

Technology commercialization

Recent activities in Korea

Dongseop Kim and Jungwon Hwang

This article introduces the technology commercialization system in Korea and reviews the role of the Korea Technology Transfer Centre (KTTC) as a unique marketplace for technology transactions in the country. It examines KTTC's recent activities to promote technology transfer and commercialization in Korea. Founded in 2000, KTTC also works with government to frame policy and build infrastructure for technology commercialization.

Dr. Dongseop Kim
 Director of Technology
 Commercialization Division
 E-mail: doskim@kttc.or.kr

Dr. Jungwon Hwang
 Specialist of Planning
 & Administration Dept.
 Tel: (+82-2) 6009 4303
 Mob: (+82-11) 9932 9395
 Fax: (+82-2) 6009 4343
 E-mail: jwhwang@kttc.or.kr
 Korea Technology Transfer Centre (KTTC)
 14 Fl, KOTECH Bld, 701-7,
 Yeoksam-dong, Kangnam-ku
 Seoul, Korea
 Web: <http://kttc.or.kr>

Introduction

In order to be technologically competitive in the 21st century, just about all nations are making efforts to promote the industrial application of the technology they own and to increase the volume of available technology in general. Many countries are in the process of transforming their economies into knowledge-based ones, through the enactment of new laws and the creation of new organizations. Going along with this trend, the Korea government enacted the Technology Transfer Promotion Act in 1999 and established the Korea Technology Transfer Centre (KTTC) in 2000.

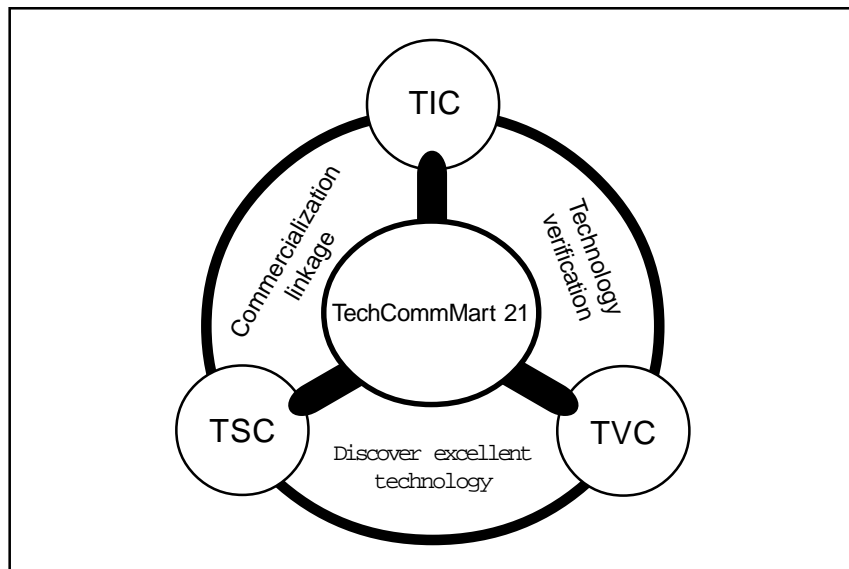
The Act was designed to facilitate the industrial use of technology developed and owned by individuals, research institutes and companies, thereby building an infrastructure for the effective transfer of technology. KTTC was established with joint con-

tributions from the government, financial institutions, and venture business related organizations. The aim was to build infrastructure, and thus provide a marketplace where sellers would have easy access to buyers/investors, while the latter would have easy access to technologies with high commercial potential.

Since the enactment of the law, technology transfer and technology commercialization have become important factors in both the public and the private sectors in working out technology innovation strategies. It is clearly appreciated now that successful technology development does not just mean successful completion of R&D but also extends to its successful commercialization.

In spite of these efforts to facilitate technology commercialization in Korea, only about 30 per cent of patented

Figure 1: The position of TCM in technology commercialization



technologies are commercially used at present, and only a small portion of technology developed by public research institutes and universities is, from a buyer's standpoint, in a state of readiness to be transferred or commercialized. This article will discuss recent trends and activities in technology commercialization policy in Korea, focusing on technology transfer and technology appraisals. The role of KTTC and other related organizations for the effective execution of the system will also be discussed.

Technology transfer activities

"Promoting technology transfer and commercialization that creates profit" is what Korea's technology transfer and commercialization system aims to achieve. In order to obtain this object, three strategies have been suggested.

