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ANALYSIS OF BUSINESS DEMOGRAPHY DATA FOR REGIONAL DEVELOPMENT POLICY

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KRIHS Korea Research Institute for Human Settlements

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KOREA RESEARCH INSTITUTE FOR HUMAN SETTLEMENTS SPECIAL REPORT 2018

KRIHS

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- A Study on Industrial Location Strategy toward the Future Socio-Economic Changes, 2016, KRIHS
- A Study on the Local Economic Development Strategy in Population Ageing, 2015, KRIHS
- New Industrial Location Strategy for Job Creation, 2013.KRIHS
- Industry Location Study for the SMART growth of the Capital Region, 2011.12.31.

Contents

Summary

2017 will be significant for Korea, as the working age population posts a negative growth for the first time in its history, pushing the country to the edge of a demographic cliff. When slow growth becomes the norm, businesses need to secure competitiveness to survive, and single-person households will likely live closer to their jobs. Automated systems will accelerate the replacement of manual labor by machines and AI.

This study projected how rapid socioeconomic changes will change the Korean manufacturing sector environment and systematically analyzed institutional improvements needed for national territory and industrial locations by conducting large-scale big data analytics and empirical analyses. This study enhanced the reliability of big data analytics through dual analysis, by conducting big data analytics of future trends and verifying the results with empirical data, and provided quantitative data that supports future policy development.

It is imperative to set a clear direction for industrial location policies by focusing on either promoting balanced national development or satisfying business needs. It is also essential to apply different approaches to different types of industrial locations, with regard to the designation process for industrial parks and supportive measures. The UK and Japan have shifted their policy focus from balanced distribution of industrial locations toward the concentration on large cities and the capital areas. As such, this study suggests that Korea should prioritize efficiency over equality in supplying industrial locations. In addition, more comprehensive management is needed to achieve efficient supply of industrial sites that are currently divided across different government ministries. Policy focus should be placed on supplying industrial sites to urban areas, rather than supplying low-cost factory sites to rural areas to ensure that businesses can be more competitively located.

CHAPTER I.

Introduction

Korea is undergoing sustained for structural and socioeconomic changes. Korea's potential GDP growth has sharply fallen since 1990 and is expected to decline from the high 3% range in 2010 to the 2% level in 2020 and the 1% range in 2030. With the lowest fertility rate among OECD countries, Korea is likely to hit the demographic cliff, as its working age population will be declining from 2017, and enter a prolonged period of stagnation as is the case with Japan. The widening of fiscal deficits would pose a limit to government-led economic growth. The industrial landscape is undergoing fundamental changes at a rapid pace with the opening of the global economy, cross-border economic integration resulting from the organic connections between countries, and the acceleration of offshoring trends among major industries.

In general, Korea's industrial location policies still rely on the supply of industrial parks without significant changes. However, the continuation of socioeconomic changes is anticipated to bring about fundamental changes to industrial locations. The changes in the labor structure such as an aging population should reshape the demand for industrial locations with the rise of one-person businesses, introduction of new manufacturing methods such as 3D printing, and growing demand from non-manufacturing sectors such as financial services, healthcare, and science and technology services.

Given such changes in Korea and abroad, this study aims to recognize the external environment of industrial locations that is subject to socioeconomic changes and identify major changes and trends that characterize the demand and development of industrial locations. The study also intends to present forward-looking industrial location strategies through an empirical analysis.

The study first examins the changes of Korea's industrial locations by analyzing exogenous socioeconomic factors such as the global economic slump, aging population, and changing social structures as well as changes in industrial location demand resulting from the changes in demand from manufacturing sector and new manufacturing methods.

The study conducted big data and social network analysis (hereinafter SNA) to project socioeconomic changes and megatrends in the future. After extracting relevant keywords from future trend outlooks, key economic theories, and precedent research, the study groups, the keywords to establish a correlation between the trends and derives trends for industrial locations and national territory. The study develops a big data set based on news media reports to identify megatrends for industrial locations and national territory and conducts a SNA to track socioeconomic trends that affect industrial locations. In the process, SNA mapping was used to chart a correlation between changes in respective conditions and trends in industrial locations and national territory.

To understand how location affects a company's competitiveness in terms of profitability, or whether proximity to major cities or the Seoul Metropolitan Area affects top- and bottom-lines, the study analyzes the type of industry locations and the correlation between the operating margin and proximity to large cities and the Seoul Metropolitan Area. This provides interesting findings and significant implications for Korea's industrial location policies represented by industrial parks.

Lastly, the study presents strategies and implications with a focus on Korea's industrial location policy objectives, ways to supply and develop industrial locations, and supportive measures and designation procedures.

"To understand how location affects a company's competitiveness in terms of profitability, or whether proximity to major cities or the Seoul Metropolitan Area affects top- and bottom-lines, the study analyzes the type of industry locations and the correlation between the operating margin and proximity to large cities and the Seoul Metropolitan Area. This provides interesting findings and significant implications for Korea's industrial location policies represented by industrial parks."

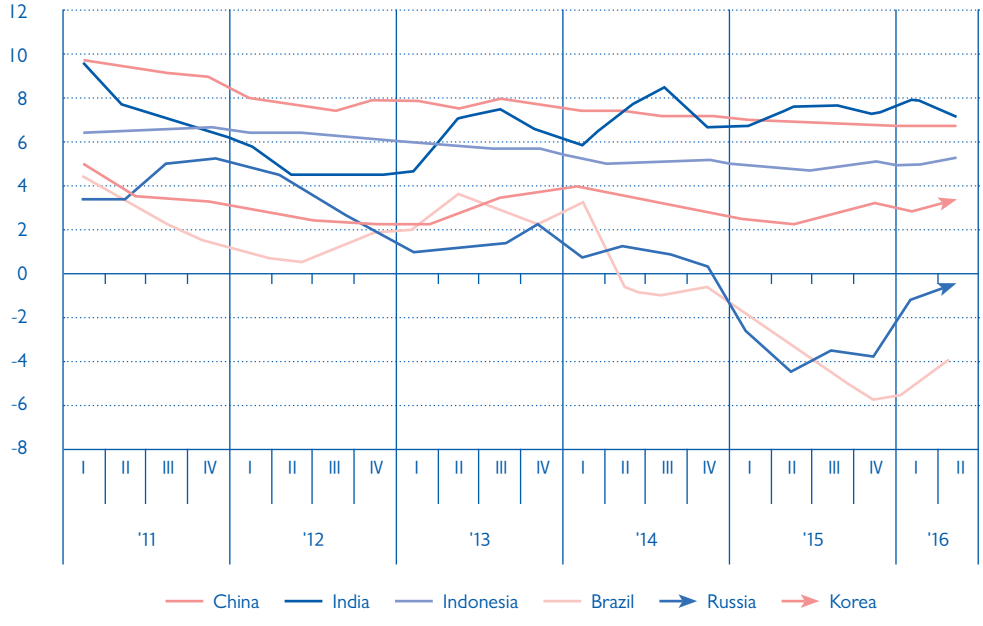
CHAPTER II.

Changes in Industrial Location Conditions

1. Global Economic Slump and the New Normal

Korea is facing sustained structural and socioeconomic changes and entering a slow growth phase, while the global economy is in the midst of a prolonged recession. With a decline in effective demand and stagnant economic growth, industrial location demand will likely change across different sectors such as manufacturing.

Figure 1. GDP Growth Rates in Emerging Economies (YoY, %)



Source: Jung Sung-Chun, 2016, 2017 World Economic Outlook, KIEP,Today World Economy, 16th, No.33, KIEP

Notably, the shortage of effective demand is coinciding with a global oversupply, which gives rise to job uncertainties and wage issues. Despite an economic recovery, the US is witnessing rising income polarization as high net-worth individuals and high-skilled groups earn more than before amid the absence of nominal average wage gains (Kim 2015, 12-14). The same is true of Korea. Since the late 1990s, Korea has entered a structurally slow growth phase with potential GDP growth estimates falling from the high 3% level in 2010 to the 2% level in 2020 and the 1% level in 2030 (Kim and Lee, 2015). Corporate Korea's average operating margin continued to slide from 5.7% in 2011 to 4.8% in 2014 (Yu and Lee 2015, 10), which suggests a bearish economic outlook for a considerable period and subsequent changes in industrial land demand. That is, a global economic slump and the age of the New Normal do not bode well for the future of industrial locations.

2. Occurrence of Externalities such as Changes in Demographic Structure

01. http://blog.naver.com/hi_nso?Redirect=Log&logNo=220828524817, Last access dated on October 20, 2016

The global economic recession and demographic changes, which characterize the New Normal, are emerging as key variables in the industrial location environment. In Korea, the share of the population aged over 65 stood at 13.2% (6.56 million persons) in 2015, an increase of 2.2 million[01] from 2005, and is expected to exceed the 14% threshold for an aged society during 2017 and 2018 and enter a super-aged society by 2026. Given that it took 12 years for Japan and 39 years for France to enter a super-aged society, Korea is expected to become a country that makes the fastest transition to a super aged society in the world.

