STI in History*:

Evolution of Korean STI Policies

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1. INTRODUCTION

As the opening of the 'STEPI Guide to Korean STI Policies,'[1] this paper provides an overview of the evolution of Korean science, technology and innovation (STI) policies from the early 1960s to the present while providing a foundation for follow-up three papers. An evolutionary approach is adopted for the framework taken under this group of papers. The papers under this group are organized from a historical perspective. The reason for adopting such an evolutionary approach is to provide a better understanding on Korean STI policies as a whole for those who are not familiar with Korea and Korean STI policies.

Since they take the evolutionary approach, these papers try to describe their respective issues as objectively as possible. The authors in this group have taken value-free positions in describing their papers. This opening paper also provides a value-free position but with a minimum typological perspective in dividing the whole history of Korean STI policies into a number of discernible periods. This typological perspective is discussed in the framework section.

This paper focuses on STI policies of Korea from the early 1960s to 2011. It is widely agreed that modern STI policies started with the inception of the *First Five-year Economic Plan* of 1962. Since then, Korean STI policies have dramatically evolved according to changed environments and development strategies. Following this introduction, the second section examines the general framework conditions the Korean STI policies are based on. The third section provides a framework dividing

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* The 'STI in History' is reserved for (series of) articles, essays, or editorial summaries that highlight events, individuals, or STI policies from a historical perspective.

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[1] "STEPI Guide to Korean STI Policies ("STEPI Guide")" is a web-based platform developed by the Science and Technology Policy Institute (STEPI) to guide various users including policy makers, analysts and scholars around the world on the science, technology and innovation (STI) policies of Korea. It provides rich references on Korean STI policies in a systemic way to policy makers and scholars in developing countries as well as in advanced countries. To provide more appropriate answers in a concise manner to various policy questions at diverse levels on the past and current Korean STI policies, the STEPI Guide adopts a hierarchical module system in organizing its references (i.e., articles). A module, the basic unit of the STEPI Guide, is a relatively short article that addresses a specific topic or issue at a certain level and is hierarchically linked to other modules within a framework. This paper is a leading module followed by the next three modules (papers).

STI policies into three broad periods and describes the main STI policies and activities in each period. These three periods are detailed the follow-up three papers. The last section discusses the overall assessment of whole Korean STI policies.

2. BACKGROUND

Korean history traces back to almost five millennia ago when the kingdom of Gojoseon was established in 2,333 BC. While several kingdoms including Goryeo, Joseon and Korean Empire have succeeded since then, its territory has expanded and shrunk repeatedly. Nonetheless, its main territory has largely been centered on the Korean Peninsula located in North-East Asia. The current territorial boundaries were established just after World War II when Korea became independent from the Japanese Colonial Empire (1910-1945). The aftermath of World War II unfortunately resulted in two Koreas (the Democratic People's Republic of Korea in the north and the Republic of Korea in the south) divided at the 38th parallel and eventually led to the Korean War (1950-1953). The Korean Peninsula remains divided along the Korean Demilitarized Zone (DMZ) as the de facto border between the two Koreas. In this article, Korea refers to the Republic of Korea, also called South Korea.

Korea is a nation of a small area of only 100,210 km^2 (38,691 sq miles) with a population of almost 50 million in 2010 (www.wikipedia.org). As well, Korea is a resource-poor country with no oil reservoirs and scarce mining resources (MEST, 2008). Even agriculture is not easy because mountains cover more than 70% of its land mass. Experiencing Japanese colonial occupation and the Korean War, Korea was left as one of the poorest countries in 1953, with only $67 per capita GDP (ecos.bok.or.kr). Now, its per capita GDP has reached $20,759 in 2010, more than three hundred times that in 1953 (ecos.bok.or.kr). The Korean GDP was ranked 12th in 2011 (estimate) with $1.556 trillion in total GDP (PPP) (www.wikipedia.org). Korea became a member of the OECD in 1996 and the G20 in 1999. Korea achieved enormous economic growth, the 'Miracle of Han River', within a half century.