A cost-effective transfer system

The first strategy is to create a cost-effective technology transfer system. In other words, buyers and sellers must get more opportunities to meet and reduce expenditure in searching for the right buyers and technologies, by being provided with proper technology and company databases. Since the 1990s, several government organizations have held technology-related fairs and techno-marts to encourage meet-

ings between technology owners and buyers or investors. Needless to say, these events helped technology owners, especially individuals and small/medium-sized companies who do not have the necessary network of their own.

The weak point of fairs or techno-marts was that they were held only once or twice a year and opportunities were thus rather limited. Also no active follow-ups were made after the event. There was thus a need for a more permanent marketplace where technology owners and buyers would meet regularly, as well as for a follow-up system that would provide further support, in aspects of contract terms and legal matters, in negotiation. KTTC's Technology Commercialization Mart (TCM) was started as part of its technology commercialization programme to satisfy these needs for open access to technologies and buyers. Figure 1 illustrates how TCM fits into the whole commercialization programme. A technology supplied by TSC (technology supply chain) and verified by TVC (technology verification chain) will be provided to TIC (technology investment chain). With TCM at the centre, technology suppliers, technology buyers and investors are connected to each other, creating a synergy effect.

KTTC's workflow, according to the technology commercialization programme, is also depicted in Figure 2. The programme starts from technology

supply, going through verification and marketing, and culminates with licensing or investment.

TSC varies from universities and public research institutes to individuals and large conglomerates, including both domestic and overseas technologies. TVC consists of both in-house experts and outside specialists. Engineers from research institutes and industries, patent agents, venture capitalists and market analysts are the main outside specialists. TVC reviews technologies supplied from TSC and identifies those with high commercial potential. Technology that passes this verification step is registered in a database, and a detailed analysis information, such as the merits of the technology and its commercial validity, is attached to each technology.

TCM21 (Technology Commercialization Mart in the 21st century) is a marketplace where investors, technology sellers and buyers meet, thereby increasing opportunities for a right match. Starting from August 2001, TCM 21 is currently held once a week. It was started with technologies from individuals and companies. Now, however, the scope of technologies presented expands to technologies from universities and research institutes as well as from overseas.

TIC is a network system that completes the technology commercialization programme. Even after the technology transfer deals are successfully closed, technology buyers often face problems in the commercialization process. According to a survey in 2002, the biggest hurdle was the additional expenditure needed for commercialization. Expenditure for large-scale production and marketing are included in this category. The second difficulty turned out to be the lack of support from technology suppliers. TIC was composed of banks, venture capital companies, and other kinds of investment organizations to give support to companies with lack of funds, thereby raising the possibility of commercializing advanced technologies.

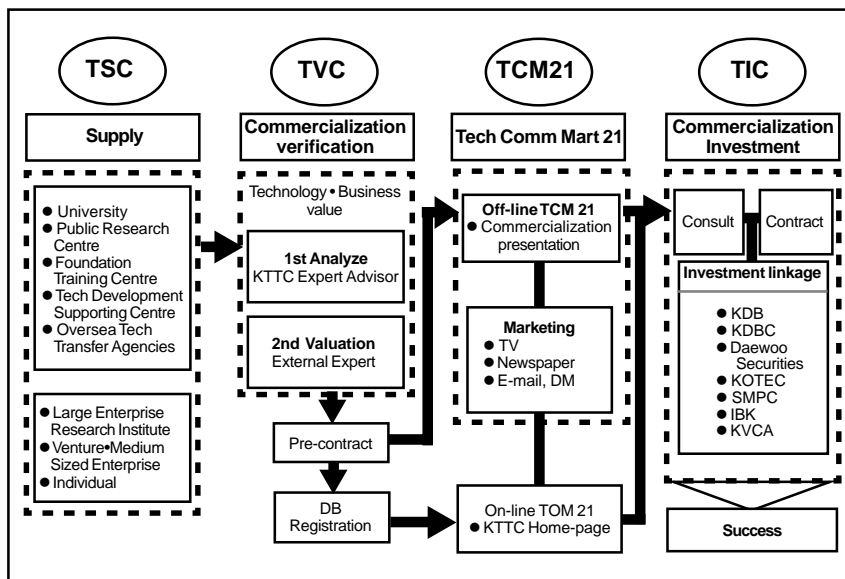
In addition to providing a permanent marketplace, it is as critical, for building a cost effective technology transfer system, to reduce the time and expenditure needed for potential technology and part-

ner search. On behalf of MOCIE (Ministry of Commerce, Industry and Energy), since 2000 KTTC has been in charge of building up a technology database from universities, research institutes, and companies. The purpose is to provide easy access to high quality information as well as to standardize the format of the technology database. As of December 2003, approximately 13,000 were registered, with 900 containing in-depth market analyses. Market trends for 230 technology fields and nearly 5,000 corporates are also provided.