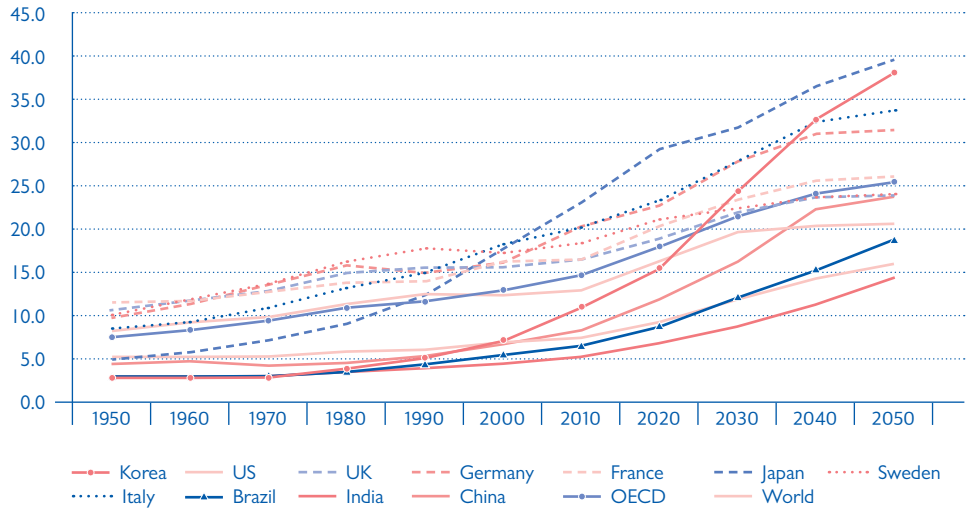
Table 1. Population Aging in Korea (1960–2060)

Source: Statistics Korea 2011, 13

Median Family	1960	1970	1980	1990	2000	2010	2020	2030	2040	2050	2060
Total Population (millions)	25,012	32,241	38,124	42,869	47,008	49,410	51,435	52,160	51,091	48,121	43,959
Breakdown (%)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
65+	2.9	3.1	3.8	5.1	7.2	11.0	15.7	24.3	32.3	37.4	40.1
65–74	2.2	2.3	2.8	3.5	4.9	6.9	9.1	14.6	15.8	15.3	15.1
75–84	-	-	-	-	2.0	3.4	5.1	7.2	12.5	14.4	14.8
85+ (75+)	(0.7)	(0.8)	(1.1)	(1.6)	0.4	0.7	1.6	2.5	4.1	7.7	10.2

Korea has the lowest fertility rates among OECD countries. The combination of population aging and low fertility rates is worsening the problem. Korea's working age population peaked at 37 million in 2016 only to plunge thereafter. Thus, Korea is highly likely to hit the demographic cliff in a couple of years and slip into a serious economic stagnation.

Figure 2. Share of the Population Aged over 65 by Countries (1950–2050)



Source: Park et al. 2010, 9.

Korea's working age population is projected to fall from 2017, pushing the country into a prolonged period of recession due to the shortage of effective demand as is the case with Japan. The subsequent increase in welfare spending should gradually widen the government's fiscal deficit. The expected slowdown in growth rates, aging population, lower fertility rates, and explosive growth for welfare demand would put the brake on government-led economic growth.

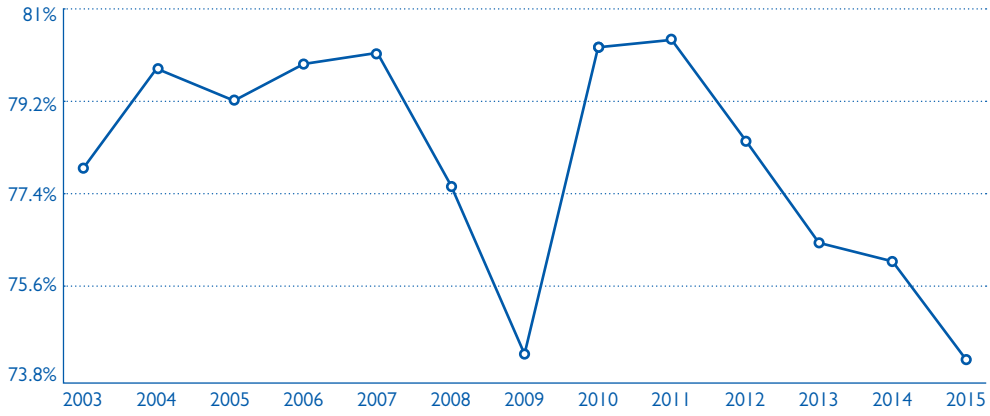
3. Manufacturing Slump and Demand for Industrial Locations in Korea

Hyundai Research Institute (2016, 2–12) diagnosed that the Korean manufacturing output records a negative annual growth for three consecutive quarters or longer, which signals a prolonged recession that is already underway. Specifically, the median value of revenue growth rates for Korean businesses stands at 2.7%, versus 3.6% during the 2008 financial crisis, whereas the average revenue growth rates come in at 12% versus 7.3% during the crisis. The discrepancy shows that large corporations continue to drive overall revenue growth, and small to midsize companies report weaker revenue growth than they did during the 2008 financial crisis. Further, Korean manufacturers recorded an operating margin of 1.8% in 2015, falling short of the levels seen during the 2008 financial crisis (3.7%) and the Asian financial crisis of 1997-1998 (5.3%). As such, the Korean manufacturing sector is undergoing a serious crisis.

Another worrying signs is the declining utilization rate of the manufacturing capacity. The Korean manufacturing sector's average utilization rate fluctuated from 2003 to 2015 and has continued the downward trend from 2010 in the wake of the 2008-2009 financial crisis (See Figure 3).

Figure 3. Average Utilization Rate in the Korean Manufacturing Sector by Year

Source: Statistics Korea



As a result of a decline in the utilization rates as well as productivity, the share of marginal companies, which were unable to service debts with operating profits, rose for three consecutive years to reach 15.2% (3,295 companies) in 2015 (Hyundai Research Institute 2016, ii).

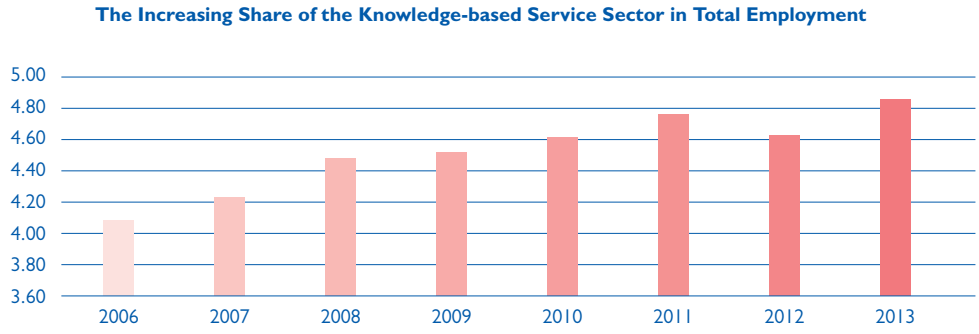
4. Arrival of Industry 4.0 and Transformation Toward a Service-oriented Industry Structure

European countries such as Germany were no match to Korea in price competition due to their high labor expenses. However, these countries are now overtaking Korea by leveraging digital technologies such as Industry 4.0-based smart factories and introducing new manufacturing methods that integrate production, quality control, facilities, worker safety, environmental preservation, and factory automation. Latecomers such as China are playing catch-up with low-cost technologies. The Fourth Industrial Revolution integrates physical instruments (e.g., sensors, actuators, and mobile devices) for production, inventory, and customer management through the internet and creates a link between physical production and the web-based virtual space to enable ex-ante verification, real-time control, and ex-post analysis. The evolution of the Fourth Industrial Revolution is projected to enable frequent product changes to meet customer needs and innovate the post-production logistics and delivery systems.

More flexible and competitive production methods would negate the need for traditional manufacturers in Europe and the US to turn to low-cost countries in East Asia or China, prompting them to bring production facilities back home.

Although there is no consensus on how the diffusion of Industry 4.0 will change industrial locations, many researchers including Park Yeong-geun and Kim Yeong-hun (2014, 3) project that eco-friendly factories with dramatically low levels of noise and waste pollution will make their way into cities, reducing proximity to employment and accelerating the urban concentration of industrial locations. As such, the development of Industry 4.0 is anticipated to bring out changes to the current system, under which low-priced large plots outside cities are developed and supplied as industrial parks.

Figure 4. The Percentage of Those Employed in the Knowledge-based Service Sector



Source: Suh et al 2015, 29.

The increasing share of the knowledge-based service sector in total employment has a bearing on industrial location policies in Korea. Five major cities host about 89.5% of startups in the knowledge-based service sector with the Seoul Metropolitan Area accounting for the lion's share (Suh 2015, 67). Demand for new types of industrial locations is expected to increase in the Seoul Metropolitan Area and major cities.

> **"More flexible and competitive production methods would negate the need for traditional manufacturers in Europe and the US to turn to low-cost countries in East Asia or China, prompting them to bring production facilities back home."**

CHAPTER III.

