S&E

Space & Environment
is a quarterly English magazine intended to disseminate research output and international activities of Korea Research Institute for Human Settlements

Vol. 80
DECEMBER 2019

ISSN 2671-9037
9 772671 903003 94

Published by Korea Research Institute for Human Settlements (KRIHS, http://www.krihs.re.kr/)
Publisher Hyun-Soo Kang
Edited by Global Development Partnership Center (http://gdpc.kr/)
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Designed and Produced by MYOUNGMOON Design&Printing (http://www.designmmt.co.kr/) Tel. +82-2-2079-9252
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Location Policies for Innovative Growth Companies in the Fourth Industrial Revolution Era

Hoje Kang, Seunghan Ryu, Yeonmi Seo

1. Location Policies for Companies in the Fourth Industrial Revolution Era

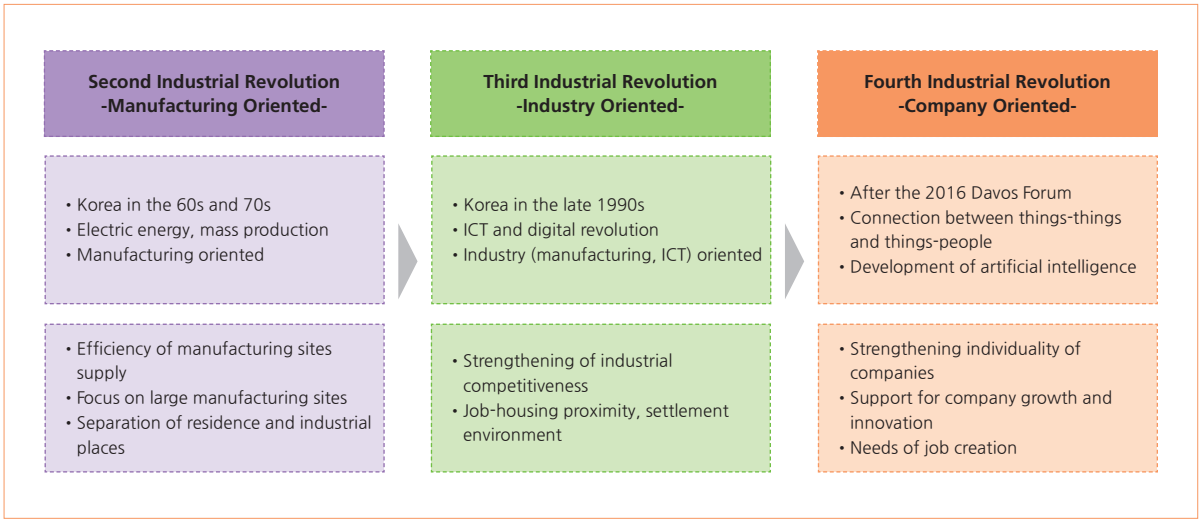
Klaus Schwab(Schwab 2016.24) predicted that in the future, countries will experience changes that will undermine job security and quality due to the Fourth Industrial Revolution. As the development and utilization of advanced technologies such as the Internet of Things (IoT) and 3D printing become active, a new industry(e.g. bitcoin mining) which is different from the existing business, emerges; and hereby the prediction includes that life becomes convenient and society faces revolutionary change, but at the same time, individuals and businesses that are not able to adapt to technology or have no skills are get left behind and social problems such as job shortages will arise.

Therefore, in response to the Fourth Industrial Revolution Era, the Korean government has defined 'Innovation Growth' as a 'growth strategy for fundamentally changing the structure and constitution of the economy and society and realizing a people-centered economy,' and is pursuing key strategic goals of finding future food and creating jobs(Innovation Growth Portal 2018).

However, in the Era of the Fourth Industrial Revolution, policies based on unclear industry classifications are getting difficult to respond effectively to changes as new industries are being created while boundaries between industries are breaking down and the speed of convergence between industries is increasing due to the development and complexity of technology. For example, a business that sells coffee after putting in a container is classified as a coffee-processing industry, whereas a business that brews coffee beans as a service industry. A printing business is classified as a manufacturing industry, whereas printing poetries and novels from 'literary vending machines' is also as a service industry. Even among the companies classified under the same industry category, there are significant differences in employment, revenues, and growth.

Therefore, in the Fourth Industrial Revolution Era, the

Figure 1. Changes in the Fourth Industrial Revolution Era and Needs for Company Location Support



Source
H. Kang, et al. 2018, 41.

change of location policy is required to support companies that drive innovation, growth, and job creation rather than to support specific industries with industry classification based on end products. Figure 1

2. Classification of Innovative Growth Companies and Characteristics of Location

In this study, the company data of NICE Information Service is utilized to define a group of companies leading innovation and growth based on the indicators of innovation, growth, and employment for 284,000 companies from 2014 to 2017, and the distribution of their location is analyzed.

First of all, an innovative growth company is defined as a company that created innovation through R&D spending while simultaneously achieved employment and revenue growth, and the cluster of 809 companies are selected, each of which showed increase in R&D expenditures, revenues, employment, and wages from 2014 to 2017. Second, a gazelle company is defined as a company that continuously grew revenues and created employment through an in-house innovation of sales organization and management regardless of R&D expenditures, and the companies with the average annual increase in employment and also revenues by more 20% during the same period were selected. Lastly, an innovative company is defined as a company that spent only R&D costs regardless of job creation or growth, and a total of 16,847 companies that spent R&D costs every year were selected. Figure 2

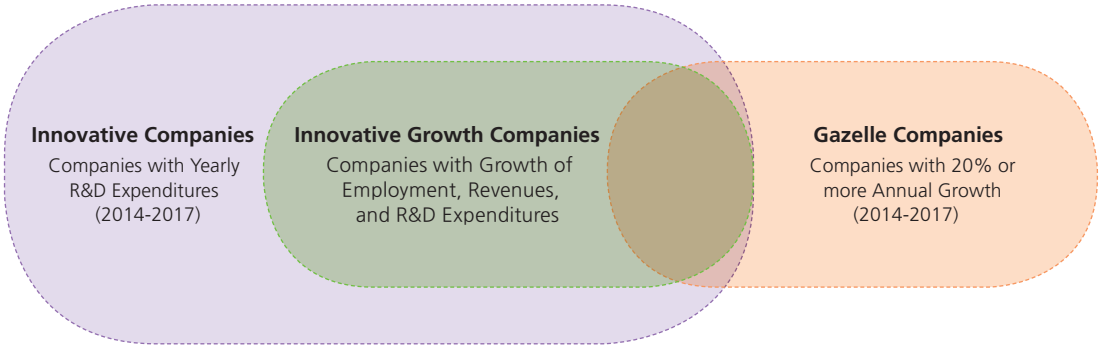
As a result of analysis, application software development and supply companies and non-manufacturing companies as well as knowledge-based manufacturing companies are major types of industry both in the innovative growth companies that achieved growth of employment and revenues along with innovation, and in the gazelle companies that were selected based on only growth rates, and therefore the following implication was drawn: location support policies focused on the manufacturing industry should be extended to non-manufacturing and service industries which are leading innovative growth.

In general, innovative companies that spend R&D costs have a higher concentration in metropolitan areas and higher pay level comparing with those which do not spend R&D costs, and have the characteristics of steady growth, and therefore the relationship between R&D and company growth and concentration level in large cities can be confirmed. Figure 3

In particular, the cluster of 809 innovative growth companies analyzed through the Nearest Neighbor Hierarchy Analysis was found to be concentrated in the southern part of the metropolitan area. Innovative growth companies show clear spatial distribution limits even in the same metropolitan area; to the north companies are distributed to Jongno-gu in Seoul, to the east to Jungwon-gu in Seongnam, and to the south to Seobuk-gu in Cheonan-si, which is located in Chungcheongnam-do directly adjacent to Gyeonggi-do.

Apart from the metropolitan area, some cluster places for innovative growth companies are developed in Daejeon, Gwangju, and Busan metropolitan areas, all of which are

Figure 2. Classification of Innovative Companies, Innovative Growth Companies, and Gazelle Companies



Source
H. Kang, et al. 2018, 48.

located in R&D special zones. The results of interviews with the innovative growth companies located in these provinces showed that technology exchange with national research institutes and the location at planned high-quality living conditions helped the companies' growth and location. Figure 4

3. Recommendation on Location Policies for Innovative Growth

For innovative growth pursued by the government, it is necessary, ultimately, to foster innovative growth companies, and various supporting policies should be proposed for this purpose. In this study, the establishment of innovative ecosystems in local provinces and company-oriented support of location is proposed as an alternative.

First of all, the local provinces, which are suffering severe brain drain due to the Fourth Industrial Revolution, should provide a high-quality residential environment and expand technology transfer by focusing on national research institutes so that companies founded and growing in local provinces can be competitive like the example of innovative growth companies located in R&D special zones mentioned earlier.

At the same time, support should be tailored to ensure that location is preferentially distributed among companies that lead innovation growth out of the industry support policies based on the existing industry classification. In the Era of the Fourth Industrial Revolution, when the boundaries between industries are being collapsing, local provinces and countries cannot maintain their competitiveness with manufacturing-oriented economic development strategies. It is necessary to consider strategies to enhance competitiveness other than the manufacturing industry like the examples of the Vietnam-Singapore Industry Park (VSIP) which does not designate any industrial area and the South Lake Union in Seattle which has improved the settlement environment by attracting hospitals and attracted Amazon's Global headquarters.

