# INTERNATIONAL COOPERATION OF SCIENCE AND TECHNOLOGY FOR DEVELOPING ECONOMY: LESSONS FROM KOREAN FOOTPRINT

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***Abstract:***

***Purpose*** *- This paper aims to investigate the development trajectory of Korean economy accompanied with science and technology, and suggest customized development strategy and international technology cooperation plan for a developing country, Vietnam.*

***Design/methodology/approach*** *- This research applies a qualitative analysis to review the economic development history of Korea and Vietnam and the model of supporting the developing countries. From an amount of the reviews, this paper suggests the Vietnam-Korea technological cooperation plan.*

***Findings and Implications*** *- There are four suggestions for advancement of the technology policy of Vietnam. First, the overall policy direction for the Vietnam 2016-2020 plan lacks individual industry policies. Localization of high-value-added products should be actively pursued within the network of FDI and export supply. Second, Vietnam should move toward manufacturing high-value-added products in order to enter the global value chain with local products, as Korea did in the 1980s. Third, attempts to grow the Vietnamese manufacturing industry should proceed towards actual inspection. Lastly, the authors suggest that Vietnam should cultivate manpower to foster researchers and improve their expertise.*

***Originality/value*** *- There is little research that investigates both development trajectories of Korea and Vietnam, and suggests the modified development strategies for Vietnam. This paper fills this gap.*

***Keywords:*** *Developing economy; Industry development; Science and technology innovation; Technological cooperation.*

## 1. Science and technology, economic development

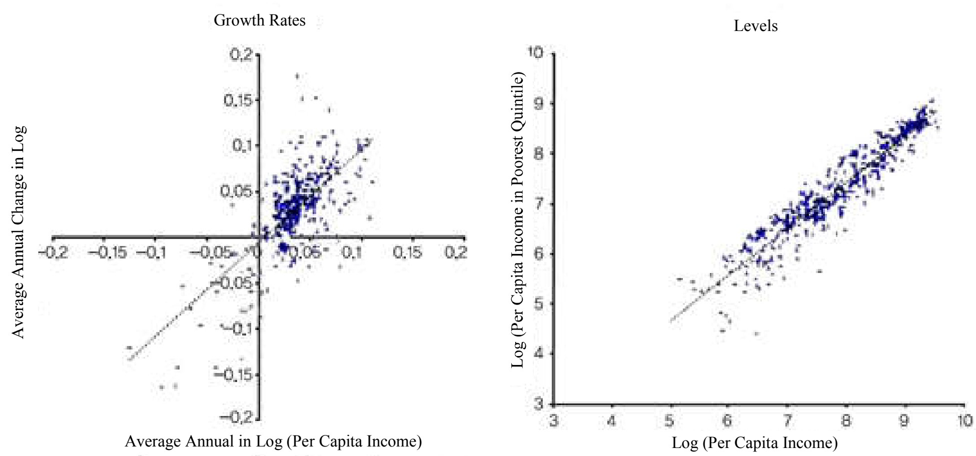
The history of human civilization is one of inventing tools and developing technology, as exemplified by the fact that we classify the early history of mankind into the Agrarian, Bronze, and Iron eras. As the social groups that share ideas (ideologies and religions) have grown beyond the ties of blood, speech and writing have served as a means of communication to strengthen unity, and develop human traditions and cultures. Science and technology can be called the cornerstone of the development of human civilization in the sense of the "advancement of tools technology" as a basis. Technological inventions have improved the necessities of life (i.e. food, clothing, and shelter), strengthened the protective layer against the enemy, and have evolved a civilization that leads to spiritual abundance through healthier life and art.

The evidence of science and technology is more prominent since the Industrial Revolution. New machines such as steam engines and automobiles were invented and the agrarian society turned into an industrial society with the Industrial Revolution of the 18$^{th}$ century. New tools and machines were used to better understand nature and to increase knowledge stock while humans accumulated better skills, technology, and wisdom at the same time to sustain the development of civilization. In the 20$^{th}$ century, advanced equipment and technologies such as aircraft, nuclear power, telephone, computer, semiconductor, and wireless communication have matured as the information society has continued to develop. Today, we are living at the peak of the most abundant civilization in the history of humanity, thanks to the remarkable technological development that followed the Industrial Revolution.

