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How Should Techno Parks Innovate to Support Start-ups and Small and Medium-Sized Enterprises Effectively in the Era of the Fourth Industrial Revolution?

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Abstract

In 1995, the Republic of Korea started to establish Techno Park (TP) in order to develop the regional industry while promoting the balanced development of the land. By 2008, 18TPs were established nationwide and have become cradles for developing local industries. And recently evolved forms of TP such as Daedeok Techno Valley and Pangyo Techno Valley emerged. In addition, 19 Centers for Creative Economy and Innovation (CCEI) were established nationwide and Tech-Incubator Program for start-ups (TIPS) was introduced to support and mentor start-ups. TPs in Korea become bureaucratic in course of time, and the new trial of innovation of TP is needed. In Korea, professional TIPS-accelerators mentoring and investing start-ups have a history of only five years. But they support and mentor start-ups efficiently, and have obtained good results.

In this paper, we propose that TP attract TIPS-accelerators actively and collaborate with each other to support and mentor start-ups and SMEs effectively.

Keywords

Technopark, TIPS, Accelerator, Start-up and SMEs, Mentoring and nurturing

I. INTRODUCTION

Developments in science and technology can have profound effects on a country's economic growth and employment rate. The Republic of Korea had joined the ranks of developed countries at an incredibly rapid pace following a period of war and widespread destitution largely due to the government's dedication to the development of science and technology over the last 40 years. It is a powerful example of how the growth of science and technology in a country is linked to its economic development. (Oh, 2008; Oh and Nur, 2016; Parry 2014)

The government of the Republic of Korea has supported a large, long-term research fund for professors in science, technology, engineering, and mathematics (STEM). They established national research institutes for various STEM fields and hoped to create synergistic effects by intensively supported and managing each field at a national level. These national research institutes were able to pursue large-scale projects that universities and private companies were financially incapable of. Researchers from these institutes have gone on to make

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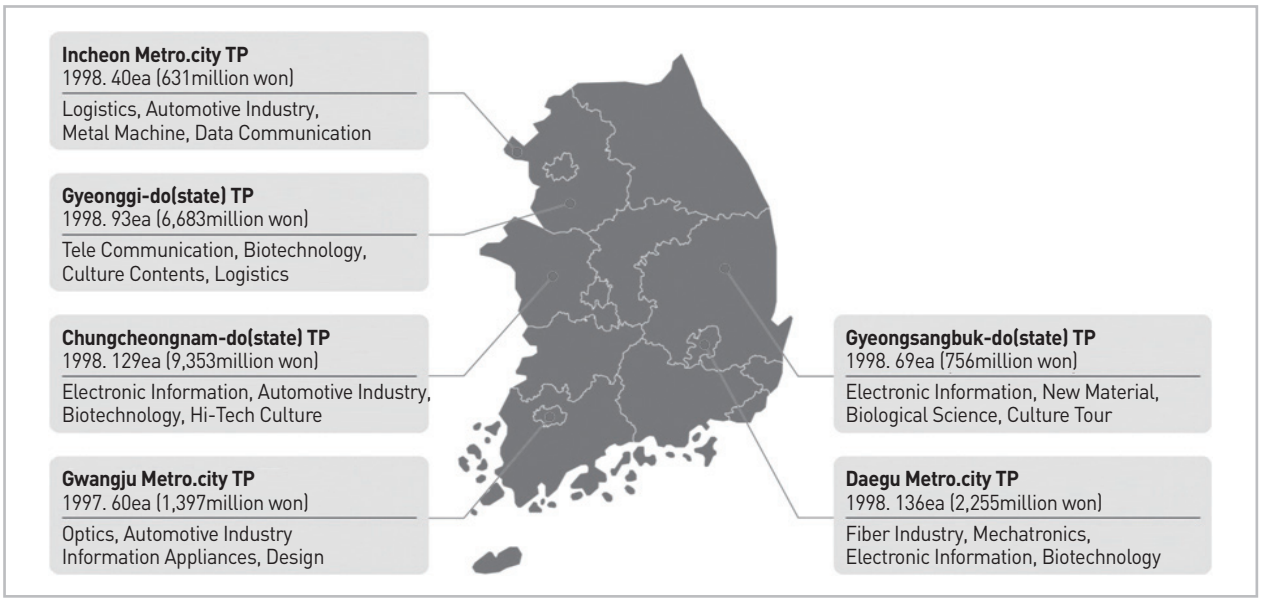

Fig. 1. The first 6 TPs established in Korea

Source: authors

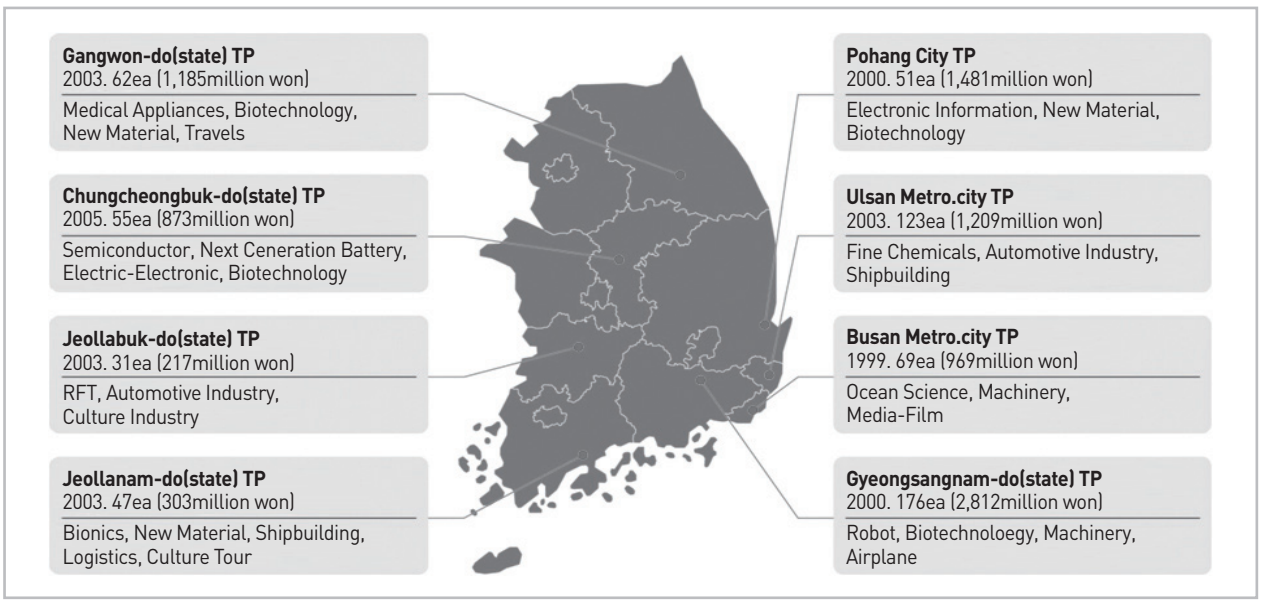

Fig. 2. The second 8 TPs established in Korea

Source: authors

profound contributions at various STEM colleges, universities, and large enterprise research institutes such as Samsung, Hyundai Motors and LG. As such, not only did they contribute to the nation's economy by continuing STEM research, but also by increasing the sales of large corporations. (Oh, 2008; Oh and Nur, 2016; Parry 2014)

To promote widespread industrialization, the government established the technoparks (TP) to contribute to technologi-

