporated into the fifth Five-year Economic Development Plan. This was to nurture basic research as the source of technological innovation and to strengthen the research function of universities. The Basic Sciences Promotion Policy aimed to (1) increase investment resources for basic science research by expanding the Korea Science Foundation Fund to 20 billion Korean Won.

(2) It encouraged and supported the creation of research groups in specialized areas to strengthen the basic science research activities by universities. Meanwhile, it encouraged the improvement in research quality to drastically vitalize academic activities in natural sciences. (3) It increased government support for basic science research funding to complement the research function of science engineering universities and graduate schools. (4) It supported attending and hosting international academic conferences to increase academic exchanges of science technology with foreign universities and research institutes. Furthermore, it hosted workshops in each specialized field to absorb advanced knowledge of science and technology.

Table 4-6 | Some Performances of Academic Research Supported by Ministry of Education (1963-1984)

| | No. of papers | Participants (persons) | Funding (thousand Korean Won) |
|---|---|---|---|
| 1963 | 126 | 128 | 1700 |
| 1964 | 98 | 108 | 7700 |
| 1965 | - | - | - |
| 1966 | 120 | 159 | 17000 |
| 1967 | 484 | 543 | 60,000 |
| 1968 | 338 | 486 | 120,000 |
| 1969 | 504 | 811 | 240,000 |
| 1970 | 397 | 735 | 216,000 |
| 1971 | 815 | 1280 | 317,300 |
| 1972 | 1040 | 1672 | 468,000 |
| 1973 | 1029 | 1599 | 468,000 |
| 1974 | 1036 | 1578 | 421,200 |
| 1975 | 799 | 1179 | 470,200 |
| 1976 | 772 | 1100 | 1,562,850 |
| 1977 | 974 | 2749 | 2,059,974 |
| 1978 | 1320 | 3724 | 4,079,827 |
| 1979 | 1848 | 4791 | 5,154,065 |
| 1980 | 2592 | 8032 | 4,981,357 |
| 1981 | 2436 | 5768 | 4,514,934 |
| 1982 | 2157 | 10729 | 4,597,871 |
| 1983 | 1978 | 8833 | 4,058,859 |
| 1984 | 1678 | 9752 | |

Source: Twenty Years' History of Science and Technology Administration, p. 201

Table 4-7 | Number of Basic Research Papers Published in SCI Journals by Domestic Korean Scientists

(Unit: numbers of research papers)

| Year | 1972 | 1974 | 1976 | 1978 | 1980 | 1982 | 1984 |
|---|---|---|---|---|---|---|---|
| Volumes | 27 | 50 | 51 | 104 | 159 | 332 | 555 |

Source: Twenty Years' History of Science and Technology Administration, p. 203

## 5. Conclusion

In the 1960s, the Korean government felt the need to actively pursue economic development plans and improve science technology to support them. To achieve this, the government aimed to create a systematic science and technology administration. It began by first establishing the Ministry of S&T in 1967 to pursue science and technology administration systematically and efficiently. The Ministry of S&T was entrusted with the installation of comprehensive basic policies, aggregation and coordination of plans, technology cooperation and promotion of other science technologies.

The Ministry of S&T was the coordinator of science and technology policies, but it could not actively undertake this role due to its relations with the Economic Planning Board (EPB) and other agencies. In a bid to complement its function, the government set up the National Science and Technology Council in the 1970s, the Nationwide Science and Technology Council and the R&D Council in the1980s to enable the coordination of science policies.

In 1973, the government founded the Korea Advanced Institute of Science (KAIS), a specialized graduate school in science and engineering, to develop science and technology manpower that would play a central role in the promotion of science and technology. Later it was integrated with the Korea Institute of Technology, a school providing bachelors degree programs, to provide the core manpower to achieve Korea's economic development.

Additionally, the government actively engaged in continuous introduction of technologies and cooperation in international science and technology to raise the level of fledgling Korean technology. During the early stages of the introduction of foreign technology, the country had to depend on the unilateral aid from advanced countries, but it gradually tried to transfer, absorb and improve technology through international collaboration in advanced technologies with countries.

