

STI POLICY AND ACADEMY-INDUSTRY COOPERATION FOR INNOVATION AND ENTREPRENEURSHIP IN DAEJEON, KOREA

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ABSTRACT

This study reviews technological innovation to examine science, technology, and innovation (STI) policies and strategies for academy-industry cooperation for innovation and entrepreneurship in Daejeon. STI policy in Daejeon is based on a vision that harmonizes regional and national policies at a regional level, fostering of a key innovation cluster and strategic industries in Daejeon, and a new growth engine of converging industries such as information technology (IT), biotechnology (BT), and nanotechnology (NT). This paper proposes the following: First, considering the harmony of national and regional policies, STI policy should be promoted at the regional level considering venture and SMEs. Second, we recommend nurturing a global innovation cluster as part of a regional STI and venture ecosystem. This will support the region of Daejeon as the heart of a global innovation cluster by having Daedeok Innopolis and the International Science and Business Belt as its two major axes. Third, we recommend strengthening academy-industry cooperation in Sejong and other regions.

Keywords: Daejeon, STI policy, Academy-industry Cooperation, Innovation Cluster.

I . INTRODUCTION

In the current unstable competitive conditions, regional innovation systems and innovation clusters are receiving attention as units of national competitiveness(Lee, 2008). Although industry-level and innovation system analyses at the national level can be conducted to strengthen national competitiveness, an innovation cluster, which facilitates an examination at the regional level, is being reviewed as a new unit of competitiveness(Lee, 2008). Regional innovation clusters such as Silicon Valley and Research Triangle Park in the United States, Oulu Technopolis in Finland, and Biopolis in Singapore are emerging as new competitive alternatives(Shin, Lee, Nam, Choi and Choi, 2006),

As innovation clusters are considered an important alternative at the regional level, such clusters, along with regional STI(Science, Technology, Innovation) policy, are being promoted in each country. In other words, innovation cluster policy and STI promotion policy have a very high correlation at the regional

level(Lee, 2008). Along with nurturing innovation clusters to give a region a competitive edge, hard and soft STI policies at the regional level such as a technological development project for fostering regional industries and a policy for networking inside and outside regional strategic industries are being promoted(Lee, 2008).

Today, STI policy suited to the regional level is being promoted by each local government in Korea. Each local government, such as Gyeonggi-do, Daejeon, and Jeonbuk, established institutes exclusively for STI to promote regional STI policy suited to regional conditions. However, a slight difference in regional conditions exists in each region. In Gyeonggi-do, Gyeonggi Institute of Science and Technology Promotion was established to promote science and technology and foster strategic industries; Gyeonggi techno-park plays a role in nurturing technology in the region and related industries and supporting venture businesses(GSTEP, 2010). In Daejeon, Daedeok Innopolis Foundation nurtures Daedeok Innopolis and Daejeon techno-park, while institutes fostering related regional

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industries promote regional strategic industries and support venture businesses(Daejeon TP, 2012). Each local government has built an autochthonic, indigenous STI ecosystem suited to regional conditions by linking with national regional development policy.

Of all the regions, "Daejeon region" has an unusual meaning. "Region" was added to Daejeon to highlight the meaning of "region" as a unit of competitiveness. Most government-funded research institutes of Korea are located in the Yuseong district of Daejeon; promoting regional STI policy at such a national level is slightly different from promoting it in other regions. The meaning of regional STI policy in other regions consist of nurturing a regional innovation cluster and promoting a technological development project for regional strategic industry and policy to vitalize academy-industry cooperation through networking between strategic industries and innovation agents(Lee, 2008). However, STI policy in Daejeon should consider another factor, national STI policy, in addition to STI policy at the regional level. The region of Daejeon is a place for realizing the national STI policy of Korea. Because national STI planning is conducted there, regional STI policy suited to regional conditions together with regional support needs to be promoted in order for the national STI infrastructure to be managed effectively and efficiently.

Accordingly, examining the STI policy in Daejeon may seem somewhat complex compared to examining it in other regions. This is because as national STI policy and regional STI policy mix and ostensibly overlap, STI policy can be seen as ambiguous, allowing one to question whether it is a national policy or a regional policy.

For example, while the innovation cluster policy for Gwanggyo Technovalley and Pangyo Technovalley in Gyeonggi-do is fostered by a local government, this government even has ownership of the nurturing of an innovation cluster. By fostering such an innovation cluster, related regional STI policy is promoted(GSTEP, 2010).

However, Daedeok Innopolis, the representative innovation cluster in Daejeon is based on national government-funded research institutes that have been founded since 1973; its concept is to create innovation by partnering with private research institutes, venture businesses, and universities in the region(DIVA, 2013). It has developed an innovation cluster concept for which it is seeking national and regional development at the same time as an organic link is forming between national infrastructure and innovation agents in the region. Along with this activity, the International Science and Business Belt currently is being advanced as a new growth engine for Korea(MSIP, 2013). The Science Belt is being

promoted as a concept to win a Nobel Prize through basic science promotion beyond the creation of Korea's next generation of growth engine and to explore new science and technology capabilities(MSIP, 2013).

In this study, the International Science and Business Belt is defined as a new type of innovation cluster focused on basic science. As such, the International Science and Business Belt involves mixed national and regional concepts and is expected to be promoted with Daejeon as a base.

