STI IN HISTORY: KOREAN STI POLICIES IN TECHNOLOGY CATCHING-UP STAGE[1]

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1. Introduction

Korea enhanced its global status through the industrialization of the 1960s and the 1970s; however, there was also an increased economic and social burden due to the growth. The 1979 energy crisis caused oil prices to soar and put the domestic heavy chemical industry (a consumer of imported oil) in difficulty. Economically, the Korean government recognized that an export-oriented industrial structure that depended on imported raw materials was no longer sustainable. In addition, from a social aspect, it was difficult to maintain an industrial structure that was dependent on low-wage labor because of a burgeoning labor movement and a more active pro-democracy movement.

In the 1980s, the Korean government sought to find "technology solutions" to the problems caused by export-oriented industrialization. The government "technology drive" strategy established a common goal to replace the existing "export drive", and achieve the "technology catching up" with advanced countries in the public and private sector. Subsequently, Korea quickly became a country of high-tech industries. In the process of technology catching up, light industries (such as textiles) that used to contribute greatly to the exporting business, started to decline; however, high-tech industries (such as electronics, computers, and communications) emerged as key industries.

In the 1990s, the idea of technology catching-up was maintained to promote high-tech industries. During this time, there was rapid globalization and this strengthened the basis for a technology development strategy; in addition, the high-tech industries of conglomerates showed rapid growth. In the late

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1990s, Korean companies (including Samsung) were able to compete with famous global brand companies in international markets. In line with such confidence, the Korean government focused on a post catch-up strategy. However, after the 1997 Asian Financial Crisis the basis for this transformation seemed to weaken a little.

This paper shows that Korea's science and technology policies in the 1980s and the 1990s acted as the prime mover for the catching up. These efforts of catching up were harnessed by the national science and technology system that focused on the government-funded research institutes (GRIs) that were created before this period. The system was to expand into a National Innovation System (NIS) that included other principal agents such as universities and the private sector.

2. Background

In the 1980s and the 1990s, the common understanding of the Korean government, industry, and scientific community was that the Korean industry faced a sandwich crisis of being stuck between advanced countries and the following developing countries. In this context, the Korean government sometimes exaggerated the "economic crisis" through the media. It encouraged a widespread social support on 'saving the economy' and changed the government focus on the economy. Since the 1960s, the slogan of "modernization" was the governing ideology of the Korean government to attract broad participation and public support; however, since the 1980s, the government projects have been carried out under the slogan of "saving the economy".

Through the rapid economic growth of the past twenty years, Korea joined the ranks of semi-advanced countries; however, Korea was not satisfied with this achievement and tried to catch up with advanced countries by defining itself as a sandwich state that needed to escape from being stuck in the middle. We can understand the situation from the changes that occurred in the domestic and foreign conditions during the time.

The first occasion was the 1979 energy crisis. The heavy chemical industry that depended on imported oil, was the hardest hit; subsequently, the Korean economy in 1980 recorded negative growth (-2.7%). Korean society suffered a bigger economic shock as it was, at that time to expect an annual economic growth of over 10%. This gave weight to the attempts of the Chun Doo Hwan government to reform the industrial structure and

restructure insolvent enterprises through the industrial rationalization strategy. In order to achieve this, the 'technology drive' policy was justified as the major means to reduce dependence on imported materials *(KOSEF, 1986; STEPI, 1997)*.

While the argument that Korea was in an economic crisis continued, the second occasion that encouraged the improvement of the industrial structure was the burgeoning labor movement in Korea. Throughout the 1980s, many strikes and labor demonstrations fought against low-wage labor and poor labor conditions. It was difficult for the Korean economy to maintain an industrial structure based on labor exploitation. As a strategy to resolve this, the Korean government promoted the development of the technology-intensive high-tech industries and implemented the industrial policy in the direction of decreasing labor-intensive industries.

The third occasion was the post-Cold War era caused by the unification of Germany in 1989 and the collapse of the former Soviet Union in 1991. During this time, there was rapid globalization in Korea. The liberalization of overseas trips and incorporation into the global market created a widespread public awareness that Korea was no longer a geographically small isolated country, but a country that would be able to compete on the international stage. There was a sense of inferiority that Korean products did not meet global standards and the spirit of challenge to overcome this was prevalent. Subsequently, phrases like "global standards" and "international competitiveness" were established as the basis for national policies that further accelerated the catch up with advanced countries.