High-quality human capital is widely pointed out as one of the success factors that enabled such remarkable Korean growth. It is attributed to the Korean emphasis on education based on Confucian traditions. Confucianism, adopted by Joseon Dynasty from late 14th century, placed classical scholars at the top of social classes followed by farmers, manufacturers, and then, merchants. Confucianism has remained one of the prevailing social values even though the social class hierarchy widely collapsed at the end of the Korean War. Korean people tend to sacrifice everything for their children's education under the most desperate situations. To a significant extent, such a relentless emphasis on education enables the Korean education policies to produce and provide high-caliber scientists and engineers. Currently Korea has the highest college enrollment rate of 72.5% in 2011 (MEST, 2011).

3. FRAMEWORK AND EVOLUTION

3.1 Framework

Korean STI policy is regarded to have started at the inception of the *First Five-year Economic Development Plan* in 1962 (MEST, 2008). After the Korean War, Korea remained one of the poorest countries in the world through the early 1960s. Almost all infrastructure was destroyed and political instability was extreme. Even daily necessities such as foodstuffs and clothing were heavily dependent

on foreign aid that financed more than 70% of Korea's imports from 1953-1960 (www.koica.go.kr). Economic growth was marginal, with the meager increase its per capita GDP from $67 in 1953 to $82 in 1960 (ecos.bok.or.kr).

After seizing political power through a military coup in 1961, President Park Chung-hee placed his administration's highest priority on economic development. The Park Administration developed the First Five-year Economic Development Plan in 1962 that focused on the development of import-substitution and export-oriented light industries (MEST, 2008). The plan included strategies for science and technology (S&T) development. There was no infrastructure or industrial capacity, only cheap labor; the establishment of import-substitution and export-oriented light industries required factories and skilled technicians. To meet such demands, Korean S&T strategy focused on the import of turnkey plants and technology learning. Korea started with building institutions and systems for S&T development since there were no systems for people to learn imported technologies and to provide skilled technicians. The first institution established was the Korea Institute for Science and Technology (KIST) in 1967 (Choi, 1983). One year later, the Ministry of Science and Technology (MOST) was established for the effective planning and implementation of S&T policies (MEST, 2008). Later, as economic and industrial development progressed, S&T policies evolved as well. In this way, Korean STI policies have always acted in concert with and supported Korean economic and industrial policies. Such evolutionary interactions among economic, industrial and S&T policies are summarized in Table 1.

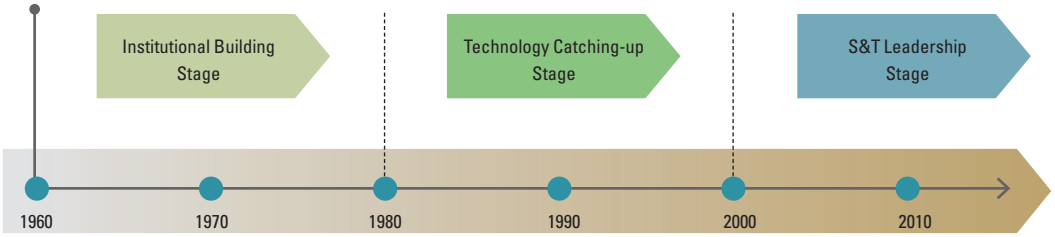
TABLE 1 Korean Development and Role of STI Policies