Projection of Industrial Location Trends Using Big Data and SNA

1. The Need for Developing Future Industrial Location Strategies Using Big Data

Big data means a collection of large datasets that are analyzed with information technologies to extract valuable information and predict future changes based on the generated knowledge (Lim and Park 2015, 77). The use of big data makes it possible to address uncertainties, risks, smart technologies, and convergence that come with the future society. The incorporation of big data into future strategy development is so widespread across the world that developing future strategies is almost equated with identifying future policy agenda through big data-based projections (Song 2013, 1)[02] . Korean government organizations such as the Ministry of Security and Public Administration and the Korea Communications Commission harness big data to devise measures to enhance competitiveness for businesses and the nation. Developing policies and providing administrative services through big data have emerged as a policy agenda that is more important than ever.

02. Singapore (RAHS), the UK (Horizon Scanning Center) and the EU (iKNOW) are using big data to develop future strategies. (Lim and Park 2015, 77).

2. Big Data Collection and Analysis Methods

Big data analysis, which is gaining attention, primarily concerns an analysis of unstructured data. Unlike structured data such as figures, collecting and analyzing unstructured data in the form of newspaper, news, and tweets require text mining. The development of data mining technologies in recent years led to the creation of news article databases, which provided the basis for recent studies (Kam and Song 2012, 55). Big data analysis of news articles, tweets, and blog postings has been used since 2012. However, as opposed to news articles, personal social media mostly comprise unverified sources such as retweets and quotes. Therefore it is essential to secure reliability when using social media sources for research purposes.

To determine socioeconomic changes that affect future policies for industrial locations, the study collected around 219,000 news articles published between 2014 and May 31, 2016, and were considered to reflect social trends. Using predetermined keywords regarding socioeconomic changes and national territory such as industrial locations, the study extracted 8,125,483 natural language results to establish big data for analysis.

Table 2. Method and Scope of Analysis

Method of Analysis	Natural language-based text mining
Period of Analysis	June 1, 2014 – May 31, 2016
Scope of Analysis	-219,508 news articles published during the period of analysis -8,125,483 natural language results derived from keyword index

To conduct big data analysis, the study used *Megatrends Surrounding Future Industries and their Implications on the Korean Society* (Choi et al. 2015) published by the Korea Institute for Industrial Economics & Trade in 2015 as well as SNA to ensure research feasibility. Through SNA, the study established correlations between keywords in the socioeconomic, environmental, spatial, and territorial contexts that are related to industrial locations and analyzed socioeconomic changes in the order of their relevance to industrial locations.

3. Future Industrial Location Trends Using Big Data and SNA

3.1 Classification of Future Trends that Affect Industrial Locations

The study extracted big data from news articles and analyzed them by combining keyword searches concerning national territory with the big data analytics method adopted by Choi Yun-hee, et al. (2015). Choi et al. provide important policy implications for future industrial strategies using big data. However, as the research is devoid of megatrends for space and national territory, it provides very limited insight for industrial location policies that should take location as well as spatial policies into consideration.

As such, this study added megatrends for cities, locations, and spaces that were excluded from Choi et al. to conduct big data collection and SNA. Apart from industries, global economies, politics, society and technologies, this study extracted key megatrends for the national territory based on the related literature as follows.

- The national territory will develop with three major cities—Seoul, Busan, and Gwangju—respectively leading the Seoul Metropolitan Area, Ulsan and provinces of Gyeongsangnam-do, and Jeollanam-do (Kim 1999, 8)

- The population concentration in the Seoul Metropolitan Area is likely to stabilize,

rather than accelerate, with a declining share of population living in the area. The manufacturing sector should give way to the service and convergence industries. Excluding Seoul, six metropolitan cities should demonstrate visible growth. (Ju 1999)

- The rise of sharing economy and driverless vehicles should improve efficiency in the use of parking space. Working places are spatially dispersed, with such facilities as video0conferencing, telecommuting and outsourcing should increase (Park and Glenn 2015, 92)

- Smart infrastructure should expand driven by IT, a creative workforce, and core talents. Urban development should increase in density as in compact cities (Maeil Business 2016)

Representative studies of the future trends for national territory include Lee Yong-woo, et al. (2009, 2010, 2011, 2012, 2013, 2014). Even though the research subject is future trends for national territory, its projections are mostly related to future macro trends for socioeconomic and environmental factors such as an aging population, global warming, and the expansion of the global economy, representing a significant degree of overlap with other research on future industrial and economic trends. As such, this study stripped away these exogenous dimensions and extracted future trends in urban, residential, and national territory segments.

Long-term Outlook for Future National Territory Development and Implementation Strategies (Lee 2012)

- A diverse use of marine space such as the development of offshore cities
- A decline in housing demand due to low fertility rates and aging population
- An increase in demand for small residential units with Korean household size getting smaller
- An increase in eco-friendly high-rise smart buildings
- A widening gap between the Seoul Metropolitan Area and the rest of the territory

The Future of National Territory II (Lee 2010)

- A rise in home-ownership rates and stabilization of the housing market
- An increase in residence in cities, which serve multiple roles as a residential, occupational, and recreational space
- Urban concentration of R&D and production activities by high-tech industries
- A decline in the supply of manufacturing-dominated industrial locations
- The shift of industry spaces towards multi-functionality
- The occurrence of a gap between existing industrial parks and major cities that are in the midst of urban renewal
- Multi-dimensional and multi-purpose land development in major cities (underground development, high-rise development)

The Future of National Territory III (Lee 2011)

- Concentration of knowledge-based manufacturing and service sectors in the Seoul Metropolitan Area
- Polycentric development of Seoul Metropolitan Area across Seongnam, Anyang, Suwon, Paju, and Goyang
- Increasing convergence of the residential areas and industrial clusters in high-tech industries
- Proliferation of telecommuting and a decline in traffic congestion

As a result, based on precedent research on future trends for national territories, cities, and residential environments, this study defined seven national territory trends and one economic trend as follows and added them to the collection of future trends defined by Choi Yun-hee, et al. (2015).

National Territory

1) Development of high-tech industries in the Seoul Metropolitan Area or metropolitan cities
2) A decline in commuting distance or work-home integration
3) A decline in demand for regional industrial locations
4) Further concentration of highly skilled talents in metropolitan cities or the Seoul Metropolitan Area
5) High-rise or high-density development in city centers (compact development or compact cities)
6) Extension of living sphere
7) The rise of the sharing economy in factories, houses, and cars

Economy

1) An increase in jobs for the elderly

On top of the 30 global industrial trends identified by the precedent study (Choi et al. 2015), this study added seven national territory trends and one economic trend and presented a total of 38 mega trends for national territory and industrial locations as follows.

Source: Author

Table 3. Megatrends Affecting Industrial Locations

Sector	No.	Megatrend
Society (S)	1	Changes in demographic structure due to aging population and an increase in average age
	2	Rapid population growth in developing countries and a stagnant population growth in advanced countries
	3	An increase in global middle-income population
	4	An increase in women's income and status
	5	Changes in the traditional concept of families
	6	Wider spread of individualism
	7	Spread of a lifestyle which prioritizes quality of life over work
Technology (T)	1	Arrival of a digital society, where data collection, analysis, and use is possible anytime
	2	Changes in jobs with workers replaced by computers or artificial intelligence
	3	Spread of real-time health management service to meet health care demand
	4	Incorporation of augmented reality and virtual reality into daily lives
	5	Spread of customized production systems and an increase in individual manufacturers
	6	Acceleration and spread of technology changes
	7	Spread of naturalism in response to negative effects of technology development
	8	An increase in borderless terrorism such as cyber crimes
Environment (EV)	1	An increase in negative effects of climate changes
	2	Concentration of demand for key resources such as water in a few countries and regions
	3	Global shortage of food and water
	4	Growing risks of depletion of natural resources such as oil and gas
Economy (EC)	1	Accelerating growth of emerging economies
	2	China's rise as the world's largest economy
	3	Expansion of cross-border exchange in products, services and human resources
	4	Aggravating economic polarization and inequality
	5	Global economic recession
	6	Knowledge-based economic growth
	7	An increase in jobs for the elderly
Politics (P)	1	US hegemony on decline; a shift to a multi-polar world
	2	An increase in international conflicts and regulations due to higher interdependence
	3	Spread of economic integration across countries
	4	Deepening international conflicts stemming from ethnicity or religions
	5	Limitations in public service due to public sector debt growth
National Territory (NT)	1	Development of high-tech industries in the Seoul Metropolitan Area or metropolitan cities
	2	A decline in commuting time or work-home integration
	3	A decline in regional industrial locations (industrial parks) demand
	4	Concentration of highly skilled talents in metropolitan cities and the Seoul Metropolitan Area
	5	High-rise or high-density development in city centers (compact development or compact cities)
	6	Extension of living sphere
	7	A rise of the sharing economy in factories, houses, and cars

3.2 Natural Language Processing of Big Data through Text Mining

This study conducted news article collection and text mining based on the future trends defined as above. For megatrend analysis, the study collected 8,125,483 news articles from June 1, 2014, through May 31, 2016, but excluded social networks such as blog services, Twitter, and Facebook, which serve as a platform for sharing news articles and thus do not have a material impact on megatrend analysis. This study established a large-scale unstructured database by processing and filtering the entire texts of news articles (approximately 8 million pieces) published during the period to enable keyword search.