The national economic affairs management style of the Korean government focused on the arrangement of national resources for the economic growth and the supremacy of the growth ideology (that had been continuously promoted since 1960) acted as the basis for the catching up strategy. Under such domestic and foreign conditions and environment, there was a consensus created in Korean society that considered economic growth as the best national value. The Korean government implemented a strategy that focused on growth during the 1980s and the 1990s.

3. Policy

3.1. Science and technology plans for the "Technology drive"

During the 1980s and the 1990s, the "technology drive" was the key principle that motivated the science and technology policy. The 'technology drive' was an idea that involved a virtuous circle in the development of technology, industry, and the nation through the quick improvement of the domestic technology to the level of advanced countries. The Korean government promoted this idea and sought to develop the high-tech manufacturing industries as well as the national prestige into the ranks of the advanced countries. During the 1980s (based on the strong administrative power of the Chun Doo Hwan government and the Roh Tae Woo government) the technology drive strategy was implemented through the policies in a downward trend from the nation to the people. However, during the 1990s, the role and function of the private sector was larger than the public one and the subsequent democratic governments of Kim Young Sam and the Kim Dae Jung sought a development strategy led by the private sector instead of growth led by the government. Like this, there were several differences in the methods, but there is no doubt that the technology drive strategy was an important part of the major government administrations from the 1980s-1990s *(MOST, 1981; Korea, 1993).*

The "technology drive" strategy that replaced the "export drive" strategy, showed the strong commitment of the Chun Doo Hwan government to foster high-tech industries through the operation of a strong government administration and intervention in the private sector economy. This is revealed in the "*Fifth Economic and Social Development 5-Year Plan: Science and Technology Field Action Plan, 1982-1986"* (The Fifth S&T 5-year Plan) that was planned during the onset of the Chun Doo Hwan government. The plan established "Emerging as a Strong Technology Nation in the World Stage" as the slogan and the key objective was the advancement of industrial technology and increased international competitiveness through the development of science and technology. This started the government's technology development strategy of the 1980s that led to the modification and expansion of the science and technology promotion system, the expansion of independent technology capacity from the private enterprises, the reinforcement of the function of universities, and the development of advanced industrial technology into a strategic business.

The science and technology policy of the 1980s increased the weight of the policy to develop information and communications technology due to the

effect of the 'information society' discourse that led future discussions on the development of an advanced country status. Many of the large national R&D projects were involved in the information and communications technology R&D resources. In the 1990s, the tendency to focus the resources in the IT field continued. When the Kim Young Sam government presented the "New Economic 5-year Plan" (1993-1997), the key to science and technology policy was "facilitating technology development and informatization". In addition, most of the seven areas selected as the next-generation product technology development projects were projects related to information and communications technology in the "Science and Technology Innovation 5-year Plan" (The 5-year STI Plan) of 1997; in addition, this included the term "in-novation" for the first time in the government's science and technology plan.

The difference with the science and technology policy of the 1990s was that the private sector played an increased leadership role in science and technology activities. The Kim Young Sam government implemented a demand-oriented technology development policy led by the private sector in the science and technology field. To achieve this, the national projects were adjusted. Until the 1980s, the technology entities were government-funded research institutes that led the technology development activities of the private sector; however, the private sector is now taking the lead in the implementation of the technology development activities with the government and the government-funded research institutes assisting them.

From the 1980s to the mid-1990s, the trend of science and technology policies emphasized the continued importance of the "technology drive". However, the Korean science and technology industry suffered difficulties after the 1997 Asian Financial Crisis. Many workers in the science and technology field lost their jobs as the private sector decreased R&D activities. In addition, there was talk of a "crisis of natural science and engineering" as students avoided selecting natural sciences and engineering as their majors when entering university. The traditional belief that industries and the economy would automatically develop if the science and technology developed turned into distrust; science and technology, considered to be the growth engine, was the first to be eliminated when there was a crisis in the national economy. The "technology drive" strategy seemed to lose its power during the 1997 Asian Financial Crisis.

The Kim Dae Jung government quickly overcame the shock of the 1997 Asian Financial Crisis, and the government pushed "the strengthening of science, technology and innovation". This was a policy ideology that was stronger than the existing "technology drive" that dealt with the global market by simply catching up with technology and developing new technology. The "innovation drive" (that later became the ideology of the Korean science and technology policy) included the development of new technology and comprehensively considered the preparation for the future, the development of each sector of innovation, and the overall development of the innovation system. Subsequently, Korean science and technology policy entered the era of "innovation drive" for the 21st century *(MOST, 2003)*.