It is difficult to examine the STI policy in Daejeon only at the regional level, unlike that in other regions. While national and regional perspectives need to be understood simultaneously, they need to be reinterpreted and examined from a regional perspective. In other words, Daedeok Innopolis or the International Science and Business Belt are today promoted by the Ministry of Science, ICT, and Future Planning; such important innovation cluster policy, on which the fortunes of the nation depend, cannot be achieved without a regional STI policy. One reason is that policy for fostering an innovation cluster relies heavily on geographic location policy and creates innovation through organic links with related regional infrastructure.(Lee, 2008).

Another reason is that the innovation cluster policy cannot be examined in isolation from regional strategic industry policy, and the promotion of venture businesses and small and medium-sized enterprises (SMEs) in the region from regional STI policy and regional industry policy perspectives needs to be organically linked with the cluster policy to effectively promote businesses in the region.

This study considers the peculiar conditions of the region of Daejeon, and examines the STI policy and academy-industry cooperation in Daejeon for venture and SMEs from a regional perspective. To this end, it analyzes the STI infrastructure and policy governance in Daejeon. Then, it concretely examines the STI policy in Daejeon. Innovation clusters in Daejeon, Daedeok Innopolis, and the International Science and Business Belt are explored, and then technological development projects in Daejeon and policies to foster regional venture businesses and academy-industry cooperation are examined. Next, strategies for the STI policy in Daejeon and academy-industry cooperation are identified.

II. THEORETICAL BACKGROUND

2.1 Regional Innovation System and Innovation Cluster

Today, regional technological innovation systems are receiving attention as subsystems of a national innovation system, as is an emphasis on the importance of establishing science and technology systems at the regional level(Lee, 2008). As the national innovation system takes a very inclusive approach at the national level, it can be difficult to include regional needs. However, a regional innovation system can be promoted by considering a close link with the development direction of regional industry since the latter was planned(Cooke, Uranga, Etxebarria, 1997). In order to make the regional innovation system effective, the demand-side policy meeting the development trend of regional industry and demand is more effective than supply-side policy creating new business through research development (R&D)(Lee, 2008; Cooke, Uranga, Etxebarria, 1997). Regional STI policy should aim to increase competitiveness of venture businesses/SMEs through strengthening the capacity of the regional innovation system, thus enhancing local residents' quality of life.



Source: GSTEP(2011)

<Figure 1> Regional Innovation System and Innovation Cluster

An innovation cluster is the center of such a regional innovation system(Lee, 2008; Cooke, Uranga and Etxebarria, 1997; Hertog et al., 2001; Polt, 2002). An innovation cluster concentrates innovation agents related to "innovation" in a particular region; innovation activities occur intensively, centering on the agents and a region having a comparative advantage over other regions in terms of innovative competitiveness, thereby standing out in value-added creation(Hertog et al., 2001; Polt, 2002; Porter, 1998). Moreover, an innovation cluster based on an organic link between innovation agents concentrated in a particular region and a value chain of a particular industry is interdependent on innovation agents participating in the process of technological innovation. As a way to produce synergy, it can be considered a concept that includes processes ranging from learning the network of academy-industry cooperation to commercialization(Porter, 1998).

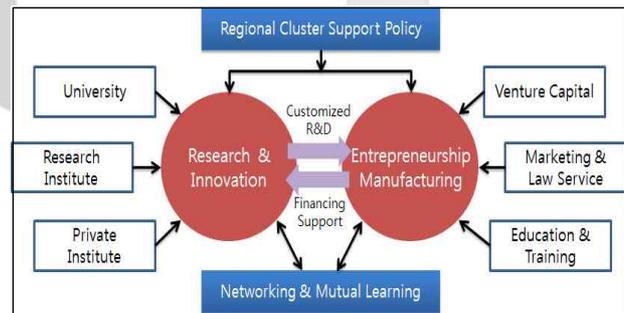
When such a technological innovation cluster is built, companies can benefit from acquiring knowledge needed for technological innovation(Hertog et al., 2001; Polt, 2002).

Today, technological innovation clusters are receiving attention at the national policy level because businesses, universities, and research institutes are agglomerated within an innovation cluster, and such a cluster creates economies of scale as well as a snowball effect, thereby being a source of national competitiveness(Lee, 2008; Hertog et al., 2001; Polt, 2002).

Moreover, if the innovation cluster policy succeeds, it should have a significant impact on other policies, as location policy, labor policy, and industrial policy can be coordinated(Lee, 2008).

2.2 Innovation Cluster and Academy-Industry Cooperation

Various innovation agents of academy-industry cooperation exist within an innovation cluster; innovation can be created when such innovation agents are linked organically(Hertog et al., 2001; Polt, 2002; Porter, 1998). This is because when heterogeneous innovation agents are connected to each other, diversity is achieved and new ideas and innovation are created(Granovetter, 1973).



Source: GSTEP(2011), OECD (1999)

<Figure 2> Concept of Innovation Cluster

Thus, networking within academy-industry cooperation plays a very important role for creating innovation and, accordingly, efforts are being made to promote it. In other words, innovation network policy can be a policy supporting formation and development of innovation networks in various forms. Supporting joint academy-industry research can be a representative policy for innovation networks(Lee, 2008).

Under a regional innovation system, a policy for academy-industry cooperation that actively supports and promotes networking is needed(Cooke, Uranga, Etxebarria, 1997).