Just as science and technology are important to the development of human civilization, competence in science and technology is a necessary requirement for the development of wealth and power in each country. Science and technology has not only changed the basic elements of quality of life such as food, shelter and clothing, but also has changed the way individuals think, the values of society, and a nation's ruling ideology, and improved nations' power. Looking at the history of the world after the Age of Exploration, the countries that prioritized technology and commerce became more powerful, and the hegemony of the international society was changed based on which country led in new technology. Unlike France, which persecuted the Huguenots and commerce for religious reasons, the UK provided the Huguenots with privileges such as tax exemption and industrial funding. Through this, the UK laid the groundwork for technological development and the Industrial Revolution. Technological advancement, which began in the wool industry, enabled the UK to reign as "the empire on which the sun never sets". Beginning in World War II, the emerging power of the US also came from its world-leading science and technological capabilities. Mass production systems, the utilization of electricity, the development of electromagnetic and semiconductor technology, digital technology, computer, nuclear power, and space exploration are all advanced technologies invented by the US in the 20$^{th}$

Century. Considering that all of the nation's leading the era have respected and favored science and technology, we can see that science and technology have been the important driving forces of national development and a key to rise and fall of the world.

However, how does science and technology make national development possible? First, national development must be backed by economic growth. The development of a country basically means that the problems associated with the people's shelter, food and clothing are solved, and furthermore, people are guaranteed national security and a life with equal educational opportunity and human rights. To accomplish this, personal incomes must increase across all of society - which is only possible through economic growth. Also, economic growth does not affect only the upper class of the society. A trickle-down effect affects all, down to the very bottom of the social strata (Figure 1). Economic growth does not guarantee national development and the happiness of the people. But for a country to be rich and powerful and for its people to enjoy the benefits of national security and welfare, economic growth is a necessary requirement, and the cornerstone of science and technology must be strong.




*Source: Dollar and Kraay (2002); The National Academy of Engineering of Korea (2011)*

**Figure 1.** The relationship between per capita income and per capita income of the poorest (the bottom 20%)

The fact that a nation's science and technological capacity is key to its economic growth is often explained by total factor productivity (TFP). Economic growth is achieved through technological innovation in addition to increased labor and capital input. Generally in economics, TFP growth is interpreted as residual effects excluding labor and capital input, with technological progress representing the majority[1]. Higher income countries are more likely to contribute to GDP growth in TFP growth (in other words, technological advancement) (Table 1). In low/middle income countries, the contribution rate of TFP growth to GDP growth is 10-20%, while in high income countries it is 30-50%. In Japan, Korea, Taiwan and other high growth countries in East Asia, the contribution rate was almost 33.3%. Looking at this contribution in different time periods, the rate of 21.4% was similar to that of low/middle income countries in the 1970s when technology level was low, but the rate was very high at 45.2% in the 2000s when the technology level was improved. As such, it was important to secure the capacity of science and technological capability during Korea's economic development process, and Korea has been developing into a high-income country through securing high technology and progress.

**Table 1.** Contribution of GDP growth to increase in TFP by economic size

| Economic size | Contribution of GDP growth to TFP increase |
|---|---|
| Low/middle income countries | 10-20% |
| High income countries | 30-50% |
| East Asia's fast growing countries | 33.3% |
| Korea | 21.4% (1970s) → 45.2% (early 2000s) |

*Source: IBRD (1993); Science and Technology Policy Institute (2010)*

## 2. Development trajectory of the Korean economy with science and technology

Korea was one of the only countries that had been colonized before World War II that developed its economy through industrialization and entered the ranks of developed countries (i.e. OECD member country). There have been many discussions among scholars in international organizations and researchers from developed and developing countries about the "Miracle of the Han River" and Korea's process of industrialization has been benchmarked by the least among the less developed countries after developing countries. Nonetheless, the analysis of the contribution of science and technology to Korea's economic growth and related policy proposals seems to have been limited. But looking back on Korea's economic trajectory, it is clear that the fostering of Korea's science and technological capacity was one of the major factors that promoted industrialization.

[1] Total factor productivity (TFP) includes all of the various factors such as R&D, accumulation of knowledge and human capital, opening a country more internationally, making the financial and labor market system more efficient, and in particular the effect of R&D investment *(Science and Technology Policy Institute, 2010)*.

Korea recognized the importance of technology from the beginning of its industrialization, and has developed a science and technology capacity that is suitable to its industrial structure and the demands of its manufacturing industry at every stage of its economic development. Such policy trends are reflected well in "Strategies for the Development of Science and Technology in Developing Countries" by Hyung Sup Choi. Korea has consistently pursued three main policies: (i) the creation and strengthening of its science and technology infrastructure; (ii) the strategic development of industrial technology; and (iii) the creation of a climate that supports science and technology. These three policies were expanded and spread to the private sector through the Korean National Innovation System (NIS). The author believes that Science and Technology Innovation (STI) is the driving force behind Korea's profitable industry.