In addition, in the metropolitan area where competition for location is high, location regulations for innovative growth companies should be significantly relaxed in order to allocated limited land in an efficient manner. At the same time, however, regulations should be tightened for manufacturing-oriented small-sized industrial parks showing unplanned development and for induvial manufacturing factories. In conclusion, the policy implications are summarized below. Figure 5

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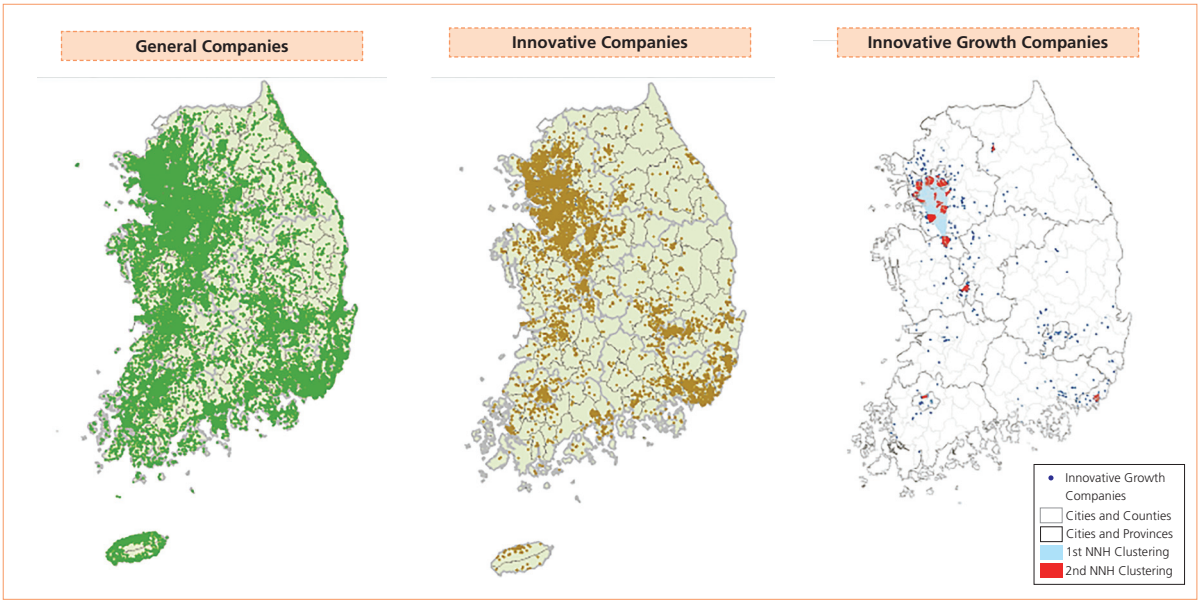
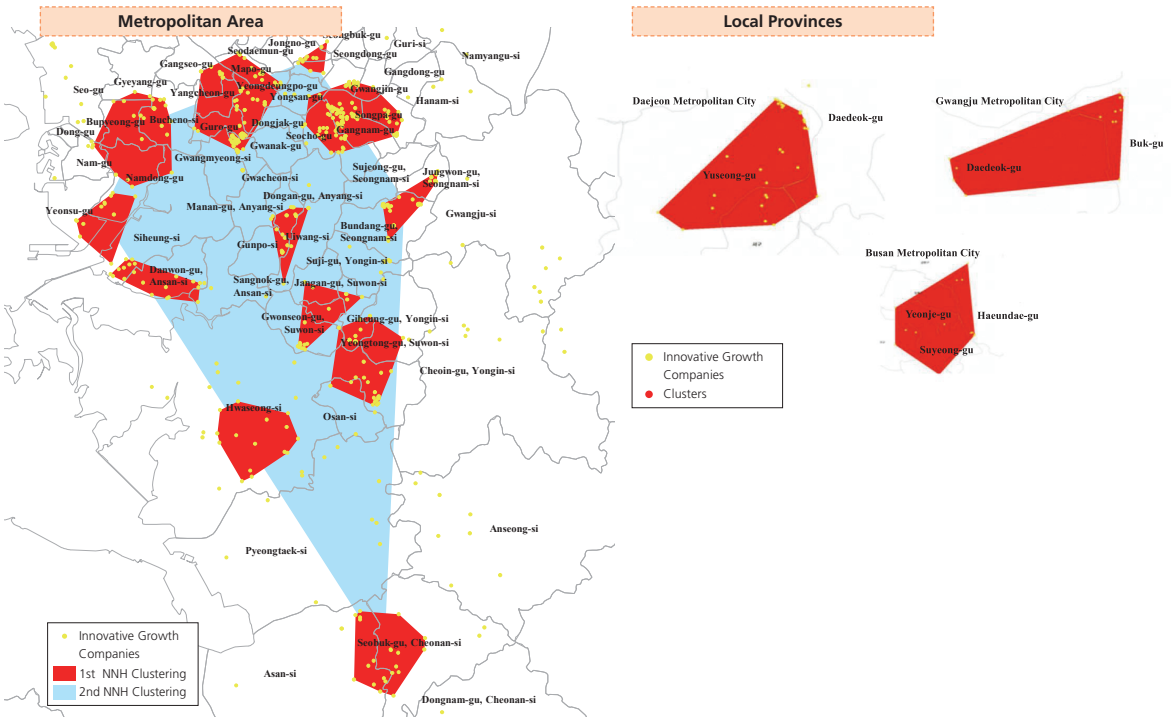
Figure 3. Spatial distribution of General Companies, Innovative Companies, and Innovative Growth Companies



Source
H. Kang, et al. 2018, 60; 97 (reference data was prepared by the author based on 2018 NICE Information Service data)

Figure 4. Spatial Distribution of Innovative Growth Companies in Metropolitan area and Local Provinces



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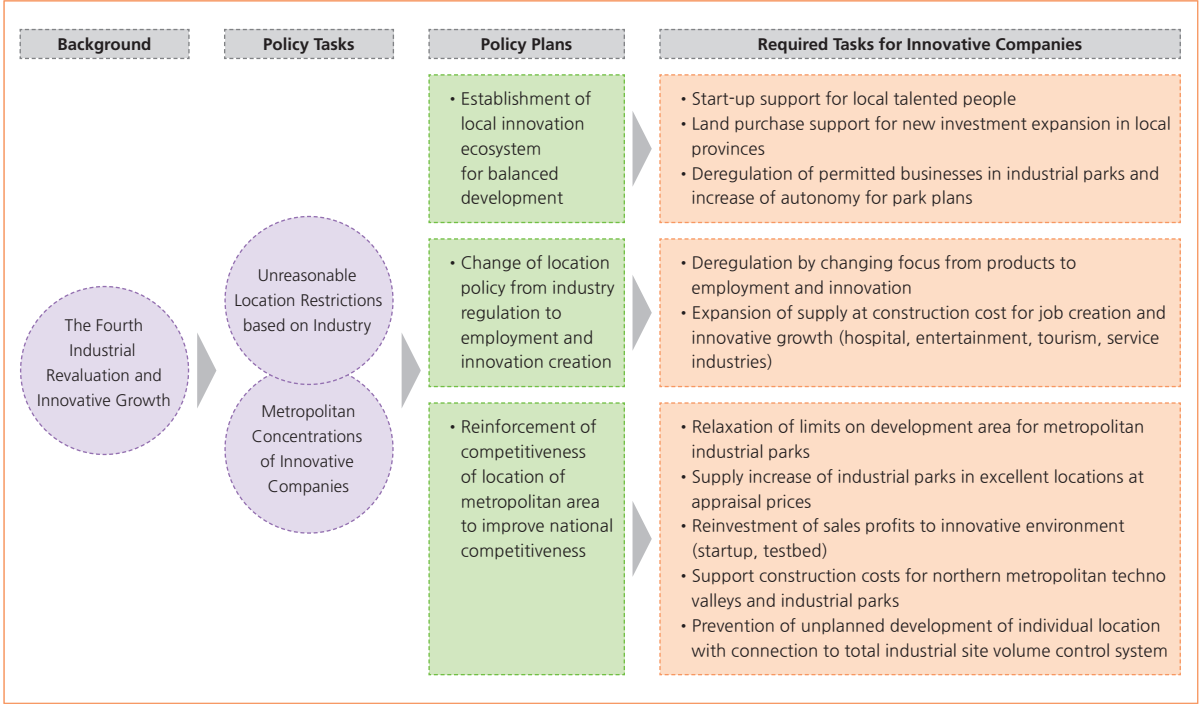
Kang, Hoje, et al. 2018, 98-99 (reference data was prepared by the author based on 2018 NICE Information Service data)

Figure 5. Basic Directions and Required Tasks of Location Policies for Innovative Companies



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H. Kang, et al. 2018, 119.