Types of academy-industry cooperation vary by purpose. In other words, purposes of academy-industry cooperation can be divided into joint research, technological development, educational

training, production support, technology transfer, people exchange, and information exchange(Lee, 2008). Such academy-industry cooperation appears in the form of research development, joint laboratory operation, spin-offs, and licensing; much networking is required to make it possible(Lee, 2008; Choi, Hong, Jang and Bae, 2012; Kim and Choi, 2014). Academy-industry cooperation is formed by various sub-network activities; visible cooperation activities are only the tip of the iceberg compared to actual networking activities(Lee, 2008; Polt, 2002).

Along with the increasing organic relevance of academy-industry cooperation within an innovation cluster, an innovation cluster can be divided into a pre-development cluster formation stage, growth stage, expansion stage, and adjustment stage(SRI, 1999; Sadik, 2001). In the early stage of innovation cluster formation, academy-industry cooperation is loose. In the expansion stage, the academy-industry network relationship becomes complex and speed of networking increases dramatically(SRI International, 1999; Sadik, 2001).

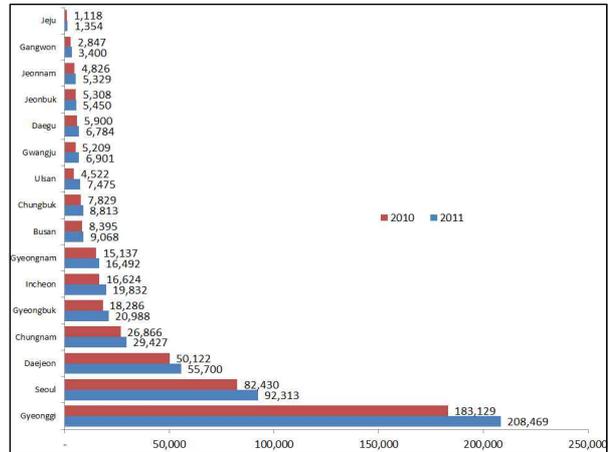
Along with the regional innovation system (the innovation cluster and its development examined earlier), STI policy at the regional level should be examined in light of academy-industry cooperation between innovation agents. Thus, STI policy promoted in many local governments consists of establishment of a regional innovation cluster, a technological development project at the regional level for academy-industry cooperation, and networking policy.

III. TECHNOLOGICAL INNOVATION SYSTEM IN DAEJEON

3.1 Backgrounds of STI Policy and Industry-Academia Cooperation for Innovation and Entrepreneurship in Daejeon

Before the understanding of backgrounds of STI Policy and industry-academia cooperation for Innovation and Entrepreneurship, we examined the current status and governance of Innovation activities in Daejeon.

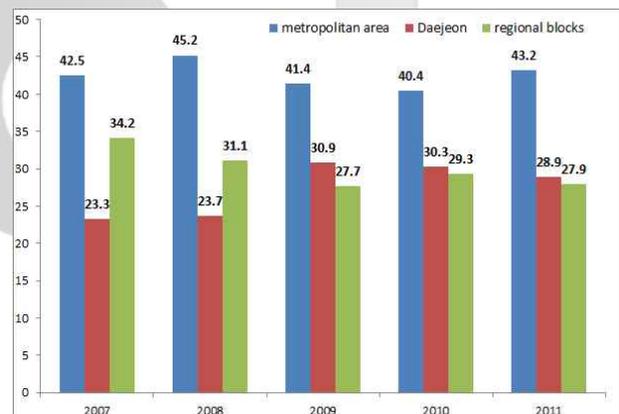
Firstly, the 2011 budget for research development project in Daejeon is KRW 5.57 trillion, which is the third largest amount after Gyeonggi and Seoul. Of 16 cities, the regions with the largest R&D expenditures in 2011 were the region of Gyeonggi with KRW 20.8468 trillion, Seoul with KRW 9.2313 trillion, then Daejeon with KRW 5.57 trillion and Chungcheong with KRW 2.9427 trillion(KISTEP, 2011; 2012).



Source: Revised from KISTEP(2012), Status of R&D Activities in Korea by Region, 2012-24

<Figure 3> 2011 R&D expenditure by region, National Science and Technology Council/ KISTEP survey of R&D

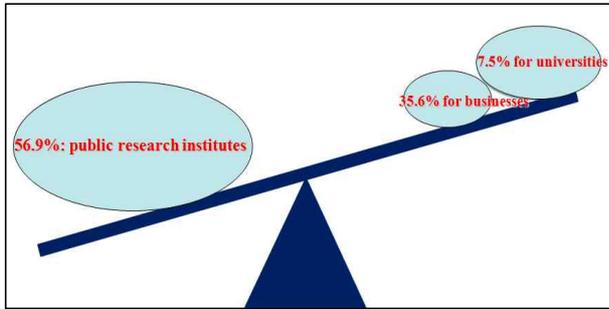
Secondly, in particular, of the national R&D project budget of KRW 14.1793 trillion, KRW 4103.7 billion, or nearly 29.0%, was invested in Daejeon. This is the nation's largest investment, greater than KRW 3571.4 billion in Seoul and KRW 2194.1 billion in Gyeonggi(KISTEP, 2011, 2012).