Period	1960s	1970s	1980s	1990s	2000s	2010~
Era	Export-Oriented	Export-led	Economic Liberalization	Democrat.	Advancement	Global Leading
Focused Industries	Light Industries	Heavy Industries	Assembly & Processing Industries	ICT	Knowledge Intensive Industries	Knowledge Service/New Converging/ Green Ind.
Competitive Factor	Cheap Labor	Skilled Labor	Capital Investment	Technologies	S&T Innovation	Advanced S&T Innovation
Demanding S&T HR	Skilled HR	Technical HR	Higher S&E	High Caliber S&E	Creative S&E	Creative & Converging S&E
Demanding Tech.	Plant Mgt.	Facility M&O	Mfg.	Core Tech.	Indigenous Tech.	Source Tech.
S&T Policy	Turn-key Capital Import/ Tech. Learning	Internalizing Imported Tech./ Reverse Eng.	Modify Imported Tech./ Develop Domestic Tech.	Advancing Tech. Catch-up/ Large Gov. R&D Prog.	Focus on indigenous tech./ Systemize S&T Prog.	Globalize S&T/ Focus on Convergence

Source: Jang (2011)

Such evolution in Korean STI policies can be summarized and categorized largely into three stages (Figure 1). Since the First Five-year Economic Plan, Korean STI policies have mainly concentrated on building institutions necessary for the establishment of a national innovation system (NIS) from a condition where there were no infrastructure, actors, and policies. Largely this stage lasted until the late 1970s.

FIGURE 1. Historical Evolution of Korean STI Policies



Later from the early 1980s to the late 1990s, Korean STI policies focused on catching up advanced global technologies (MEST, 2008). During this period, advanced countries became reluctant to transfer their advanced technologies as Korea was technologically capable of competition with advanced countries. Korea has tried to independently develop advanced technologies through the establishment of national programs for research and development (R&D). By the early 21st century, Korea began to place itself on the cutting edge in some technological areas such as semiconductors and telecommunications. From the early 2000s, Korean STI policies have concentrated more on the enhancement of capabilities to produce indigenous innovation and provide global leadership in science and technology.

This broad categorization of Korean STI policy evolution is proposed as a framework to organize all other papers. There could be other good typologies to describe Korean STI policies; however, this framework is adopted for the following reason. As stated, the *STEPI Guide* provides appropriate lessons to other developing countries that at different development levels of stages. It is best to distinguish what Korea has done in the institutional building stage and what Korea experienced in the catching-up stage. In this way, developing countries can draw appropriate and suitable lessons for to their unique conditions from Korean experiences. The policies and concerns in the later stage of S&T leadership can be a good case study source for comparison with those of other advanced countries.

Below some major STI policies and activities are described in a very broad manner. Detailed description on each period will be delivered in the follow-up papers.

3.2 Institutional Building Stage[2]

The military regime under the Park Administration provided a political stability and strong leadership in driving economic development until the late 1970s. Korean industrial capacity and infrastructure was destroyed after the Korean War. Under this given condition, the adopted development strategy was to select and focus on a few strategic industries that could substitute imports and promote exports. The industries promoted intensively during the 1960s were light industries such as textiles, shoes, and foodstuffs. Later in the 1970s, the Korean government strategically promoted heavy industry and chemical industries (such as steel, machinery, shipbuilding, and chemicals) in order to substitute capital imports to construct factories. The biggest challenges in such a development strategy were the heavy dependence on foreign technologies and a shortage of skilled technicians and engineers (MEST, 2008).

[2] For a detailed description in this period, refer to Hwang (2011).

To cope with those challenges, Korean STI policies focused on institution building during the 1960s and 1970s. First, government-supported research institutes (GRIs) were established to understand and absorb imported technologies and subsequently build technological capabilities that could be modified and advanced. The first GRI was KIST, which later sprang off many other GRIs. These GRIs have a played major role in Korean development by providing necessary technologies to the strategically selected industries. Second, a special administrative body for STI policies, the Ministry of Science and Technology (MOST), was established in 1968 to make concerted S&T policies. MOST played a central role in the formulation of S&T plans, gathering limited S&T resources and implementing S&T policies effectively. Third, the Korea Advanced Institute for Science and Technology (KAIST) was established in 1971 to provide high-caliber scientists and engineers demanded by industrial development.