Increasing the number of technology professionals is another way to build an efficient technology transfer system. In Korea, there are three types of technology transfer specialists in the field. The first are the public and private technology transfer organizations. Sixteen of them, including KTTC, have been appointed by the government under the Technology Transfer Promotion Act and are in charge of either different technology fields or different parts in the commercialization process, depending on each organization's expertise. The second are technology transfer agents. Anyone with certain qualifications and accomplishments can register as a technology transfer agent. As of January 2004, 173 technology transfer agents were registered. Lastly, there are the professionals working at TLOs in universities and government-funded research-institutes. Most major universities and government-funded research institutes have set up their own TLOs. Nonetheless, most TLOs are not active due to the limited number of professionals and insufficient budgets. In 2002, for the purpose of more effective TLO operation, universities and research institutes formed TLO consortia. With support from MOST (Ministry of Science and Technology), four TLO consortia currently operate with the mission of enhancing public to private technology transfers.

In order to ensure the successful operation of professional technology transfer brokers, continuous education and adequate incentive systems are essential. The current insufficient incentive reward structure needs to be changed, and government is working on improving the system such that the benefit from profits expands to technol-

Figure 2: Technology commercialization programme by KTTC



ogy transfer personnel (which is at present mainly focused on technology inventors).

In order to educate technology commercialization personnel in institutes and industries, various basic courses and several advanced training courses have been offered in the fields of technology transfer, technology valuation, business valuation, and M&A. In particular, professionals with expertise in technology marketing, deal negotiations and technology appraisals are in great need, and advanced courses are more focused in these areas. In advanced courses, training curricula focus on gaining a sense of actual practice through various case studies. Current training programmes in Korea in the field of technology commercialization are summarized in Table 1.

Strengthening national network

The second strategy is to strengthen the regional technology transfer system. By nurturing techno-parks around the nation as core Regional Technology Transfer Centres (RTTC), together with TLOs in universities and public research institutes, it is expected that they would function as a regional hub. The RTTCs will identify buyer needs from regional industries and work closely with four TLO consortia and other public research institutes. The main function of RTTCs and their relationship

with other organizations is illustrated in Figure 3.

Four techno-parks were first set up as RTTCs in 2003. They were Bu-san TP, Chung-nam TP, Kyung-gi TP, and Kyung-book TP. Three or four more RTTCs will be appointed in 2004, reaching a total of eight RTTCs. The current status of R&D scales of corresponding cities and states, as well as the number of manufacturing companies within the region, will be considered in selecting RTTCs. Figure 4 shows the location of KTTC and areas where RTTCs are expected to be launched. The lines represent interchanges between KTTC and RTTC as well as RTTC and RTTC.

KTTC also plays a central role in managing and connecting each regional centre and derives from the RTTC selection procedure. KTTC is also in charge of educating RTTC personnel by either providing regular training programmes or dispatching registered technology transfer agents to help them with operations. Manuals in technology marketing, patent application, and technology database management, have also been developed and distributed to TLOs and selected RTTCs.

Bridging the research-commercial gap

Most technologies – especially from universities and research institutes –

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Table 1: Training programmes in technology commercialization