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Industrial Location Strategies for Building an Innovative Start-up Ecosystem

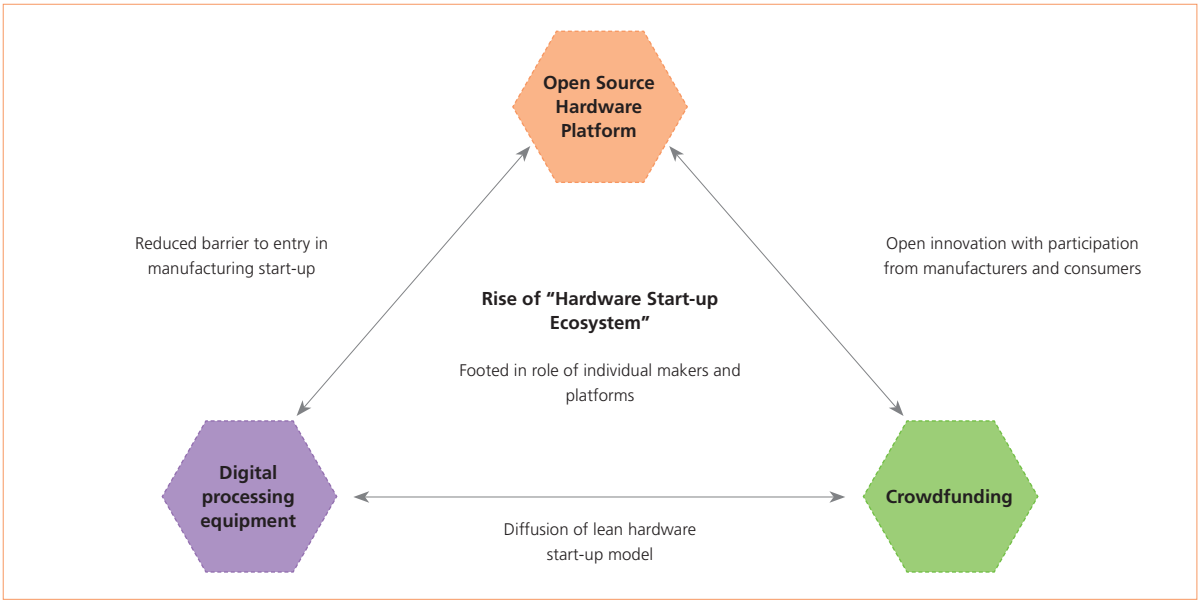
Sungchul Cho

1. Introduction

From the restructuring of the shipbuilding industry to the hydrogen economy, the improvement of manufacturing industry is a subject that is discussed regularly in economic issues. Faced with a new competitive order in which existing growth formulas no longer hold up, bold innovation and new industry development are demanded of our manufacturing industry. In responding to such challenge, an active start-up ecosystem is a foundation that is necessary. Start-ups bring diversity and innovation to the market, helping to renew the competitiveness of existing industries. In particular, the entry of innovative start-ups can also pressure existing companies to reconsider their inertial behavior and consider new investments. Taking note of this importance, not only our government, but also other governments, such as Germany and the United States, are carrying out various support projects to create a start-up ecosystem to renew the competitiveness of the national manufacturing industry.

Since manufacturing start-ups require large investment from the beginning and technological barriers to entry are high, it was understood that the leading role is played by spin-off start-ups from large and mid-sized companies rather than a start-up ecosystem. However, recent socio-technological changes are facilitating the formation of new trends in the start-up ecosystem. The first is a change in the technological conditions. The recent technological change, commonly referred to as the Fourth Industrial Revolution in Korea, refers to a technological paradigm shift in which the existing manufacturing industry is radically reconstructed through the convergence of hardware

Figure 1. Changes in the manufacturing start-up environment and rise of the start-up ecosystem



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and software technologies. This phenomenon is expanding the opportunities for technology-based manufacturing start-ups in various fields. Indeed, recent emerging industries, such as robots, drones, AR and VR, and IoT(Internet of Things), are dominated by hardware start-ups that combine AI(Artificial Intelligence) technologies with manufacturing capabilities. The second is the cultural flow. The recent trend of manufacturing start-ups, called the "Maker Movement," is a cultural phenomenon made possible by technological change. While technologies such as 3D printers have lowered initial costs and provided new opportunities for individual founders, social platforms such as makerspace and crowdfunding have set the stage for tangible and intangible "maker communities" that want to use new technologies to solve everyday problems. Figure 1

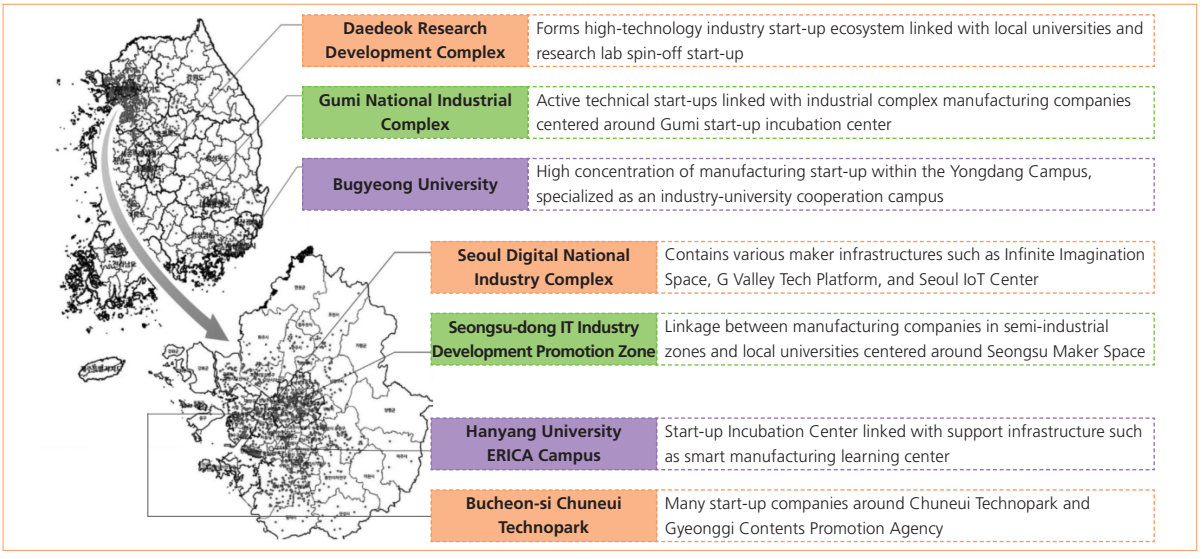
Despite the growing interest in the manufacturing start-up ecosystem, studies accounting for the mechanisms at work have been relatively rare. This article explores the current state of technology-based hardware start-ups through a nationwide firm database analysis. In addition, by conducting on-site research and survey on major start-up bases, policy implications for the location of manufacturing start-ups are derived.

2. Spatial Distribution of Technical Manufacturing Start-ups

In order to secure sample information on technology-based manufacturing start-ups in Korea, this article employs CRETOP+ database provided by Korea Enterprise Data, a corporate credit research and evaluation institution. Korea Enterprise Data is a corporate credit research and evaluation institution that owns a corporate information database on over 7.5 million companies. In particular, CRETOP+ DB combines business information requested for corporate credit evaluation from Korea Enterprise Data with business information from the Korea Credit Guarantee Association and the Corporate Information Council, and is the largest corporate database in Korea with business information on approximately 5.52 million companies as of 2018. The benefits of CRETTOP+ DB for the purpose of this article is that the database provides detailed location information of the relevant businesses. Moreover, the database collects financial statement information such as operating profit and sales amount of companies, and information such as the number of employees and patent registrations by time, and allows for a multi-faceted evaluation on the growth trends or innovativeness of the company in question. In this study, a "start-up" is defined as a company which was founded within the last five years. Subsequently, whether a start-up is a technical start-up is determined based on the ratio of total assets to intangible assets and portion of R&D expenditures in comparison to revenue.[01] Figure 2, 3

<Figure 2> is the result of expressing the spatial distribution of the technology-based hardware start-ups on a map. 1,863 technical-based hardware start-ups, representing 64.13% of

Figure 2. Spatial distribution of major concentration areas of technical manufacturing start-up



Source
Author analysis using CRETOP+ DB by Korea Enterprise Data. Red circles indicate location of technical manufacturing start-ups.

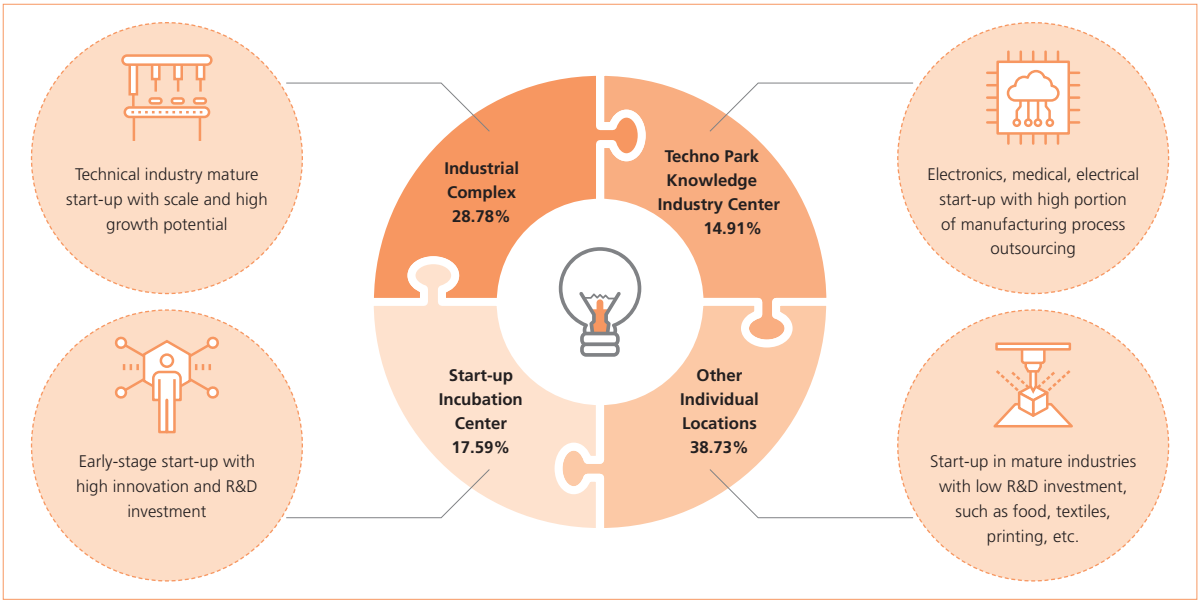
01. Specific process and definition of variables is described in Sung Chul Cho, Ki-chan Nam, and Cheolsoon Chang (2018).