Source: Revised from KISTEP(2012), Status of R&D Activities in Korea by Region, 2012-24

<Figure 4> Portion of investment in national R&D projects by region, 2011 R&D expenditure by region, National Science and Technology Council/KISTEP survey of R&D

Thirdly, when R&D characteristics in Daejeon, which is led by public research institutes, are examined, the portion of the 2010 R&D budget for the region of Daejeon by research agent is 56.9% for public research institutes, 35.6% for businesses, and 7.5% for universities, leading R&D in Daejeon to be classified as public research institute-led R&D. Finally, The majority of the R&D institution is situated in Yuseong-gu, north-west part of the Daejeon. There situated the Deadeok Innopolis, the largest innovation cluster in Korea.



Source: Revised from KISTEP(2012), Status of R&D Activities in Korea by Region, 2012-24

<Figure 5> R&D budget for the region of Daejeon by research agent, public research institutes, businesses, and universities, 2011 R&D expenditure by region

3.2 Comparison between the Daejeon and Other STI environments

For the easy understanding of STI Policy and industry-academia cooperation for Innovation and Entrepreneurship in Daejeon region, we have to compare Daejeon with the Gyeonggi Province. Of 16 cities, the regions with the largest R&D expenditures in 2011 were the region of Gyeonggi with KRW 20.8468 trillion, Seoul with KRW 9.2313 trillion, then Daejeon with KRW 5.57 trillion (KISTEP, 2011, 2012). Gyeonggi Province has the highest R&D expenditure and the best corporate R&D activities occurs in the region. That means approximately 40% R&D investment, 30% R&D organization and 30% R&D manpower situated in Gyeonggi province. Compared to Daejeon region, distinctive R&D investment of Gyeonggi province are as follows; Firstly, Corporate R&D investment is higher than those of the university and public research institutes, in Daejeon, vice versa. Secondly, Corporate R&D is the highest in Korea, however, the majority of SMEs do not invest in R&D. SMEs are more than 7 times in number, but less than 1/10 in R&D investment. STI environment of Gyeonggi is firm oriented (GSTEP, 2010). In contrast, Daejeon is public research institutes oriented like figure 5. But, for the development of Daedeok Innopolis, the largest innovation cluster in Korea, in addition to public research institutes, industry-academia cooperation among the venture/SMEs and University is needed. In this reason, through the industry-academia cooperation among the innovation actors, innovation and entrepreneurship should be emphasized.

3.3 Review of Governance of Innovation Activities in Daejeon

Before examining STI policy in Daejeon, innovation agents in Daejeon must be reviewed macroscopically and in detail.

Daedeok Innopolis, which is at the heart of technological innovation in Daejeon, should be examined first. The total amount of R&D expenditures in Daedeok Innopolis has been steadily rising since 2005. Total 2011 R&D expenditures of institutes that moved there were KRW 6.8172 trillion, comprising self-financed R&D expenditures of KRW 2.9123 trillion and externally financed R&D expenditures of KRW 3.9049 trillion. Of the 6T fields, ET (environmental technology) had the highest share, as it accounted for 21.7% of total R&D expenditure by institutes within Innopolis, followed by IT (17.1%) and BT (8.2%) (Daejeon TP, 2012; DMC 2013; DIVA, 2013, Daedeok Innopolis Development, 2015).

The number of institutes that moved into Innopolis has increased annually. In 2011, 1,399 institutes, including government-funded research institutes, government and national institutes, educational institutes, public institutes, businesses, and other non-profit corporations, moved in. In 2011, the number of the moved-in businesses associated with these totaled 1,306, and the number of SMEs totaled 1,223, accounting for 93.6% of the whole. When explored according to business type, we find 43 businesses listed on a stock exchange and 30 KOSDAQ-listed businesses, and 610 venture businesses and 420 Innobiz-certified businesses in existence in 2011 (Daejeon TP, 2012; DMC 2013; DIVA, 2013, Daedeok Innopolis Development, 2015).

Amid such R&D activities, arrangement of academy-industry cooperation and establishment of Daedeok Innopolis in Daejeon, Daejeon Metropolitan City, began to nurture regional strategic industries after 2002 according to the phase 1 project promotion of nine regions of Project for Regional Strategic Industries (4+9 projects) (Daejeon TP, 2012; DMC 2013; DIVA, 2013, Daedeok Innopolis Development, 2015). The first phase project created biotechnology centers, a high-frequency center, and a robot center; the second phase project selected wireless convergence devices, biomedicine, services/defense robots, and nano/chemical materials. These were chosen as specialized fields of four strategic industries and are now supported. A center specializing in the field of nano/chemical materials, which was not included in the first phase, was established in the second phase. Support services for businesses such as technology support, marketing, and work force were established and are being operated.

By focusing on four strategic industries of Daejeon-information technology, biotechnology, mechatronics, and advanced components and materials-institutes fostering and supporting R&D in Daejeon are ready to provide support as they plan and promote the regional R&D projects in the Daejeon techno-park, Daedeok Innopolis Foundation, Daejeon Business Agency, Chungcheong Leading Industry Office, and many business incubators (Daejeon TP, 2012; DMC 2013; DIVA, 2013, Daedeok

Innopolis Development, 2015).

