

# **Technology Commercialization in Republic of Korea**

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The purpose of this article is to introduce past and current activities of technology commercialization in Korea and to present its perspectives in the future. Korea is working on various activities to promote technology commercialization in Korea by inducing universities and corporate research centers to participate in the national technology transfer programs. This article will focus on the policy and supporting programs employed by the companies and the government for technology commercialization in Korea.

In 2000, Korea Technology Transfer Center (KTTC) was established to promote transactions of technology transfer and commercialization following the enactment of the Technology Transfer Promotion Act. In the first year, not a single case of commercial technology transfer and commercialization was completed under the management of KTTC. However, in 2005, 256 cases of technology transfer transactions and commercialization consulting were completed under the management of KTTC.

## **1. Introduction**

Moving into the 21st century, knowledge based industries are expected to be the most critical and strategic ones for the survival and the growth of companies, regions, and nations.

Over the past 40 years, Korea has shown remarkable economic growth with rapid changes of its Technology Strategy such as Technology Transfer and Technology Commercialization. One of the most important driving forces of this growth is investment in large-scale facilities, development of infrastructure, and aggressive acquisition of the most advanced technology in global marketplace.

Activities in technology transfer and commercialization became robust in Korea with the enactment of the Technology Transfer Promotion Act in 2000. To encourage the transfer and commercialization of R&D under government funding, the Act encourages

universities and public research institutes to have technology transfer offices (TLOs) within their respective institutions.

Before the Act, the Korean government focused on developing technological knowledge by way of increased R&D investment. As a result, Korea became the eighth largest R&D investment country in the world. After the Act, however, Korea's R&D policy emphasized the transfer and commercialization of R&D. Recently, the Korean Government announced a long-term plan for technology transfer and commercialization under the mandate of the Technology Transfer Promotion Act.

In this perspective, this text will introduce various indicators such as R&D and Intellectual property conditions as well as recent commercialization policy & trend of Korea. Also, as a key player of technology commercialization in Korea, main activities of KTTC will be shown on the latter part.

## 2. Technology Market in Korea

### 2.1 R&D Condition

Research and development costs of Korea amount to 22 billion U\$ in 2004 and 19 billion U\$ in 2003. And the ratios of scientific and technical investment per national economy almost reach to the same level of advanced country.

<Table 1> Korean R&D costs Progress

(Unit: million \$, %)

Year	2001	2002	2003	2004
The total R&D costs	16,111	17,325	19,069	22,185
The total R&D costs per GDP	2.59	2.53	2.64	2.85

※ Data: The Korean Ministry of Science and Technology, each year

<Table 2> International comparison of the total R&D costs

(Unit: billion \$, %)

	<b>Korea</b>	<b>USA</b>	<b>Japan</b>	<b>Germany</b>	<b>France</b>	<b>UK</b>
	<b>('04)</b>	<b>('03)</b>	<b>('02)</b>	<b>('03)</b>	<b>('02)</b>	<b>('02)</b>
The total R&D costs	19.4	285	124	60	31.4	29
The total R&D costs per GDP	2.85	2.62	3.12	2.50	2.20	1.88

※ Data: The Korean Ministry of Science and Technology, each year

Considering R&D progress, the role of private sector is increasing steadily, and it means that private companies are expanding R&D investment to achieve technical competitiveness in global market.

<Table 3> R&D costs Progress classified resources

(Unit: million \$, %)

<b>Year</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>	<b>2004</b>
The total R&D costs	16,111	17,325	19,069	22,185
Government resources	4,187	4,548	4,663	5,446
Year-on-year increase	21.3	8.6	2.5	16.5
Private resources	11,847	12,700	14,327	16,631
Year-on-year increase	14.1	7.2	12.8	16.1
Foreign resources	75.7	76.3	78.9	108.4
Ratio of government and Private resources	26 : 74	26 : 74	25 : 75	25 : 75