the total, are located in the capital region, and it is also possible to see a concentration of technical start-ups in non-capital regions. However, start-up concentration regions outside the capital areas showed much smaller size or number of cases. Furthermore, compared to the capital region, incubators within the national industry complex or universities and research institutions were serving as the base. Meanwhile, in the case of the capital region, many cases have been found in which start-up companies formed individual locations in urban centers and forming a concentrated region. Observation of such areas shows that there is a tendency to concentrate around semi-industrial areas and industrial complexes in the capital region where start-up infrastructure such as maker spaces, hardware accelerators, and government support programs are concentrated. In addition, large-scale manufacturing sites were rarely used, and business type industrial spaces including the Knowledge Industry Center were observed as the main location types. Figure 4

Representative technology start-up concentration areas in the metropolitan and non-capital areas are Hanyang University's ERICA campus and Gumi National Industrial Complex, respectively. Founded in 1997, ERICA campus business incubation center has 68 start-ups as of 2018, which generates annual sales of KRW 31.7 billion and employment of 280 employees (internal data from the business incubation center, dated October 8, 2018). As shown in <Figure 4>, Hanyang University's ERICA Campus provides full support for start-ups by mobilizing the resources and knowledge pool of the university. By providing incentives to researchers participating in industry-university cooperation, the company is actively connecting start-up companies enrolled in the family company program with the university research community. In addition, it is making efforts to link prospective founders to start-up incubators through cooperation with the youth start-up academy in Ansan. In addition, the campus supports graduating companies that have completed the incubation process through linkage with Gyeonggi Technopark located on campus in order to support follow-up growth, and in cooperation with Gyeonggi Technopark, is promoting joint projects with local partners.

Following an interview, it was possible to summarize the benefits of having a technology start-up in an incubator within university in five ways. First, the rent is relatively low compared to the knowledge industrial center located in the city. Second, it is possible use of the university's common equipment, laboratory infrastructure, and test and measurement services at a low cost. Third, it is easy to organize joint research and development activities with professional research personnel such as university faculty members or obtain advice therefrom. Fourth, it is possible to access various talent pools within the university, so the talent matching desired by businesses is relatively easy compared to suburban industrial complexes. Lastly, it is easy to use various living infrastructure facilities such as restaurants, libraries, sports facilities, bookstores, lodgings, and banks that exist in and around the university. Figure 5

Figure 3. Summary of major characteristics by type of location of technical manufacturing start-up



Note
Statistics in the middle figure refers to the percentage of 2,905 total technical manufacturing start-up belonging in each location type.

The Gumi National Industrial Complex, shown in <Figure 5>, is an example of the start-up ecosystem where various types of innovation and support organizations located in industrial complexes form a network to support technology start-up companies step-by-step. An analysis of the company DB showed that 21 technology start-ups were located in Gumi National Industrial Complex. Gumi National Industrial Complex provides customized support for high-tech hardware start-ups through connection of regional universities, childcare centers, research institutes, public institutions, etc., with Geumoh Techno Valley and Creative Economy Innovation Center.

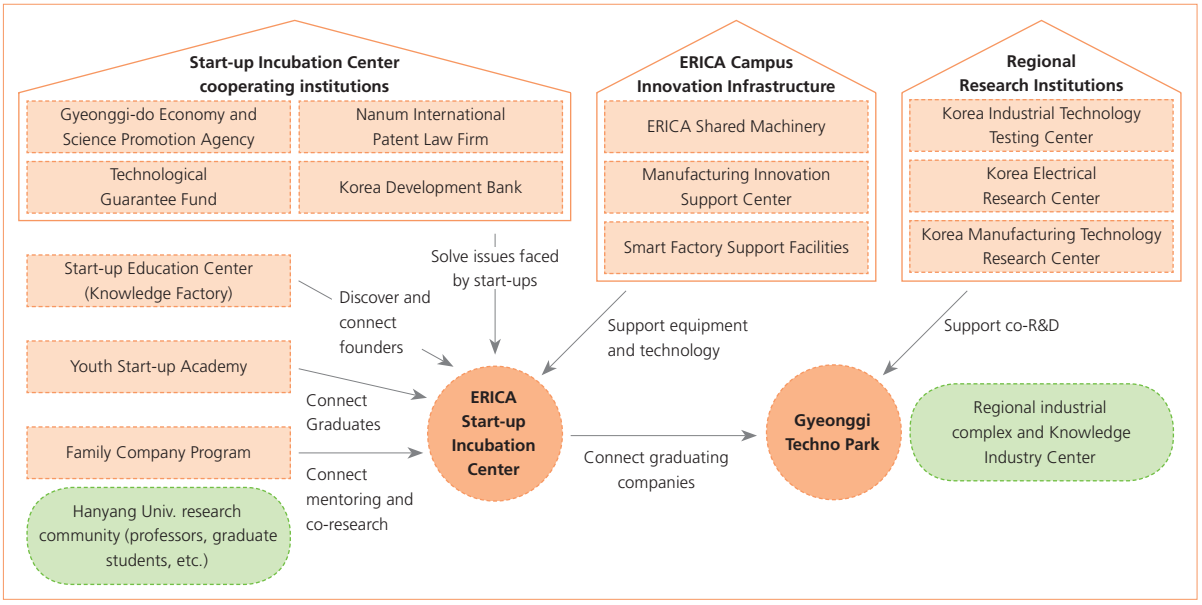
3. Survey of high-tech hardware start-ups' location choice

The analysis contained in the previous chapter alone cannot interpret detailed information such as the motivation for location of each company or differences in business models. To compensate for this, a structured survey was conducted among the representative directors of 418 companies out of the 2,905 technical manufacturing start-ups nationwide.

First, a study of start-up founders and their backgrounds showed that young founders in their 20s and 30s accounted for 25% of the sample and middle-aged founders in their 40s and 50s consisted 70% of the sample. Among the representative directors of start-up companies in industrial complexes, the proportion of engineers from SME manufacturers was high, while a majority of the sample consisted of spin-off start-ups concentrating on B2B transactions within the industrial complex. Majority of the start-ups in the industrial complex responded that their core competitiveness lies in manufacturing or design capabilities. Meanwhile, majority of the start-ups located in the city occupied office spaces without manufacturing space, and a high proportion of the companies were process-free manufacturers outsourcing most of the manufacturing process. 14% of the total sample outsourced the entirety of the manufacturing process, and these companies responded that the core competitiveness lies in the software development capabilities, brands, and design. Approximately 10.0% of the sample consisted of start-ups that were spin-offs of universities or research institutes, or incubation start-ups from incubator institutions. Representative directors of these types of start-ups were relatively younger and were more likely to take export-oriented business strategies from the beginning.

Next, a survey of the location factors showed that in the case of start-ups specialized in manufacturing capability, the reason for choosing the current location was the production conditions such as expandable manufacturing space, parts procurement network, accumulation of related companies, and low rent. Meanwhile, process-free manufacturing companies that focus on software, services, and brand competitiveness often prioritize good settlement conditions or access to a pool of skilled workers. Moreover, while start-ups in the early stages

Figure 4. Structure of start-up and innovation ecosystem at Hanyang University ERICA Campus



Source
Compiled by author based on interviews and field research results

of growth prioritized networks and talent hiring related factors in location factors, while start-ups nearing maturity phase tended to prioritize wider manufacturing space and proximity to customers or partner companies. Figure 6

About 76% of the surveyed companies predict that there will be a demand for space expansion in the future, but demand for manufacturing space is higher than that of office space. When asked about the factors the government should consider in creating a space to support technical manufacturing start-ups, "a large space for manufacturing and loading" accounted for the majority of the first-priority responses. Next, there was a high portion of responses desiring being located together with government-supported programs, specialized prototype manufacturing organizations, and high-tech manufacturing equipment such as 3D printers. In most cases, the National Industrial Complex was preferred as the place for such support space, but companies within incubators or specializing in software capabilities preferred small locations located near city centers.