Some scholars have raised the question of whether there is a Korean model that has led the development economy. Mainstream scholars in Korea agree that there is a Korean model that led Korea from the world's poorest economy to a developed country in a relatively short period of time (approximately 30 years). This model has high value as a good example to be shared with developing countries, and many of them are considering science and technology as an important area in which to cooperate with Korea.

Table 2, as an R&D scoreboard of the results of economic growth, shows the development trajectory along which Korea has expanded its science and technology capabilities over the last half-century. Korea has continuously increased its total R&D investment since the 1960s, when Korea's national budget was quite low. Korea's R&D investment was ranked 6$^{th}$ in the world in 2016, and the R&D investment relative to GDP is 4.29% (2014), the highest in the world. R&D investment in science and technology has continued to increase, even after repeated changes in government, the IMF currency crisis and the US subprime crisis.

The Korean government has been innovating the science and technology as well as industry ecosystem by setting up infrastructures in areas where science and technology was barren, attracting/nurturing R&D investment in the industry, and then handing over the leadership in technology development to the private sector. Initially, an overwhelming 97% of the R&D budget was government-funded, but as the private sector's capacity strengthened, private investment increased, reaching three times the government investment by the 1990s. With such policy, the number of full-time equivalent (FTE) workers engaged in technology development has also increased steadily. The number of researchers employed in 2014 was 345,463 from 1,750 researchers who were employed in 1963 (197.4 times). The budget input and the increase in research manpower paid off in performance. As seen in table 2, as research and development activities increased, the output of international academic papers and patent applications also continued to grow steadily.

**Table 2.** Korea's economic growth and R&D index in science and technology

| Category | 1963 | 1970 | 1980 | 1990 | 2000 | 2010 | 2014 |
|---|---|---|---|---|---|---|---|
| GDP (US$M) | 3,864 | 9,410 | 67,802 | 284,757 | 561,633 | 1,094,499 | 1,411,334 |
| Total R&D expenses (US$M) | 4 | 32 | 321 | 4,676 | 12,245 | 37,935 | 60,528 |
| Public: Private Sector (%) | 97:3 | 71:29 | 64:36 | 19:81 | 28:72 | 28:72 | 24:76 |
| R&D/GDP (%) | 0.25* | 0.39* | 0.56* | 1.72 | 2.18 | 3.47 | 4.29 |
| No. of Researchers | 1,750** | 5,628** | 18,434** | 70,503** | 108,370 | 264,118 | 345,463 |
| No. of SCI international papers | | 27 | 159 | 1,587 | 12,3165 | 41,385 | 54,691 |
| No. of patent applications | 771 | 1,846 | 5,070 | 25,820 | 102,010 | 170,101 | 210,292 |

**R&D/GNP, **Head counts*

*Source: Statistics Korea; The World Bank, World Development Indicators*

The drivers that science and technology have contributed to the development of Korea's economy are as follows.

*First*, Korea has set the manufacturing industry as a key axis of economic development and prioritized the development of its export industry. Historically, policies for the economic growth of developing countries can be largely divided into two branches. One is import substitution policy, and the other is export-oriented policy to foster the export industry. Many South American countries have chosen the former, while the East Asian countries (i.e. Japan, Taiwan, and China) have mostly pursued the latter. Korea is one of the countries that promoted an export-driven policy from the initial stage of its economic development. In order to foster the export industry, an open economy system had to be introduced, and to be able to compete in the world market, technology competence had to be secured. While there are differences in terms of scale and method, Taiwan and Hong Kong have pursued similar approaches. Later, China also benchmarked the Korean model to stabilize the manufacturing industry base, and continues to grow at a tremendous pace, moving beyond its standing as a middle-income country. Since then, China has advanced a step further by promoting the "Rise of China" with a Chinese national innovation system in the basic science and high technology sector.

*Second*, from the beginning of industrialization in the 1960s, the government set up and implemented a technology development plan together with its economic development plan. Korea determined that securing profitability without having independent technology is impossible even if the factory was established with foreign capital. Based on this parallel plan, “creating and strengthening the science and technology infrastructure” became the policy priority. First, laws and systems were created to establish the foundation, a research organization was developed for industrial technology support, and an administrative support team for science and technology was formed (Table 3). Expanding vocational education and engineering colleges has been important. On the basis of the Third Five-Year Economic Development Plan, policies to strengthen science and technology were continuously pursued. First, Technical Service Training Law and Special Research Institute Developing Law were established, and Korea Institute of Science and Technology (KIST) was diversified to establish various specialized laboratories (such as mechanical, chemical, marine, electronic communications, and standards), which greatly increased and diversified research institutions.