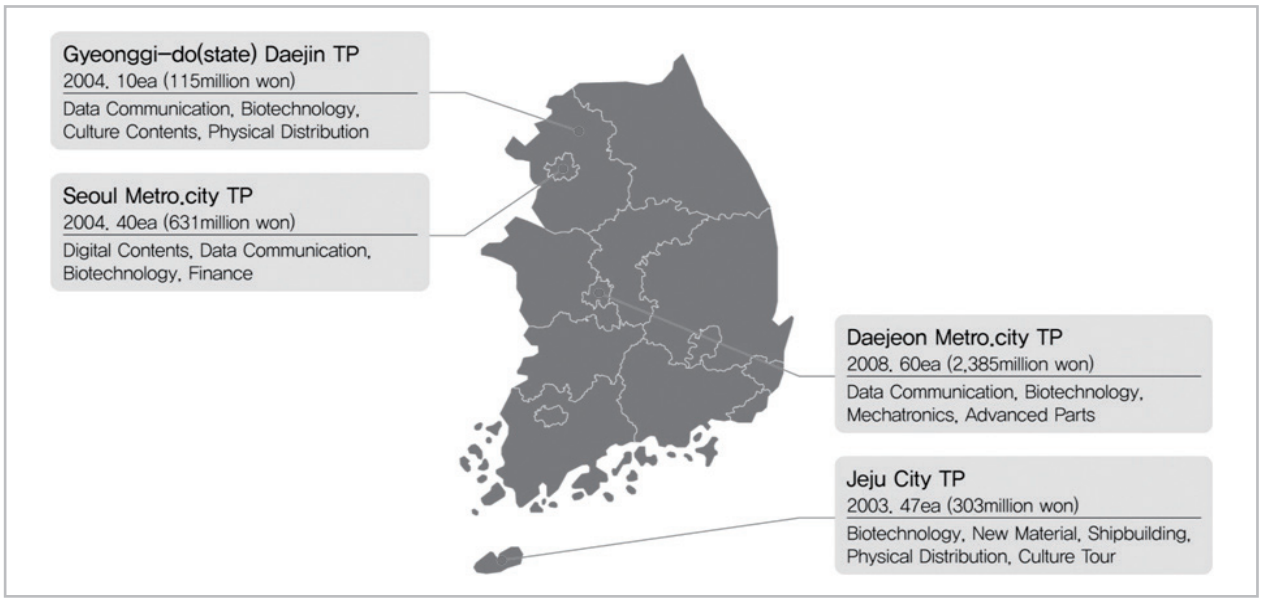

Fig. 3. The third 4 TPs established in Korea

Source: authors

cal ventures on a local level. Local governments aimed to develop high-value-added industries, such as semiconductors, displays, automobiles, and electronics, to provide quality jobs and raise tax revenue for local residents. The national government highly supported these aims, and sought the research of highly educated scientists and engineers to develop them. They looked to the example of the German local government and the Fraunhofer Institute, which had 66 sectors across the country. The research and technology established at the Fraunhofer Institute were either sold to or leased to companies, which led to economic development and employment creation. The Fraunhofer Institute contributed to the creation of a large number of powerful small and medium-sized enterprises in Germany. Similarly, Korea's government established 18 TPs throughout the country with local governments to promote the balanced development of national land. The Republic of Korea is divided into nine provinces, six metropolitan cities, and Seoul city which is the capital of the Republic of Korea. In the early stages of TP, it was thought to be very efficient to commercialize the technology of engineers and scientists who had studied for a long time. (Oh, 2008; Oh and Nur, 2016; Kanayama, 2015)

TPs were established in the days of President Kim Young-Sam 20 years ago, and then expanded upon during the following president's term. The first six TPs were created in 1996, followed by eight in 2005 and four in 2008, for a total of 18 TPs across the Republic of Korea. As planned, TPs played the role of both a medium and a catalyst for developing local industries. The first TPs were established in Gyeonggi province, Daegu city, Gyeongbuk province, Chungnam province, Incheon city and Gwangju city (Figure 1).

The second 8 TPs were established in Busan city, Pohang city, Chungbuk province, Jeonnam province, Jeonbuk province, Gangwon province, Gyeongnam province and Ulsan city (Figure 2). The last four TPs were created as private TPs and later converted to government-funded TPs (Figure 3). Thus, there was one TP for each of the 16 administrative districts with the exception of Gyeonggi province which had a relatively large economic output and was given two TPs (Figure 4). In the case of Daejeon city, the TP was created in close connection with the technical personnel from Daedeok Science Complex and eventually Daedeok Techno Valley —the largest TP in Daejeon— was built near Daedeok Science Complex (Figure 5). (Oh, 2008; Oh and Nur, 2016)

In addition to Daejeon TP, the TPs in Gyeonggi, Chungnam, Chungbuk, Daegu, Gyeongbuk, and Busan are known to perform well.

There are several TP spaces in a city or a province. TPs were established in universities as well as industrial complexes. TPs in universities aimed to create a synergistic connection with