IV. STI POLICY AND INDUSTRY ACADEMIA COOPERATION FOR INNOVATION AND ENTREPRENEURSHIP IN DAEJEON

4.1 Daejeon Case Analysis Framework : Strategic Industries, Venture/SMEs Support and Innovation Cluster

In this study STI Policy and industry-academia cooperation for Innovation and Entrepreneurship was deeply analyzed. From the vision and status of STI Policy in Daejeon, technology development and Venture/SMEs support to Innovation cluster was scrutinized. Case analysis was done as follows; vision and status of STI Policy, Fostering strategic industries, Step-by-Step support for venture businesses/SMEs, Innovation Clusters in Daejeon.

<Table 1> Daejeon Case Analysis Framework

Sequence of Analysis	Detailed factors for successful implementation
Vision and Status of STI Policy in Daejeon	<ul style="list-style-type: none"> · The vision of STI in Daejeon is to build a city foundation for world-class scientific technology and industrialization. · The goal is to realize new growth engine industries for the future rich city of Daejeon.
Fostering Strategic Industries	<ul style="list-style-type: none"> · Nurturing Regional Strategic Industries · Nurturing New Region-Specialized Industries · Nurturing Root Industries
Step-by-Step Support for Venture Businesses/SMEs	<ul style="list-style-type: none"> · Step-by-Step Customized Technological Development Support Projects · Nurturing Intellectual Property of Venture Businesses/SMEs and Related Support · Projects to Create a New Convergence Engine of Growth in Daejeon
Innovation Clusters in Daejeon	<ul style="list-style-type: none"> · DaeDeok Innopolis · International Science and Business Belt

4.2 Vision and Status of STI Policy in Daejeon

The vision of STI in Daejeon is to build a city foundation for world-class scientific technology and industrialization. The goal is to realize new growth engine industries for the future rich city of Daejeon. Detailed projects for the goal include building a city as a worldwide research base, enhancing the primary industries, expanding and nurturing a new convergence engine of growth, and strengthening business competitiveness(DMC 2013). First, in order to nurture the city as a worldwide research base, the International Science and Business Belt and Daedeok Innopolis are fostered; at the same time, an industrial complex for

commercialization of research is created. Second, new region-specific industries, strategic industries, root industries, and other preliminarily valid industries are enlisted to enhance the primary industries. Third, expanding and fostering a new convergence engine of growth means nurturing defense, nano/bio convergence, IT/SW convergence, and video/robot industry convergence. Fourth, projects for intellectual property, technology commercialization, marketing, and work force development will be promoted to strengthen corporate competitiveness(Daejeon TP, 2012; DMC 2013; DIVA, 2013).

4.3 Fostering Strategic Industries in Daejeon

4.3.1 Nurturing Regional Strategic Industries

Daejeon Metropolitan City began to nurture regional strategic industries, such as information technology, biotechnology, mechatronics, and advanced components and materials, after 2002 according to the phase 1 project promotion of nine regions of the Project for Regional Strategic Industries (4+9 projects)(Daejeon TP, 2012; DMC 2013; DIVA, 2013). The first phase project created biotechnology centers, a high-frequency center, and a robot center; the second phase project selected wireless convergence devices, biomedicine, services/defense robots, and nano/chemical materials as specialized fields of four strategic industries that have been supported. A center specializing in the field of nano/chemical materials, which was not included in the first phase, was established in the second phase. Support services for businesses such as technology support, marketing, and work force were established and are being operated.

The project continuously nurtures four strategic industries in Daejeon, information technology, biotechnology, mechatronics, and advanced components, thereby promoting sustainable growth of businesses and enabling them to become primary industries in the region. The project targets four strategic industries and convergence industries, and it is composed of promotion projects for technology development, business support, marketing, work force, and technology transfer, etc.

4.3.2 Nurturing New Region-Specialized Industries

Regional strategic industries that have been promoted since 2003 were changed to new region-specialized industries focused on industry and creating region-based employment(Daejeon TP, 2012; DMC 2013; DIVA, 2013). The goal is to foster technology development, marketing, and the work force by

industry field. Industry fields of new region-specific industries include the precision mold manufacturing industry, knowledge convergence industry, R&D service industry, optical equipment and materials industry, and biomaterials industry. First, the precision mold manufacturing industry includes precision molding, factory machines, cutting machines, molding, and molding machines. Second, the knowledge convergence industry includes embedded SW, system SW, and SW intelligence. Third, the R&D service industry includes physical chemistry, biological R&D, design services, and patent attorney services. Fourth, the optical equipment and materials industry includes manufacturing of optical instruments and medical devices. Fifth, the biomaterials industry includes traditional Korean medicine, cosmetics, health-functional food, and functional biomaterials.

4.3.3 Nurturing Root Industries

Root industries began with a goal of strengthening their competitiveness, forming the basis of traditional manufacturing industries and new growth engines in Daejeon(Daejeon TP, 2012; DMC 2013; DIVA, 2013). The objective is to build a Daejeon industry ecosystem that grows together with high-tech industries through root industries. The root project is composed of creating an industrial ecosystem, strengthening business competitiveness, and building a region-based network. First, creating an industrial ecosystem involves building root industry promotion centers and precision processing support centers by region. Second, strengthening business competitiveness is composed of industry and business management reform, commercialization support for excellent businesses, and technology consulting support. Third, building a region-based network is composed of business promotion and exchange support, and establishing a business analysis and development roadmap.