※ Data: The Korean Ministry of Science and Technology, each year

<Table 4>International comparison of the total R&B costs classified resources

(Unit: billion \$, %)

	<b>Korea</b>	<b>USA</b>	<b>Japan</b>	<b>Germany</b>	<b>France</b>	<b>UK</b>
	<b>(’04)</b>	<b>(’03)</b>	<b>(’02)</b>	<b>(’03)</b>	<b>(’02)</b>	<b>(’02)</b>
<b>Government</b>	2.45	3.7	2.6	3.9	3.3	3.25
<b>Private</b>	7.5	6.3	7.4	5.4	4.7	6.5
<b>Foreign</b>	0.05	0.0	0.04	0.72	2.1	0.24

※ Data: The Korean Ministry of Science and Technology, each year

## 2.2 Intellectual property condition in Korea

Korea ranked third in yearly average numbers (34,052) of retention patent during 1998 to 2000, so the quantitative patent activity has reached to developed national level. In 2004, the numbers of annual patent application come up to about 140,000 that increased by 17.4% compared with 120,000 in 2003. In 2004, the numbers of World PCT(Patent Cooperation Treaty) application are also 3,554 that increased by 20% from the year 2003. Korea hold 2.7% of all the PCT application number in 2003 and ranked 7<sup>th</sup> in the world. Now Korea is regarded as one of the top patent application countries in the world.

<Table 5> Patent application progress classified Rights

(Unit: case, %)

	<b>2001</b>	<b>2002</b>	<b>2003</b>	<b>2004</b>
<b>Patent</b>	104,612	106,136	118,652	139,291
<b>Year-on-year increase</b>	2.6	1.5	11.8	17.4
<b>Utility model</b>	40,804	39,193	40,825	37,733
<b>Year-on-year increase</b>	9.8	△ 3.9	4.2	△ 7.6
<b>Design</b>	36,867	37,589	37,607	41,173
<b>Year-on-year increase</b>	8.9	2.0	0.1	9.5
<b>Brand</b>	107,137	107,876	108,917	108,399
<b>Year-on-year increase</b>	△ 2.7	0.7	1.0	△ 0.5

<b>Sum</b>	289,420	290,792	306,001	326,596
<b>Year-on-year increase</b>	2.2	0.5	5.2	6.7

※ Data: The Korean Intellectual Property Office, each year

<Table 6>International comparison of PCT application (2003)

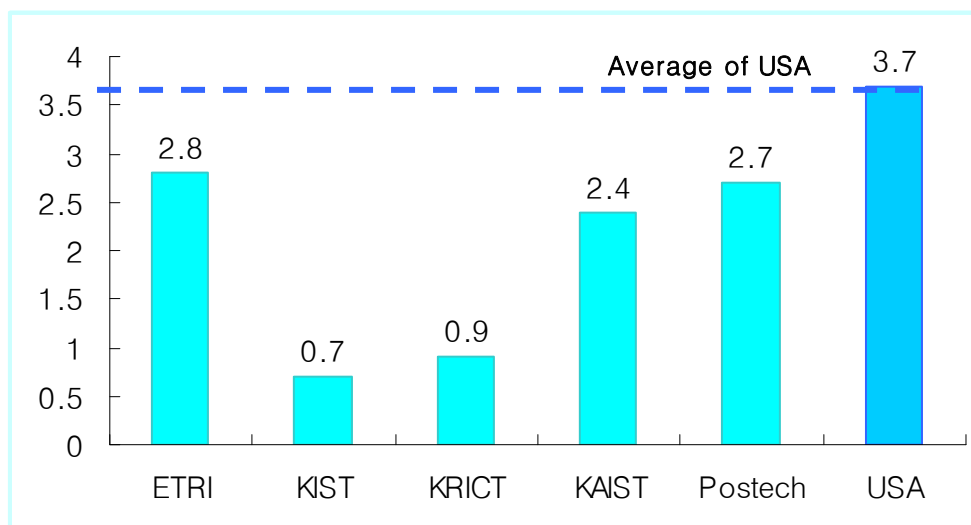
(Unit: case, %)