The government research institutes (GRIs) were the main actors in R&D activities. The Korean government founded the Korea Institute of Science and Technology (KIST) in 1966 with the support of the U.S. This research institute received financial support in the form of contributions, rather than subsidies, which limited government intervention and ensured autonomy in research. Such a research support system became an important precedent in the establishment of various GRIs.

The Ministry of S&T formulated a research complex to gather GRIs and private research institutes in one place to efficiently operate its R&D system. Modeled after the Japanese Tsukuba Science City, the research complex was constructed in Ilwon, Daedeok, of the Choongnam Province during the late 1970s.

The major R&D projects of the Korean government during its economic growth period were R&D Projects for Atomic Energy, Specialized R&D Projects and incubation of basic research. Atomic energy R&D projects played a significant role in building the foundation for R&D by gathering science engineering manpower at a time when there was no science and technology administration. Furthermore, it acquired atomic energy R&D capacity and contributed to the construction of nuclear power plants. As for Specialized R&D Projects, they were focused on projects that could effectively support the country's economic development. They expanded the foundation for the development of future cutting-edge technology and carried out strategic R&D projects that could not be undertaken by the private sector.

# Chapter 5

## Achievements in Science and Technology Promotion

1. Development of the Country with Science and Technology
2. Changing Public Perception of Science and Technology

# Achievements in Science and Technology Promotion

Achievements in the promotion of science and technology during Korea's early economic development phase can largely be considered in two aspects. The first aspect is how science and technology led national development. The Korean government decided that science and technology was a bold investment for the future of the country and continued to push this initiative forward. Since the 1960s, the country's GDP rose steadily with its economic growth. This increased total investments in science and technology, and the investment ratio rose as a percentage of GDP. As investments continued to increase, Korea became the world's fastest growing country in terms of science and technology manpower and the number of theses and patents. According to IMD's World Competitiveness Yearbook published in 2012, Korea's competitiveness in science ranks fifth and technology 14$^{th}$ in the world. In contrast, national competitiveness in economy, government, businesses, and infrastructure ranked 27$^{th}$, 25$^{th}$, 25$^{th}$, and 20$^{th}$, respectively. This demonstrates that science and technology is driving Korea's national competitiveness.

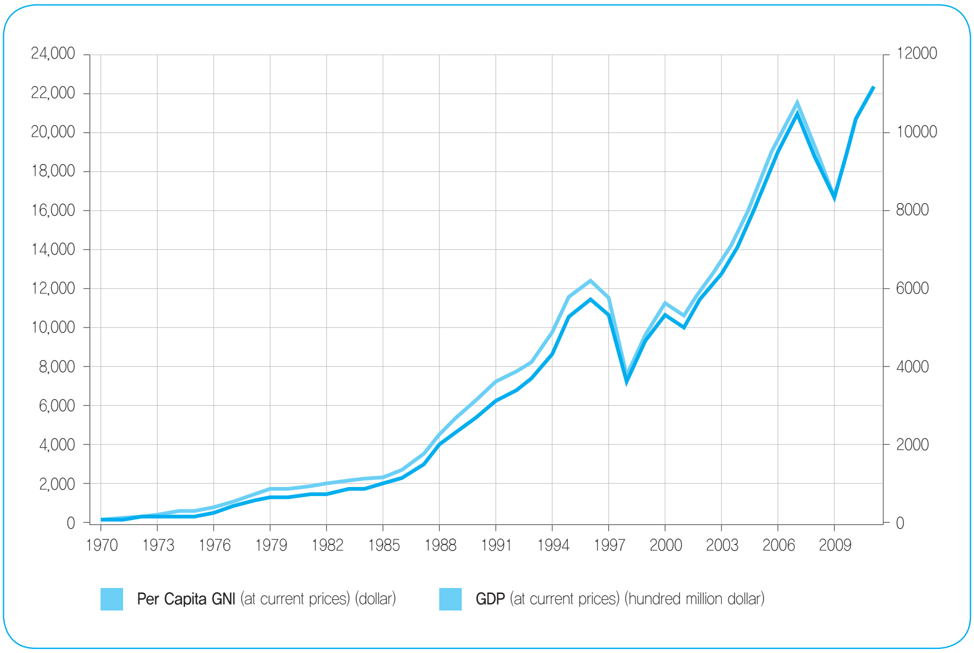
The second aspect is a huge transition in Korea's social and cultural arenas through the promotion of science and technology. This explains why Koreans have a considerably positive and optimistic outlook on science and technology. This section examines the science campaigns that were held since the early stages of economic development in order to create a national recognition on the importance of science and technology. As a result of such efforts, the interest and understanding of the Korean people in this field today is similar to how people of advanced countries recognize the value of science and technology.