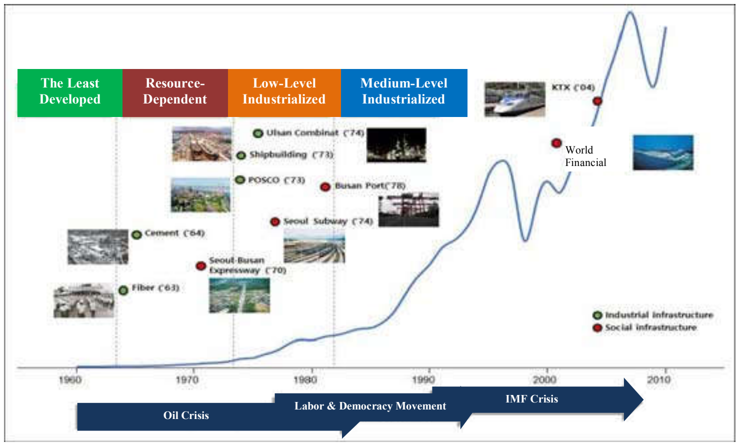
**Table 3.** Laws enacted during the 1st and 2nd Five-Year Economic Development Plans, and Organizations Expanded

| Period | Year | Law Enacted | Year | Expanded |
|---|---|---|---|---|
| 1st Five-Year Economy Development Plan (1962-1966) | 1965 | Korea Institute of Science and Technology Special Act | 1966 | KIST and Korean Federation of Science and Technology Societies |
| 2nd Five-Year Economy Development Plan (1967-1971) | 1967 | Government Organization Act [Law No. 1947, revised in part] | 1967 | Ministry of Science and Technology |
| | | | 1969 | Korea Foundation for the Advancement of Science and Creativity |
| | 1970 | Korea Science Institute Establishment Act | | |
| | | | 1971 | Korea Advanced Institute of Science (KAIS) |

*Third*, for the initial technology development plan, “Strategic Development of Industry Technologies” was placed as the top priority while localizing the technology for which there was clear demand in promoting manufacturing industry, and various action plans were executed. First of all, the promotion of the heavy chemical industry was designated as a priority, and capital and a technology introduction was provided to businessmen with passion and capability. Also, in the early days when the research capacity of private companies was insufficient, KIST and other government-funded research institutes quickly learned and acquired the advanced technologies Korean companies needed from overseas, and transferred them to the relevant industries. The expansion of the earlier-mentioned specialized research institutes has strengthened the base of the heavy chemical industry and played an important role in developing the economy since the 1990s.

*Fourth*, the policies to foster the industry, technological capacity, and growth ecosystem have been innovated at every stage of economic growth. Over the past century, Korea's national innovation system has evolved into a process of: implementation-localizing technology-improving and developing technology. As shown in Figure 2, it has succeeded in becoming a fast follower through change and improvement, step by step. The technology development capacity accumulated from the beginning in the industry demand-oriented manner has led to the growth of high-tech companies in the information and communication technology (ICT) industry since 2000. By securing advanced technology and high-quality workers, Korea has become the leading upper-middle income country. Since 2000, Korea has become a smart follower and a path mover.

During the period of introducing technologies, a black-and-white television assembly factory was set up by a foreign company in 1966 and a full petrochemical industrial complex was built in 1975. During this period, the technology capacity of private companies was insufficient that public research institutes learned foreign technologies as a center of industry technology development, and then transferred them to the industry on demand. The policy issue during the technology internalization period was to transform the industry structure in order to support a heavy chemical industry. During this period, Korea started producing its own products with a mixture of localized technologies and newly introduced technologies. In the automobile industry, the Pony, Korea's very first domestically-produced car, was released in 1976, and in the semiconductor industry, 64k DRAM was developed in 1983. The technology internalizing period is when the number of private companies, universities, and researchers in Korea increased substantially, and the country started to secure the capacity for research. Finally, during the period of technical improvements and self-development (mid-1990s to 2000s), Korea gained international competitiveness in major industries and started developing world-leading technologies better than advanced technologies. Korea developed the world's first 64M DRAM in 1992, followed by CDMA technology, putting it in the forefront of international wireless mobile communication in 1994. By 2004, Korea was exporting engines with improved performance to other countries (2004). During this period, both private companies and universities had a high capacity in the research and development of industrial technology.