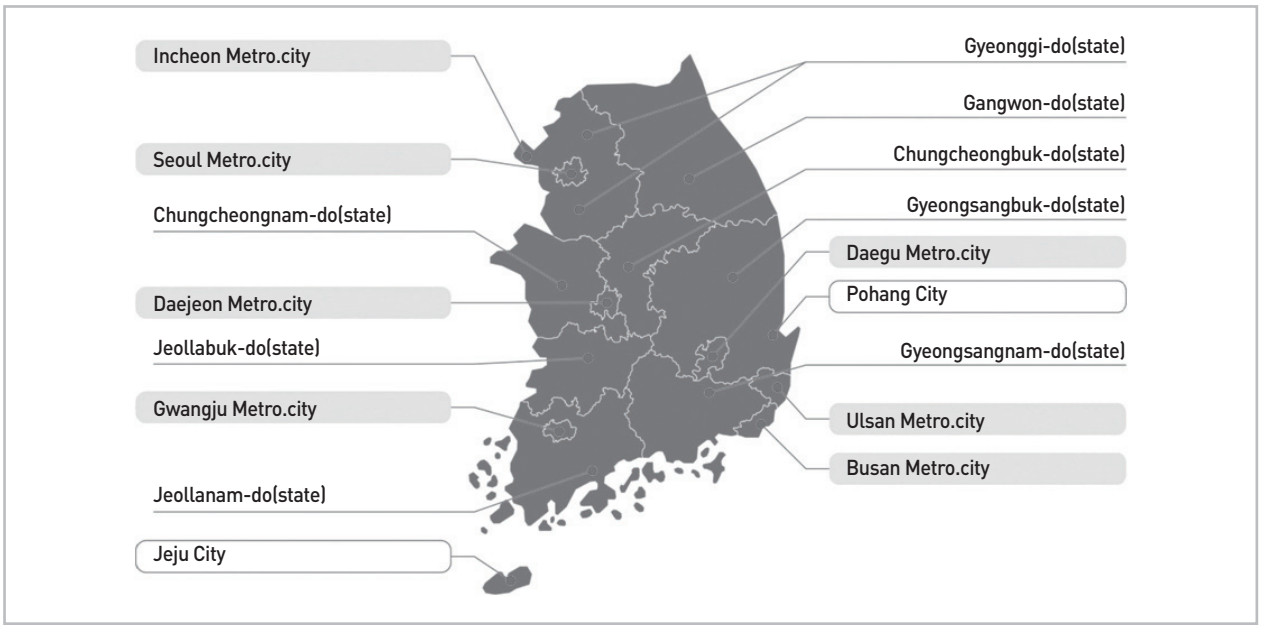

Fig. 4. Cities where TP's were established in Korea

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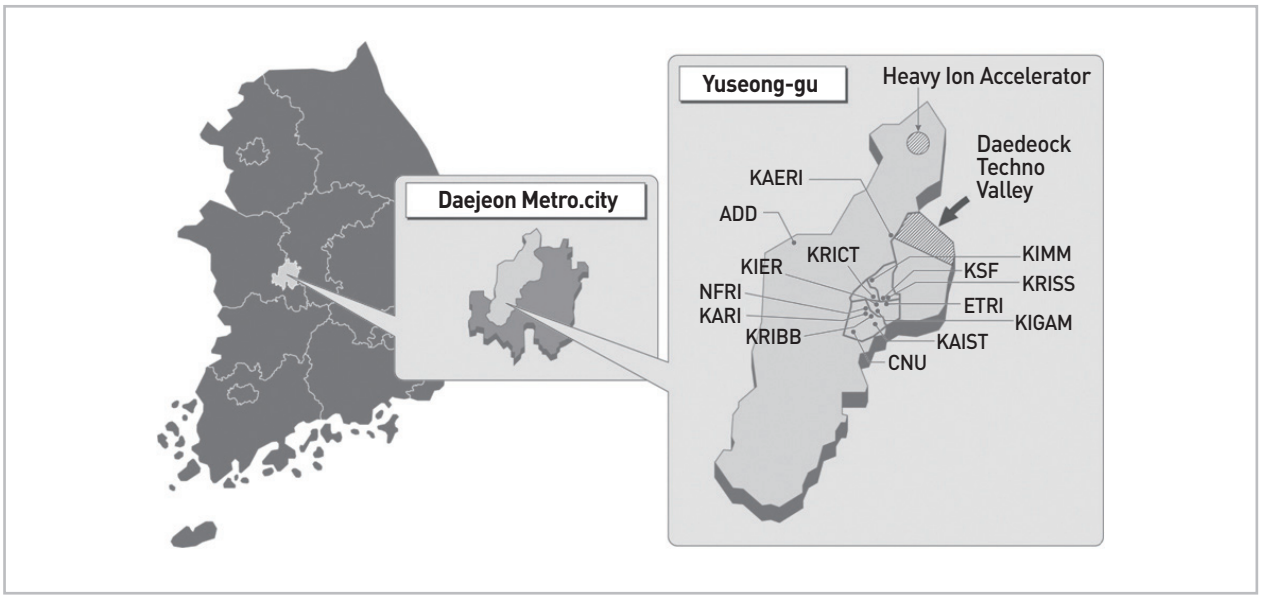

Fig. 5. Daedeok Techno-valley where Daejeon TP is and main research facilities of Daedeok Science Town

Source: authors

the incubation center, which is the university's own organization (the authors interpret the incubator center as a kind of TP space). The TP space in a university may be occupied by a company founded by a professor at the university, or a company founded by scientists and engineers with high-value technology. Companies residing in the university's TP space

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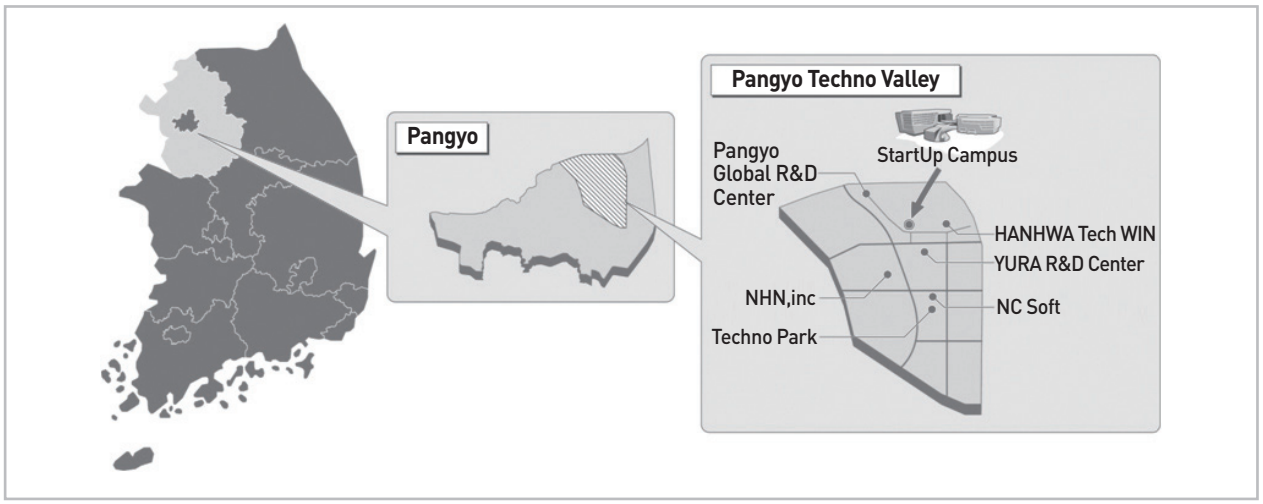

Fig. 6. Geographical position and composition of Pangyo Techno Valley which is the most famous TP space in Korea

Source: authors

have the advantage of being able to select students and recent graduates for internships and full-time employees. Many national research institutes in the Daedeok Science Complex have their own laboratories in local universities such as Chungnam National University, due to being able to easily obtain talented employees in the course of technology commercialization.

In addition to 18 original TPs, local government expanded TPs to establish TP spaces on new sites. In the 2000s, the central government and Gyeonggi province local government strategically created TP spaces like Pangyo Techno Valley to foster specific industries such as IT and stem cell technology (Figure 6). Daedeok Techno Valley and Pankyo Techno Valley became so self-sufficient that they were practically thought of as futuristic small cities. Like cities, they have areas dedicated not only to research and development, but also pleasant residential space, green space (park, river, lake, etc.), educational facilities, shopping and entertainment facilities, and administrative support facilities. Local governments in the Republic of Korea made efforts to revitalize local TPs for the development of local industries, as TPs made significant contributions to maintaining local productivity.

In the fourth industrial revolution, all countries are faced with the need to change the paradigm of industrial structure. Companies such as Google, Facebook, Uber, Alibaba and Tesla, which did not exist 20 years ago, are leading to change the way we live in. Most technological leading countries such as the United States, Japan, Germany, the United Kingdom, China, and Korea are trying to grasp initiatives in robot, AI, IOT, connected automobile, VR-AR, PinTech and biotechnology industries. Among those industries, the bio-healthcare industry is thought to have the highest sales and operating margin per capita and manpower. As a nation's industry develops, the wages of workers increase and the demand for eco-friendly industries grows, making it difficult to maintain traditional manufacturing industries. Developed countries need to upgrade their industries to higher service industries than traditional manufacturing industries. In the early days of the establishment of the TP, the Korean TP was biased toward industries related to traditional manufacturing. In the 20 years since the establishment of the Korean TP, the power of the TP has been declining dramatically, and efforts are being made to increase the power of the TP and increase the economic growth and employment rate of the local community.

II. HOW CAN WE BIND BETWEEN UNIVERSITIES AND TP COVALENTLY?

1. Combination of National Science Research Complex and TP: Daedeok Science Complex and Daedeok Techno Valley (Daejeon TP)

Daedeok Science Complex is located in Yuseong-gu, Daejeon city in the center of South Korea and is the largest scientific research complex in Korea. Daedeok Science Complexes