This chapter shall study the results of Korea's efforts to promote science and technology on a national level during the early stages of economic development from these two aspects. Provided Korea's science and technology promotion projects were carried out from a long-term perspective, it is difficult to discuss their achievements solely based on the statistics until the early 1980s as mentioned in the previous chapters. Therefore, this chapter shall discuss Korea's achievements in science and technology from the early 1960s leading up to today in 2012.

## 1. Development of the Country with Science and Technology

Changes in per capita GDP show that the Korean economy has managed to maintain steady growth since the 1970s except for two events of the Asian financial crisis in 1997 and the global financial crisis in 2008. GNI per capita first exceeded 1,000 dollars in 1977, and 10,000 dollars in 1995. GNI per capita passed the threshold of 20,000 dollars in 2010. As evidenced by these milestones, Korea is showing constant growth since it began its economic development.

**Figure 5-1 |** Long-term Trends in GDP and GNI per capita




Source : ECOS (Economic Statistics System), The Bank of Korea

Let us compare changes in GDP and investments in science and technology. The proportion of science and technology investments in GDP was 0.38 percent in 1970, but it grew to around 4 percent in 2011. As shown in the table below, total R&D has continued to increase since 1970. The proportion of R&D investments in GDP has also increased. It is worth noting that investments in science and technology have steadily increased before and after the Asian financial crisis in 1997 and the global financial crisis in 2008. In the case of 1998, there was a partial contraction in R&D investments due to the national financial crisis, but in 2008, science and technology investments remained strong. This illustrates that despite economic difficulties, Korea did not slacken investments in this field.

Table 5-1 | Trends in R&D

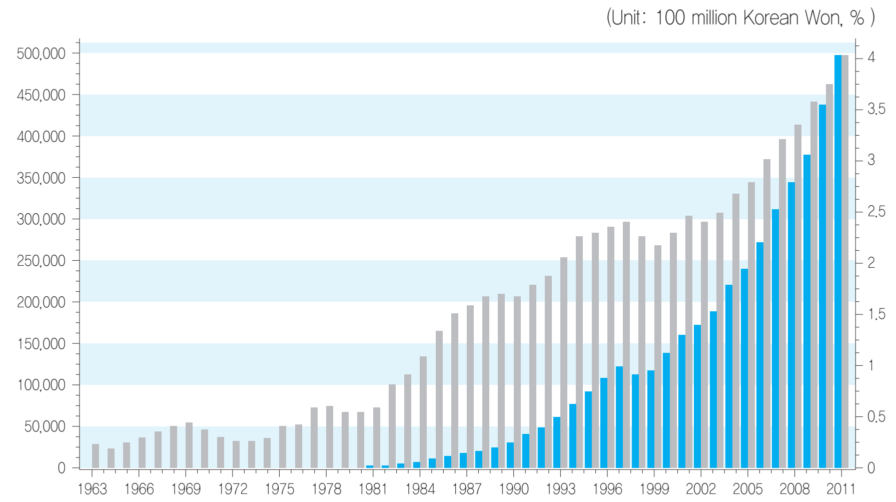
(Unit: KRW 100 million)

| Year | 1970 | 1980 | 1990 | 1995 | 1998 | 2000 | 2005 | 2008 | 2011 |
|---|---|---|---|---|---|---|---|---|---|
| Total R&D Investments | 105 | 2,117 | 32,105 | 94,406 | 113,366 | 138,485 | 241,554 | 344,981 | 498,904 |
| % of GDP | 0.38 | 0.54 | 1.68 | 2.30 | 2.26 | 2.30 | 2.79 | 3.36 | 4.03 |

Source: NTIS (National Science and Technology Information Service), National Science and Technology Commission

The long-term trend in Korean science and technology investments can be identified in the following graph. The gray bar represents R&D investments as a percentage of GDP, and the blue bar represents total R&D investments. With a few exceptions, Korea's R&D investments as a percentage of GDP has continuously increased since it initiated economic development. Furthermore, total R&D investments have grown relatively steadily from the various impacts GDP trends are subject to. This demonstrates that Korea's investment in science and technology was carried out in accordance to the country's long-term outlook.