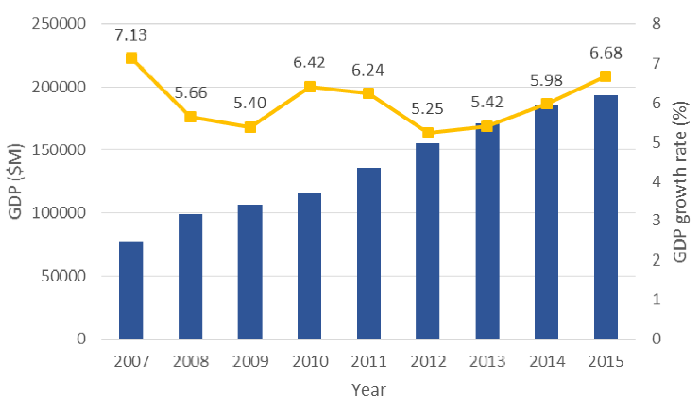



*Source: The National Academy of Engineering of Korea (2011)*

**Figure 2.** History of Korea's science and technology based economic growth

### 3. Understanding the economy and R&D stages of Vietnam

Vietnam has continuously maintained a high rate of economic growth since its inception as a modern industrial society through the DoiMoi economic policy of incorporating the market economy. Based on this, Vietnam adopted the 2011-2020 Economic and Social Development Strategies and 5-year Development Plan in 2011 and signed various international economic treaties (i.e. joining the WTO and signing the FTA) to actively promote its entry into the global market. Despite the recent slowdown in economic growth due to a global economic recession, Vietnam continues to maintain a growth rate of 6% annually (Figure 3). Also, Vietnam's GDP per capita has reached $2,200 in 2015, making it one of the lower-middle income countries.




*Source: The World Bank, World Development Indicators*

**Figure 1.** Vietnam GDP change (blue) and GDP growth rate change (yellow)

Looking at the structure of the industry, the share held by the agricultural sector has been gradually reducing, from 25% (2000) to 22% (2012), while the industrial production sector has increased, from 36% to 41%. Also, the state's role is very important, as state-owned enterprises (SOEs) account for 40% of the gross national product. Vietnam's international trade amounted to $327.8 billion (up 10% from the previous year), with exports of $162.2 billion and imports of $165.7 billion. The top 10 export items, which together account for 49.7% of total exports, are telephones and their parts, textiles, apparel, computers, electronic products and parts, and footwear (Table 4). As can be seen, Vietnam has a high proportion of exports of light industries such as textiles, apparel, and footwear, while also having a considerable proportion of high-tech electronics. This means that Vietnam has an industrial structure that can support sustained economic growth. However, the wage increase caused by economic development in Vietnam has experts currently raising the question of whether this will weaken the country's competitiveness. As such, there is a need to further enhance the technological competitiveness of labor and factors for capital inputs to strengthen the value added of the manufacturing industry and economic growth.

**Table 4.** Top 10 exports of Vietnam in 2015

| **Rank** | **Items** | **Export amount** ($M) | **Year on year growth rate** (%) | **Weight** (%) |
|---|---|---|---|---|
| 1 | Telephones and their parts | 30,176 | 27.9 | 18.6 |
| 2 | Textiles, apparel | 22,815 | 9.1 | 14.1 |
| 3 | Computers, electronics, and parts | 15,610 | 36.6 | 9.6 |
| 4 | Footwear | 12,011 | 16.3 | 7.4 |
| 5 | Machines/equipment/other parts | 8,168 | 11.7 | 5.0 |
| 6 | Wood and wood products | 6,899 | 10.7 | 4.3 |
| 7 | Marine products | 6,573 | -16 | 4.1 |
| 8 | Transportation and their parts | 5,844 | 2.9 | 3.6 |
| 9 | Crude oil | 3,720 | -48.5 | 2.3 |
| 10 | Steel, Video Camera and its parts | 3,026 | 36.3 | 1.9 |

*Source: Korea Trade-Investment Promotion Agency (KOTRA)*

Next, Vietnam's science and technology capabilities should be considered. Vietnam is equipped with legal, institutional, and research organizations, and is increasing its government budget through governance of science and technology R&D (Table 5). Vietnam's R&D budget more than tripled in the

7-year period from 2005, with a steady annual growth of 46%. In addition, more than 2,600 experts are conducting R&D activities in more than 30 research institutes and several regional institutes within Vietnam Academy of Science and Technology (VAST). As well, the basic research carried out by 7,000 faculty members at Vietnam National University should also be noted. In 2014, there was a total of 1,374,780 researchers in Vietnam, which is 1,465 per one million people.