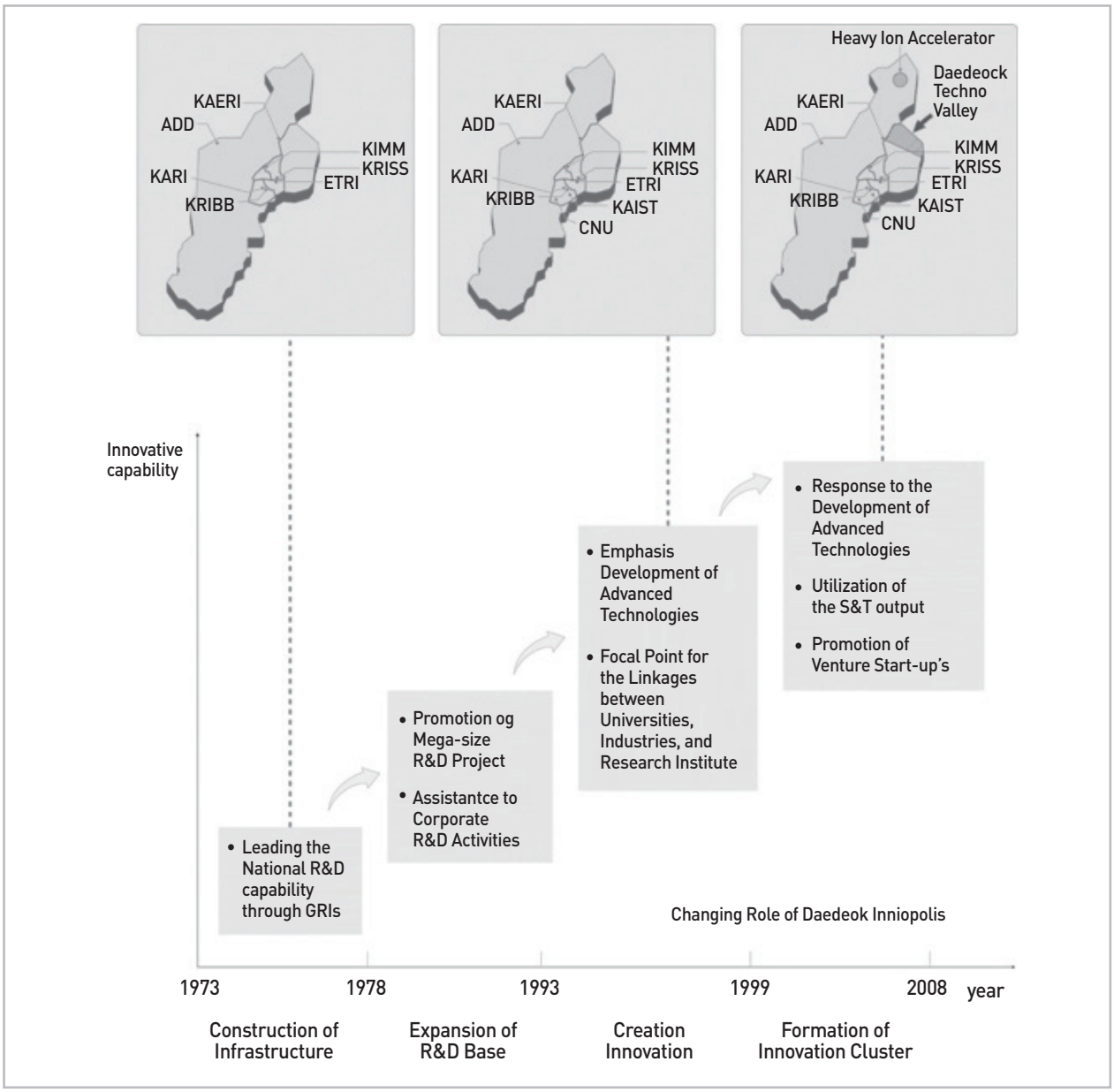

Fig. 7. History of change and extension of Daedeok Science Town and Daedeok Techno Valley

Source: Oh, 2008

has more than 20 national science and technology research institutes such as Electronics and Telecommunications Research Institute (ETRI), Korea Atomic Energy Research Institute (KAERI), Korea Institute of Machinery and Materials (KIMM), Korea Research Institute of Standards and Science (KRISS), Korea Research Institute of Chemical Technology (KRICT), Korea Institute of Energy Research (KIER), Korea Research Institute of Bioscience and Biotechnology (KRIBB), Korea Aerospace Research Institute (KARI), Korea Institute of Geoscience and Mineral Resources (KIGMR), National Fusion Research Institute (NFRI), Korea Astronomy and Space Science Institute (KASSI), National Institute for Mathematical Sciences (NIMS), and Agency for Defense Development (ADD) etc.

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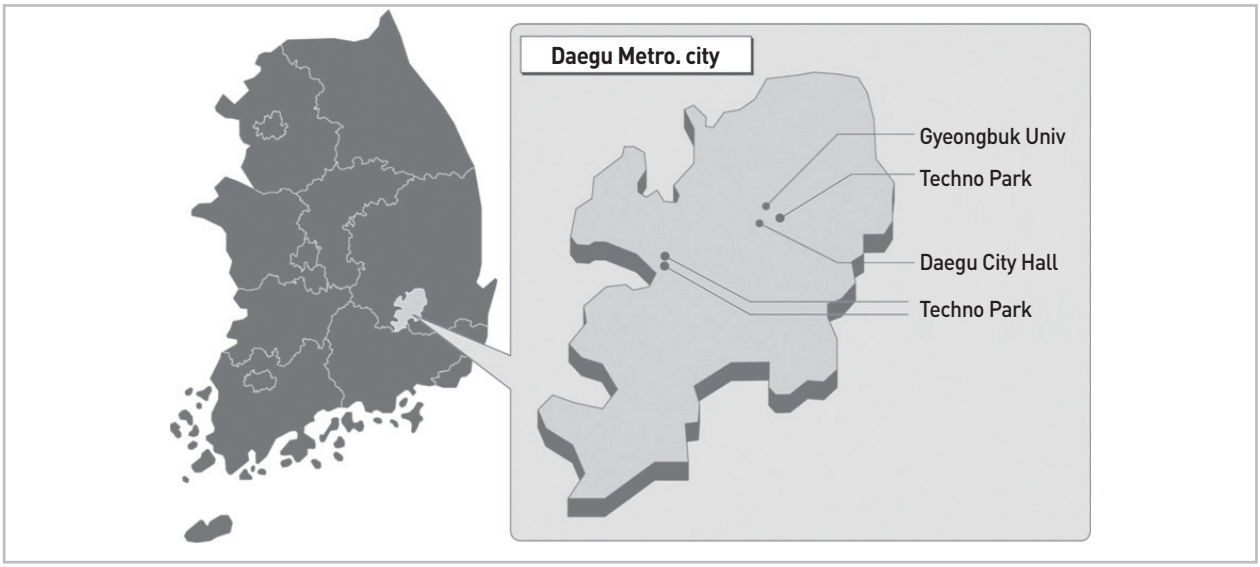

Fig. 8. Geographical position of 3 TPs of Daegu Metropolitan City which are mainly located in Universities

Source: authors

There are also foundations such as National Research Foundation of Korea and Daedeok Innopolis Foundation that distribute research grant and commercialization fund of research output. Daedeok Science Complex has more than 20 large enterprise research institutes such as LG Chem Research Park, and numerous start-ups and research institutes of small and medium enterprises.

Daedeok Science Complex was established in 1973, and for more than 20 years, it was the center of research and development for the future of the country. It was a resource pool where national R & D funds are granted and excellent science-technology personnel gathered. Daedeok Science Complex and the other national TPs all over Korea are very different from their original infrastructure. One of the most important factors that cannot be excluded in developing the Daedeok Science Town is that many research institutes have received talented people from KAIST and Chungnam National University, which are the major universities located in Daedeok Science Complex. The key factor of research and development of science-technology is human resource.