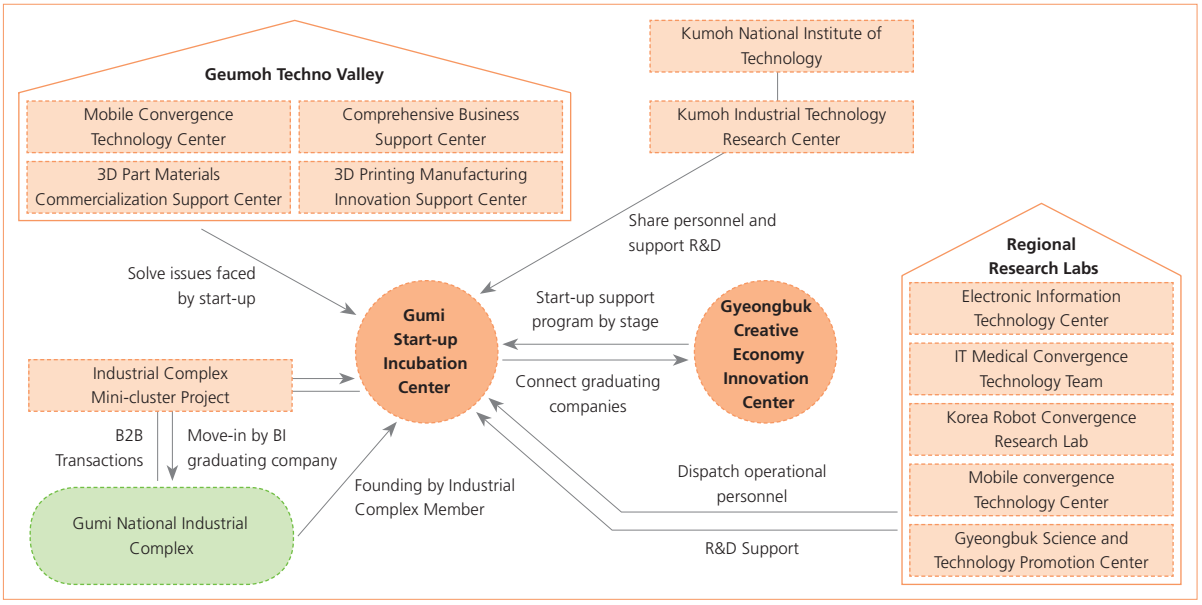
4. Conclusion

The main implications from the above results are as follows. First, technology-based hardware start-ups showed a clear trend of spatial concentration. In particular, start-ups in sectors where technology competitiveness was important were more likely to be located near companies in the same industry. Analysis shows that about half of all start-ups are located in policy-rich clusters such as industrial complexes and techno parks. Of the technology-based hardware start-ups, innovative start-ups focused on developing new products and services focused on industry concentrated areas, while manufacturers focused on securing price competitiveness within mature industries could observe a pattern of preference for individual locations. The reason why a highly innovative start-up company prefers a concentrated location is that learning and imitation through contact and cooperation with various external actors are important in the early stage of innovative start-up. (Chesbrough et al., 2006).

Second, various networks supporting start-up companies are developing in the main base where technical manufacturing start-ups are concentrated. Although the structure of the network and the types of shared resources varied from one network to another, the role of an intermediary that effectively linked early-stage founders to a variety of supporting agencies was common. In Gumi National Industrial Complex, the industrial complex's minicluster business promoted the B2B network of start-ups and established companies, whereas at Sewoon Shopping Center, know-how of skilled craftsmen was handed down to maker founders through intermediaries such as the Sewoon Collaboration Support Center.

Third, it is observed that incubators located in universities and research institutes play a critical role as a base for innovative

Figure 5. Structure of start-up and innovation ecosystem of Gumi National Industrial Complex



Source
Compiled by author based on interviews and field research results

start-ups. Start-ups located in incubators, which accounted for about 18% of the total technical manufacturing start-ups, were the ones with the most innovation and progressive investments compared to other types of companies. These observations can be interpreted as confirming the discussion that the incubator's infrastructure plays a key link in the start-up of the technical manufacturing industry. In fact, the majority of incubators are located in anchor institutions with knowledge production capabilities, such as universities, research institutes, and creative economic innovation centers, which confirms that the key condition for proper technology incubation is its connection with other innovators. In order to provide a start-up location linked with universities, an approach is needed that provides a location to activate the industrial ecosystem on campus by reversing the existing strategy of attracting university institutions to industrial complexes, which has been realized through the "Campus Innovation Park" project carried out by Ministry of Land, Infrastructure and Transport, Ministry of Education, and Ministry of SMEs and Startups this year.

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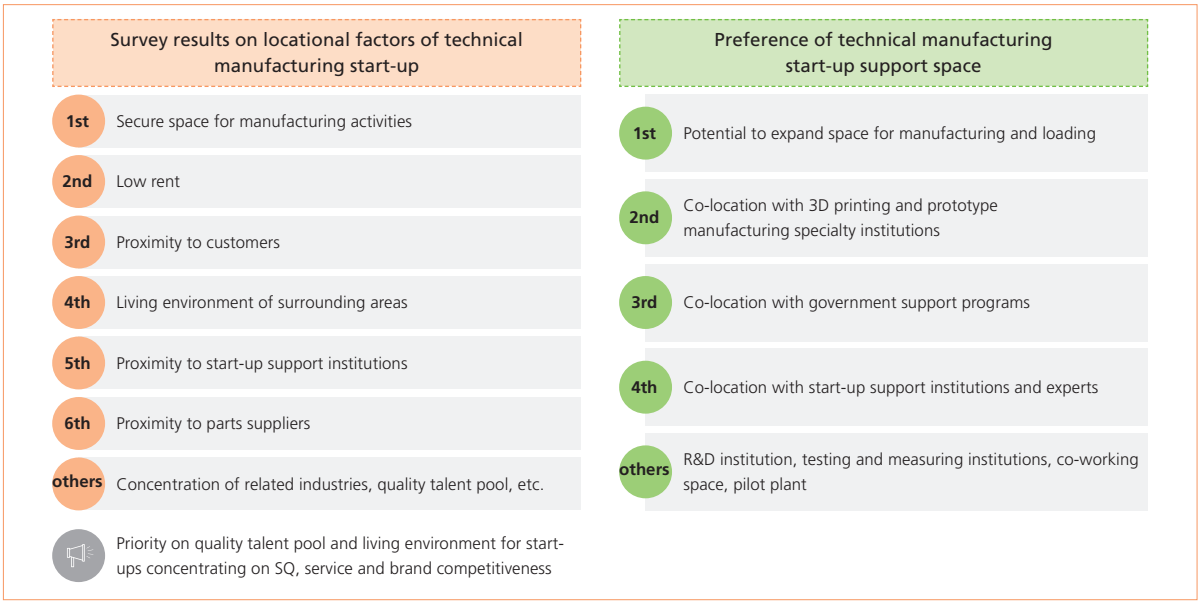
Figure 6. Survey Results on Locational Factors of Technical Manufacturing Start-up and Preferences on Start-up Support Space



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Compiled by author

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Promoting Linkage between 10 Innovation Cities and HEIs(Higher Education Institutions) in the region

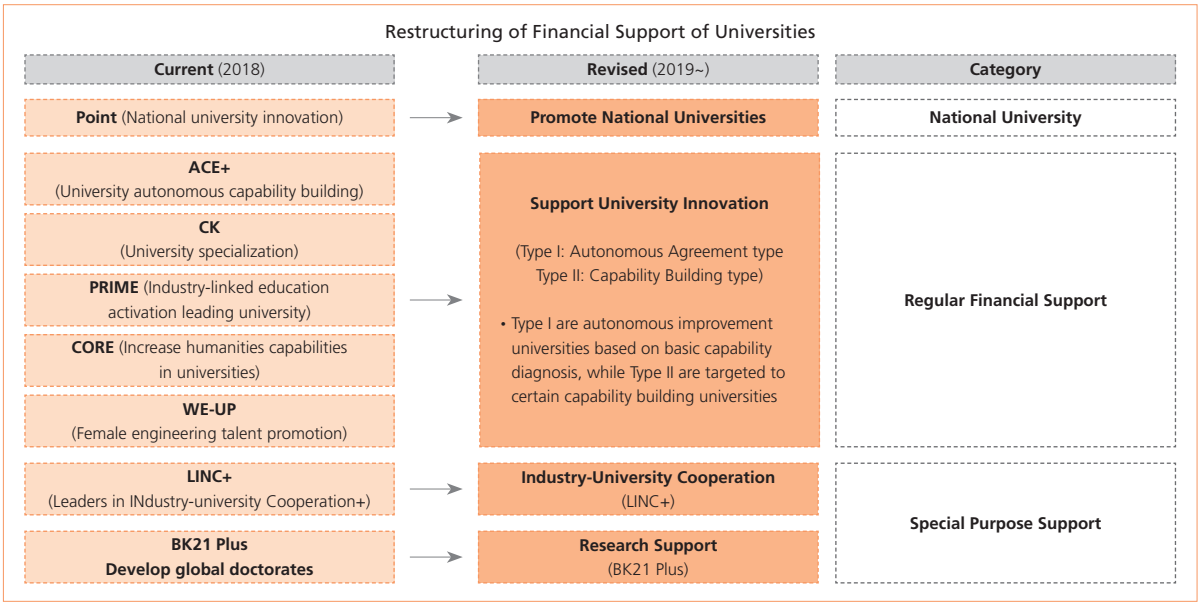
Yeonmi Seo, Eunnan Kim, Eunju Cho

1. Background to Adoption of Policy to Link Innovation Cities and HEIs in the region

10 Innovation Cities have been built since 2005 through relocation of public institutions to non-capital regions with the purpose of decreasing concentration in the capital region and independent regional development. Beginning in 2018, when the relocation of public institutions to non-capital regions was nearing the end, Season 2 of Innovation Cities began. Season 2 policy, which aims to foster new growth centers for balanced national development, differs from existing policies in that it targets not only public institutions for Innovation Cities but also residents, HEIs and research institutions. In particular, a policy linking Innovation Cities and HEIs are being pursued for the specialized development of Innovation Cities.

The linkage between Innovation Cities and HEIs is focused around policies to develop and supply talent based on the demands of relocated public institutions and corporations through mandatory of recruitment of local talent, easing regulations on universities moving into Innovation Cities, and creating a cooperative cluster of local governments, local universities, and relocated public institutions, and is currently in the early stages of adoption. In addition to education and research, the universities play a wider role in regional development as consumers in the local communities. However, at present there is a lack of discussions on strategies for establishing various roles for universities and activating the linkage for the development of Innovation Cities.