4.4 Step-by-Step Support for Venture Businesses/SMEs in Daejeon

4.4.1 Step-by-Step Customized Technological Development Support Projects

For step-by-step support for venture businesses/SMEs in Daejeon, support projects for early-stage start-up businesses, commercialization of technological development, and industrialization of technological development will be promoted pre-periodically(Daejeon TP, 2012; DMC 2013; DIVA, 2013). First, focusing on start-ups, technology commercialization and opening of enterprise institutes, strengthening competitiveness of business incubators, universities and supporting start-up businesses

by youth, funding for stable management, and secondary conservation funding to start up a business will be promoted. Second, academy-industry joint technological development, nurturing a technological development base, support for manufacturing prototypes, a project to promote public technology transfer, support for modernizing traditional industries, and support for commercialization of high-tech technology will be promoted for commercialization of technological development. Third, commercialization support includes commercialization of technology, a market test-bed, a global project for promising SMEs, marketing support for regional industries, and marketing support for strategic industries.

4.4.2 Nurturing Intellectual Property of Venture Businesses/ SMEs and Related Support

In order to nurture the intellectual property of venture businesses/SMEs, R&D support, securing of rights, commercialization, design brand development, and technology development and transfer are pursued(Daejeon TP, 2012; DMC 2013; DIVA, 2013). To this end, patent technology distribution businesses as well as consultation on patent information, brand value, and improving design value, knowledge-based services, and a focus on statute revisions to improve the jurisdictional system of patent infringement actions will be promoted.

4.5 Projects to Create a New Convergence Engine of Growth in Daejeon

4.5.1 Motivating and Enhancing a New Growth Engine of the Bio-Convergence Industry

In order to nurture a bio-convergence industry, support for commercialization of BINT convergence high-tech medical devices, support for biopharmaceutical technology, a project to strengthen competitiveness of new bio-convergence technology, and technology support for the bio-materials industry and the med-bio connect business will be promoted(Daejeon TP, 2012; DMC 2013; DIVA, 2013).

4.5.2 Building a Hub City for the Nano-Convergence Industry

In order to foster a nano-convergence industry, building a platform for commercialization of nano-convergence, a project to promote its use, a Daejeon nano-convergence R&D BD center, and an international nano-industrial city forum and exhibition will be promoted(Daejeon TP, 2012; DMC 2013; DIVA, 2013).

Specifically, a nanotechnology fab center and center for functional nanotechnology will be built, and installation of national nanotechnology cooperation, announcing development strategies for nurturing a nanotechnology convergence industry, and nano-convergence cooperation with Dresden in Germany will be promoted.

4.5.3 Nurturing the IT Convergence Industry

To support the IT convergence industry, technology support for a new IT representative primary industry in Chungcheong, support for an IT convergence green industry project to vitalize smart applications, promotion of the regional SW industry, a project to strengthen SW quality capacity, and a project to create a cluster in order to nurture global high-tech businesses will be promoted.

4.6 Innovation Clusters in Daejeon

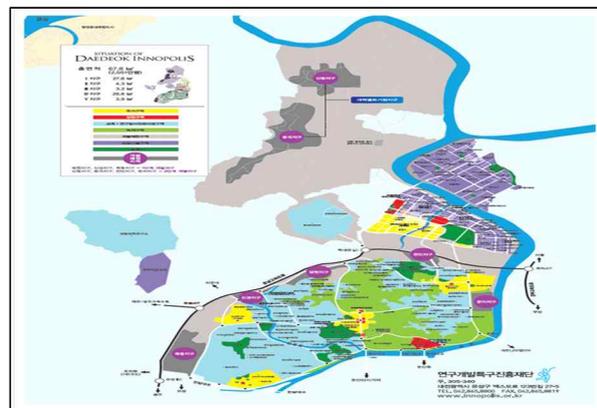
4.6.1 Daedeok Innopolis

After the first development in 1973, Daedeok Science Town, now called Daedeok Innopolis recently completed the first phase of development. The second phase would be pursued in earnest starting in 2013(DMC 2013; Daedeok Innopolis Development, 2015). Such an R&D area is focused on government-funded research institutes, which are the basis of the national R&D project. It is a complex ecosystem of technological innovation that links research findings with venture businesses and SMEs in the Daedeok techno-valley, creates synergy through academy-industry cooperation with surrounding universities, and can be considered an innovation cluster(DMC 2013; Daedeok Innopolis Development, 2015). Daedeok Innopolis includes Daedeok research complex, Daedeok techno-valley, and Daedeok industrial complex. Thus, it has world-class level of national R&D performance, is capable of technology commercialization of performance, and includes all processes from starting up a venture business to nurturing venture businesses. Accordingly, it is a technological innovation ecosystem that includes the two main pillars of an innovation cluster: innovation and entrepreneurship.

4.6.2 International Science and Business Belt

The basic concepts of the International Science and Business Belt involve establishing the Institute for Basic Science (IBS), which has a heavy-ion accelerator in a large facility, and developing and applying research results based on the IBS to business to build a livable innovation cluster of science

culture(MSIP, 2013).