Figure 7 is quoted from the book written by Professor Deog-Seong Oh, who discussed the birth and background of Daedeok Science Complex, the effects of its development for the national industry, and how Daedeok Science Complex has developed in connection with Daejeon City in his book. (Oh, 2008)

2. Roles of TP

As mentioned earlier, local governments of Seoul special city, 6 other Metropolitan Cities, and 9 provinces felt the need for an organization to easily transfer the results of research conducted by university professors and researchers to manufacturer in order to develop local industries, and made their TPs (Figure 4). The TP spaces of each city were built within the university or near the university so that the science-technology outputs from university labs could be easily transferred to the enterprise. Furthermore, it has led many entrepreneurs to commercialize technology using science-technology products from universities. In addition to TP which created by the Ministry of Commerce, Industry and Energy (MOCIE) of the central government and the local government, entrepreneurship incubation center in universities is regarded as a typical technology-based entrepreneurial space (BI) in order to activate entrepreneurship in Korea. The main sponsor and operator of TP is the local government and that of entrepreneurship incubation center is the university. Since its inception, Daegu TP has been co-chaired by the mayor of Daegu city and the president of Kyungpook National University, in order to promote technology transfer between university and industry, or to increase establishment of start-up based on the results of university research (Figure 9). Kyungpook National University is the national university that represents the Daegu City-Gyeongbuk province. Excellent students from Daegu city-Gyeongbuk

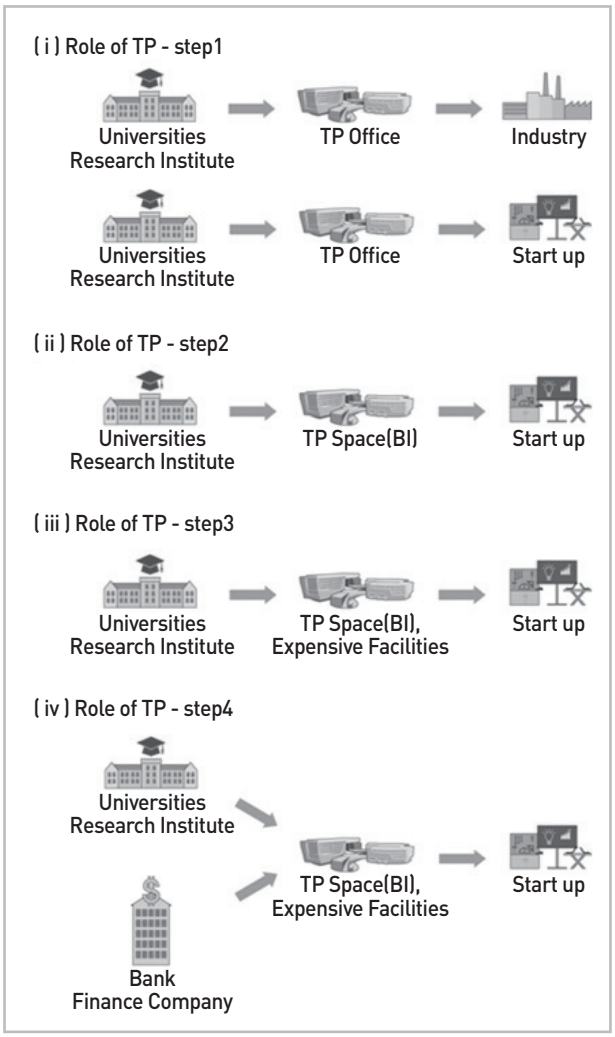

Fig. 9. Changing role of TP in Korea

Source: authors

province region prefer to enter Kyungpook National University unless they enter the top universities in Korea such as Seoul National University and KAIST. Daegu TP not only establishes its business incubator space (BI) in the city's industrial complex, but also places it inside the university, and the board members, which operate the TP, consist of the mayor of Daegu City and the presidents of universities. The case of Daegu TP shows not only a role of universities supplying manpower to TP but also that university itself can take the role of TP. From this, it can be thought that TP space in Korea may be an industrial complex where industrial products were made, and a business incubator center of university.

Many countries have a science-technology research complex that represents the entire country. The examples are Mongomary NIH, NIST complex of Maryland in the US which is located within 30km from Washington D.C., Daedeok Science Complex in Korea, and PUSPIPTEK complex in Indonesia. With the exception of this national science-technology complex, universities play a vital role in technology development in most provinces of the country. High-technologies are often developed in university labs. (Oh, 2008; Oh and Nur, 2016; Parry, 2014; Kanayama, 2015)

At the initial stage of TP creation within a country, TP can play roles in transferring technologies developed at universities to industry or help faculties or students from universities to undertake technical start-ups based on the technology they have developed.

As the start-up begins to form their own businesses, the TP begins to provide start-up space (BI) for start-ups. TP make efforts to build buildings for entrepreneurial space of startups and supply factory sites where factories for products can be set up.

In addition, TPs began to put expensive equipments in their TP space so that start-ups can easily use them. Funds for buying expensive equipment in TP can be provided by the local government or the central government.

Start-up requires operating funds, development funds, and mass production funds until they are successful. The TP connects the start-up to the central government's Technology Guarantee Fund and the Credit Guarantee Fund to fund start-ups, thereby guaranteeing loans for bank loans.

With the help of TP, many technical start-ups will be able to make products by technologies and IPs transferred from universities or national research institutes. The primitive role of TP is (Role of TP-step1) or (Role of TP-step2). However, the TP that will be built later will be set up to include all the roles from (Role of TP-step1) to (Role of TP-step4) at the beginning by acquiring various know-hows of TPs established previously. The longer the history of each TP is, the lower the growth engine of the companies residing in TP. Each TP will strive to attract new technological start-ups that are armed with new vision, talented people, and technology.

3. TP's competitor/helper, Center for Creative Economy and Innovation

The TP of the Republic of Korea was created by MOCIE and the local government at a fund ratio of 50 to 50. MOCIE paid cash to build buildings and equipment, and local governments provided land. The main purpose of TP is to undertake com-

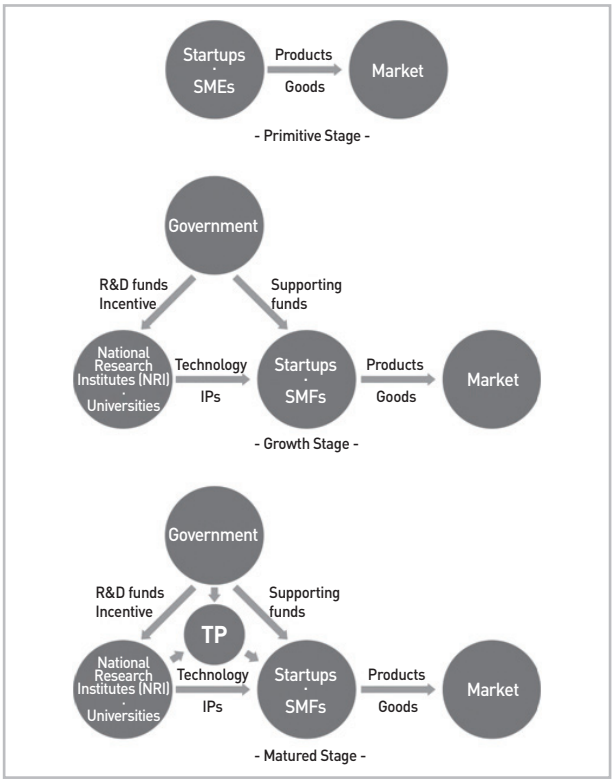

Fig. 10. Changing role of TP according to stage

Source: authors

mercialization of industry-academia-research institute linkage system. TP has expensive equipments that cannot be bought by small and medium-sized enterprises (SMEs), allowing SMEs to use them at a certain amount of money. TP enables start-ups and SMEs to use land, buildings, and expensive and large-scale machinery at low cost. TP is helping SMEs to produce and sell their technological products at affordable prices. TP is a headquarter of industry-academia-research institute linkage system. (Oh, 2008; Oh and Nur, 2016; Parry, 2014; Kanayama, 2015)