Figure 1. Restructuring of Financial Support of Universities



Source
Ministry of Education (2018), Restructuring Plan for University Financial Support to Increase Autonomy and Competitiveness of Universities (Proposed)

2. Policies relating to HEIs and Innovation Cities

Strengthening competitiveness of HEIs

The Moon Jae-in government reorganized the university financial support project to strengthen university autonomy and enhance innovation capacity. The reorganized university financial support project consists of four projects—national university development, university innovation support, industry-academic cooperation, and research support—for three categories including national university, general financial support, and special purpose support. First, the national university development project aims to reinforce the public role of the national university and to enhance its competitiveness in the areas of regional strength. It plans to expand the role of national universities as regional hubs for education, research, and innovation to create an environment that can contribute to balanced national development and win-win development. Second, in the university innovation support project, autonomous improvement colleges and capacity building colleges are selected based on the results of basic competency diagnosis. Third, the special purpose support project is divided into LINC+(Leaders in INdustry-university Cooperation+) and the research support BK21 Plus(Brain Korea 21 Program for Leading Universities & Students), and emphasis is placed on fostering manpower tailored to national and regional needs and on research and development of new technologies to reinforce the intensive capacity of university-university cooperation and research which are core functions of a university. Figure 1

Supporting mutual growth of HEIs and local industries

In order to support the mutual growth of HEIs and local industries, we are promoting LINC+(Leaders in INdustry-university Cooperation+) and the 4th Industrial Revolution innovation universities. The LINC+ project implements LINC+ policies by combining and expanding industry-university cooperation universities project (LINC), which has been implemented by the Ministry of Education since 2012, and society-tailored discipline activation project for the purpose of supporting mutual growth of HEIs and local industries. The LINC+ project will find ways to build diversity in the field of industry-university cooperation by discovering bottom-up models that are appropriate for each university and expand its achievements to the local community. The 4th Industrial Revolution innovation university project aims to promote innovation in the curriculum and educational environment within the university for fostering problem-solving talents with convergence knowledge and 4C capabilities to respond to industries that will emerge in the 4th Industrial Revolution.

Supporting employment of local talent

In order to support the employment of local talent, there are efforts promoting local leading universities. Since 2014, there have been efforts to promote local leading universities to foster an environment where universities and local communities

can grow together, and since 2018, there has been a pilot project to foster local leading universities in which participation from local governments and public institutions has been expanded to maximize diffusion of results.

University-related policies in Comprehensive Development Plan for Innovation Cities

The Comprehensive Development Plan for Innovation Cities aims to promote linkage between Innovation Cities and local universities through open labs, industry-university convergence district and industrial zone campus, open campus, mandatory hiring of local talents by relocated public institutions, etc. Open labs is a project being promoted as a part of MOTIE's "Innovation City-Public Institution Linkage Promotion Project" and seeks to establish prototype and design factory, test-bed research facilities and equipment, maker space, etc. Industry-university convergence district and industrial zone campus aims to establish a virtuous cycle of activating cooperative R&D-development of high-quality talent-employment by designating industry-university convergence districts which university campuses and research labs can occupy in Innovation Cities and nearby industrial complexes. Open campus seeks to supply qualified talent and increase their employment through curriculum tailored to demand of relocated public institutions institutions. Pursuant to the Special Act on Establishment and Development of Innovation Cities, the head of the relocated public institutions must hire a certain ratio, as determined by a Presidential Decree, of candidates that have completed or plan to complete higher education in the relevant region. In particular, mandatory local talent hiring by relocated public institutions has been in place since 2018 to alleviate job search problems of local young professionals, and each relocated public institution publicizes hiring records each year.

3. Current state of Innovation City-HEIs linkage project[01]

Subject and purpose of linkage of local universities

Local universities are primarily involved in projects linked with relocated public institutions in Innovation Cities. When a local university is located within an Innovation City, it will typically establish joint universities, local university joint campus, industry-university-research cluster campus, or industry-university convergence districts. Local universities are linking with Innovation Cities to foster talent for relocated public institutions and companies in the Innovation Cities.

University agents linked with Innovation Cities

University students are the most important participants in the case of university participation in projects promoted in connection with relocated public institutions and companies in Innovation Cities. In the case of university participation in Innovation City-related projects, there are cases where local

01. Selected 127 project plans involving universities out of 10 Innovation Cities development plan and analyzed the subject of linkage within the Innovation City with the local university, the purpose of linkage between Innovation City and local university, subject within the university being linked with Innovation City, and utilization of policies for linkage between Innovation Cities and local universities.

university sites are used instead of Innovation Cities.

Utilizing policies to link Innovation Cities and HEIs

The open campus project is most often used as a system and policy for fostering talent for relocated public institutions and companies in Innovation Cities. Regional leading universities are being promoted in seven Innovation Cities. In order to nurture talented people for Innovation Cities, some of the functions of existing universities are transferred to Innovation Cities or through establishment of new universities and graduate schools. Table 1

4. Issues in Linkage between Innovation Cities and HEIs

Linkage focusing on relocated public institutions and fostering local talent

In the regional innovation ecosystem, the university emphasizes the function of cultivating human resources through higher education, while there is a lack among local innovation agency or community of awareness of the role of local universities in industry-university cooperation activities such as joint research, technology transfer and commercialization, or community-university cooperation activities in the form of community problem solving.

In particular, projects related to industry-university cooperation such as joint research and development, technology transfer, commercialization, and start-up between Innovation Cities and local universities are linked to only the level of support for local SMEs by relocated public institutions and local universities, and the results of such projects are still inadequate.

Low satisfaction of educational curriculum and talent development of HEIs

Although hiring of graduates from local universities is increasing due to the mandatory hiring of local talent by public institutions relocating to Innovation Cities, the relocated public institutions consider it difficult to acquire qualified talent from the region. The relocated public institutions have low satisfaction rates for reasons such as considering the educational curriculum tailored to demands of the relocated public institutions as operated by the local universities as lacking.

Lack of point of communication for linkage between Innovation Cities and HEIs

The linkage between relocated public institutions and local universities are not conducted through cooperation and collaboration between different agencies for a common purpose, but as an individual project of a specific agency. The relocated public institutions have weak network within the region and it is difficult for them to find a point of

Table 1. Overview of Policy Utilization (Plan) for Linkage with HEIs by Innovation City

Innovation City	Talent development				Industry-University Cooperation		Community Service
	Open Campus	Development of Regional Leading University	Contract Departments	Attract and Establish Universities	Open Lab	Industry-University Convergence Zone	Smart City Integrated Platform
Busan	•	•	•	•	•		
Daegu	•	•				•	
Gwangju/ Jeonnam	•			•	•	•	
Ulsan	•	•		•			
Gangwon	•		•	•	•	•	•
Chungbuk	•	•			•	•	
Jeonbuk	•	•		•		•	
Gyeongbuk	•	•	•	•		•	
Gyeongnam	•		•	•	•		
Jeju	•				•		

Source
Compiled by Author

communication for collaboration. Moreover, when the relocated public institutions seek to pursue cooperation projects with a university, the university pursues such projects independently at the individual college level or industry-university cooperation department, resulting in difficulties from the perspective of the relocated public institution. From the perspective of universities, there has also been criticism that each relocated public institution operates as an independent institution and thus requires individualized project plan for each institution.

5. Policy Agenda for Promoting Linkage between Innovation Cities and Local Universities

Establishment of roadmap for pursuing linkage projects between Innovation Cities and local universities

Since the linkage project between Innovation Cities and regional universities is still in the early stages of cooperation, it is necessary to establish a clear roadmap for business promotion through consultation between relocated public institutions, local governments, and universities, and expand linkage projects sequentially. Due to budget constraints, it is difficult to simultaneously carry out the linkage project between the relocated public institution, local industry, and the local university within the Innovation City development plan; therefore, the priority of each linked cooperation project should be determined through consultation with related organizations, and a comprehensive roadmap for project promotion should be prepared.

Increased role of HEIs in fostering talent tailored to Innovation Cities

In order to secure supply of qualified talent within the region it is necessary to increase the quality of education in local universities through measures such as reorganization of existing curriculum and establishment of convergence majors or track-type curricula through linkage between HEIs and relocated public institutions.

Establishment of linkage between corporations and local universities for specialized development of Innovation Cities

For specialized development of Innovation Cities, it is of utmost importance to establish an industry-university cooperation system among relocated public institutions, resident corporations, and local universities. There is a need to reinforce the perception of the role of local universities in industry-academic cooperation activities such as joint research, technology transfer and commercialization, or community-academic cooperation activities in the form of community problem solving.

Establishment of governance for linkage between Innovation Cities and HEIs

In order to vitalize the linkage project between relocated public institutions in Innovation Cities, companies, and HEIs, it is necessary to establish a system that can support the comprehensive management of projects and linkage between institutions. In order to increase the efficiency and effectiveness of the link between the relocated public institutions in Innovation Cities and HEIs, the Innovation City development support center needs to play a role as a regional growth base. Proper organization and manpower should be prioritized to facilitate the core functions of the Innovation City development support center.

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“It is necessary to establish a system that can support the comprehensive management of projects and linkage between institutions.”