Fourth, Korea brought back many patriotic scientists and engineers who gained overseas experience to staff the established GRIs and S&T universities. Subsequently, those GRIs and universities could solve the brain-drain problem to a greater extent. Fifth, a legal framework for science and technology has been established. They include laws such as the *S&T Promotion Act, Technology Development Acceleration Act,* and *Technology Service Promotion Act.* These legislations provided clear guidelines for S&T policies and activities. Sixth, Daedeok Innopolis (a research town) was built in 1973 by gathering most GRIs and numerous private research labs together (DDI, 2003). This research town has greatly promoted the transfer of technologies developed by GRIs to private firms. Seventh, MOST enhanced a cultural foundation by strongly promoting an S&T awareness campaign. The high degree of open awareness over S&T has helped garner public support for S&T investments.

Institutions established during this period have provided necessary technologies for selected industries as well as founded a strong basis to advance Korean STI further and to form a sound national innovation system. They effectively built capacities to learn, absorb, and modify advanced technologies through the promotion of major actors for science and technology that became a self-sustaining system to further advance Korean S&T.

3.3 Technology Catching-up Stage[3]

In the 1980s, Korea faced a somewhat different environment. As Korean S&T capacities progressed to a greater extent, advanced countries started to be reluctant to transfer their technologies to Korea. Korea could not rely on cheap labor for its industrial development as labor movement had also widely progressed. Korea had to develop necessary technologies by itself. The 'technology catching-up' strategy had been widely adopted with a focus on more sophisticated high-tech industries such as electronic assembly, information, and communication industries. The 'technology-driven' strategy replaced the 'export-driven' strategy.

It started with the establishment of national R&D programs. The Specific National R&D Program was installed in 1982, which was followed by many other government programs such as the Industry-based Technology Development Project in 1987, G7 Project in 1992, and later the Creative Research Promotion Program in 1997. These public R&D investments have supported GRIs and private firms as well.

The installment of government R&D programs brought about some fundamental changes in Ko-

[3] For a detailed description in this period, refer to Hong (2011).

rean S&T. First, leveraging such government R&D programs allowed the Korean government to effectively encourage private firms to establish private research labs and invest in their own R&D. Such a policy enabled the private sector to increase their private investment in R&D dramatically. Private firms have slowly started to play a more leading role in developing industrial technologies while GRIs have played an assisting role. Second, the focus of GRI's activities has changed from learning imported technologies to developing domestic technologies due to the technology protectionism of advanced countries. Third, such a focus shift has also changed the quality of demanded human resources. In prior stages, skilled technicians were in great demand for utilizing imported technologies; however, higher quality scientists and engineers were more in demand during the 1980s and 1990s.

Fourth, such a human resources demand shift resulted in the expansion of research universities, KAIST in particular. In order to encourage universities to turn their main functions from teaching to researching, a Science Research Center (SRC) and a Engineering Research Center (ERC) were established at thirteen universities. Later the Pohang University of Science and Technology (POSTECH) was established in 1986 with the sponsorship of the Pohang Steel Corp. (POSCO). Fifth, it became important to have them collaborate with GRIs as the private sector and universities grew into important innovation actors. To promote cooperative R&D among main actors (including GRIs, universities and industrial firms) the *Cooperative R&D Promotion Act* was enacted in 1994. Sixth, while MOST has been the only agency to develop S&T in the 1960s and 70s, S&T activities have expanded into many other agencies including the Ministry of the Postal Service (later the Ministry of Information and Communication) and the Ministry of Trade and Industry during the 1980s and 90s. Seventh, as the agencies and actors involved in R&D expanded, there arose a necessity to coordinate them. To meet this challenge, the 'National Science and Technology Council' was established as an advisory body under the President.