For two years from 2014, the government of the Republic of Korea established Center for Creative Economy and Innovation (CCEI) nationwide. (Cho and Cho, 2015; Cho and Cho, 2016) What CCEIs are doing now is that TPs have done before. TP have lost their growth momentum over the past two decades since it was established, and they lack driving force to attract talented people to startups. After Park Geun-hye's government took over, the central government built up CCEIs to induce the establishments of many startups and support them quickly that TP couldn't do well. (Cho and Cho, 2015; Cho and Cho, 2016)

CCEI is another type of TP or TP space. First of all, CCEI provided office space for start-ups. And CCEI provided start-ups with management-accounting-legal support as well as di-

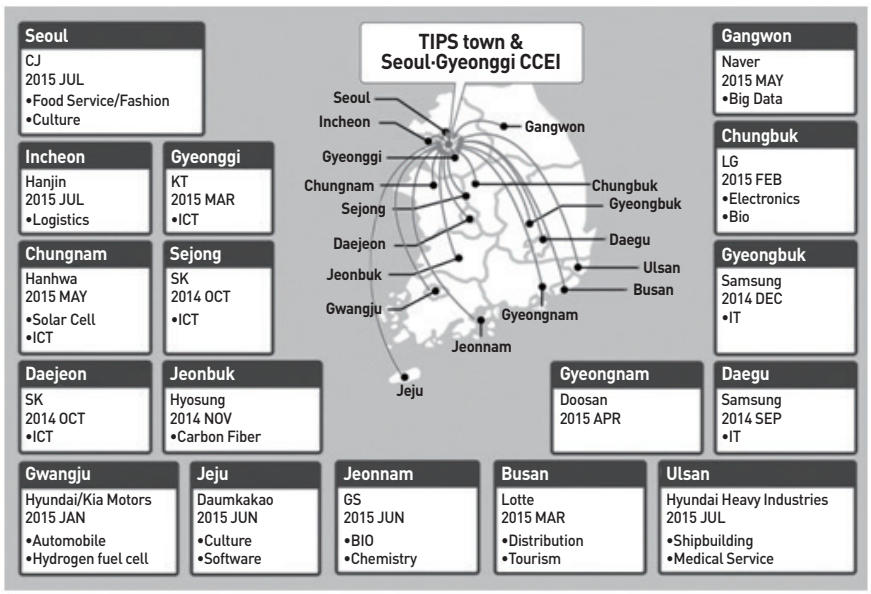

Fig. 11. Status of centers for creative economy and innovation (CCEI) in Korea

Source: Cho and Cho (2016)

rect investment of small scale money, follow-up investment connection, production and marketing support which was a help that the existing TP could not give to startup so that they achieved excellent results in the establishment of start-ups, quantitative indicators of investment attraction for the start-ups within a short period of time. Each CCEI is established and operated by a combination of central government, local government, and private large corporations. In the past, start-ups had great difficulty in selling their products and attracting subsequent investment even if they developed technology. Large companies in charge of CCEI are expected to be able to quickly help start-ups and SMEs develop their products in the form of B2B and B2C businesses. It was the most important purpose of establishing CCEI to help establishment and growth of start-up close to large enterprises operating each CCEI. In many cases, the head director of the CCEI is the executives from each large company in charge of CCEI. So CCEI is more like a private organization than a government organization. CCEI has been able to achieve quantitative indicators in a short period of time as it not only speeds up selecting and assisting start-ups, but also supports and grows start-ups related to business of each large company in charge of CCEI. From the success of the short-term CCEI, we can think of what TP needs to complement

However, the CCEI has the problem that it is difficult to carry out continuous mentoring of start-up due to the replacement of the directors from each large company responsible for it and the officials in charge of the operation, and the linkage and accountability for follow-up investment is low. In order to compensate for this, the government of the Republic of Korea is making a system to help civilian accelerators who can nurture and grow start-ups of CCEI. (Cho and Cho, 2016) CCEI has strengths in establishing start-ups, training, networking, demonstration events, B2B and B2C projects in conjunction with large companies. TPs are strong in their use of large and proprietary entrepreneurial space, and high-priced and large-scale equipment. In that sense, authors think it would have been easier to combine the advantages of CCEI and TP if it started within the existing TP when the CCEI started. Even if they are physically distant from each other, it is necessary to study how to maximize the merits of the two organizations by linking TP and CCEI.

4. TP's competitor/helper, high-tech industry complex

The existing TP is hard to expand the space due to the SMEs and start-ups in which they are residing. Therefore, it is difficult to make additional investment to existing TPs for the future of the country or local government. Land of several hundred ha, the expansion of space and the intersectional transportation network should be basically guaranteed for the construction of robot industrial complex, bio-healthcare complex, medical device complex, etc, in order to prepare for the future of the country after 20 ~ 50 years. The government of the Republic of Korea has designated the biohealthcare-medical Device Industry as one of the nation's important future industries and has created two high-tech industrial complexes. Osong Life Science National Industrial Complex was established in Osong region of Chungbuk province, and the Daegu-Gyeongbuk Advanced Medical Complex was established in Donggu, Daegu city.

Osong Life Science National Industrial Complex began to be built in 1997 and was first completed in 2010. And by 2040, Osong Life Science National Industrial Complex will spend about the central government's budget of 5 billion USD for the creation of one hundred ha complex. Osong Life Science National Industrial Complex has regulatory-permitting agencies related to the medical-bio industry such as the Food and Drug Administration, National Health Research Institute, Center of Disease Control, Korea Health Industry Development Institute, Korea Health and Welfare Human Resources Development Institute and Food and Drug Safety Evaluation Institute. It is a region that is seeking to become a fast track of licensing for new drug and medical devices, which is a region of great interest to companies in the field of biohealthcare-medical devices. (Oh, 2008; Oh and Nur, 2016)

These two high-tech industrial complexes are representative projects supported by the central government for the future of the country and also contribute to balanced development of the country. The success of Osong Life Science National Industrial Complex will depend on to what extent the complex attract promising companies with technology and outstanding people to help generate revenue and jobs for the local government and meet the blueprint of the national future industry. The local government, Chungbuk province office, strives to attract promising companies by promoting competitive companies not only in the province but also nationwide to activate Osong Life Science National Industrial Complex. Chungbuk TP is also making efforts in various aspects to activate the complex. At the center of Osong Life Science National Industrial Complex, there is KTX station which is Osong station. KTX, which is highspeed electrical train that runs at 300km/hr and connects Seoul city with Busan city,

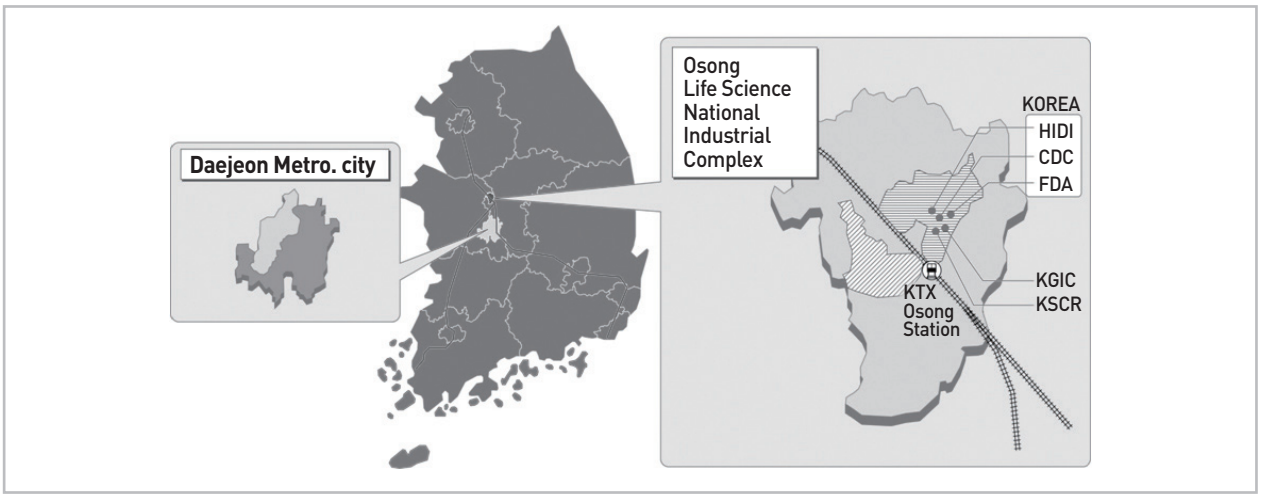

Fig. 12. Location of Osong Life Science National Industrial Complex which is located near the important traffic, KTX Osong station