	<b>Korea</b>	<b>USA</b>	<b>Japan</b>	<b>UK</b>	<b>Germany</b>	<b>France</b>
<b>The numbers of application</b>	2947	39250	16774	6090	13979	4723
<b>Proportion</b>	2.7	35.7	15.2	5.5	12.7	4.3
<b>Rank</b>	7th	1st	2nd	4th	3rd	5 <sup>th</sup>

※ Data: The Korean Intellectual Property Office, each year

The effectiveness of intellectual property affects economic development positively. (As patent application increase by 1%, there is 0.11% synergistic effect of the rate of economic growth). Korea is inspired by patent application activity increasing consequently, but not so many agencies and major companies have carried out the patent activities. Especially, 5 major companies hold 67.8% of all the patent application and about 80% of all the foreign patent application during 1982 to 1999. Except for some colleges in top class, the patent activity is not so successful. Research facility's patent application activity is also very sluggish except for ETRI (Electronics and Telecommunications Research Institute) and KIST (Korea Institute of Science and Technology).

Moreover, as a result of patent reference analysis, quality of retention patent of Korean colleges and research facility proved below the average level of American registered patent. And most of the private companies except for Samsung Electronics ranked very low in patent technology competitiveness index. (According to the Patent Scoreboard of the United States Technology Review (2004.5), Samsung Electronics (4th in the semiconductor and 6th in the electronics), LG Electronics (14th), LG Philips LCD (18th), Hyundai Motor (36th), KT (53rd)) Hence, the numbers of patent application and registration as well as uplift of technical value level of patent are required.



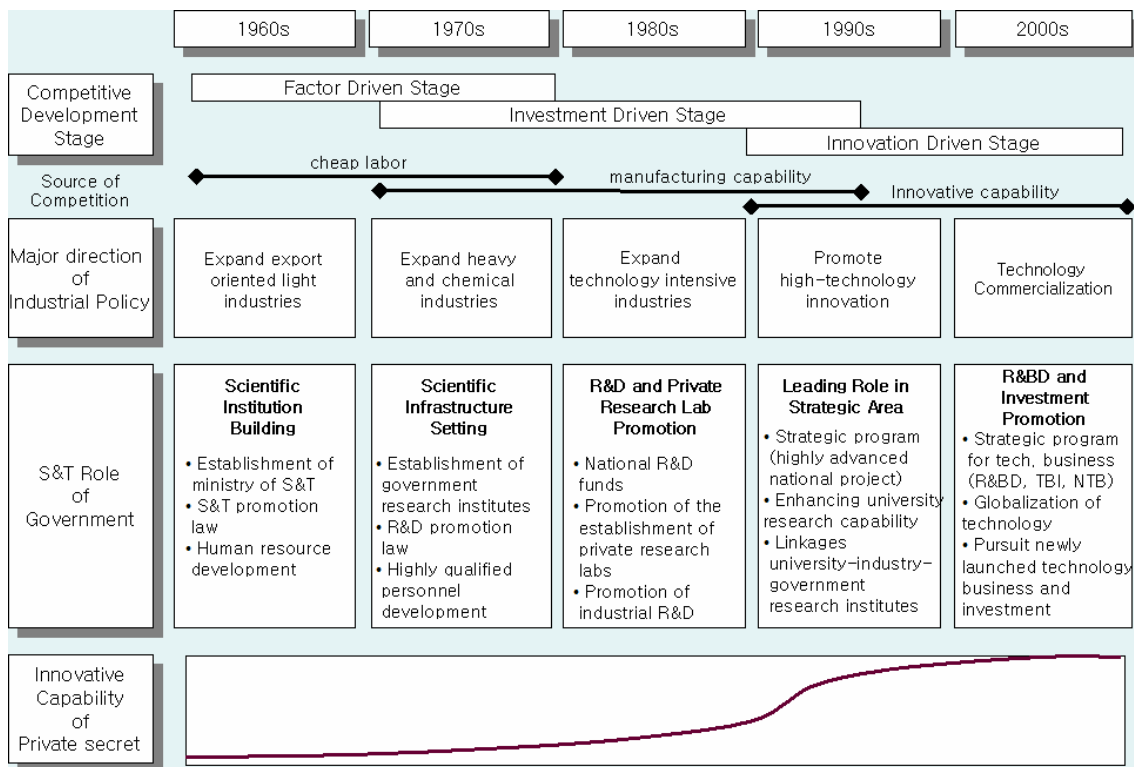
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Figure 1 > Reference ratio of USA patent registration of Korean research facilities