### Figure 5-2 | Long-term Trends in R&D Investments




Source : NTIS (National Science and Technology Information Service), National Science and Technology Commission

Advancements in the Korean economy stimulated R&D activities, which led to a significant diversity of R&D participants. The following table shows changes in subjects utilizing R&D investments in Korea. During the 1960s-70s, private R&D activities were few, and government research institutes were main actors in R&D. This structure had changed significantly since 1980. With the rapid increase of R&D activities by businesses, the private sector became a main actor of Korean R&D. After 1980, there was a gradual boost of R&D activities by universities. Overall, while government research institutes grew during the early stages of economic development, private research institutes during the maturation of economic development.

### Table 5-2 | R&D Investments by Subject
(Private sectors : Public Research Institutes : Universities and Colleges)

| Year | 1969 | 1975 | 1980 | 1985 | 1990 | 1995 | 2000 | 2011 |
|---|---|---|---|---|---|---|---|---|
| Ratio | 35:61:3 | 29:66:5 | 38:49:12 | 65:25:10 | 74:18:8 | 73:19:8 | 74:15:11 | 77:13:10 |

Source : NTIS (National Science and Technology Information Service), National Science and Technology Commission

Next, let us examine changes in R&D manpower. In 1969, the total number of R&D personnel in Korea were about 12,000. At the time, R&D personnel per population of 10,000 were 1.4 persons. There are no accurate statistics on PhD-level personnel in the 1960s, but they are estimated to be no more than 1,000 persons. Total R&D manpower in 2011 reached 530,000, with R&D personnel per population of 10,000 at 54 persons in 2010.

**Table 5-3 | Changes in R&D Manpower**

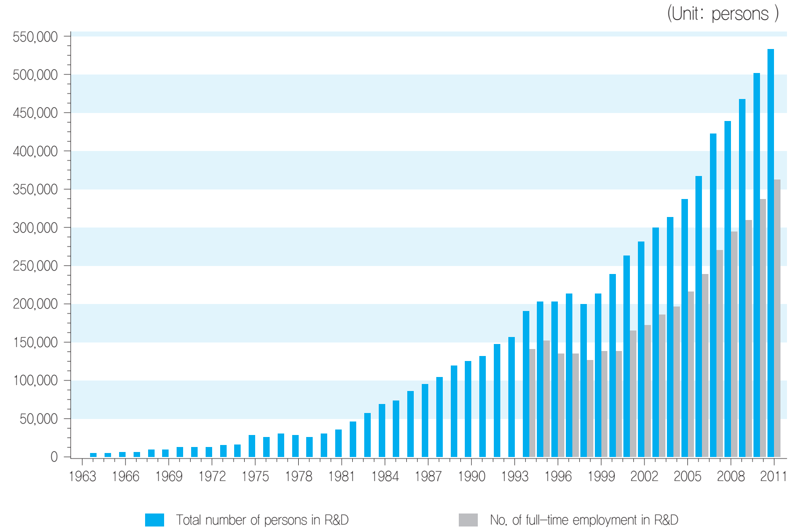
(Unit: Persons)

| Year | 1969 | 1976 | 1980 | 1986 | 1996 | 2006 | 2011 |
|---|---|---|---|---|---|---|---|
| Total R&D Manpower | 12,145 | 27,051 | 30,473 | 87,430 | 202,347 | 365,794 | 531,131 |
| PhD-level | - | 2,700 | 3,400 | 9,000 | 36,106 | 60,013 | 84,674 |
| Per 10,000 persons | 1.4 | 3.3 | 4.8 | 12.5 | 21.8 | 41.4 | 54.0(2010) |

Source : Compilation of Twenty Years' History of Science and Technology Administration, NTIS (National Science and Technology Information Service), National Science and Technology Commission

The following graph shows long-term trends in total R&D personnel and the proportion of regular R&D personnel from the beginning of economic development to today. The blue bar represents total R&D personnel, whereas the gray bar stands for the number of regular R&D personnel. Around the Asian financial crisis in 1997, a slight decline in the number of R&D personnel can be found. But overall, the number of R&D manpower has increased steadily from 1963 to 2011.