3.2. Expansion of the science and technology governance system

The "technology drive" was the key principle of the Chun Doo Hwan administration and the first thing that the government did in the early 1980s was to strengthen the function and prestige of the Ministry of Science and Technology (MOST). A symbolic event was when sixteen government-funded research institutes (fragmented into different agencies and apartments) were merged into nine institutes and placed under the control of MOST. MOST was unified as the main government agency and it was possible to decrease the overlapping R&D tasks implemented by each research institutes to efficiently implement the "technology drive" policy.

The function of the MOST in the 1970s was to establish the basis for science and technology development and support industrial technologies. The prestige and function of MOST expanded in the 1980s after it played a leading role in the newly initiated national R&D projects. The Chun Doo Hwan government implemented a National R&D Project as part of a larger research project; subsequently, there emerged a triangle between the MOST, the government-funded research institutes, and private enterprises. The ideology of "technology drive" was embodied among them.

The MOST was not the only entity involved in cooperation between the government, research institutes, and private enterprises, there was also participation by other governmental agencies like the Ministry of the Postal Service and the Ministry of Trade and Industry. Starting from the mid-1980s, the proportion of government agencies (besides the MOST) that participated in R&D projects increased, and the scale of the national R&D

projects grew; science and technology R&D projects assumed a government-wide nature. At the end of 1990s, the Kim Dae Jung government upgraded the prestige of the MOST to a higher standing in the government decision-making process to strengthen the mediation function of the science and technology policy.

Another big change that occurred after setting "technology catching" up as a national goal was the establishment of a review board for science and technology policy to make comprehensive policy decisions and gather opinions. In 1982, the Chun Doo Hwan government established the "Technology Promotion committee with Enlarged Membership" to expand the public participation in the planning and decision making of national projects. In practice, about 200 members participated from relevant agencies, political organizations, scientific communities, industrial bodies, and the media at the meeting under the supervision of the President and the Minister of the Science and Technology. This organization changed its name to the "Science and Technology Promotion Committee" under the Roh Tae Woo government. The activities of this large consultation body were officially systemized in 1991 with the establishment of the Presidential Council for Science and Technology.

In 1998, the consultation meeting changed into the "National Science and Technology Committee" due to the trend to emphasize the comprehensive mediation function of the national science and technology projects. As a presidential council, this committee created major policy agendas for the national science and technology business that were directly propose to the President of Korea. This allowed the direction of the science and technology policy to be set at the highest level of the decision-making system and comprehensively supervised projects that were scattered in various government agencies. The consultation bodies of science and technology in the 1980s and 1990s that led the "technology drive" were symbols of the close bond between science and technology and the Korean government *(MOST, 2008).*

3.3. Development of the National R&D projects

The science and technology activities in Korea in the 1970s focused on the introduction and application of foreign technology; however, the implementation of national R&D projects in the 1980s refocused the main activities involved in the catching up with the foreign advanced technology

towards independent technology development. This commenced with the "National R&D Project" in 1982 that would be a "Specific R&D Project" or "Strategic R&D Project" (the translation included the adjective "National" since this project was the only current national project). This project can be divided into government led projects that had significant public interest and private sector projects that resulted in substantial profits. In government led projects, all of the research funds were from the government; however, in private sector projects, the government and the private sector shared the costs. The main actors that participated in national R&D projects were government-funded research institutes and enterprises that implemented the R&D activities through the formation of multilateral consortiums.

The overall business type and scale expanded in the mid-1980s as various government agencies began to award national R&D project orders that also included the implementation of the Ministry of Industry and Commerce "Industry-based Technology Development Project". In the process of such expansion, the complexity of the national R&D project increased. The Roh Tae Woo government divided the national R&D project into two types in 1990. One was projects in the form of a technology push led by the MOST that included the development of fundamental technology, the joint international cooperation, and the basic research project. The other was the projects in the form of demand pull lead by agencies concerning industries, such as the Ministry of Information and Communications and the Ministry of Trade and Industry that included the development of high-tech industry to improve the industrial competitiveness, the development of technological solutions to difficulties of small business, and quality improvements in manufactured products.

In the 1990s, the MOST set the national R&D project goal as the ability to meet the technology levels of technologically advanced countries. National projects in the 1980s had the exemplary nature that tried out the technologies developed by the advanced countries; however, national projects during the 1990s further clarified the goals of catching up with the advanced countries in the high-tech fields. The symbolic project was the "Leading-edge Technology Development Project" (G7 project) that started in 1992. The G7 Project was the ambitious plan of the Korean government to join the top seven countries in the world in terms of the high-tech field. This project was implemented through a ten year investment that lasted until 2001. Due to these technological efforts, Korea entered the 21st

century equipped with science and technology competitiveness that ranked in the global top ten.