**Table 5.** Changes in Vietnam's R&D budget

| **Year** | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|---|
| **Budget** (billions VND) | 4,270 | 5,430 | 6,310 | 6,590 | 7,870 | 9,180 | 1,500 | 13,170 |

The increase in resource input (i.e. manpower and budget) in R&D has begun to show remarkable results. In 2013, 1,848 scientific and technical papers were published, which was more than twice as many as the 871 published in 2009. Patent applications also increased, showing a similar growth trend (Table 6). Comparing Vietnam with other countries, it published 3.1% as many academic papers as Korea, 0.45% as many as the US, and registered 2.1% as many patents as Korea and 0.77% as many as the US. While this is still insufficient, the average growth rate of the number of papers published is 21% in Vietnam, which is much higher and more promising than Korea (7.2%) and the US (1.6%).

**Table 6.** International comparisons on the number of published scientific papers and number of patent applications

| **Category** | **Country** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** |
|---|---|---|---|---|---|---|---|
| Scientific journal articles (Number) | Vietnam | 871.8 | 1,112.0 | 1,217.9 | 1,581.0 | 1,848.4 | - |
| | Korea | 44,684.1 | 49,539.1 | 53,821.3 | 56,897.0 | 58,844.1 | - |
| | USA | 388,037.2 | 398,121.9 | 409,369.8 | 414,758.5 | 412,541.5 | - |
| Patent application s (Domestic residents) | Vietnam | 2,890 | 3,582 | 3,560 | 3,805 | 3,995 | 4,447 |
| | Korea | 163,523 | 170,101 | 178,924 | 188,915 | 204,589 | 210,292 |
| | USA | 456,106 | 490,226 | 503,582 | 542,815 | 571,612 | 578,802 |

**When authors contributing to a paper were from different countries, the number of publications was calculated by applying a ratio.*

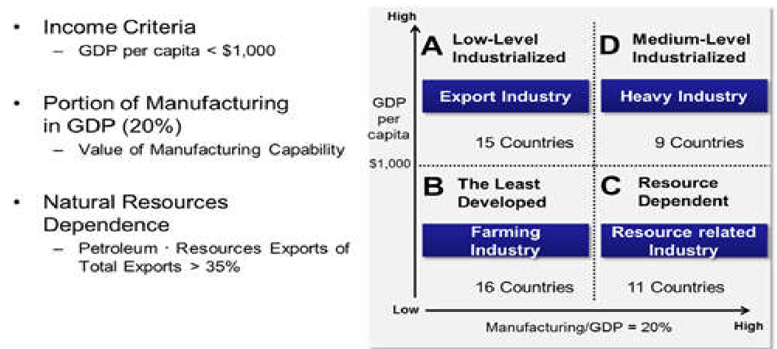
*Source: The World Bank, World Development Indicators*

## 4. Customized technological cooperation of beneficiary countries

International organizations such as the UN, World Bank, and developed countries are continuously pursuing development cooperation with less developed countries. This is because it is widely believed that the global sharing of prosperity in terms of economic and social wealth is the cornerstone of eradicating the hunger and poverty of underdeveloped countries, and moreover, maintaining the world peace. In addition, all developing countries recognize that the social welfare achieved through economic growth is the key to political stability and development. Since the end of World War II, international aid activities have been expanded and many underdeveloped countries are overcoming the prevailing hunger and transforming into developing countries. Nevertheless, they have not yet completely escaped from poverty, and still remain at the bottom level of the middle-income countries.