### 3. Policies to Promote Technology Commercialization in Korea

Korea has developed diverse programs for technology commercialization and some may provide insights to other developing countries. Economic growth of Korea depends on the policy related to technology and technological innovations inside Korea. In this regard, Korean government places great emphasis on stimulating technology business and on promoting climate conducive to technology market as shown Figure 2. in 2000.

To perform those missions, Korean government established Korea Technology Transfer Center (KTTC). [1,9]



<Figure 2> Science & Technology strategy Roadmap of Korea Government

### 3.1 Technology Commercialization Policy

#### 3.1.1 Technology commercialization policy

After the late '80s, the external indicators of R&D investments grew immensely with the national industry technology budget increasing from 10million USD in 1986 to 1 billion USD in 2003. Rather than focusing on how much has been injected, main focus is on technology commercialization oriented policy & systems to determine the results with the utilization in industry.

Technology commercialization concept of the Ministry of Commerce, Industry & Energy concentrates on the strengthening industry & corporate competitiveness through production & marketing activities. Especially, the construction of commercialization infrastructure including industry support, venture start-up, quality, & standards, on/offline technology market, technology evaluation etc. are considered as the major area of interest, and with the enactment of the technology transfer promotion act in 1999 and through various technology commercialization initiatives and budget support, it is

currently being recognized as the main platform of technology commercialization in the government. [15,19]

The technology commercialization concept of the Ministry of Science & Technology emphasize on the proliferation of R & D itself rather than commercialization. Because the role of the Ministry of Science & Technology is mainly focused in relation to the management and proliferation of fundamental research & application research, and the expansion effects of the developed technology from the R&D of government funded research organizations are embraced as the eventual objectives of technology commercialization.

The Ministry of Information & Communication is doing throughout the entire process from the proposal of R&D subjects to the technology commercialization of the research & development results. The features of information & communication related technology shows short life cycles and independent infrastructure such as equipment, factories, energy etc.

On the other hand, the commercialization support operations of Korea include small & medium business technology support, research results proliferation operations, research center start-up support etc. This program is to support the activation of small & medium business competitiveness & technology development through the commercialization of relevant technology from the public side. The support areas in relation to small & medium businesses through this program include property rights concessions & technical fee exemptions for technology possessed by research organizations, 80% government subsidization of technology support programs, loans for commercialization etc.

The government emphasizes small & medium enterprises to solve technical barriers onsite by the utilization of the local university technology development support, and constructing autonomous joint industry-university technology development systems. And for the regional IT universities, joint area industry-university technology development consortia are being designated and supported actively.

Next, to activate local technology market and to perform efficient commercialization of technologies from local universities, research centers, and corporations, Regional Technology Transfer Centers are being established in regional techno-parks, and they are being cultivated as the strategic points of regional technology transfer.[9,10]

### **3.1.2 Technology commercialization related laws**

Korea has almost 40 individual acts related to technology commercialization. Most of them consist of acts in relation to technology development, commercialization support, and individual corporation cultivation. In some cases, they are also briefly prescribed in acts on cultivation & support on particular industry areas, finance related acts, area cultivation related acts etc. <Table 7> shows major acts of promotion & support prescribed in.