Source: authors

Daegu city and Gwangju city, must pass through Osong station. People in the southeastern region of South Korea such as Busan city and Daegu city, and people in the southwestern region of South Korea such as Gwangju city and Jeonju city must pass through Osong station when they take the KTX to go to Seoul. Since Osong Life Science National Industrial Complex is only 40~60 minutes away from Seoul, Daegu, and Gwangju there is no place as good as Osong to meet people from all over the country to hold meetings for research, development and production of life sciences, medical and biotechnology. As the Osong Life Science National Industrial Complex becomes active, other TPs in the country will be shrinking. Promising tech-based startups, SMEs and large corporations in bio-healthcare and medical devices will prefer Osong Life Science National Industrial Complex which is convenient for transportation. Other TPs across the country should work together rather than compete with Osong Life Science National Industrial Complex and Chungbuk TP to create a plan to help promising companies of bio-healthcare and medical devices in their province. Sejong city, the administrative capital of the Republic of Korea, is located 15 km south of Osong, and Daedeok Science Complex is located 15 km south of Sejong city.

As far as the authors know, many researches have been made to link Daedeok Science Complex, Daedeok Techno Valley-Sejong city-Osong Life Science National Industrial Complex to belt. These attempts will be good models for Osong Life Science National Industrial Complex not to compete with TP in other regions but to coexist with TP in other regions (Daejeon TP, Chungnam TP). In terms of geographical location and convenience of transportation, Osong Life Science National Industrial Complex should take the role of TP for the whole of the Republic of Korea, not just for Chungbuk province. Osong Life Science National Industrial Complex should draw a blueprint that can be linked organically with other TPs in Korea and coexist.

5. TIPS-accelerator, TP's helper and helper for harmony of industry-academia-research institute triangle system

The total population of the Republic of Korea is about 50 million. The population of Seoul city, the capital of the Republic of Korea is 10 million, the population of Incheon city in the west of Seoul is 3 million, and the population of Gyeonggi province is 13 million. The metropolitan area, including Seoul city, Incheon city, and Gyeonggi province has a population of 26 million, accounting for more than half of the total population of the Republic of Korea. Young people in the Republic of Korea are most likely to be in Gangnam-gu, Seoul which can be reached in about an hour using public transport from any part of the metropolitan area.

Young people prefer a dynamic life that they can enjoy a cultural life more than an idyllic life. The streets with lots of buildings where the lights are on for 24 hours and people can enjoy their leisure time call young people. Researchers, people in production jobs also prefer dynamic street. So Samsung Electronics, Hyundai Motors 'head office and research insti-

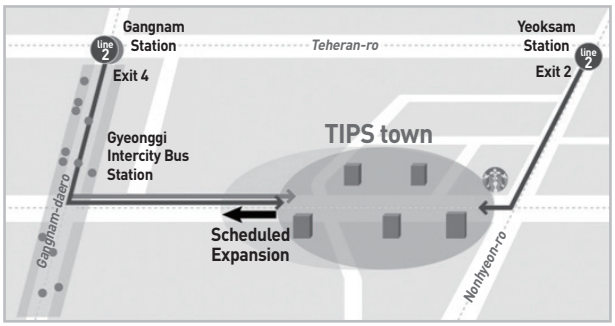

Fig. 13. Location of TIPS town where half of the total population of South Korea can approach in about an hour using public transport

Source:Cho and Cho (2016)

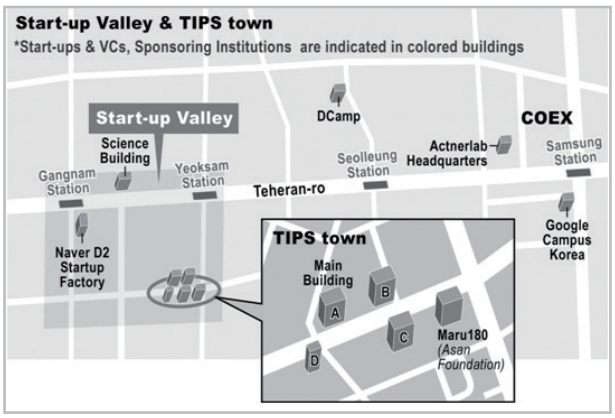

Fig. 14. Composition of TIPS town and related startup spaces

Source:Cho and Cho (2016)

tute, and LG Electronics' research institute are located in Gangnam area.

The government agency of the Republic of Korea, Small and Medium Business Administration (SMBA), investigated the preferences of young people and built an entrepreneurship town in Gangnam, and the town is called TIPS town. (Cho and Cho, 2015; Cho and Cho, 2016) Tech Incubator Program for Startup (TIPS) is a program that helps Korean start-ups with high technologies. Many start-ups want to receive investment from TIPS-accelerator and pass the TIPS interview. (Parry, 2014) TIPS town was made to achieve synergies by collecting TIPS-accelerator and start-ups benefiting from TIPS. As TIPS town becomes more active, local TPs are more likely to lose promising startups from TIPS town. SMBA of South Korea is encouraging local promising start-ups to receive TIPS benefits without moving to Seoul. Actnerlab is a well-known TIPS-accelerator for bio-healthcare, medical devices and hardware in Korea.

Company A is a company that developed room temperature-atmospheric plasma medical equipment and is located in Yangsan city, Gyeongnam province near Busan. Company A received TIPS after receiving the investment of Actnerlab and plans to produce plasma medical devices at a factory located in Yangsan city, Gyeongnam province.

Company B is a company that developed technology to clean nanometer level impurities in semiconductor and display production process by CO2 bullet after producing CO2 bullet, and it is located in Pohang city, Gyeongbuk province. Company B received the TIPS benefit after receiving the investment of Actnerlab, and is preparing to produce the products in the Pohang CCEI.

Company C has developed materials such as photoresist used for semiconductor, display, and OLED, and is located at Daedeok Techno Valley in Daedeok Science Complex. Company C received benefits from the TIPS program after receiving the investment from Actnerlab, and plans to produce their materials at their company in Daedeok Techno Valley.

Company D is a company that develops technologies to produce large quantities of RA therapeutic, rare disease treatment, and anti-cancer drugs at low prices by applying gene scissors to plants, and is located in Gyeonggi province. Company D has benefited from the TIPS program after receiving the investment from Actnerlab, and plans to relocate its headquarters to Osong Life Science National Industrial Complex in Chungbuk province.

Company E is a company that has developed technology to make boronitride nanotube in large quantity with high quality at low price and is located in the business incubation center of Chungnam National University in Daedeok Science Complex. Company E is benefiting from the TIPS program after receiving the investment from Actnerlab and plans to build a factory in Daejeon TP near the company for the production of the product. Most of the employees of Company E are from Chungnam National University where Company E is set up. CEO of Company E is a researcher at Korea Atomic Energy Research Institute. He is currently working to leave the institute and start a company to contribute directly to the national industry. Company E can be a typical example of how industry-academia-research institute triangle system can contribute to the national industry in harmony. Company E is also an example of how Daedeok Science Complex and university can share knowledge and coexist.