In the catching-up stage during the 1980s and 90s, Korean STI policies tried to upgrade their technological capacity to compete with advanced countries in the global market. STI policies rather than the economic policies became the main agenda by adopting 'technology-driven' strategies. The policies focused on strengthening the research capacities of private firms and universities and changing their roles accordingly. Such strategies have been largely successful resulted in putting several products (such as semiconductors and shipbuilding) at the top of their industries globally.

3.4 S&T Leadership Stage[4]

Entering the 21st century, Korea can identify itself as a global leader at least in several areas. Korea is no longer a follower but expected to be a leader in the global community; however, being a leader entails very complex issues. Up to the 1990s, the core Korean strategy was to follow benchmarks and catch up to them. Now, Korea faces circumstances where Korea has to find its own way.

Korean STI policies tried to escape from the old technology-driven catching-up strategies and to shift to innovation-driven strategies. There are many issues involved. First, as the major sources of creative innovation, small and medium enterprises (SMEs) were strongly promoted with the *Act on Special Measures for the Promotion of Venture Businesses of 1998* and technology development loans provided by the Korea Development Bank, the Industrial Bank of Korea, and the Korea Technology Finance Corporation. Although there were some fluctuations with the 1997 *Asian Financial Crisis*,

[4] For a detailed description in this period, refer to Lee (2011).

the total number of SMEs reached over 24,000 in 2010. Second, research universities were supported with various programs to promote basic and creative research such as Brain Korea 21, Frontier R&D Program, National Research Center (NCRC), Medical Research Center (MRC), and Advanced Basic Research Lab (ABRL). Third, STI policies focused on searching for new growth engines. Also various programs were initiated including the 21st *Century Frontier R&D Program, the New Growth Engine Program, and the Global Frontier R&D Program.* The new growth engines are largely identified as convergence technologies that include broadcasting-communication convergence, IT-fusion systems, robotics applications, new materials nano fusion, biopharmaceutical, medical equipment, and value added foodstuffs.

Fourth, STI policies started to notice technologies with social and welfare orientations; subsequently, many R&D programs explicitly aimed to develop social and welfare-oriented technologies. Fifth, an effective coordination mechanism became necessary because almost all ministries have become involved in R&D activities and have developed their own STI policies. A number of governmental reforms have been done that include: the establishment of the National Science and Technology Council (NSTC), the promotion of MOST to the Deputy Prime Minister level, the creation of the Innovation Office, the reorganizations of the Ministry of Education, Science and Technology (MEST) and the Ministry of Knowledge Economy (MKE), and recently the transformation of NSTC into a standing administrative agency. Sixth, regional innovation became one of the major STI issues from the balanced regional development perspective. Efforts for regional innovation include the 'Techno-Parks,' established in several pilot regions, the Innovation Cluster Program, initiated in 2005, and the expanded 'Daedeok Innopolis.' Seventh, a global dimension came into the STI policy area. By joining the Organization for Economic Cooperation and Development (OECD) in 1996, Korea officially became a member of the rich country club. By joining the Development Assistance Committee (DAC) of OECD in 2009, Korea became an ODA donor country. By hosting the G20 Summit in 2010, Korea became one of twenty countries shaping the world order. The extension of its S&T partnerships with most major countries has allowed Korea to become a global player.

4. ASSESSMENT

Within a half century, Korea has evolved from one of the poorest countries into a major economy. Korean STI policies have helped such remarkable progress by effectively changing its paradigm at the right time. During the early stage (1960s and 70s), it focused on building major institutions for its national innovation system. During the transition stage (1980s and 90s), it focused on catching-up to advanced technologies. Later in recent years (2000s), it focused on the promotion of indigenous innovation and a new role as a global leader.

These hard but swift shifts have been done within a generation. Korea is the only country that has transformed from an ODA recipient to an ODA donor country. Such rich and successful experiences have become the most demanded benchmarking model for many developing countries; however, sharing such experience should be very careful since all countries have all different conditions and environments. What is valuable to other countries most are not the experiences themselves, but the ways and approaches to make these experiences.

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