Source: Daedeok Innopolis Development(2015)

<Figure 6> Current State of DaeDeok Innopolis

Recently, the International Science and Business Belt installed the IBS and a heavy ion accelerator within Daejeon Expo Science Park, thus becoming a base district and building a worldwide hub of basic science research(MSIP, 2013). Moreover, the academy-industry work force program and joint R&D are supported through a functional district. The Belt is formed in a structure that completes a virtuous circle linked with research performance of the base district and with business(MSIP, 2013).

V. STRATEGIES FOR STI POLICY AND ACADEMY-INDUSTRY COOPERATION IN DAEJEON

The strategy can be deduced by external and internal analysis of environments. We already analyzed the external STI environment in chapter III Technological Innovation system in Daejeon. in which the characteristics and distinctive feature of STI environment of Daejeon was reviewed. In addition to external analysis, the chapter IV STI Policy and industry-academia cooperation for Innovation and Entrepreneurship in Daejeon, deeply analyzed the innovation system in Daejeon. With this external and internal analysis, we deduced the Strategies for STI Policy and industry-academia cooperation for innovation and entrepreneurship in Daejeon as follows; First is the promotion of STI policy based on foresight at the regional level. Second is the nurturing global innovation cluster for innovation and entrepreneurship in consideration of regional STI ecosystem. Thirdly, strengthening academy-industry cooperation with the Sejong city and other cities

5.1 Promotion of STI Policy based on

Foresight at the Regional Level

Foresight can be achieved by professional planning, networking by experts, and future studies (Miles & Keenan, 2003). In addition to foresight achieved at the business and national levels, such foresight can be promoted at the regional level. Through foresight at the regional level and consensus reached by residents and experts in a region, a desirable future image can be identified.

Unlike in other regions, KRW 4.1037 trillion, 29.0% of the national R&D project budget of KRW 14.1793 trillion, is invested in Daejeon. This is the nation's largest amount of investment, greater than the KRW 3.5714 trillion invested in Seoul or the KRW 2.1941 trillion invested in Gyeonggi Province (KISTEP, 2011, 2012). Daejeon is a very important region for creation of the national growth engine in which such R&D investment is being made and, at the same time, a place where various STI policies will be promoted in accordance with the regional STI policy to nurture regional strategic industries and regional growth engine industries. In other words, it is a place where national and regional STI policies are mixed and realized. The policies should be promoted after they are reinterpreted from the perspective of a regional innovation system rather than from a perspective of regional STI policy. Therefore, a foresight-based STI vision embracing national and regional policies should be established to harmonize with national STI activities. Venture businesses/SMEs should be nurtured and promoted by linking the results with promotion of regional strategic industries and new growth engine industries. In other words, a desirable future image should be established at the regional level through consensus reached by STI policy stakeholders and residents, and a desirable regional scenario should be established based on that future image. To achieve this, STI policy should be developed comprehensively and promoted by use in STI infrastructure in the region.

5.2 Nurturing Global Innovation Cluster for Innovation and Entrepreneurship in Consideration of Regional STI Ecosystem

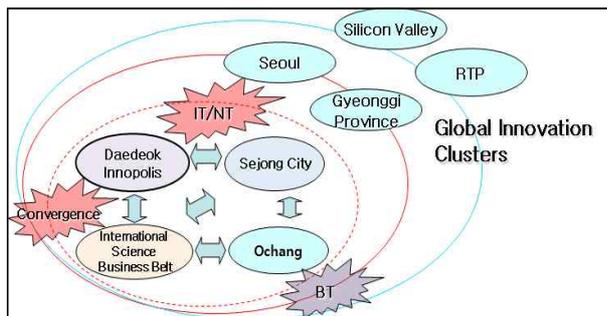
Daedeok Innopolis exists in Daejeon as a policy platform to achieve such an STI vision. After the first development in 1973, Daedeok Innopolis recently completed the first phase of development. A second phase would be pursued in earnest starting in 2013 (Daejeon TP, 2012). Such an R&D area is focused on government-funded research institutes, which are the basis for the national R&D project. It is a complex ecosystem of technological innovation linking research findings with venture

businesses and SMEs in Daedeok techno-valley and creating synergy through academy-industry cooperation with surrounding universities. It can be considered an innovation cluster. Although the development of Daedeok Innopolis is heavily affected by the main axis, the performance of government-funded research institutes, its performance affects not only national performance but also the development of the regional economy, as it is linked with technology commercialization of venture business/SMEs in the region. Thus, the design of Daedeok Innopolis should develop when an organic link is formed not only with government-funded research institutes but also with the science and technology ecosystem in the region. Moreover, currently, the International Science and Business Belt is being promoted as the heart of the region of Daejeon by linking with Daedeok Innopolis. It was determined to promote the IBS, which is a core of the International Science and Business Belt in Daejeon Expo Park. Such a basic science infrastructure will enable the capability of new basic science to be realized in the region of Daedeok at the regional level. After the International Science and Business Belt was promoted at the center of Daejeon, the region became equipped with the infrastructure needed to promote basic science and commercialization capacity at the regional level. Like Daedeok Innopolis, neither Silicon Valley nor Research Triangle Park in the U.S., which are regarded as global innovation clusters, initially included all infrastructures ranging from basic to technology commercialization. Thus, in order to nurture Daedeok Innopolis and the International Science and Business Belt as global innovation clusters, this is the time when development policy and strategies for organic links are needed.