The increase in university applicants for basic research can be seen as a R&D project characteristic in the 1990s. National R&D projects in the 1980s were formed around government-funded research institutes; however, the universities did not have the opportunity to participate in such projects.

In 1989, the Roh Tae Woo government enacted the Basic Sciences Promotion Act; subsequently, thirteen universities were selected as the Science Research Center (SRC) and the Engineering Research Center (ERC) received assistance in 1990. This project was a long-term basic research project that received research funds of one billion won per year to conduct research for a maximum of nine years. In addition, the creative research promotion project started in 1997 so that individual university researchers could receive long-term research funds. Subsequently, the research capacities of the universities in the 1990s increased greatly and provided the opportunity for the Korean universities to overcome the limitations of the traditional "educational" function and develop into research universities that are commonplace in advanced countries.

The system that planned and managed these projects also expanded with the progress of national R&D projects. Most of the project planning was done through the bottom-up method (until the mid-1980s) that subjugated researcher proposed projects to government decisions based on purpose. However, a top-down method of planning that introduced the strategic concept has since been established for national projects. In the process, the number of institutes that specialized in planning, managing, and evaluating science and technology policy increased. After the Korea Science and Engineering Foundation (KOSEF) (now the NRF, the National Research Foundation) was established in the late 1970s, the number of independent bodies (such as the Science and Technology Policy Institute (STEPI) and the Institute of Industrial Technology Policy (ITEP)) increased *(MOST, 1987; STEPI, 1991; STEPI, 1997)*.

3.4. A system to develop human resources in science and technology

The human resource policy of the government in the 1970s concentrated on the development of high-quality technicians required by industry. In the 1980s where the "technology drive" was the slogan, the Korean

government made the development of high-quality scientists and engineers who could develop technology as their key task. High-quality scientists and engineers were also needed in the 1970s; however, Korea tried to supply them through the 'reverse brain drain' policy for Korean scientists and engineers who received overseas education instead of domestically developing individuals. This policy was efficient to acquire talented people in a short period; however, there were limitations on the number of people that could be recruited. In addition, it was difficult to guarantee the continuity of the development with them alone.

The trend to expand large national R&D projects and increase company research institutes in the private sector made it urgent to establish a system to develop high-quality scientists and technicians in Korea. In response, the Korean government made a specialized educational system in science and engineering education that was separate from the existing middle and high school education system. The graduate degree courses at the Korea Advanced Institute of Science and Technology (KAIST) were expanded; in addition, science high schools and science and technology universities were established. This established the system to develop competent scientists and engineers from science high schools, science and technology universities, and KAIST.

These schools provided high-quality education equipped with the latest research equipment and lectures delivered by professors. In addition, they provided benefits like military service exemptions and scholarships to motivate outstanding talent. In particular, early high school graduation of gifted students (which was forbidden in the regular curriculum) was introduced to encourage under 30 years of age PhD holders.

In 1986, the Pohang University of Science and Technology (POSTECH) was established with the sponsorship of Pohang Jecheol (later POSCO). This created an industrial-university cooperation model between universities and companies. In particular, POSTECH claimed to support the development of a "research university" that encouraged the innovation of other colleges and universities in the science and technology field and to surpass the "education" function of traditional academia. Since then, the discussion about the role and function of universities in Korea focused on a "research-oriented university". This led to the policy in the 1990s that strengthened the function of graduate schools in higher education.

Until the 1980s, high-quality human resources were developed mostly from KAIST; however, that function expanded to each university in the 1990s. The research environment of universities quickly improved due to the increase in government R&D investment and projects that supported research-oriented universities. The number of graduate school students grew with a noticeable increase in science and technology university applicants. From 1994 to 1998, projects that supported engineering colleges were implemented. As a result, the engineering college of eight universities received 600 billion won from the government and private enterprises. The BK21 (Brain Korea 21) project began in 1999 with the goal to innovate higher education to prepare for the knowledge-based society and provided the opportunity to improve the overall quality of Korea's higher education (including the science and technology field). The talented people educated from the domestic higher education would lead the 'innovation drive' in the upcoming knowledge-based society *(STEPI, 2002)*.

3.5. The diversification of the science and technology legal system

The change that occurred in the legal system concerning science and technology in the 1980s and the 1990s can be divided into two types. One was the trend where the private and public sector was developed to implement the 'technology drive' and the enactment and revision of the legislation as an institutional strategy for both sectors to cooperate. The other was the trend where laws were enacted for different areas of science and technology for the catching up with the advanced countries.