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Smart Regulatory Strategies for Regional Development in the Fourth Industrial Revolution Era

Wooseong Jeong

1. Regional Development in the Fourth Industrial Revolution Era

After the fourth industrial revolution was issued worldwide, major developed countries such as Germany, the U.S., and Japan have been establishing the fourth industrial revolution strategies, which are in line with the industrial and institutional environment. Korea has succeeded as a fast follower through fostering the manufacturing industry, but a strategic approach becomes more important than ever due to the institutional environment such as a rigid legal system, industrial ecosystem focused on large companies, and innovation practice led by government.

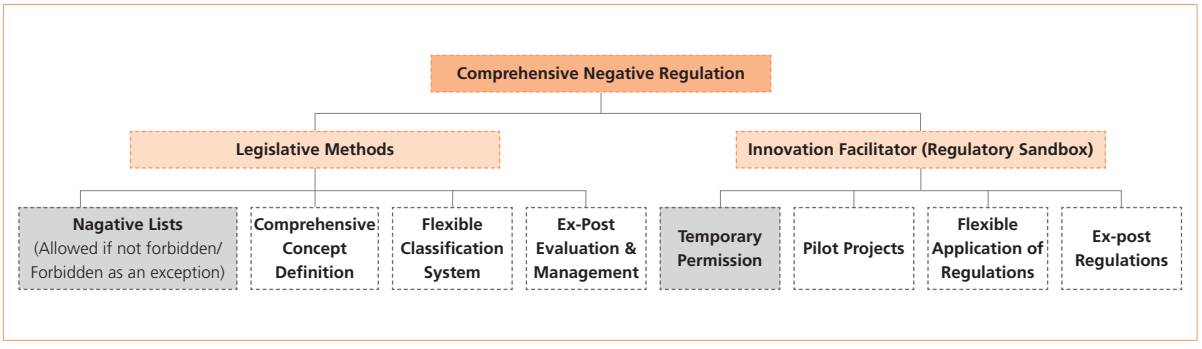
2. In the Fourth Industrial Revolution Era, Necessity for New Regulations

Flexible and agile regulations are required in response to the features of the fourth industrial revolution such as 'super-convergence', 'super-connectivity', and 'super-intelligence.' Since Korea is based on a positive regulatory system of continental legal traditions, it is difficult to cope with the convergence · complex characteristics of industry and rapid changes in the era of fourth industrial revolution. In particular, supplier-oriented regulations and uniform · rigid regulations by the central government have been pointed out as factors that hinder the activation of new industries and new technologies.

The results of corporate recognition survey[01] also showed high dissatisfaction and negative awareness of the existing regulations as well as the necessity of introducing institutional improvement including new regulation design.

- The overall regulatory level and intensity recognized by companies are high
  - Regarding the overall regulatory level in Korea, 'high + very high' (41.9%) responses are much more than 'low + very low' (10.1%) responses. By industries, 'high + very high' responses of companies related to the fourth

Figure 1. Concept of Negative Regulation



Source
Inter-ministerial Report (September 2017). Guidelines for finding negative regulations in new business areas (2nd edition). p.2

01. This survey was conducted on a total of 198 companies in the general manufacturing industry (automotive parts, machinery, etc.) and the fourth industrial related sectors (drones, robots, artificial intelligence, etc.) by online survey method via email from October 29 to November 16, 2018

industrial revolution (3.41 points) are much more than those related to manufacturing companies (3.21 points).
  - Regarding the overall regulatory intensity recognized by companies, 'strong + very strong' (27.8%) responses are much more than 'weak + very weak' (11.6%) responses.
- Regarding the necessity for new regulation improvement, 77.8% of respondents answered "necessary"
  - Among the reasons, 'Prior certification procedures for products such as safety certification are complicated' (53.2%) shows the highest responses, and then 'Requirements and standards for new technologies and new industries are limited' (50.0%), 'There is no applicable provision for new technology and new industry' (37.7%), 'New ways of sales or business activities are heavily regulated' (28.8%), 'Constraints for testing new technologies and new products are severe'(19.5%), 'Temporary deferral for existing regulations is required' (14.4%) are shown in order (duplicate answers).

3. Regulatory Improvement Strategies for the Fourth Industrial Revolution in Korea

1) Introduction of Comprehensive Negative Regulation

The legal and institutional approach as a prior permission · ex-post regulatory system can be divided into 1) comprehensive and flexible legislative methods and 2) the introduction of regulatory sandboxes that allow prior permission for deferral of regulations for new industries.

The flexible legislative method is a measure to complement comprehensiveness and flexibility in terms of legislative technology and is divided into a negative list method, comprehensive concept definition method, flexible classification system, and ex-post evaluation method; and a regulatory sandbox means a regulatory exception that allows a company to freely demonstrate new industries and new technologies by deferring or exempting from regulations, or a prior permission under certain conditions. Figure 1

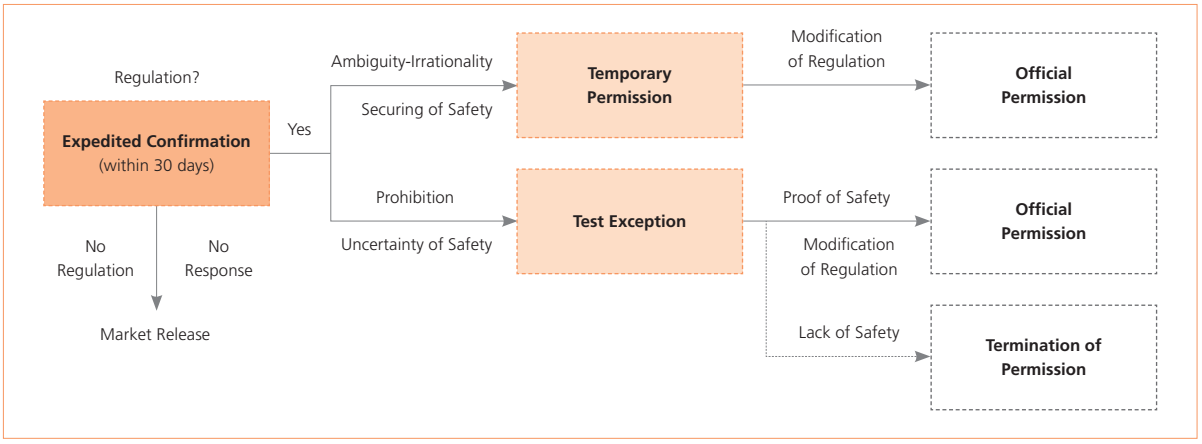
2) Introduction of the Korean Regulatory Sandbox

Korea has established legal grounds for the application of regulatory sandboxes at regional level through the Special Act on Regulation-Free Zones and Special Economic Zone for Specialized Regional Development

The government has introduced regulatory sandboxes in the four areas of information and communication technology, industrial convergence, financial technology, and new regional industries based on 「Special Act on Promotion of Information and Communications Technology, Vitalization of Convergence Thereof, etc.」, 「Industrial Convergence Promotion Act」, 「Special Act on Financial Innovation Support」, 「Special Act on Regulation-Free Zones and Special Economic Zone for Specialized Regional Development」, and special cases for test exception, temporary permission, and expedited confirmation were applied

Of these, the Regulation-Free Zones according to the Special Act on Regulation-Free Zones and Special Economic Zone for Specialized Regional Development foster new industries in non-metropolitan areas by easing core regulations into packages on a regional basis, which differs from other types of regulatory sandboxes in that menu-style regulation exemptions[02] are applied according to regional characteristics

Figure 2. Flowchart for Exception System of Regulatory Sandbox



Source
Inter-ministerial Report (September 2017). Implementation results of regulatory sandboxes for 6 months. Presses release.

and financial supports such as budget and tax are provided. Figure 2

4. Smart Regulation Strategies in the Era of Fourth Industrial Revolution

Regulatory policy efforts are required to open the door for technological innovation and new value creation through regulatory reforms including changes in existing regulatory methods and procedures.

1) Implementation Directions for Smart Regulation

The regulatory directions for the development of new industries for regions are suggested below.

Negative regulations : Removing barriers to the entry of new technologies and industries through a flexible interpretation of regulations and transition to negative methods is necessary

Flexible and agile regulations : Regulations should be flexible and agile to facilitate the creation of new technologies and market entry of new industries

Integrated regulations : Regulations should have predictability and integration based on a systematic perspective

Place-based regulations : Regulations should be aligned with local industrial conditions and characteristics, and new technologies and performances of new industries should go along with regional development such as strengthening local competitiveness, improving the quality of life and creating jobs Figure 3

2) Implementation Strategies for Smart Regulation

In this study, smart regulation for regional development is defined as 'a flexible, adaptive, and result-oriented place-based negative regulatory system for improving regional competitiveness, improving quality of life, and improving urban services.'