5.3 Strengthening Academy-industry Cooperation with the Sejong City and Other Cities

STI policy in Daejeon should develop along with the formation of the organic connection with surrounding STI policies. Sejong, which is very close to Yuseong District in Daejeon, is the administrative heart, and at the same time is building science and technology infrastructure to nurture innovation clusters. It is expected that various science and technology infrastructures related to convergence research will be built at two universities in Sejong. Furthermore, STI policy research institutes are located in Sejong, thus promoting the nation's STI policy research and planning. Considering the science and technology infrastructure built in Sejong near Daejeon, the STI policy in Daejeon should be planned within a comprehensive framework linking it with Sejong. Currently, cluster development policy seeks more than a cluster in the form of a park. It seeks a cluster in the form of

a belt linking with other clusters. Thus, by linking the innovation cluster in Daejeon with Sejong, clusters in the form of belt should be promoted, seeking long-term synergy.



<Figure 7> Strengthening academia-industry cooperation with the Sejong City and Other Cities

Moreover, performance of national government-funded research institutes in Daejeon should be utilized beyond regional development and expand to other regions through a frame of cooperation. Unlike the region of Daejeon, STI policies in other local governments heavily rely on technological development projects and networking between innovation agents. Thus, basic and commercialization research results in Daejeon should not be limited to nurturing a SMEs/venture ecosystem in Daejeon but instead expand to Jeonbuk, Daegu, and metropolitan areas, thereby being utilized at the national level.

VI. CONCLUSION AND IMPLICATION

As examined in this paper, the STI policy in Daejeon can develop within the organic link among central research institutes, regional venture businesses/SMEs, and regional universities grounded on the innovation cluster in Daedeok Innopolis. The STI policy in Daejeon is planned and carried out when it promotes academy-industry cooperation along with construction of innovation clusters. Currently, the International Science and Business Belt is being promoted as an innovation cluster in Daejeon in addition to the constructed Daedeok Innopolis. In addition, it is expected that Sejong near Yuseong district, which is the heart of STI in Daejeon, will develop as the center of administration and science and technology.

Considering such historical and external situations, this paper expanded upon the following three strategies to develop STI policy as well as academy-industry cooperation in Daejeon. First, STI policy based on foresight at the regional level should be promoted. That is, the regional STI vision, based on foresight embracing national and regional policies, should be established to harmonize with national STI activities, and venture businesses/SMEs should be nurtured by linking performance with

promotion of regional strategic industries and new growth engine industries. Second, a global innovation cluster should be nurtured and promoted in consideration of the regional STI ecosystem. To this end, Daedeok Innopolis should link with national government-funded research institutes and the regional STI ecosystem and, at the same time, with the newly promoted International Science and Business Belt for development. Third, academy-industry cooperation with Sejong and other regions should be strengthened. In other words, the innovation cluster in Daejeon should link with Sejong, promoting a cluster in the form of a belt and seeking synergy in the long term. Moreover, basic and commercialization research results in Daejeon should not be limited to nurturing the SMEs/venture ecosystem in Daejeon but instead expand to Jeonbuk, Daegu, and metropolitan areas, thereby being utilized at the national level.

As discussed in this paper, Daejeon is the heart of national STI and at the same time is very important regionally. Considering such importance, STI policy in Daejeon and academy-industry cooperation should be planned from a perspective of a regional innovation system. Beyond this paper, which examined STI policy in Daejeon from a comprehensive perspective, we anticipate that other studies will examine STI policy in Daejeon from various perspectives.

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혁신과 창업을 위한 대전의 과학기술정책과 산학협력

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최종인**

국 문 요 약

본 연구에서는 대전의 혁신과 창업을 위한 과학기술정책과 산학협력방안에 대해서 고찰한다. 이를 위하여 대전의 기술혁신시스템에 대해서 고찰하였다. 대전의 과학기술시스템은 지역과 중앙의 과학기술혁신거버넌스가 조화를 이루고 있다. 정부출연연구소, 민간연구소, 지역의 벤처/중소기업, 대학 및 관련지원기관인 대전테크노파크, 대전벤처협회 등 지원기관이 구축되어있다. 이를 기반으로 한 혁신클러스터로서 ‘대덕연구개발특구’와 새로운 기초과학 중심의 혁신클러스터인 국제과학비즈니스벨트가 있다. 대전의 과학기술정책은 지역수준에서 중앙과 지역정책의 조화를 이루는 과학기술정책의 비전을 바탕으로 주요 혁신클러스터 육성, 대전지역의 전략산업육성, 신성장동력으로 IT, BT, NT 융복합 산업의 육성, 벤처기업의 단계별 육성이다. 이러한 과학기술정책의 기본 방향 하에 대전지역의 혁신과 창업을 위한 과학기술정책과 산학협력활성화 전략을 고찰하면 다음과 같다. 첫째, 중앙과 지역의 조화를 고려하여 지역수준의 예측을 기반으로 과학기술정책 추진하는 것이다. 둘째, 지역과학기술 및 벤처생태계를 고려한 글로벌 혁신클러스터 육성이다. 대전지역을 대덕연구개발특구이외에 국제과학비즈니스벨트를 양대축으로 하여 세계적인 혁신클러스터의 중심으로 육성하는 것이다. 셋째, 세종시 및 수도권 등 광역권 산학협력 강화 추진하는 것이다.

핵심주제어: 과학기술정책, 창업, 산학협력, 혁신클러스터, 대전

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