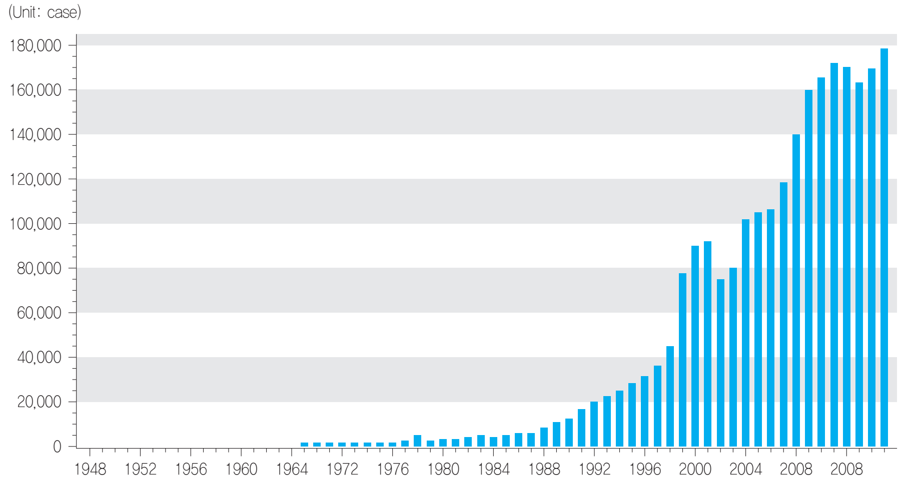
**Figure 5-3 | Long-term Trends in R&D Manpower**




Source : NTIS (National Science and Technology Information Service), National Science and Technology Commission

Lastly, let us study the trends in the number of patents, another indicator of major achievements in science and technology. Patents are important indicators demonstrating how science and technology activities lead to commercialization. Therefore, the increase of patents can be seen as a diagnosis of the growth of industries based on science and technology. The following graph illustrates trends in the number of annual patent applications in Korea. In 1970, the number of domestic patent applications was 1,846 in 1985, but the number exceeded 10,000. In 2000, there were over 100,000 patent applications, and in 2011, there were about 180,000. Similar to other trends, the number of patents also declined immediately after the 1997 financial crisis. After science and technology investments were restored, however, a strong rising trend is maintained to this day.

**Figure 5-4 | Long-term Trends in the Number of Annual Patent Applications in Korea**




Source: NTIS (National Science and Technology Information Service), National Science and Technology Commission

Triadic Patent Families are an international standard for patents. They are patents that are applied for simultaneously in the U.S., Japan and Europe. The greater number of these patents signify greater number of high-quality patents. Additionally, Triadic Patent Families often increase with greater domestic patent applications. The following table is a comparison of the number of triadic patent families of advanced countries. Korea only had nine of them in 1987. The lowest number among countries was shown in the table. But in 2010, Korea produced triadic patent families almost as much as France. Compared to Germany, U.S. or Japan, Korea has still a long way to go. But noting the rising trend in the number of patents, the proportion of triadic patent family applications in Korea is higher than that of other countries. Given the long-term trends in the number of domestic patents and triadic patent families, the achievements of Korea's investments in science and technology can be said to be quite exceptional.