<Table 7> Technology commercialization related acts for each ministry of Korea.

Related Ministry	Major related laws
Ministry of Science & Technology	Science & technology promotion law, technology development promotion law etc.
Ministry of Commerce, Industry, & Energy	Laws relating to industry development & formation of industry technology infrastructure, technology transfer promotion law, invention promotion law, government owned patent, disposal, management regulations (presidential directive) etc.
Ministry of Information & Communication	Basic law on information promotion, software development promotion law etc.
Other Ministries	Support programs based on technology development related laws of each ministry

The Ministry of Commerce, Industry, & Energy controls the acts relating to industry development & formation of industry technology infrastructure, technology transfer promotion act, invention promotion act, government owned patent disposal, management regulations (presidential directive) etc. The aim of the industry development act is to contribute to national economy development by promoting the advancement of the infrastructure through enhancing competitiveness and balanced growth.

Main contents of this act include plans containing industrial technology development, technology implementation, technology development results utilization etc. And by establishing annual industry infrastructure technology development programs, alliances will be formed and executed annually with public & private research organizations, technology research associations, specialized production technology research centers, universities, government funded research organizations etc. and funding for these projects will be facilitated.

The technology transfer promotion act was pronounced in January 2000, and the major contents include establishment & operation of the Korea Technology Transfer Center, designation of local technology transfer organizations & specialized technology evaluation organizations, establishment of exclusive technology transfer teams within public research organizations, cultivation of private technology transfer organizations & technology transfer businesses.

The Ministry of Science & Technology governs the science & technology promotion act, technology development promotion act etc. The science & technology promotion act prescribes the details relating to the support systems for the establishment & execution of fundamental policies & comprehensive plans in relation to science & technology. And main contents of this act include the establishment of fundamental policies & comprehensive plans for the promotion of science & technology including the promotion of developed technology utilization.

The Ministry of Information & Communication controls the basic act on information technology promotion, software development promotion act etc. The basic act on information promotion is focusing on improving people's lives and advancing national economy by promoting information systemization, forming the information communication infrastructure, and realizing the advancement of the information communication infrastructure. It includes the establishment of basic plans on information systemization promotion, technology development & utilization required to form the information communication industry infrastructure, execution of projects relating to technology alliance, technology guidance, funding support, establishment & location support etc.

The software development promotion act pursue software development & usage and promotion of the software industry, it focuses on improving people's lives and developing the national economy.[13,16]

### **3.1.3 Technology Commercialization Programs**

The technology transfer subsidy program is a system which subsidizes part of the technology implementation costs when the transferred technology obtained through government designated technology transfer organizations is to be commercialized, and it subsidizes up to 70% or 50million of the technology transfer contract deposit paid to the technology provider when the technology is transferred from research centers, universities, corporations etc.

The small & medium business transferred technology development program is a system where a part of the additional technology development funds required for the commercialization of technology transferred from domestic & overseas universities, research organizations, corporations etc. are subsidized, and it provides up to 75% or 100million of the total development cost for technologies that can be merchandized within a year.

The patented technology transfer promotion program is to promote superior patented technology transfer & patented technology commercialization by providing loans for a part of the funding required in the process of utilization/commercialization, development etc. of technology transferred from domestic & overseas universities, research organizations, corporations etc. and supports patented technology that can be merchandized within 3 years.

Supporting patent registration program is to subsidize patent costs for utilization promotion through accumulation prevention and private transfer of superior research results developed by universities, government funded research centers, national & private research organizations etc.

R&D support program is to promote early commercialization public technology developed by government funded research centers, universities, and non-profit private research entities with additional R&D of public technology, and provides commercialization costs from the receipt of the public technology to the mass production stage.

Next, there is the technology guarantee system of the Korea Technology Credit Guarantee Fund. This is a system where the government funded Korea Technology Credit Guarantee Fund guarantees the technology possessed by the firm based on a technology evaluation enabling loans to be gained from banks without actual collateral.