The study extracted 210,000 items of megatrend data by conducting keyword searches based on the large-scale unstructured database. Megatrend data indexing was conducted including similar keywords as follows.

Table 4. Megatrend Keyword Search Queries

Megatrend	Data Indexing Keyword
National Territory 3: A Decline in Demand for Regional Industrial Locations (Industrial Parks)	(Region or Province) and Industries and (Industrial Parks or Location or clusters) and (Demand or Need) and (a Decline or a Fall or to Decline or have Declined or is Declining or Declined and Therefore or as Result of the Decline, Declined but or Declined, Yet)
National Territory 4: Further Concentration of Skilled Talents in Metropolitan Cities or the Seoul Metropolitan Area	(Highly Skilled or Creative or High-tech or Highly Educated) and (Human Resource or Talents) and (the Seoul Metropolitan Area or Metropolitan Cities) and (Centralization or Concentration or Polarization or Inequality or Divide or Distortion)
National Territory 5: High-rise and High-density Development in City Centers (Compact Development or Compact Cities)	([Urban Center or Urban Areas or Cities] and [High-Rise or High-Density]) or (Compact Cities or a Compact City or Center of Compact Cities or Compact Center or Center of Compact Cities or Smart City or Smart Urban Area or Center of Smart Cities)

See appendix for data indexing keyword by megatrend

Source: Author

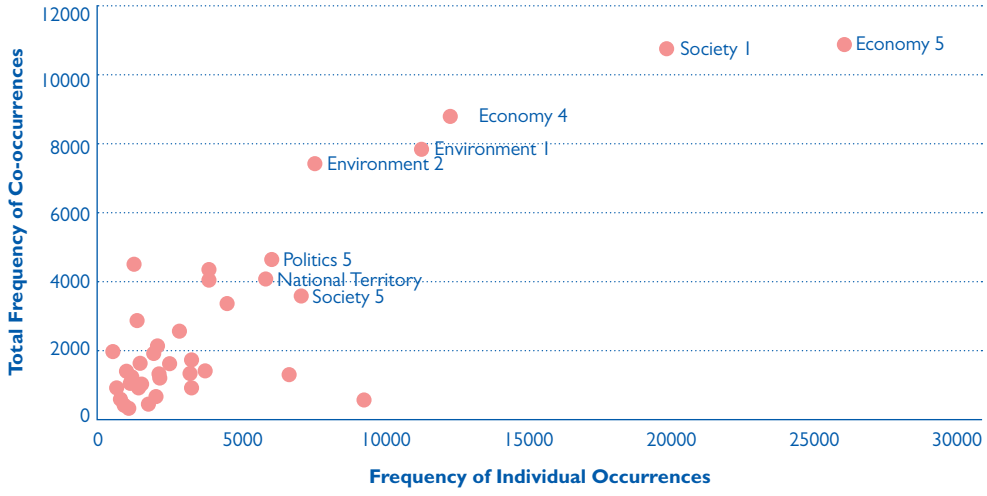
Based on the 210,000 megatrend data, this study applied a text mining technology to quantitatively compare the correlation between keywords. In the event that keywords occur throughout a news article, this study limited the scope of analysis to occurrences in the same sentence to identify the correlation between data indexing keywords, on the premise that co-occurrence of keywords in the same sentence has a stronger correlation than those in the same paragraph.

That is, if a news article includes keywords that represent trend A and trend B, the two trends are considered correlated. The study applied the same text mining technique to all news articles searched and collected in order to establish correlations between trends.

Figure 5 shows the correlation between the trends. The frequency of individual occurrences on the X-axis is the number of news articles with reference to respective megatrends, and the total frequency of co-occurrences on the Y-axis is the number of news articles where a megatrend are collocated with one or more of the 38 megatrends. For instance, Economy 5 (Global economic recession) posted approximately 30,000 individual occurrences and more than 10,000 co-occurrences (i.e. concurrent exposure or occurrence with another trend in the same sentence) in the corpus of news articles.

Figure 5. Individual Occurrence and Co-occurrence by Megatrend

Source: Author



As seen in Figure 5, the frequency of individual occurrences displays a positive correlation with that of co-occurrences. The megatrend with the highest frequency of occurrence and co-occurrence is Economy 5 (Global economic recession), which makes it one of the most important socioeconomic changes.

Society 1 (Population aging and changes in demographic structure) proves to be the second most important megatrend. The study found that these two megatrends should be prioritized in the social context, not to mention in the development of future national territory and industrial location policies.

Table 5. Analysis of Global Megatrend Relation

Category	No.	Megatrend	Frequency of Occurrence (A)	Share	Total Frequency of Co-occurrence (B)	Share	Impact Factor (B/A)
Society (S)	1	Changes in demographic structure due to aging population and an increase in average age	19,540	11.5%	10,879	6.4%	0.56
	2	Rapid population growth in developing countries and a stagnant population growth in advanced countries	740	0.4%	1,016	0.6%	1.37
	3	An increase in global middle-income population	1,287	0.8%	1,348	0.8%	1.05
	4	An increase in women's income and status	1,546	0.9%	1,037	0.6%	0.67
	5	Changes in the traditional concept of families	7,015	4.1%	3,819	2.3%	0.54
	6	Wider spread of individualism	993	0.6%	520	0.3%	0.52
	7	Spread of a lifestyle which prioritizes quality of life over work	2,192	1.3%	1,308	0.8%	0.60
Technology (T)	1	Arrival of a digital society, where data collection, analysis and use is possible anytime	3,857	2.3%	4,475	2.6%	1.16
	2	Changes in jobs with workers replaced by computers or artificial intelligence	2,120	1.3%	1,434	0.8%	0.68
	3	Spread of real-time health management service to meet health care demand	2,030	1.2%	759	0.4%	0.37
	4	Incorporation of augmented reality and virtual reality into daily lives	3,720	2.2%	1,517	0.9%	0.41

Category	No.	Megatrend	Frequency of Occurrence (A)	Share	Total Frequency of Co-occurrence (B)	Share	Impact Factor (B/A)
Technology (T)	5	Spread of customized production systems and an increase in individual manufacturers	3,288	1.9%	1,835	1.1%	0.56
	6	Acceleration in technology changes and spread	1,592	0.9%	1,135	0.7%	0.71
	7	Spread of naturalism in response to negative effects of technology development	1,172	0.7%	1,177	0.7%	1.00
	8	An increase in borderless terrorism such as cyber crimes	6,648	3.9%	1,409	0.8%	0.21
Environment (EV)	1	An increase in negative effects of global warming or climate changes	11,149	6.6%	7,953	4.7%	0.71
	2	Concentration of demand for key resources such as water in a few countries and regions	7,509	4.4%	7,550	4.5%	1.01
	3	Global shortage of food and water	4,474	2.6%	3,461	2.0%	0.77
	4	Growing risks of depletion of natural resources such as oil and gas	3,883	2.3%	4,173	2.5%	1.07
Economy (EC)	1	Accelerating growth of emerging economies	1,060	0.6%	1,524	0.9%	1.44
	2	China's rise as the world's largest economy	2,858	1.7%	2,682	1.6%	0.94
	3	Expansion of cross-border exchange in products, services, and human resources	2,559	1.5%	1,745	1.0%	0.68
	4	Aggravating economic polarization and inequality	12,161	7.2%	8,931	5.3%	0.73
	5	Global economic recession	25,724	15.2%	11,003	6.5%	0.43
	6	Knowledge-based economic growth	2,124	1.3%	2,221	1.3%	1.05
	7	An increase in jobs for the elderly	2,020	1.2%	2,046	1.2%	1.01
Politics (P)	1	US hegemony on decline; a shift to a multi-polar world	1,509	0.9%	1,737	1.0%	1.15
	2	An increase in international conflicts and regulations due to higher interdependence	1,375	0.8%	2,968	1.8%	2.16
	3	Spread of economic integration across countries	3,242	1.9%	1,014	0.6%	0.31
	4	Deepening international conflicts stemming from ethnicity or religions	1,325	0.8%	4,610	2.7%	3.48
	5	Limitations in public service due to public sector debt growth	6,004	3.5%	4,720	2.8%	0.79
National Territory (NT)	1	Development of high-tech industries in the Seoul Metropolitan Area or metropolitan cities	9,219	5.4%	680	0.4%	0.07
	2	A decline in commuting time or work-home integration	1,763	1.0%	535	0.3%	0.30
	3	A decline in regional industrial locations (industrial parks) demand	837	0.5%	701	0.4%	0.84
	4	Concentration of highly skilled talents in metropolitan cities and the Seoul Metropolitan Area	608	0.4%	2,075	1.2%	3.41
	5	High-rise or high-density development in city centers (compact development or compact cities)	3,183	1.9%	1,433	0.8%	0.45
	6	Extension of living sphere	1,137	0.7%	421	0.2%	0.37
	7	The rise of the sharing economy in factories, houses, and cars	5,801	3.4%	4,199	2.5%	0.72

Source: Author

In the national territory category, National Territory 7 (The rise of the sharing economy in factories, houses, and cars) posted the highest frequency with 5,801 individual occurrences and 4,199 co-occurrences.