Table 5-4 | Trends in Applications of Triadic Patent Families of Major Advanced Countries

(Unit: case)

| Category | 1987 | 1990 | 1995 | 2000 | 2005 | 2010 |
|---|---|---|---|---|---|---|
| Denmark | 100 | 126 | 189 | 223 | 311 | 303 |
| Germany | 4,273 | 4,142 | 4,919 | 5,804 | 5,779 | 5,685 |
| Russia | 66 | 20 | 63 | 73 | 60 | 73 |
| United States | 9,287 | 11,260 | 12,362 | 13,794 | 15,352 | 13,837 |
| Sweden | 398 | 443 | 760 | 618 | 831 | 882 |
| United Kingdom | 1,469 | 1,458 | 1,588 | 1,622 | 1,667 | 1,598 |
| Austria | 182 | 175 | 223 | 275 | 429 | 407 |
| Israel | 73 | 84 | 161 | 321 | 420 | 335 |
| Italy | 591 | 645 | 622 | 638 | 745 | 707 |
| Japan | 7,210 | 9,607 | 9,598 | 14,749 | 14,859 | 15,067 |
| China | 12 | 12 | 21 | 71 | 312 | 875 |
| Canada | 295 | 291 | 390 | 526 | 668 | 638 |
| France | 1,754 | 1,910 | 1,976 | 2,140 | 2,402 | 2,447 |
| Finland | 114 | 152 | 319 | 350 | 344 | 353 |
| Korea | 9 | 68 | 331 | 732 | 2,219 | 2,182 |
| Australia | 191 | 187 | 236 | 373 | 342 | 284 |

Source: OECD, Main Science and Technology Indicators

As can be gathered from the above, advancement in science and technology went hand-in-hand with national growth in Korea. The Korean government has continued to expand investments in science and technology believing it was investing in the country's future. Additionally, the Korean science and technology community worked harder than those of other countries in pursuing R&D activities. The inter-complementing relationship between the government and the science and technology community has led to the building of a rich foundation for Korea's growth.

## 2. Changing Public Perception of Science and Technology

Achievements in the promotion of science and technology should be examined not only from a quantitative aspect as in the first chapter, but also from a social and cultural perspective. What is clear is that during the early 1960s, there were not many people in the Korean society who considered science and technology activities important. At the time, technicians were regarded as a lowly profession. In contrast, poor people believed that becoming a lawyer was the only way to climb the social ladder.

Today, many Koreans study science and technology and work in a related field because of the change that happened only over a course of 50 years. The Park Chung-hee administration set the country's top priority as achieving a "self-reliant economy", and led the country's late industrialization through an ideology of modernizing the country and the people's movement "Let's live well!" But the motto "Let's live well!" alone is not enough to enhance people's capacity. For people to become suitable industrial manpower, they had to study engineering and technical skills. The Korean government initiated a campaign in this aspect during the 1970s titled the "Learning Science Movement".

The Learning Science Movement was a form of an enlightenment campaign. It provided a "Learn Science" program to everyone from primary and middle school students to farmers, fishermen and employees. It even had a skills training and rehabilitation training program for prisoners. It was literally a campaign to teach science to all people.

Adopted as a nationwide campaign, various government departments conducted their own programs to implement the Learning Science Movement. While the Ministry of Culture and Public Information promoted the campaign, the Ministry of Commerce implemented technology innovation programs. The Ministry of Agriculture and Fisheries carried out the campaign to transform all farmers and fishermen into technicians, and the Ministry of Education focused on strengthening education in science and technology. The Ministry of S&T acted as the headquarters of the Movement and the Korea Science Foundation (currently, the Korea Foundation for the Advancement of Science and Technology) carried out projects to oversee all other projects.

As a symbolic event of the Learning Science Movement, the government designated "National Science Day". The Park Chung-hee administration designated April 21 as National Science Day, immediately after founding the Ministry of S&T. In commemoration of this day, the government awarded highly achieving scientists and engineers, and held a Science Competition for primary and middle school students. These efforts are continued to this day in the form of science education programs conducted by the Korea Foundation for the Advancement of Science and Technology.

This movement in the 1960s-70s had an impact on university admissions. The following table shows that about 37,000 out of 100,000 freshmen selected science and engineering as their major in 1965. This figure showed a steady increase until the early 1980s. Statistics for the year 1980 were unavailable and could not be incorporated. Although the rising trend slowed slightly after 1985, the important fact is that about half of the students entering university study science and engineering as their major. In 2000, their number reached over 900,000.