The industrial technology development loan fund of the Ministry of Commerce, Industry, & Energy has a program where long-term low interest loans are provided to promote the localization of major capital goods and advanced technology products and supplement new technology.[1,10,13]

### **3.1.4 Technology commercialization funding**

For individuals or firms to successfully conduct technology commercialization, it is necessary to obtain funding. Apart from self-funding, other sources of funding include policy funds of government departments, loans from financial institutions, venture capital, and angel investment funds. Below is a concise explanation of policy funds & investment funds.

#### **Policy funds of government departments**

Policy funds of government departments are the financial resources formed and implemented through government financial policy and other methods in accordance with government policy needs. These funds provide relatively low interest than standard interest to business requiring support based on the policies of the government or public organizations. The types of policy funds include contributory funding and loan support funding depending on the support type. Contributory fund is the policy funds provided from the government to the businessmen with no collateral, no guarantee, and no interest, and is mainly provided for new technology developments. After the completion of development a part of the government funded amount (30%) must be repaid divided over 3 years. These include the industry infrastructure technology development fund of the Ministry of Commerce, Industry, & Energy, information & communication R&D fund of the Ministry of Information & Communication, technology innovation development fund of the Small & Medium Business Administration. In comparison to these, loan funds are policy funds apart from contributory funding that require actual collateral or technology guarantees, and most of these are long-term low interest divided repayment loan funds.

#### **Venture capital & angel investment funds**

Venture capital (start-up investment firms, new technology financing firms) deal with advanced technology that have positive prospects, and is a financing method where comprehensive support including funding, management, technical assistance is provided to firms with small capital and management capabilities from the early stages, and investment returns are collected after cultivating the company invested in.

If only the funding itself is considered, venture capital can be seen as having similar characteristics as financial institutions like banks, but in terms of funding support, it can be clearly distinguished from existing financial institutions. While the funding support type of standard financial institutions provides funding support in the form of a loan after securing adequate collateral and charges a predetermined interest, venture capital is funding in the form of unsecured share investments to ventures that have technology but are not so strong in terms of collateral, and as the venture grows & develops, return on investments are collected by the sale of shares.

These differences can be classified in terms of risk and returns, and if a specified interest is guaranteed to standard financial institutions while not bearing the risk of success & failure with adequate collateral, venture capital can obtain many times more in terms of return in accordance with the management results of the venture enterprise, but there are cases where no returns can be collected on the investment. As a result, even if capital or collateral is inadequate, if there is suitable technology and potential for growth, support can be gained from venture capital firms and not only can they establish business but they can also obtain high feeling of accomplishment.

<Table 8> A comparison between venture capital and standard financial institutions

Category	Investment Type	Collateral	Method of Return on Investment	Level of Returns	Risk
Venture capital	Investment	No	Sale of shares after listing	Large difference depending on management results	High
Standard financial institutions	Loan	Yes	Collection of the principal amount after the given period	Specified interest	Low

Angel investment involves individual investors who appear like angels providing funds required in the early stages of company establishment. This involves the provision of required funding, management advice etc. for venture enterprises facing difficulties in raising funds after establishment, and the leading angel and supporting angel are the main constituents. The leading angel is usually in his 50s who has succeeded and retired as a manager and takes on a leading role in the support of the venture enterprise, and he/she possesses abundant capital, management experience, and technology evaluation ability, at times participating as a part-time director. The supporting angel is usually a person in a specialized field such as lawyers, accountants, consultants etc. who supports

the entrepreneur with professional knowledge or an acquaintance of the venture enterprise. Indirect support is provided and private funds are also invested at times.[15,17]

#### **4. Korea Technology Transfer Center**

KTTC is the major technology consulting and commercialization organization in Korea. As one of realizations of the measures and policies specified in the Technology Transfer Promotion Act, KTTC was incorporated in March 2000 under the support of MOCIE (Ministry of Commerce, Industry & Energy) and other Ministries related to technology and business. KTTC is the major institution for technology transfer and market in Korea.