The authors have mentioned Chungnam National University's innovation trials to explain how the university's education should change in the fourth industrial revolution. (Cho and Cho, 2016) Many national research institutes in the Daedeok Science Complex are conducting future-oriented research and encouraging their researchers to establish technical startups. Educational innovation at Chungnam National University will make college students more challenging, start up and participate in tech-based startups, making a big contribution to the national industry. And such educational innovation will be of great help in creating a harmonious ecosystem of the industry-academia-research institute triangle system like Company E.

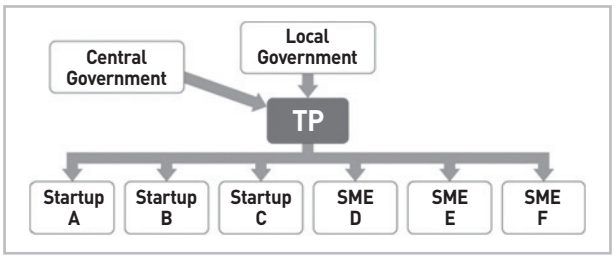

Fig. 15. Existing support method of Techno Park (TP)

Source:authors

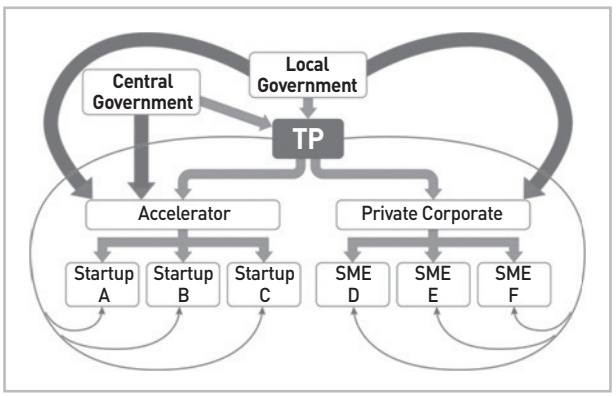

Fig. 16. Newly proposed support method based on collaboration between technopark and accelerator

Source:authors

6. Proposal for the future of TP

Local governments in the Republic of Korea are unifying many projects that foster local industries into TPs. Over the past two decades, TP has grown to be the most representative organization for local industry development in the Republic of Korea. In principle, TPs are managed on their own without receiving support from central and local governments. However, many of the profitable businesses of TP are related to the business of central government or local government, which are supported by the central or local governments. TP's role is as follows and TPs have been performing their roles well in the last two decades.

(ⅰ) TP strives to revitalize the industry in the metropolitan city or the Province.
(ⅱ) TP strives to cultivate and grow high value-added industries in the region.
(ⅲ) TP strives to grow industries with large technology barriers in the region.
(ⅳ) TP provides office space and production space at competitive prices to SMEs.
(ⅴ) TP should be equipped with expensive equipments that the local SMEs cannot buy, allowing SMEs to use them at the cheap fare.
(ⅵ) TP should provide administrative support for small and medium-sized enterprises in the region to borrow loans.
(ⅶ) TP strives to help small and medium-sized enterprises in the region to advance overseas and to develop new markets.

However, as TP itself existed as a subordinate organization of the local government or an organization within the university, it began to become bureaucratic over time. Many SMEs benefiting from TP refer to TP bureaucracy. When an organization becomes bureaucratic, flexible thinking is interrupted, and service minds are lacking. The reason for the existence of TP is to actually help and nurture SMEs in the local community in order to advance the industry in the community, and the reason is like that the reason for parents' existence is to nurture their children well. Even if the child has a reason for disqualification or if the child's behavior does not appeal to its parents, parents should continue to listen to their child's story, and think and talk in their child's position, with helping them patiently. Such a growing child will be a good adult who contributes to society and community. The attitude of the TP to the SMEs in the region should be such. Of course, TP cannot help all start-ups and SMEs in the region. If TP helps local start-ups and small businesses with limited resources and manpower, they cannot help but selectively help companies that are more productive in the region's industry. If the TP is bureaucratic, it may be beneficial for TP to transfer much of its direct support systems of start-ups and SMEs to specialized private companies like accelerator boldly and take advantage

of the companies' resources to help start-ups and SMEs. The structure of the current TP to help start up or SME in the area is as follows. (Zafar, 2015; Oh et al., 2014; Ferandez et al., 2015; Oh and Phillips, 2015)

In Figure 16, accelerators receive operating expenses from TP so that they mentor and help start-ups and SMEs in the province or the city. Of course, the accelerators should be evaluated every two or three years to see if they are qualified to continue their work to help start-ups and SMEs. There may be some tasks that TP entrusts to accelerators, but there are things that TP should do itself. When TP supports the start-ups of the region, it selects the competent accelerator first, and then let the accelerator selects the start-ups. Accelerators who nurture and support start-ups have to choose start-ups unto themselves, so the chemistry between them is not broken and the mentor-mentee relationship is likely to continue. TP's chosen accelerators are to identify the inside of start-ups and SMEs intimately to help them in management guidance, business direction and production, restructuring sales products, attracting follow-up investment, pioneering products, and maintaining account transparency.

According to the authors' judgment, TP should consider the following items.

(i) TP organically associates with TPs in other regions and provides rapid assistance to SMEs in their area.
(ii) TP should cooperate with the CCEI.
(iii) TP should cooperate with the start-up centers in Seoul.
(iv) TP should help companies enter overseas by setting up a sisterhood with overseas cities.
(v) TP should form a cohesive network with foreign cities with the help of WTA.
Conversely, WTA should be able to take on the role of the TP to network with the TP of cities in other countries, if a TP of each country desires.
(vi) TP should be active for the overseas promotion of the firms operating in the TP.
(vii) TP should use accelerators to do all of the above things efficiently.

III. CONCLUSION

The government of the Republic of Korea established Daedeok Science Complex to dramatically enhance the level of science and technology in the country and furthermore developed 18 TPs countrywide under the stimulus of the success of Daedeok Science Complex, One of TP's role has been the countrywide and balanced development of industries. TPs were developed to help industries, especially SMEs and start-ups which are specialized in each region, fostering SMEs and start-ups specialized in the electronics industry, shipbuilding industry, automobile industry, and bio-industry according to different localities. The early role of TPs was to support that the technologies developed by universities and research institutes were applied to industries and commercialized to high value-added products. As time goes on, TPs have evolved into complexes where the employees work, research, study, have a rest and enjoy various civilized life with their families. One of the most important factors for the success of TPs is the excellent entrepreneurs and engineers who enter from nearby universities. TPs can collaborate with local universities to intermediate informations for research results from professors, intellectual property rights and excellent talents, and university students or graduate students at universities who want to find employment after graduating from university to industries in the region organically. In order to fulfill their roles successfully, TP must understand the technologies developed by universities and research institutes, diagnose the possibility of success of the technologies in the market, and help the technologies be commercialized and successfully marketed. TPs should also assist SMEs and start-ups in receiving the investment needed to make the technology commercially viable. If TPs are able to function properly, the industry-academia-research institute triple helix will work well and commercialization of technologies of universities and research institutes will be smoothly transferred into industries.

Unfortunately, with the long history of TPs, the TP organization have been becoming more and more bureaucratic, exposing the degeneration of the function of helping start-ups and SMEs. In 2015, the government of Republic of Korea established and have had run a new organization, Center for Creative Economy and Innovation (CCEI) which specializes in supporting start-ups and that TP can not work well.

Therefore, it would be better for TPs to complement the parts that TPs are not able to treat well with private organizations such as accelerators who have a high level of understanding of technology commercialization and experiences organically, rather than developing their organizations which are bureaucratic enough. Central and local governments should pay great attention to allocating budgets to foster the

collaboration between TPs and accelerators to ensure that the industry-academia-research institute triple helix works well.

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