### Table 5-5 | Trends in Majors of University Freshmen

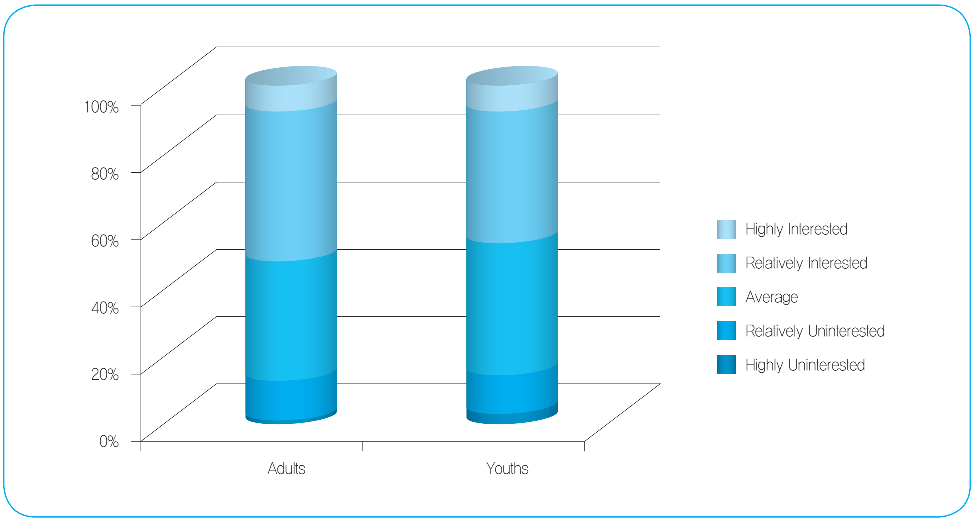
(Unit: persons)

| | 1965 | 1970 | 1975 | 1981 | 1985 | 1990 | 1995 | 2000 | 2005 | 2010 |
|---|---|---|---|---|---|---|---|---|---|---|
| Total | 108,724 | 149,123 | 211,979 | 552,716 | 1,141,002 | 1,280,693 | 1,537,017 | 2,219,765 | 2,356,839 | 2,458,015 |
| Science and engineering | 37,634 | 59,798 | 74,702 | 210,822 | 373,643 | 452,576 | 561,270 | 909,353 | 911,502 | 887,084 |
| Medicine | 11,136 | 12,925 | 16,813 | 25,679 | 39,408 | 40,430 | 53,655 | 81,118 | 79,995 | 96,933 |
| Humanities and Social Sciences | 48,841 | 55,048 | 60,090 | 196,062 | 512,045 | 562,190 | 610,025 | 940,107 | 995,298 | 1,073,995 |
| Others | 11,113 | 21,352 | 60,374 | 120,153 | 195,652 | 173,527 | 191,397 | 289,187 | 370,044 | 400,003 |
| Industrial Universities | - | - | - | - | 20,254 | 51,970 | 120,670 | - | - | - |

Source: NTIS (National Science and Technology Information Service), National Science and Technology Commission

According to a survey conducted in 2010, Korean adults and youths had a considerably high interest in social issues related to science and technology. The following graph shows that the proportion of the subject population with above-average interest-level in such issues reach approximately 90 percent.

### Figure 5-5 | People's Interest-level in Social Issues Related to Science and Technology




Source: Korea Foundation for the Advancement of Science and Technology (2010)

The below table is an international comparison of indicators representing the interest-level and understanding of the Korean people in science and technology. In case of Korean youth, their interest-level and understanding of science and technology was similar to that of the EU (2005), whereas Korean adults' understanding of science and technology was only slightly lower than those of advanced countries.

Table 5-6 | People's Interest-level and Understanding of Science and Technology (2010)

* Out of 100, Based on adults, Brackets ( ) represent Korean youths

| Interest-level | 2010 Korea | 2008 U.S. | 2005 EU |
|---|---|---|---|
| Utilization of new inventions and technology | 50.8 (54.0) | 65.5 | 54.0 |
| New scientific discoveries | 49.0 (41.9) | 63.0 | 54.0 |
| **Understanding** | **2010 Korea** | **2001 U.S.** | **2005 EU** |
| Utilization of new inventions and technology | 28.4 (32.6) | 38.0 | 37.5 |
| New scientific discoveries | 27.3 (32.3) | 42.5 | 35.5 |

Source: Korea Foundation for the Advancement of Science and Technology (2010)

As can be inferred from the above, Korean's high understanding of science and technology and an interest-level that matche those of advanced countries are a result of the science and technology promotion policies that were carried out since the early stages of nationl economic development. Today, no one in Korea regards technicians as lowly laborers. This signifies that Korea underwent a huge transition in its social and cultural spheres in step with its economic development.