The first trend started when the technology protectionism of the advanced countries intensified as cooperation between the private enterprises and government-funded research institutes were made to develop independent technology in Korea. The Chun Doo Hwan government revised the Technology Development Promotion Act (legislation No. 3521) to systemize the establishment of a research consortium between companies and government-funded research institutes as well as to provide financial funding. Subsequently, the establishment of a consortium between companies that included Samsung and Keumsung Electric and government-funded research institutes (such as KAIST and ETRI) actively occurred.

There was also a rapid increase of company research institutes, especially in the conglomerates. Most of the technologies could be developed independently from the private research institutes and their capacities

increased; contrastingly, the need for the policy to support research collaboration between conglomerates and governmental research institutes decreased. In this context, *the Industrial Technology Promotion Act* changed the main actors of the collaboration to small and medium-sized enterprises and government-funded research institutes.

In the 1980s, the main actors of national R&D projects were the government-funded research institutes: however, the universities developed into the main R&D actors as of the 1990s. The act that motivated this change was the Basic Science Promotion Act in 1989 that increased support for the R&D projects at universities with the representative examples of the SRC and ERC projects. In 1994, the universities developed into the main R&D actors and the *Cooperative R&D Promotion Act* was enacted to encourage the cooperation of each sector (universities, the government-funded research institutes, and industries).

One thing that was different in the characteristics of the science and technology legal system (that appeared during the technology catching up period) was the numerous laws enacted for different areas. The laws enacted at the time included, the *Genetic Engineering Promotion Act,* the *Software Development Promotion Act,* the *Framework Act on Marine Development,* the *Alternative Energy Development Promotion Act,* the *Aerospace Industry Development Promotion* Act, and the *Brain Research Promotion Act*. This is an indicator of the significance of the government and the private sector's commitment for "catching up" in the high-tech science and technology field. However, the acts were too fragmented and necessitated the reorganization of the science and technology legal system. As a result, in 2001, the "Basic Act on Science and Technology" was enacted as the highest act for other science and technology acts *(MOST, 2008)*.

4. Evaluation and implications

The main factor why Korea was successful in the catching up era was because of the government's challenging policy planning and its implementation of a relentless technology drive strategy. The establishment of science and technology plans every five years and the drastic increase in annual national R&D project investments transformed Korea from a country of declining low-wage industries into a country of high-tech industries.

One noticeable change was the developments in the information and communications fields. Science and technology projects continuously

focused on the information and communications field in the 1980s and the 1990s. Subsequently, there were important achievements: development of a digital electronic switching system TDX-1 (Time Division Exchange-1), the establishment of the 1986 Asian Games and the 1988 Seoul Olympic Games information system, the development of the main computer for administrative computer network TICOM (Tiger Computer), the development of CDMA, and the private sector improvement to develop semiconductor technology. These achievements were the basis for Korea's major companies to mass produce high-quality technology products in the global market.

The period between the 1980s and the 1990s was an experimental period to catch up quickly with the technology of advanced countries. In the process of these experiments, the R&D capacities of government-funded research institutes, private enterprises and universities greatly improved. As a result of the S&T policy implementation and the NIS performance during the period, Korea was able to achieve unprecedented late industrialization./.

REFERENCES

1. Ministry of Science and Technology (MOST) of Korea. (1981) *The fifth economic and social development 5-year plan: action plan for science and technology, 1982-1986*. Seoul (in Korean).
2. Korea Science and Engineering Foundation (KOSEF). (1986) *A study on the analysis and outlook of the science and technology policy during the 1980s*. Seoul (in Korean).
3. Ministry of Science and Technology (MOST) of Korea. (1987) *The national R&D project 5-year action plan (1982-1986)*. Seoul (in Korean).
4. Science and Technology Policy Institute (STEPI) of Korea. (1991) *The present status and problem of science and technology plan.* Seoul (in Korean).
5. The Government of the Republic of Korea (Korea). (1993) *The new economic 5-year plan (1993-1997)*. STEPI. "The 50 Years History of Korea's Science and Technology Policy", Science and Technology Policy Institute (STEPI) of Korea, Seoul (in Korean), 1997.
6. Science and Technology Policy Institute (STEPI) of Korea. (2002) *Korea's science and technology human resources policy*. Seoul (in Korean).
7. Ministry of Science and Technology (MOST) of Korea. (2003) *The 5 year achievements of the Kim Dae Jung administration's science and technology policy*. Seoul (in Korean).
8. Ministry of Science and Technology (MOST) of Korea. (2008) *The 40 years history of science and technology*. Seoul (in Korean).