The study analyzed co-occurrences by trends to identify socioeconomic changes that are most relevant to industrial locations and national territory and summarized the findings as in Table 6.

Table 6. Co-occurrence of Socioeconomic Trends in National Territory and Industrial Locations Trends

Category	Frequency of Occurrence	Category Number	Megatrend	Share of Total Frequency of Co-occurrence
National Territory 1: Development of High-tech Industries in the Seoul Metropolitan Area or Metropolitan	4,720	National Territory 5	High-rise or high-density development in city centers (compact development or compact cities)	10.3%
		Environment 2	Concentration of demand for key resources such as water in a few countries and regions	7.9%
		Economy 5	Global economic recession	7.7%
		National Territory 4	Concentration of highly skilled talents in metropolitan cities and the Seoul Metropolitan Area	7.1%
		Technology 1	Arrival of a digital society, where data collection, analysis, and use is possible anytime	6.8%
National Territory 2: A Decline in Commuting Time or Work-home Integration	680	Society 7	Spread of a lifestyle which prioritizes quality of life over work	24.0%
		Society 5	Changes in the traditional concept of families	9.0%
		Society 1	Changes in demographic structure due to aging population and an increase in average age	7.8%
		National Territory 7	The rise of the sharing economy in factories, houses, and cars	7.6%
		National Territory 1	Development of high-tech industries in the Seoul Metropolitan Area or metropolitan cities	6.3%
National Territory 3: A Decline in Regional Industrial Locations (Industrial Parks) Demand	535	National Territory 1	Development of high-tech industries in the Seoul Metropolitan Area or metropolitan cities	27.5%
		National Territory 2	A decline in commuting time or work-home integration	7.5%
		Environment 2	Concentration of demand for key resources such as water in a few countries and regions	6.2%
		Politics 5	Limitations in public service due to public sector debt growth	6.0%
		Economy 3	Expansion of cross-border exchange in products, services, and human resources	5.4%
National Territory 4: Concentration of Highly Skilled Talents in Metropolitan Cities and the Seoul Metropolitan Area	701	National Territory 1	Development of high-tech industries in the Seoul Metropolitan Area or metropolitan cities	48.1%
		Technology 1	Arrival of a digital society, where data collection, analysis, and use is possible anytime	7.6%
		National Territory 5	High-rise or high-density development in city centers	6.3%
		Economy 6	Knowledge-based economic growth	5.3%
		Environment 2	Concentration of demand for key resources such as water in a few countries and regions	4.3%
National Territory 5: High-rise or High-density Development in City Centers	2,075	National Territory 1	Development of high-tech industries in the Seoul Metropolitan Area or metropolitan cities	23.4%
		National Territory 7	The rise of the sharing economy in factories, houses, and cars	8.6%
		Environment 2	Concentration of demand for key resources such as water in a few countries and regions	8.5%
		Environment 1	An increase in negative effects of global warming or climate changes	7.4%
		Technology 1	Arrival of a digital society, where data collection, analysis, and use is possible anytime	6.2%

Category	Frequency of Occurrence	Category Number	Megatrend	Share of Total Frequency of Co-occurrence
National Territory 6: Extension of Living Sphere	421	Environment 1	An increase in negative effects of global warming or climate changes	14.7%
		Society 1	Changes in demographic structure due to aging population and an increase in average age	11.6%
		National Territory 1	Development of high-tech industries in the Seoul Metropolitan Area or metropolitan cities	9.3%
		Society 5	Changes in the traditional concept of families	8.8%
		Politics 5	Limitations in public service due to public sector debt growth	7.1%
National Territory 7: A Rise of the Sharing Economy in Factories, Houses, and Cars	4,199	Economy 5	Global economic recession	10.5%
		Economy 4	Aggravating economic polarization and inequality	9.8%
		National Territory 1	Development of high-tech industries in the Seoul Metropolitan Area or metropolitan cities	7.1%
		Technology 1	Arrival of a digital society, where data collection, analysis, and use is possible anytime	6.8%
		Economy 6	Knowledge-based economic growth	6.7%

Source: Author

According to Table 6, the share of co-occurrences means the share of other trends that concurrently occur with national territory trend. For example, of 4,720 search results based on National Territory 1, the search results related to National Territory 5 amounts to 486 cases or 10.3%.

The study found that the megatrend that is most related to National Territory 1 (Development of high-tech industries in the Seoul Metropolitan Area or metropolitan cities) is National Territory 5 (Compact urban development), followed by Economy 5 (Global economic recession), National Territory 4 (Concentration of highly skilled talents in metropolitan cities and the Seoul Metropolitan Area), Technology 1 (Digital society), National Territory 2 (Work-home integration), Society 7 (Individualistic lifestyle), Society 5 (Changes in the traditional concept of families such as single-person households), Society 1 (Population aging and changes in demographic structure), National Territory 7 (Sharing economy), and National Territory 1 (Development of high-tech industries in the Seoul Metropolitan Area or metropolitan cities).

The megatrend that is most related to National Territory 3 (A decline in demand for regional industrial locations) is National Territory 1 (Development of high-tech industries in the Seoul Metropolitan Area or metropolitan cities), followed by National Territory 2 (Job proximity), Environment 2 (Regional concentration of energy and resources), Politics 5 (Limitations in public service due to public sector debt growth), and Economy 3 (Expansion of cross-border exchange). The co-occurrence pattern suggests that an increase in the concentration of high-tech industries in the Seoul Metropolitan Area and metropolitan cities, where highly skilled talents reside, leads to a decline in demand for regional industrial locations, and at the same time, the government's financial constraints will limit the supply of large-scale industrial parks. The expansion of cross-border trade makes regional industrial parks less competitive than emerging economies in terms of labor expenses and land prices.

National Territory 4 (Concentration of highly skilled talents in the Seoul Metropolitan Area) was found to be most related to National Territory 1 (Development of high-tech industries in the Seoul Metropolitan Area or metropolitan cities), Technology 1 (Arrival of a digital society), National Territory 5 (Compact urban development), Economy 6 (Knowledge-based economic growth), and Environment 2 (Regional concentration of energy and resources). National Territory 5 (Compact urban development) was found to be most related to National Territory 1 (Development of high-tech industries in the Seoul Metropolitan Area), followed by National Territory 7 (Sharing economy), Environment 2 (Regional concentration of energy and resources), Environment 1 (Climate changes), and Technology 1 (Digital society). The co-occurrence pattern also points to the concentration of industries and highly skilled talents in the Seoul Metropolitan Area.

National Territory 6 (Extension of living sphere) is found to be most related to Environment 1 (Global warming), followed by Society 1 (Population aging and changes in demographic structure), National Territory 1 (Development of high-tech industries in the Seoul Metropolitan Area or metropolitan cities), Society 5 (Changes in the traditional concept of families such as single-person households), and Politics 5 (Public sector debt growth). National Territory 6 records only 421 co-occurrences, which indicates that it is not as relevant as concentration in the Seoul Metropolitan Area and major cities.

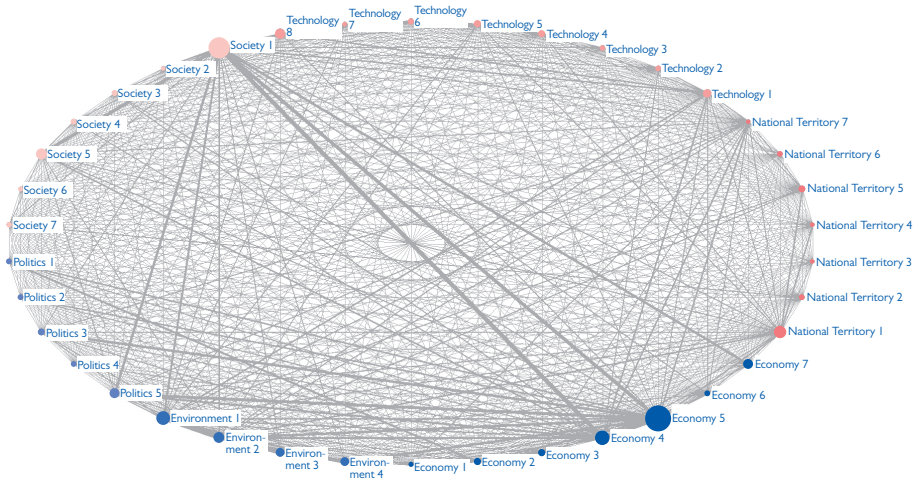
National Territory 7 (Sharing economy) is found to be most related to Economy 5 (Global economic recession), followed by Economy 4 (Economic polarization and inequality), National Territory 1 (Development of high-tech industries in the Seoul Metropolitan Area or metropolitan cities), Technology 1 (Digital society), and Economy 6 (Knowledge-based economic growth). The co-occurrence pattern suggests the rise of a sharing economy trend at the center of major cities such as the availability of shared car services with technology development and the proliferation of a sharing economy (houses, cars, bicycles) with compact urban development.

3.3 SNA Analysis and Results

As previously mentioned, it is possible to conduct a basic analysis of the correlation between respective megatrends through the frequency of co-occurrences. However, an analysis of social networks enables a more scientific analysis. In other words, an SNA map provides an insight into correlation between megatrends.