The mission of KTTC includes integrating business and technology with competitive advantages in such areas of technology transfer, valuation, and investment. KTTC has created a technology platform where new technologies are turned into new business opportunities through such means as technology incubation and its proper transfer, and has been the center for information flow of technologies through management of Technology Licensing Organization (TLO) / Regional Technology Trade Centers (RTTCs), and National Technology Bank. Also KTTC has dedicated to transfer and commercialization of technologies by operating several financing schemes including Technology Business Incubation (TBI) and Research & Business Development (R&BD) for leading to acceleration of technology commercialization with a focus on early stage companies.

Strategic approaches that KTTC makes use of include:

KTTC employs a wide variety of methods of technology transfer and commercialization ranging from licensing and stock purchases to academic exchanges and research database.

KTTC upgrades technological infrastructure and improves competitiveness by implementing a systematic and integrated globalization technology strategy that harnesses the strengths of business, academia, and government.

The technology globalization strategy of KTTC takes advantage of all opportunities to improve Korea's technological infrastructure and global competitiveness.

## **4.1 Technology Commercialization and Transfer Activities in KTTC**

### **4.1.1 KTTC Services**

#### **Technology Transfer Service:**

For partner search, KTTC reviews the technology to sell, estimates the commercial viability the market and industry trends and identify potential licensees or partners. KTTC offers support with problems generated by differences in legal system as well as systemic technology differences for negotiation and deal closing.

#### **Technology Valuation Service:**

KTTC studies feasibility on early-stage technologies through market, technical and economic analysis and performs business and technology valuation.

#### **Mergers & Acquisitions service:**

KTTC promotes M&As involving technology based companies and lab ventures and provides comprehensive services from finding a right partner to the signing a contract.

company evaluations, there is a major movement to put more emphasis in company's non-financial factors such as technology competitiveness. Technology competitiveness indexes include ability of CEO and CTO, a portion of company's R&D investment, the level of technology-related manpower, quality of intellectual properties and the level of research facilities.

### **Conclusion**

As above contents, technology commercialization policies and activities in Korea have developed constantly and systematically, shifting the central axis of industrial technology policies from R&D itself to its commercialization.

Technology commercialization is a process that requires time, money and efforts from various participants. Especially in Korea, insufficient funds, lack of diverse support

tools and lack of skills in mining commercially viable technologies at their early stages are present as major obstacles to overcome. Undoubtedly, however, outcome of successful commercialization is as influential and powerful. Technologies with commercial potential should be selected at their early stages. Also, looking at technologies with different criteria in order to make such selections is equally important.

Efforts to expand commercialization funds and to examine diverse support tools such as technology valuation guarantee system and purchase & development system to actively invest or loan in early stage companies are representative movements concurring with government's new commercialization policies. Technology transfer and technology valuation will have positive impacts in promoting profit-creating technology transfer and commercialization system in Korea.

Rapid development of industries requires adequate changes in its technology management system. Korean national system of technology management including technology transfer has experienced drastic changes over the past 40 years when Korea has made a remarkable economic growth. One of the most remarkable initiatives in technology transfer in Korea is establishment of KTTC in 2000.

KTTC and Korean government have developed and implemented a systematic, integrated technology commercialization strategy that harnesses the technological strengths of its private sector, academia, and public sector. KTTC has been successful with technology commercialization methods and an integrated globalization strategy in its early development stages. Its strategy has been so successful that institutions of technology transfer in some countries have called on KTTC to share its technology management experience and intermediate technology with them rather than asking for direct monetary aid.

It is clear that technology cooperation and commercialization methods should increase access to technology for all participating parties, thus creating an incentive for open cooperation. However, the situation of world technology and business is changing to reduce bureaucratic barriers. Therefore, it is more important that KTTC should control the business negotiation process related to technology and make efficient technology commercialization system for the open world market.

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