Establishment of a regular monitoring system for new industry regulations

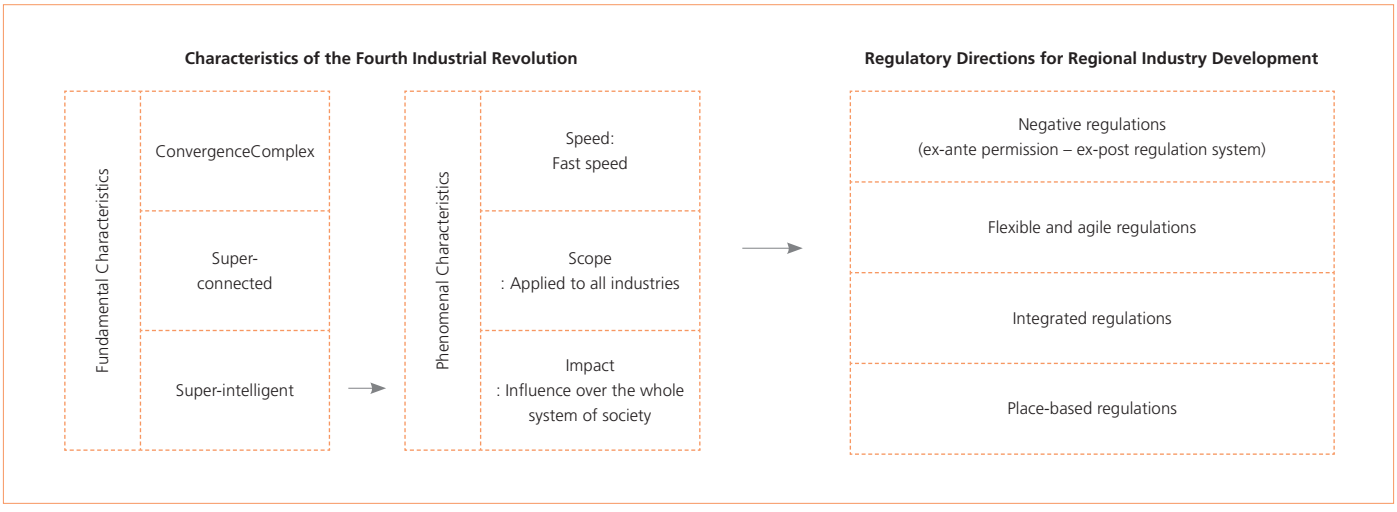
In order to respond to convergence between rapidly evolving technologies and industries and new business models, the establishment of a system of continuous reform through regular monitoring of regulations is required

① Pre-regulation Phase: Assessment of current regulatory status

Multi-dimensional review of services or phased regulations to assess whether current regulations hinder new innovations (technology or business areas), whether conform to reality, or whether are overlapped.

A comprehensive review of the overall regulations, including regulations related to various areas and external regulations such as employment or business licenses, by each department (regulatory authority) and an inter-ministry task

Figure 3. Characteristics of the Fourth Industrial Revolution and Regulatory Directions for Regional Industry Development



02. The menu-style regulatory exceptions mean a list of exceptions to regulations based on various laws and the way in which the region autonomously selects and determines the required regulatory exceptions, accordingly which are applied.

force (TFT)[03]

② Agile regulatory system: Test and pre-assessment of new regulations

Timing is important for technology and industry in the fourth industrial revolution era and accordingly, speed is important in supporting or regulating.

For local industries, examples include Regulation-Free Zones under the Special Act on Regulation-Free Zones and Special Economic Zone for Specialized Regional Development

③ Determination of the level of regulations for new technologies and new industries

Industrial sectors such as medical, bio-industry, autonomous vehicles conflicts with personal information and values of safety

The Government sets the direction for technology development and the scope of test, and accordingly presents a roadmap for the phased regulatory innovation by technology and industry

Ex-post evaluation phase: Assessment of change/ performance after regulations

Regular review of regulations at the pace of development of new technologies and business models related to the fourth industrial revolution

Development of performance-oriented criteria for assessing changes after regulations and evaluation based on the developed criteria Figure 4

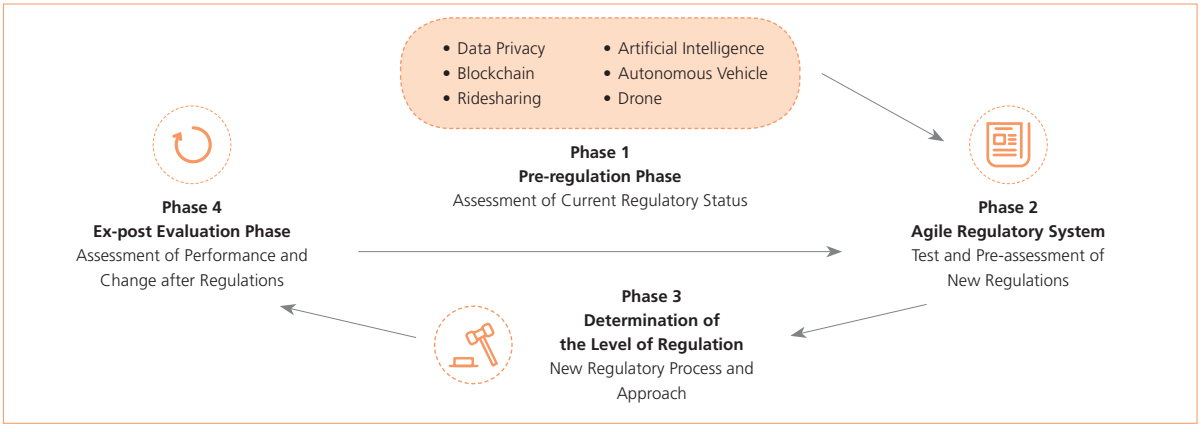
Strengthening of a performance-based regulatory assessment

Need to strengthening result-oriented regulatory elements such as outcomes or goals of regional development rather than traditional input-oriented or conditional restriction regulations where prior conditions, permits, procedures are used as means Figure 5

Evaluation of regulations also needs to be changed from input or form-oriented to performance-oriented scheme

Regarding the evaluation of improvement of regulations for corporations and industry sectors, performance criteria need

Figure 4. Smart Regulations from a System Perspective



Source
The figure is modified and cited from Deloitte Center for Government Insight analysis (https://www2.deloitte.com/insights/us/en.html. accessed as of October 20, 2018)

Figure 5. Result Oriented Regulations (Example)

Regulation Method	Input Oriented	Conditional Restriction	Result Oriented
Example	Operators who have passed the XX inspection and have a oo permit are only eligible for operating autonomous vehicles.	Vehicles of oo CC and above cannot be used as an autonomous vehicle and cannot be operated on roads over X lanes.	Vehicles are not allowed to be operated in a way that endangers human life.
Result	Various qualifications are required such as license	Cars with high horsepower are restricted in busy roads	The purpose of regulation is directly explained by conditions, Companies can have a lot of room for business operations.

03. For example, the Danish Ministry of Environment has established a task force that responds to outdated legislation due to its disruptive business model and plans to reduce the number of regulatory provisions to one-third and the number of Acts from 90 to 43 in order to rearrange all existing Acts to be in line with the digital age

to be improved as the regions can realize

For example, it is linked to indicators with high levels of local awareness such as creating stable local jobs, raising local income, increasing the level of urban services, and improving the quality of life for local residents beyond the number of start-ups or revenue growth

Differentiation of regulations according to regional characteristics

Regulation of the fourth industrial revolution era should be applied in a differentiated manner by considering spatial hierarchy such as large cities, small and medium cities, and agricultural, mountain, and fishing villages and regional industrial characteristics

Application of and intensity of regulations should be differentiated with the consideration of regional characteristics by regulatory issues Table 1

Enhancement of effectiveness of a regulatory sandbox

A regulatory sandbox is a type of regulatory exemption system where a company as the main innovator can test new products, services or business models without complying with existing standards or regulations under controlled environment

Regulators can pretest regulations on new technologies, products, and services through regulatory sandboxes

Close cooperation between the central government, local governments, and private companies is required to put a regulatory sandbox into an effective system, and it is necessary for the central government to encourage the participation of government departments and adjust matters related to interagency regulations

Establishment of cooperative regulatory governance

Regulations in the fourth industrial revolution era need to strengthen participatory regulatory governance where consumers of regulation and the general public including companies can participate rather than the approach of the regulator-the regulated from a specific field.

Developed countries such as the U.S. have applied regulation methods of citizen participation.[04]

Establishment of 'agile governance' to respond promptly to demand of various regulatory policies

Establishment of corporative regulatory system with the central government is required, where the region that, through regulatory decentralization, takes a lead in investigation and analysis of the needs of regulatory improvement required in the region.

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Table 1. Response Strategies for Regulations of the Fourth Industrial Revolution by Spatial Hierarchy (Examples)

Large Cities	**Complex and multidimensional space utilization strategies for large cities** : Focusing on flexible use of space for activation of start-ups and light, thin, short, and small type service businesses, but linking with the use of idle facilities and public lands in the cities.
Regional Innovation Hubs	**Strategies to strengthen regional innovation hubs (innovation cities, industrial parks, etc.)** : Testbed of innovative cities, the advancement of industrial parks (establishment of industrial cluster models for large cities in local provinces, the advancement of aging industrial parks, etc.), fostering of small and medium cities for hubs, expanding of the Pangyo model, etc.
Declining areas	**Linkage with local resources and regeneration strategies** : Considering of plans such as smartification of agriculture, the discovery of content by utilizing local historical and cultural resources, and improvement of accessibility to public services by adopting the concept of regeneration

Source
Compiled by author

04. The UK's red-tape challenge is a reexamination process of existing regulations and had been in progress for two years starting April 2011 as part of regulatory reform. Accordingly, the ministries were called to duty to identify whether the regulations are required to exist and conducted mutual discussions between government, companies, and the public on regulatory issues in which appeals had been filed. In January 2011, the U.S. retrospective review introduced by the Obama administration through Executive Order 13563(Improving regulation and regulatory review) evaluated the effect on regulation from the public point of view

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KRIHS (Korea Research Institute for Human Settlements) was established in 1978 in order to contribute to the balanced development of national territory and the improvement of the quality of life of people by conducting comprehensive policy-oriented research in the efficient use, development, and conservation of territorial resources.