Accordingly, the study used a network analysis tool, the UNICET6 program, to create an SNA map. The size of the circle in Figure 6 is proportionate to the frequency of occurrences of megatrends, and the thickness of the lines reflects the share of co-occurrences. In other words, the thicker the line is, the stronger the correlation between megatrends is.

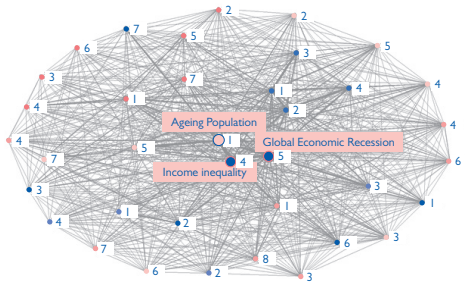
Figure 6. SNA Megatrend Map



Source: Author based on the data from UNICET6

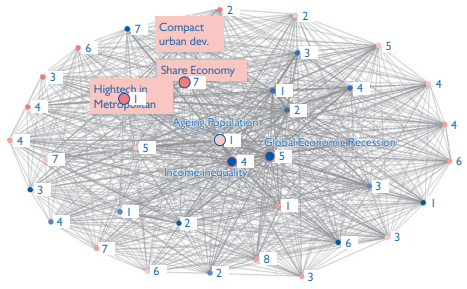
For example, Figure 6 implies that Society 1 (Population aging and changes in demographic structure), Economy 5 (Global economic recession), and Economy 4 (Economy polarization and income equality) are most socially influential megatrends. Likewise, National Territory 1 (Development of high-tech industries in the Seoul Metropolitan Area or metropolitan cities) is the most relevant trend in the national territory category.

Figure 7. MDS Map of Key Socioeconomic Megatrends



MDS(Multidmensional Scaling Map)

Figure 8. MDS Map of Megatrends in the National Territory Category



Source: Author based on the data from UNICET6

● Economy ● Environment ● Politics ● Society ● Technology ● National Territory

Apart from the correlation between trends, this study developed a multidimensional scaling (MDS) map to identify the most crucial trend.

As opposed to the SNA map, the closer a trend is located to the center of the MDS map, the more influential it becomes. Figure 7 shows that the most important socioeconomic trends include Society 1 (Population aging), Economy 4 (Economy polarization), Economy 5 (Economy recession), Technology 1 (Digital society), Environment 2 (Regional concentration of energy and resources), and Environment 1 (Global warming). In the national territory category, the most influential trends include National Territory 1 (Development of high-tech industries in the Seoul Metropolitan

Area or metropolitan cities), National Territory 7 (Sharing economy), and National Territory 5 (Compact urban development).

The correlations between trends, displayed by the MDS map, imply that the gap between urban centers and regions should widen amid economic polarization and changes in the demographic structure, compact urban development, the development of high-tech industries in city centers, and the sharing economy should develop in the center of cities.

For further explanation, the study analyzed the correlation between respective trends that affect the national territory trend as follows.

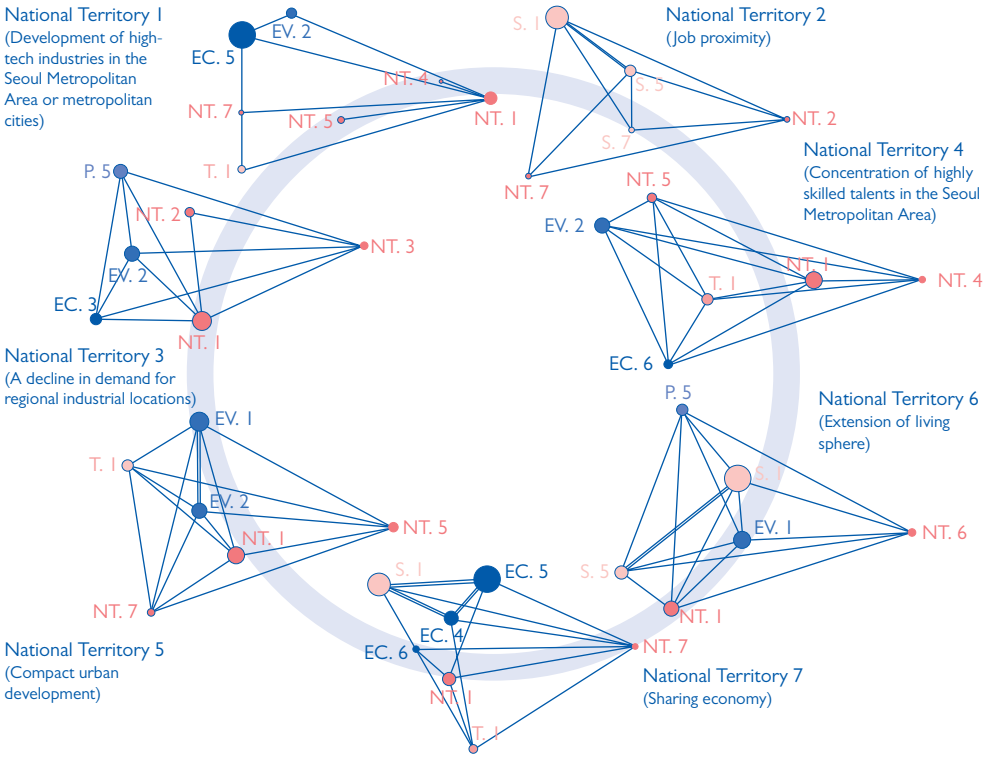
In each EgoNet, the size of a circle (node) indicates the frequency of co-occurrence of respective trends. That is, the larger the node is, the greater influence it has over other trends.

Each EgoNet used for the analysis visualizes how respective national territory trends are related with other major trends. As such, the extent of correlation is expressed by the thickness of the lines, rather than the distance. The thicker the line is, the stronger the correlation the two trends have. The findings of the EgoNet analysis are consistent with that of the MDS analysis and the figures which express co-occurrence by megatrend. EgoNet analysis intuitively shows the extent to which respective national territory trends are related to major socioeconomic changes.

Figure 9. Socioeconomic Changes and Seven Major National Territory Trends

Source: Author

- Economy(EC)
- Environment(EV)
- Politics(P)
- Society(S)
- Technology(T)
- National Territory(NT)



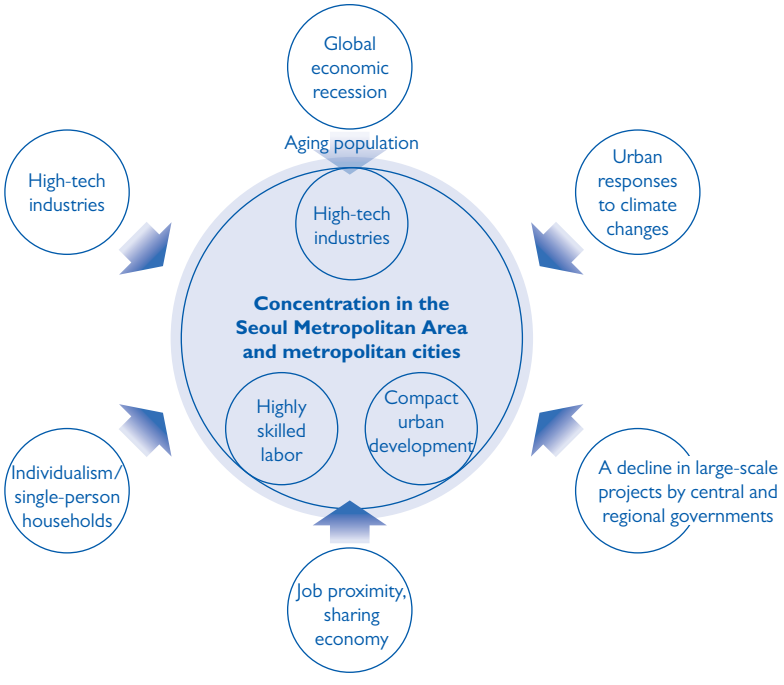
As a result, the major trends in national territory that should be prioritized in industrial location policies are the development of high-tech industries in the Seoul Metropolitan Area (National Territory 1) and concentration of highly skilled talents in the Seoul Metropolitan Area and metropolitan cities (National Territory 4). This implies that while balanced national development was the national territory trend projected in the late 1990s, concentration of highly skilled talents in the Seoul Metropolitan Area and metropolitan cities and development of high-tech industries in cities are likely to continue for a considerable time.

The trend will inevitably result in compact urban development (National Territory 5), and the concentration of highly skilled talentss in city centers would drive a shift toward single-person households or small size households (Society 5), which have an individualistic lifestyle (Society 7). It is projected that residential and lifestyle patterns should be characterized by job proximity (National Territory 2), advanced technology development (Technology 1), use of a sharing economy (National Territory 7), and individualistic and cultural spending (Society 7).