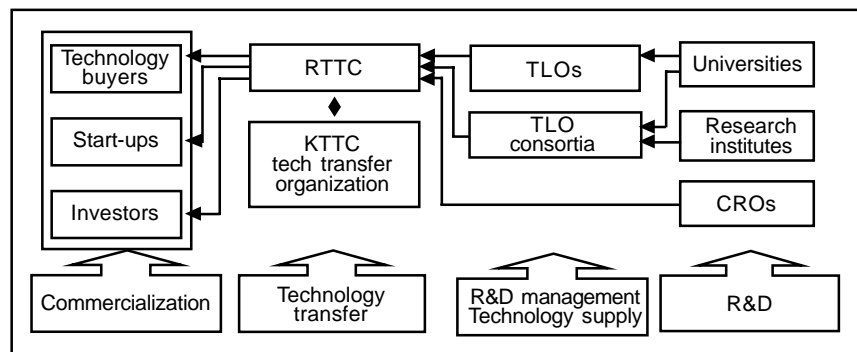
Field	Level	Main curricula	Hours	Managing organization
Technology transfer	Basic	Basic concepts of technology transfer and M&A	39	KTTC
		Basic concepts in technology commercialization, licensing, and marketing	35	KISTC
Technology transfer	Advanced	Technology marketing, deal negotiations, writing a contract	60	KTTC
		M&A strategies, deal negotiations, writing a contract	60	KTTC
Technology appraisal	Basic	Basic concepts of technology appraisals, general methods in valuation	21	KTTC
		Theories in technology appraisal, IP management, examples in technology transfer	24	KIBO
		Methods in valuation, IP management	24	KIPA
Technology appraisal	Advanced	Key factors in commercial validity assessment, advanced theories in valuation, valuation practice	60	KTTC
		Valuation methods using in M&A, valuation practice	60	KTTC

are in need of further development or patent protection/modification to be used in industries. The third strategy, therefore, is to find an efficient way to narrow the gap between research and commercial opportunity.

Several solutions have been suggested by technology policy experts. The common key processes would be, however, to identify inventions of commercial interest at their early stage, to take over patent protection or modification or further development, and to commercialize either through licensing or creating a new venture. This way, the breadth of technologies to look for can be expanded to earlier-staged ones and technologies will have better opportunity to be commercialized, passing through expert hands by further development or redefining the field of application. In addition, the role of contract research organizations (CRO) will be essential for successful commercialization.

Investment in kind by technology has not been widely acknowledged by

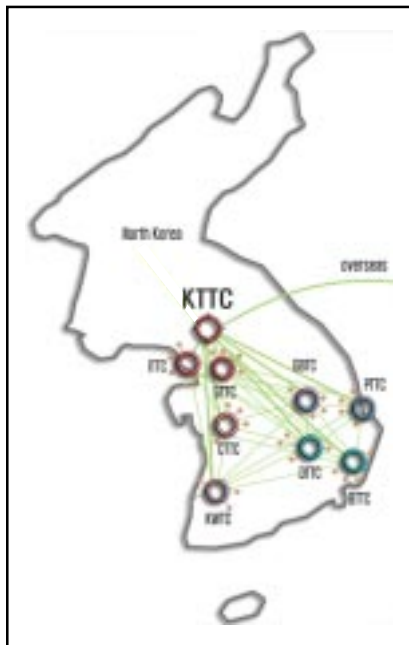
Figure 3: RTTC's main function



technology inventors in universities and research institutes in Korea. Recently, however, many technology inventors started to realize that technology transfer is not an only option for them to see their technology be commercialized. Instead, many research institutes are looking for an opportunity to create a joint venture with a partner (or partners). This can be considered a new model of technology transfer that can make continuous R&D and commercialization possible, thereby

uplifting the possibility of commercialization. Also the cooperation between technology inventors and a partner who commercializes it will be strengthened. Recently Korea Atomic Energy Research Institute (KAERI) established a joint venture with Korea Kolmar, a company listed in KSE (Korea Stock Exchange), with KAERI investing its technology and Kolmar providing capital. The success example by KAERI and Korea Kolmar is expected to influence other research institutes and compa-

Figure 4: Location of KTTC and RTTCs



panies who actively look for new opportunities, thus increasing the number of similar types of cooperation.

International technology transfer

One of the main focuses in building an effective technology commercialization system is to facilitate international technology transfers through networking and forming partnerships. Expanding the scope of cooperation from simple services, such as holding joint seminars or providing technology information to searching for potential buyers and negotiating deals is important so that the partnership does not stop at a formal level and both parties can benefit. Especially in the year 2004, technology exports to countries in Asia will be actively pursued. Technology demand surveys, in-depth commercial validity assessments followed by on-site introduction to interested buyers and investors, and target marketing will be the key factors in successful technology exports.