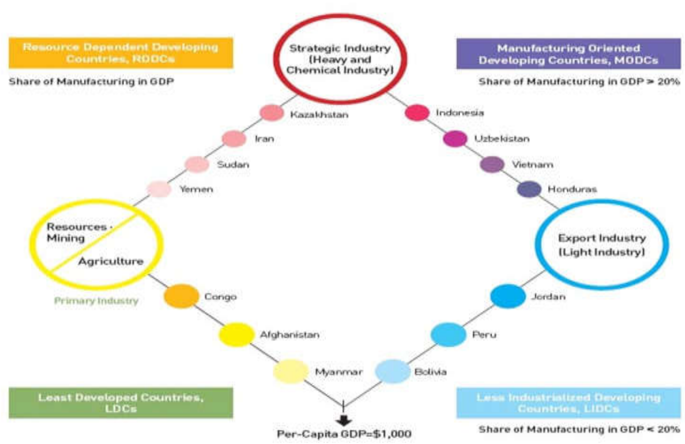
Korea achieved economic growth through industrialization over a relatively short period of time, and has developed from one of the world's poorest nations into the world's 10$^{th}$ largest economic power. From the advanced countries, Korea received a wide range of funding assistance, workforce development and technical support, resulting in a model success story called "Miracle of the Han River". Starting with the export of cheap agricultural and marine products, Korea began producing light industry products such as apparel and footwear. It went through a stage of gradually fostering its heavy chemical industry, and became more competitive in the global market with ICT digital high-tech products such as semiconductors and telecommunications. Over half a century of Korea's economic development experience has become the focus of envy and benchmarking in countries that are pursuing economic development. As a beneficiary country of the advanced countries, Korea is also a member of the OECD Development Assistance Committee (DAC) (2010) and is increasing its international cooperation with developing countries, as a responsible member of the international community.

Various methods such as livelihood support for eradication of hunger and poverty, industrialization support for economic development, education and cultural assistance through aid and cooperation between the advanced countries and the developing countries are being promoted. While there is a general consensus that "it is better to teach a man to fish than to give him a fish", aid activities from the advanced countries are usually grants (ODA projects) or long-term loans. Nevertheless, international cooperation for developing economies will be effective if the method considers the beneficiary country's stage of economic development, the existence of specialized industries, the environment, timely demand, the willingness and cultural traditions. Furthermore, for a country with the goal of economic development through industrialization, technological cooperation is more important than funding. The DAC is emphasizing technological cooperation in developing countries by "encouraging investment in knowledge, technology, technical know-how and production activities".




*Source: The National Academy of Engineering of Korea (2011)*

**Figure 4.** Korean model according to developing country type




*Source: The National Academy of Engineering of Korea (2011)*

**Figure 5.** Example of the position of developing countries in the Korean model

As a technological cooperation scheme with developing countries, a "customized support system for the beneficiary countries" method is proposed (The National Academy of Engineering of Korea, 2011). This method divides Korea's 20-30 year economic development period into 4 stages. As shown in Figure 4, the ratio of manufacturing production and average national income in GDP are differentiated into resource dependent, low-level industrialized, the least developed, and medium-level industrialized. For convenience, 20% manufacturing production and GDP $1,000 was set as a basis for categorizing and assuming that manufacturing production is the core for economic growth. This means that the appropriate aid method, support timing, and priorities suitable to the beneficiary country should be selected. Figure 5 shows the classification and approximate location of developing countries according to Korea's development trajectory.

## 5. Vietnam-Korea technological cooperation plan

As seen previously, Vietnam transitioned from a resource-dependent country into a middle-income country by establishing an active manufacturing base for light industries such as agriculture and marine products processing and textile sewing. Despite being a developing country, it managed to establish a science and technology infrastructure encompassing both hardware and software, and its R&D activities are going strong. To strengthen this base, Vietnam has set the vision of "Vietnam 2030" and developed plans for 2016-2020. To develop its high added-value manufacturing industries, Vietnam is pursuing an industrial policy that aims to make the ICT and bio technology (BT) sector into the next generation growth engine. The environment for attracting Korean capital and FDI is also excellent.

A report by the World Bank suggests that the Vietnamese government has to implement policies in its 2016-2020 plan that do not fall into the middle-income country trap. As proven well by the examples of how Korea and China overcame this trap, Vietnam should strengthen its policies to increase its manufacturing competence. It should learn a lesson from the fact there are only few examples of small and medium-income countries who escaped from the trap of neglecting the manufacturing industry due to an abundance of natural resources such as natural gas, agricultural, forest, and marine resources. From this perspective, Vietnam should utilize the industrial structure innovation activities pursued by Korea in the mid-1980s.

Then, how should one foster high value-added industries? Its population of close to 100 million people ($14^{th}$ highest in the world) makes Vietnam a good place for a domestic market substitution strategy, but this is not the most optimal approach for Vietnam. In order to acquire high added value, we must move toward a direction of fostering manufacturing industries that can pioneer the global market, rather than focusing on the domestic market. Vietnam can take full advantage of the fact that it has signed Free Trade Agreements (FTAs) with almost all countries in the world, and at the same time has the largest FDI.

*First*, the overall policy direction for the Vietnam 2016-2020 plan can be found but it lacks specific industry policies. Localization of high-value-added products should be actively pursued within the network of FDI and export supply. Relying on exports of simple assembly and low value added products is not enough.