# Chapter 6

## Implications and Recommendations

1. National Leaders' Support for Science and Technology
2. Construction of a Legal Framework to Justify the Promotion of Science and Technology
3. Establishment of National Science and Technology System
4. Changing People's Perception

# Implications and Recommendations

## 1. National Leaders' Support for Science and Technology

In addressing the issue of development in an underdeveloped country, the leadership and decision-making of national leaders are pivotal. A country's development takes on a different outlook depending on choices they make and projects they pursue to achieve national development. Korea chose to adopt science and technology as an important tool to achieve economic growth from the early 1960s. Complementing this decision, the President took the initiative to underline the importance of science and technology, volunteered to be its sponsor and encouraged its development. It was the President's promotion of science and technology that persuaded people to learn science and skills, thereby creating the social capital necessary to build the country's foundation for growth.

Therefore, national leaders need to take the initiative and personally lead the promotion of science and technology in order to see the future from a longer perspective and motivate the people to participate in national development.

## 2. Construction of a Legal Framework to Justify the Promotion of Science and Technology

In a country underdeveloped in science and technology, it is important to institutionalize science and technology. Though there is no modern national system, it is particularly effective to first build a legal system to promote this field. Needless to mention, prior to establishing such a system, a country must first examine what science and technology resources it can utilize internally.

Korea, being a country with limited natural resources, had to prioritize the enactment of laws related to science and technology manpower. This provided legal grounds to educate the best brains in the country as science engineers, to have them be justly recognized by society and participate in major national projects.

In this case, a national leader trying to achieve economic development based on science and technology must justify the promotion of science and technology from a legal aspect. Oppositions from other interest groups and inertia to preserve existing interests can only be expected in the process. This is exactly why the insightful national leader is required to make bold decisions.

## 3. Establishment of National Science and Technology System

The basic framework for a national science and technology system is composed of companies, government research institutes, and universities, which are the main actors of science and technology activities, and an administrative system which supports them. Less developed countries often lack such a system, but many developing countries have a similar system. In the 1960s, Korea had universities which provided basic theoretical education and national research institutes that were similar to public organizations of government officials. Korea's national leaders at the time, however, did not design a national science and technology system based on these existing institutes. They created new organizations, primarily the Science and Technology Agency, Korea Institute of Science and Technology (KIST), and Korea Advanced Institute of Science (KAIS) as the think-tanks to lead national development. They induced concentration of the most talented people in these new institutions and encouraged them to devote themselves to national development, thereby shaping the development of the entire science and technology sector.

Korea's experiences in advancing science and technology have huge implications to policy makers in developing countries. This is because the extent of science and technology's contribution to the country's development depends on how they create and reform their national science and technology systems. Therefore, developing country leaders must encourage domestic science and technology activities to be closely connected with their economic development. This will require bold reforms for existing science and technology systems and the adoption of new systems.

## 4. Changing People's Perception

All national leaders understand cultural customs and behaviors of their people. A country's long-lasting cultural tradition sometimes frustrate a leader's drive towards national development. However, the Korean case of science and technology promotion provides evidence that a society's deeply rooted cultural customs can change with a country's efforts. In the Korean society, there was an old-fashioned tradition that regarded technology as lowly labor. But its national leader inspired people the confidence towards economic development, and implemented policies that offered preferential treatment to those with technical skills. This was what completely transformed the way people perceived science and technology. The Learning Science Movement the Korean government initiated during the early stages of its economic development was even applied to the prisoners at the time. This campaign, compounded by huge investments in science and technology on a national level, swiftly transformed the Korean society. Such initiatives encourage many students to move on to science and engineering universities and nurture the hope of working in a science and technology-based industry. Creating such a cultural and social capital is a duty the national leader must fulfill in achieving national development.

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