KTTC has a high quality international network, with 23 organizations in 11 countries, including China, Russia, Germany and the USA. In early 2002, TCM21 with advanced overseas technologies presented by its overseas partner, CTT (Competitive Technolo-

Table 2: Main categories of technology appraisals and their applications

	Technology transfer	M&A	Loans or investment	Patent infringement	Research funding
Validity assessment	○				○
Competitiveness evaluation		○	○		○
Technology valuation	○			○	
Business valuation		○	○		

gies, Inc.) in the USA was held for the first time. Technologies ranging from advanced materials and life sciences to electronics were presented, and approximately 200 interested buyers attended, reflecting the great interest of companies in technologies from advanced countries. Active individual pre- and post-meetings and negotiations were held. Similar types of technology introduction will be held more frequently with other overseas partners for both technology import and export.

KTTC also provides support to mid- to small-sized companies with part of commercial validity assessment fees and search fees to reduce the share of small and medium-sized companies. Overall consulting services on strategy and procedure, especially on accounting, financial and legal matters, that are often considered as major obstacles in most technology transfer deals, are provided as well.

Technology appraisals

The types of technology appraisals needed in the technology commercialization process are summarized in Table 2.

Commercial validity assessment

Validity assessments on individual technology and individual projects have been carried out for a long time in research funding and technology-based loans. However, most of the studies focus only on technical aspects, such as technical advantage and the possibility of its realization. Relatively, factors such as its potential to be commercialized and its economic advantages have been neglected. As a re-

sult, commercialization rate of government-funded R&D stays below 25 per cent, which is lower than that of most OECD countries. Fortunately, a portion of its business potential when assessing a technology is increasing gradually. Generally, commercial validity depends on targeted market size, strength of competitive technologies, entry barriers, profitability and expected commercialization expenses. Developing detailed guidelines to assess the commercial validity of a technology and training qualified assessment specialists must be accompanied to establish an efficient validity assessment system

Competitive evaluation

Competitiveness evaluation of individual companies has become very important in the last few years since the number of start-ups increased rapidly since 1998, thanks to strong government support, and then went through a world economic depression. Naturally, a need to identify companies with high business potentials came to the fore. Competitive evaluation conducts a qualitative and descriptive evaluation on a company's comprehensive technology capability in various aspects rather than focus on an individual technology. It is generally accepted that the evaluation criteria for established companies and for venture companies should be different. Recently, for venture company evaluations, there is a major movement to put more emphasis in a company's non-financial factors, such as technology competitiveness. Technology competitiveness indexes include the ability of the CEO and the CTO, a portion of the

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company's R&D investment, the level of technology-related manpower, quality of intellectual properties and the level of research facilities.

Valuation

Determining the value of a technology is a comprehensive activity that requires deep knowledge of both technical and business aspects of the technology. It also requires an ability to estimate future cash flows generated and to properly discount future earnings to a present value.

There are several known approaches to value a technology. The income approach, described in a previous paragraph, is one of the widely used methods, along with the market approach. In the market approach, the technology to be valued is compared with recent (ideally) similar licensing cases. It is based on the idea of how many relevant agreements can be found that have resemblance to the technology and the deal. However, as one can presume, no technology or deal is exactly the same and an interpretive process is needed to apply the information to the technology being valued. Using a rating/ranking method provides a way to characterize how one technology or agreement differs from one another. The market approach reflects a market's estimation of the value of the technology and is, therefore, a very reliable method to apply. The problem is, the method works on the assumption that several similar cases exist. In Korea, the market approach is used only selectively to compare the value with that by income approach. Building licensing case databases to facilitate a market approach is in progress.

In the income approach, there are several key factors that a valuer should estimate, such as the economic lifetime of the technology, future cash flows and discount rate. In Korea, it is general appreciation that providing guidelines on how to estimate these key factors is the most urgent project to make the valuation results more reliable. KTTC has started to work on the project with MOCIE since 2001 and has completed guidelines for four major industries – information technology/electronics, life

Table 3. Cases of technology appraisals carried by KTTC

Use	Examples
Technology transfer	Commercial validity assessment to identify technologies; royalty rate determination in negotiations
Investment in kind	Domestic or overseas technology + Domestic capital → Start-up venture
Liquidation	Value intellectual property when company goes into bankrupt (mostly for tax purposes)
Patent infringement	Value the damage caused by patent infringement (Either as lost profit or as reasonable royalty)
Investment or loans	Competitive evaluation on companies and valuation → Provide results to banks or venture capitals
Merger & acquisition	Business valuation for technology-oriented venture companies

sciences, materials, and mechanical engineering.