*Second*, Vietnam should move toward manufacturing high value-added products in order to enter the global value chain with local products, as Korea did in the 1980s. Although the ICT and BT industries are being emphasized, it will take a long period of time for Vietnam to gain an international level of competence in advanced manufacturing in these sectors. In addition to upgrading its light industries, which have already secured a comparative advantage, there should be an emphasis on developing post-harvest processing, transporting, and storing technologies for high value-added agricultural and marine products to create short term performance. At the same time, innovating the high-tech ICT and BT sector's infrastructure should be a priority. Vietnam can create an ecosystem of small and medium-sized businesses that supply FDI enterprises (approximately 70% of the export amount) that contribute substantially to Vietnam's export of localized basic materials and high value-added parts. Combining the two policies - privatization of SOE currently underway and nurturing large economic groups (a form of Korea's chaebol) could be a good approach.

*Third*, attempts to grow the manufacturing industry should proceed towards actual inspection. The current performance management method of focusing on publishing papers and applying for patents should be transformed into an innovation center of knowledge and technology utilization of main industries. The basic research capacity of public research institutes should change from the current supply-oriented to demand-oriented industrialization strategies (translational R&D). "Strategic development of industrial technology" evidenced in a Korean innovation model in science and technology innovation is worth benchmarking. This is why attention should be paid to the establishment and operation of Vietnam-Korea Institute of Science and Technology (V-KIST).

*Lastly*, "creating a scientific and technological climate" in the long-term perspective should be emphasized. Vietnam's knowledge stock in basic science should be increased by selecting universities with a comparative advantage based on their research capacity. It is important to cultivate manpower to foster researchers and to improve their expertise. In addition to improving the expertise of the functional human resources, university and graduate school education should undergo a shift towards teaching practical business skills. In this regard, Vietnam is creating a favorable environment. One example is an international university (e.g. Vietnam-

France University) supported by Japan, Germany, USA, and France; its educational training should be managed so that it is more demand-centered.

Vietnam should be aiming for a market economy and managing long-term sustainability as an important policy for national development. There are industrial policies and various innovation capabilities to fulfill the public goal, and the science and technology base to support this is also ready. From now on, it will be necessary to strengthen this infrastructure while "strategically selecting and focusing" on the industry likely to become a future growth engine.

## 6. Conclusion

The development of science and technology not only led to the development of human civilization but also led to the development of individual countries. All of the countries that have led the way in different eras respected scientific technologies. Science and technology are an important driving force of national development, and a key to the rise and fall of nations.

Developing countries can also achieve economic growth through the development of science and technology, and Korea is one representative example of how this can be accomplished. Korea acknowledged the importance of technology from the time of its initial industrialization, and has developed its science and technology competence to adapt to industry structures at every stage of its economic development. The Korean government has set up infrastructures where science and technology were barren, attracted industrial R&D investment, and transferred the technology development to the private sector to innovate the industry and S&T ecosystem.

Vietnam, which is in the same situation as a developing country, should also follow economic growth policies based on science and technology development. Since adopting a market economy in 1986, Vietnam has continuously maintained a high rate of economic growth. Vietnam has a high export share in light industries such as textiles, apparel and footwear, while it also has a considerable proportion in high-tech products, giving it potential for sustainable economic growth. But with rising wages and an economic crisis, competitiveness could weaken. For this reason, Vietnam should improve its technology competence rather than its labor and capital input to increase the value added in its manufacturing industry.

Active technological cooperation among countries is needed to improve technical competitiveness. From Korea's perspective, to carry out technology cooperation with developing countries, it is necessary to provide a customized support system with 4 divided stages of 20-30 years of economic development stages for the beneficiary countries. From Vietnam's perspective, it needs to innovate its industrial structure, which was launched in the mid-1980s. It should focus on cultivating manufacturing industries that target the global market, rather than the domestic market, and in order to do this, the localization of high value-added products should be promoted. As well, there should be continuous investment in establishing innovative infrastructure from a long-term perspective. To accomplish this, it is considered a good idea to combine policies on privatizing public companies and to nurture large economic groups. The use of knowledge and technology should be adopted as an index for performance measurement, and the role of public research institutes' R&D should be set as demand driven. V-KIST will be able to fulfill these functions. Finally, efforts should be made to develop a climate that supports science and technology, and nurture human resources. In this way, Vietnam will achieve science and technology-based economic growth, and sustainable national development./.

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