On the other hand, public projects such as large-scale regional industrial parks led by the central or regional governments are expected to decline (National Territory 3), given public sector debt growth (Politics 5), high-tech industry development in city centers (National Territory 1), concentration of highly skilled talents in city centers (National Territory 2), and compact urban development(National Territory 4). At the same time, flood and disasters resulting from climate changes (Environment 1) and compact urban development (National Territory 5) are projected to emerge as key issues.

Figure 10. Socioeconomic Changes and Major Industrial Location Trends

Source: Author



CHAPTER IV.

Empirical Analysis of Industrial Location Megatrends

1. Empirical Analysis of Industrial Location Megatrends: Need & Objective

Through big data analytics, Chapter III demonstrated that the industrial location trends are influenced by six major socioeconomic changes: ① global economic recession, ② population aging, ③ climate changes, ④ a decline in large-scale national/regional projects, ⑤ the rise of a sharing economy, and ⑥ wider spread of individualism. Having said that, the study defined three key trends as follows[03] :

① Concentration and Compact Development of Industrial Locations in the Seoul Metropolitan Area and Major Cities

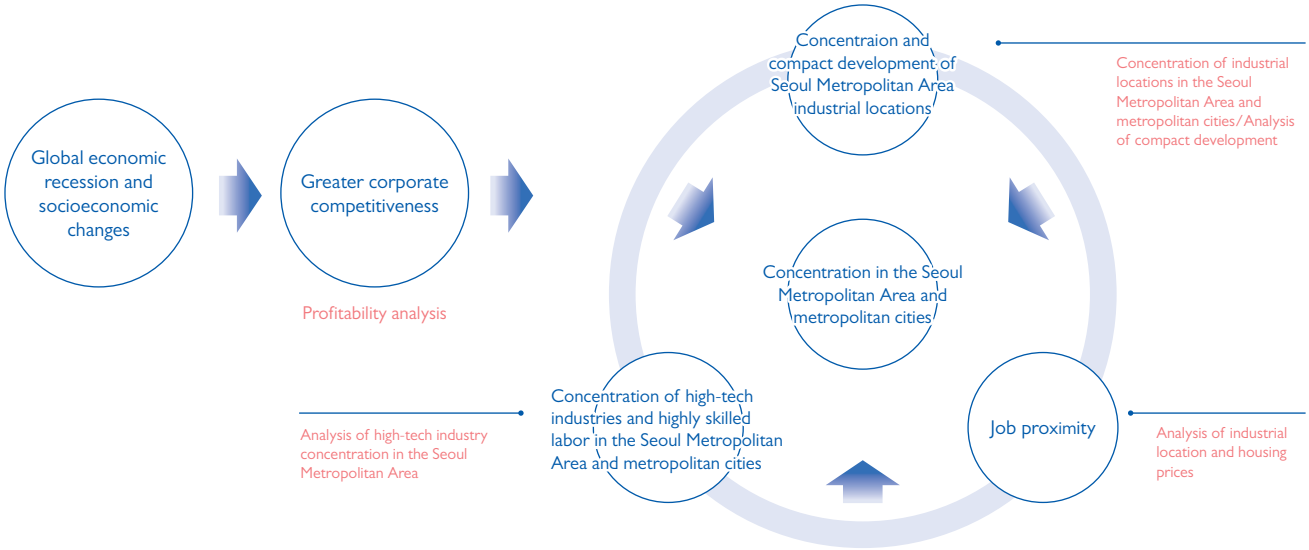
② An Increase in High-tech Industrial Locations in City Centers and Major Cities

③ Spatial Proximity Between Industrial Locations and Residence

In this chapter, the study conducted an analysis using quantified data on three major industrial location trends to cross-check the findings of big data analytics. In addition, the study collected corporate management data and analyzed the correlation between business locations and profitability to verify SNA results that global economic recession (Economy 5) has affected corporate profitability, and businesses have moved to city centers to overcome such challenges and enhance their competitiveness.

03. An analysis of the impact of socioeconomic changes on the concentration of high-tech, highly skilled talents in the greater Seoul area and compact urban development as well as an analysis of occurrences of seven national territory/industrial location trends support that these three trends are most relevant. That is, of seven national territory/industrial location trends, high-tech industry development in the greater Seoul area and metropolitan cities recorded the highest frequency of co-occurrences (4,720), followed by compact urban development (2,075), concentration of highly skilled labor (701), and job proximity (680). However, it is reasonable to consider sharing economy (4,199) as part of socioeconomic trends, rather than a national territory/industrial location trend.

Figure 11. A Flow of Empirical Analysis



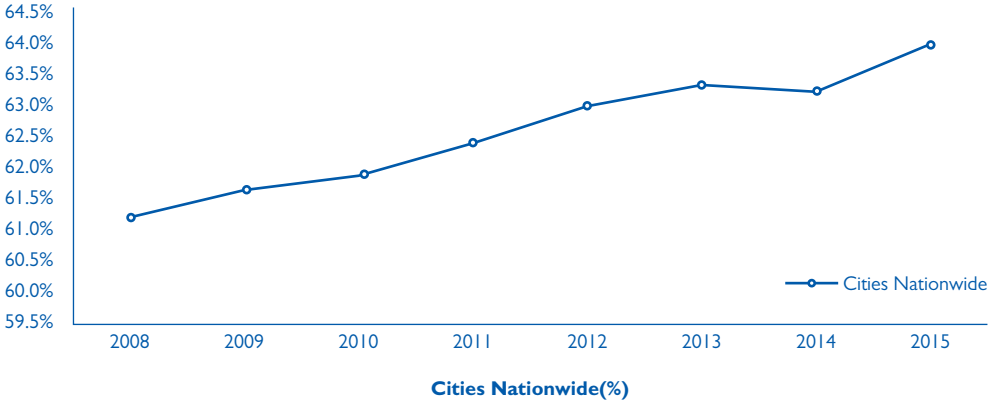
Source: Author

2. Empirical Analysis of Industrial Locations Trends

2.1 Concentration of Industrial Locations and Compact Development in the Seoul Metropolitan Area and Metropolitan Cities

The share of factories registered in cities continued to increase from 59.9% in 2006 to 64.1% in 2015, whereas the share of factories registered in rural areas dropped from 40.1% to 35.9% during the same period.

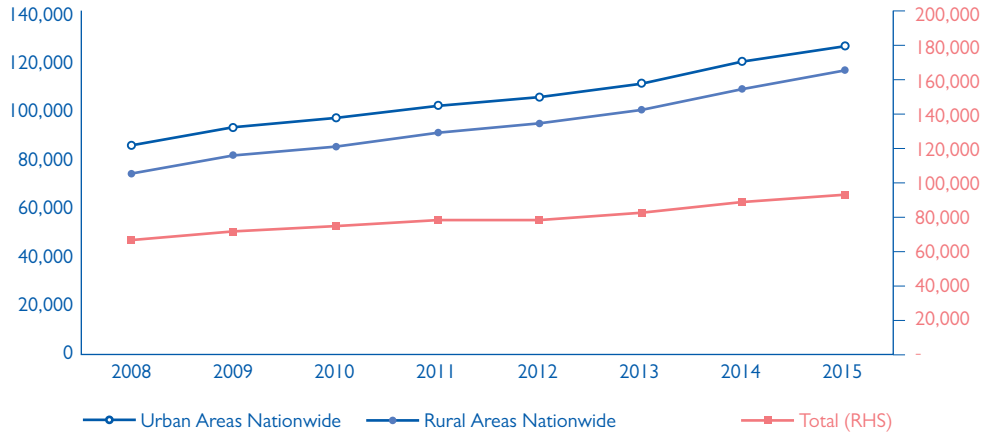
Figure 12. Share of Factories Registered in Cities Nationwide by Year



Source: Korea Industrial Complex Corporation

Figure 13. Share of Factory Location between Urban and Rural Areas by Year

Source: Korea Industrial Complex Corporation



The finding of the analysis suggests the concentration of industrial locations in cities, but it does not necessarily imply the concentration in the Seoul Metropolitan Area or metropolitan cities. As such, a separate analysis is needed to see if the share of factories registered in the Seoul Metropolitan Area or metropolitan cities has increased in accordance with big data analysis results. For this purpose, this study analyzed the increase in the number of registered factories by nationwide, city, and province from 2008 to 2015.

While the number of registered factories nationwide increased by 48% from 2008 to 2015, the figure increased only 41.4% in the Seoul Metropolitan Area. As opposed to the findings of big data analytics (Chapter III), the increase of factories registered in the Seoul Metropolitan Area fell short of the national average.