Nine organizations are currently authorized by the government as technology valuation agencies under the Technology Transfer Promotion Act. Each agency has a different area of expertise and KTTC focuses on valuation for technology transfer, investment in kind by technology, and patent infringement. Some of the assessment and valuation examples are shown in Table 3.

- KTTC usually assesses the commercial value of a technology to be transferred and determines the royalty of a technology in the process of negotiations. For example, the coreless type BLDC motor technology was transferred to Company A with the help of KTTC's valuation. Company A was successful in business with the technology and registered with KOSDAQ after 2 years.
- There is another success story in KTTC's valuation on investment in kind by technology. The technology is a method of mass production of proteins such as antibodies, vaccines by Chinese Hamster Ovarian (CHO) cell culturing, which belongs to Company V in USA. The start-up venture company, named Celltrion, was established with domestic capital and Company V's technology by the help of our technology valuation.
- One more successful case is on KTTC's valuation for liquidation. When company S in USA, a subsidiary of a Korean company, went bankrupt, KTTC successfully per-

formed the valuation of the remaining US patents for tax purposes.

Conclusion

Since the establishment of KTTC, technology commercialization policies and activities have been developed constantly and systematically, shifting the central axis of industrial technology policies from R&D itself to its commercialization.

The main activities of KTTC can be divided into three parts. The first part is maximizing the value of technology through technology transfer services - from mining promising technologies and finding a right partner to concluding a contract. The second part is providing an appraisal service, which includes the commercialization feasibility study of early-stage technologies and the valuation of technologies and businesses. The third part is promoting Mergers and Acquisitions (M&A) of technology-based companies and lab ventures. Together with technology transfer and appraisal services, KTTC provides comprehensive M&A services - from the finding of a potential partner to the signing of a contract. The services include providing corporate restructuring strategies that include the sale and purchase of businesses, as well as providing legal, taxation and accounting advice. Since establishment, KTTC has successfully licensed more than 200 technologies to 160 organizations; performed feasibility studies and valuation on 300 technologies or more, and also proceeded on 20 or so cases of M&A.

KTTC also works with government to frame policy and build infrastructure for technology commercialization. Training technology transfer and valuation professionals, studying appraisal methodologies, building technology databases and publishing reports on various technology commercialization topics are among the key parts that KTTC plays.

Technology commercialization 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 major obstacles to overcome. Undoubtedly, however, the outcome of successful commercialization is as influential and powerful. There is a good reason why technologies with

commercial potential should be selected at their earlier stages and focused. Also, it is equally important to look at technologies with different criteria in order to make such selections.

A perception that technology transfer is a buyer's market is steadily increasing in Korea. Various efforts have been made to create a technology transfer system that meets market needs and levels the technology with buyer standpoint. Efforts to expand commercialization funds and to examine diverse support tools are representative movements concurring with government's new commercialization policies. Examples of these support tools are the technology valuation guarantee system and the purchase and development system to actively invest or loan in early stage companies. It is

expected that the strategies discussed above in technology transfer and technology appraisal will have positive impacts in promoting a profit-creating technology transfer and commercialization system in Korea.

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Korea Industrial Technology Foundation

Korea Industrial Technology Foundation (KOTEF) performs the role of a market-oriented and private sector-friendly institution, which is dedicated to proliferating an environment of industrial technology innovation and to disseminating the industrial technology-focused culture across the nation. KOTEF aims to build an interlinked network where technological innovation-initiating entities participate.

Major functions of KOTEF include:

- Spread industrial technology-oriented culture; hold a variety of events and exhibitions, including the NewTech Korea exhibitions, displaying new technologies, and events to promote invention, creativity and technology development as well as public relations events;
- Collect and spread a wide range of information related to industrial technologies;
- Provide training to foster industry technicians; provide scholarships and enhance welfare of would-be industry technicians;
- Seek cooperation with international entities to promote industrial technology development, and integrate resources of institutions retaining industrial technology;
- Carry out industrial technology-related projects (including services) entrusted by the government and other institutions; and
- Engage in and provide support to businesses related to proliferation of industrial technology.

For more information, contact:

Korea Industrial Technology Foundation (KOTEF)
 135-090, 10, 12th Fl. Soe-Young B/D, 158-12, Samsung-Dong, Gangnam-Gu
 Seoul, Korea
 Tel: (+82-2) 6009 3000
 Fax: (+82-2) 6009 3187-8, 3199
 Web: <http://www.kotef.or.kr>