Table 7. Factory Registration: Capital and Non-capital Areas by Year

	2008	2009	2010	2011	2012	2013	2014	2015	Total Growth Rate
Nationwide	122,294	131,861	138,351	145,382	151,066	159,332	171,122	180,957	48.0%
Capital Area	62,023	66,545	69,051	72,048	73,997	77,473	82,659	87,683	41.4%
Metropolitan Cities	18,350	19,933	21,224	22,359	23,438	24,760	26,650	28,156	53.4%
Provinces	41,921	45,383	48,076	50,975	53,006	56,423	61,088	64,368	53.5%
Sejong City	-	-	-	-	625	676	725	750	-
Non-capital Area	60,271	65,316	69,300	73,334	77,069	81,859	88,463	93,274	54.8%

Source: Korea Industrial Complex Corporation, FactoryON (factory registration statistics)

Table 8. Factory Registration Breakdown by Region

Year	2008	2009	2010	2011	2012	2013	2014	2015
Nationwide	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Capital Area	50.7%	50.5%	49.9%	49.6%	49.0%	48.6%	48.3%	48.5%
Metropolitan Cities	15.0%	15.1%	15.3%	15.4%	15.5%	15.5%	15.6%	15.6%
Sejong City	-	-	-	-	0.4%	0.4%	0.4%	0.4%
Provinces	34.3%	34.4%	34.7%	35.1%	35.1%	35.4%	35.7%	35.6%

Source: FactoryON (factory registration statistics)

Of factory registrations nationwide, the share of the capital area has declined from 50.7% in 2008 to 48.5% in 2015. On the other hand, the share of metropolitan cities edged up from 15.0% to 15.6% during the same period. The share of provinces rose by 1.3% from 34.3% to 35.6% during the same period. In other words, factory registration increase was driven by provinces.

Unlike the big data analytics, it is difficult to tell that factory registrations are being concentrated in the capital area. Rather, the share of the capital area has declined in terms of national factory registrations.

An interesting point to note is an accelerating concentration of unplanned industry locations in the capital area. Of unplanned locations nationwide, the share of the capital area increased by 0.4% over the past ten years, while that of metropolitan cities and provinces declined by 0.1% and 0.3%, respectively. The gap between the capital and non-capital areas widens in terms of production area, as the capital area posted the highest increase of 4%, indicating a visible concentration of unplanned locations in the area. Of planned locations nationwide, the share of provinces posted the highest increase of 3.7%, while the share of the capital area declined during the same period, indicating the supply of industrial parks is concentrated in the less costly provinces.

The increase in unplanned location in the capital area can be summed up as follows.

Table 9. Changes in Production Areas by Region (m^2)

Type	Area	2006	2009	2012	2015	10-year Change
Unplanned Location	Capital Area	3,331.97	3,610.86	3,835.26	4,598.71	38.0%
	Metropolitan Cities	960.81	875.47	1,044.14	1,270.87	32.3%
	Provinces	5,137.34	4,336.38	4,631.92	5,817.62	13.2%
	Nationwide	9,430.12	8,822.71	9,511.31	11,687.21	23.9%
Planned Location	Capital Area	3,214.18	2,286.28	2,839.22	3,267.64	1.7%
	Metropolitan Cities	2,142.44	2,403.24	2,916.19	3,436.52	60.4%
	Provinces	5,037.34	5,720.48	6,734.96	9,774.92	94.0%
	Nationwide	10,393.95	10,410.00	12,490.37	16,479.08	58.5%

Source: Korea Industrial Complex Corporation, FactoryON (factory registration statistics),

Based on Korean manufacturers, Table 9 shows that the production area for unplanned locations increased by 38% in the capital area but rose only 23.9% nationwide over the past ten years, which reflects a visible concentration of unplanned locations in the capital area. In constrast, the production area for planned locations (e.g. industrial parks) edged up 1.7% in the capital area but surged as much as 94% in provinces during the same period. That is, new construction of industrial parks was concentrated in provinces, where plots are relatively cheap and underdeveloped compared to the capital area and metropolitan cities.

In the case of unplanned locations selected and developed by individual firms as per government approval, the concentration in the capital area has increased. Notably, the increase in unplanned locations was driven by the expansion of production areas, rather than by gross area . This suggests compact development in the capital area with a focus on unplanned locations.

The compact development seen by big data analytics is verifiable by the annual factory registration trend.

Table 10. Registered Factories by Year

Source: Korea Industrial Complex Corporation, FactoryON (factory registration statistics),

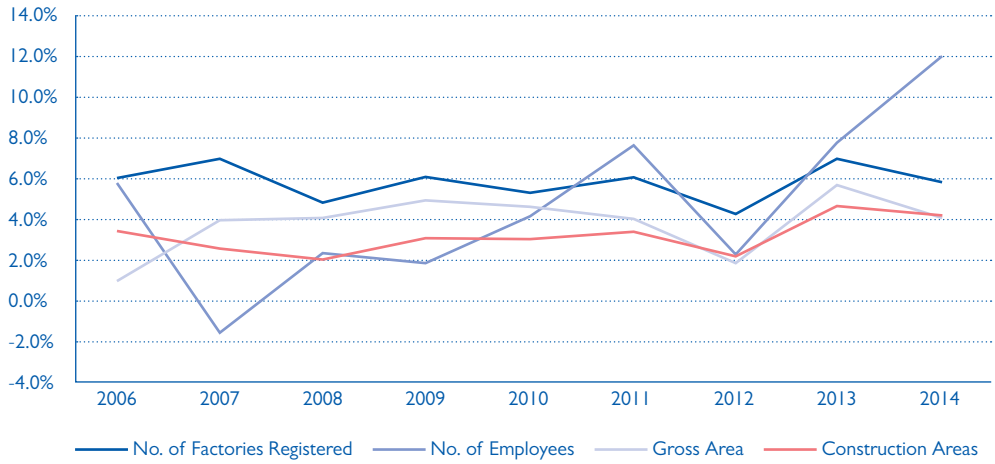
* No. of employees is based on annual reports

** Construction areas: production area + supporting area

Year	No. of Factories Registered	No. of Employees*	Gross Area (1,000m^2)	Construction Areas** (1,000m^2)
2005	110,352	2,742,179	562,735	261,782
2006	117,051(6.1%)	2,835,675(3.4%)	568,069(0.9%)	277,157(5.9%)
2007	124,698(6.9%)	2,905,792(2.6%)	590,348(4%)	272,732(-1.7%)
2008	130,020(4.8%)	2,960,971(2%)	613,111(4%)	278,941(2.4%)
2009	136,681(6%)	3,044,843(3.1%)	640,475(4.9%)	283,739(1.8%)
2010	142,580(5.3%)	3,127,632(3%)	666,228(4.6%)	294,421(4.1%)
2011	149,271(6.1%)	3,221,630(3.4%)	689,049(4.1%)	314,210(7.6%)
2012	154,023(4.3%)	3,281,326(2.2%)	699,517(1.9%)	320,099(2.2%)
2013	161,709(7%)	3,409,491(4.7%)	731,553(5.7%)	340,477(7.8%)
2014	168,126(5.8%)	3,523,380(4.2%)	754,411(4.1%)	371,774(12.0%)

Figure 14. Annual Increase in the Number of Factories Registered

Source: Korea Industrial Complex Corporation, FactoryON (factory registration statistics),



By year, the number of registered factories and the increase in gross factory area have moved almost in sync, indicating that most new factories are established through new site development. However, after hitting the bottom in 2012, construction areas surged in 2013 and onwards, while the number of registered factories and the increase in gross factory area declined. The divergence is attributable to compact development of existing factories or an increase in the construction of new factories in existing sites.

The empirical analysis found that the concentration of factories in the Seoul Metropolitan Area and major cities is not an industry-wide trend, but is mostly applicable to unplanned locations. The supply of planned locations (e.g. industrial parks) is concentrated in provinces, which are less preferred by businesses. This shows a mismatch between the supply of industrial parks and demand for industrial locations.

2.2 An Increase in High-tech Industrial Locations in City Centers and Major Cities

Under the Article 15 of Enforcement Regulation on Industrial Cluster Development and Factory Establishment, there are about 80 types of high-tech industries. The study analyzed FEMIS data as of May 2016 to assess the concentration of high-tech industries in city centers.

Contrary to expectations, the analysis found that the concentration of high-tech industrial locations in the Seoul Metropolitan Area did not increase at a rapid rate but remained steady over 50% throughout 2008 and 2015. In contrast, the share of non-high-tech industrial locations in the Seoul Metropolitan Area increased from 44% in 2008 to 46% in 2015, but still has a lower level of concentration in the Seoul Metropolitan Area compared to high-tech industries.

The share of high-tech industries registered in cities gradually increased from 31% in 2008 to 35% in 2015. Of 88,696 factories registered in 2008[04] , high-tech industrial locations amount to 25% or 22,208 factories. Of 175,932 registered factories nationwide in 2015, high-tech industrial locations amount to 50,608 or 28.8%. The share of high-tech industrial locations in cities rose from 31% in 2008 to 35% in 2015, reflecting the high-tech industry's preference for urban areas.

04. The figure is based on FEMIS data as of May 2016 and has a discrepancy with the annual factory registration data that shows 122,294 factories registered nationwide in 2008.

Table 11. Share of High-tech and Non-high-tech Industries by Area

Area	Category		No. of Factories					
			2008			2015		
			Total	High-tech Industries	Other Industries	Total	High-tech Industries	Other Industries
Nation-wide	Total		88,696	22,208(25.0%)	66,488(75.0%)	175,932	50,608(28.8%)	125,324(71.2%)
	Urban Areas		51,409	15,921(31.0%)	35,488(69.0%)	112,073	39,209(35.0%)	72,864(65.0%)
	Non-urban Areas	Management Area	34,923	5,973(17.1%)	28,950(82.9%)	60,419	11,006(18.2%)	49,413(81.8%)
		Agriculture and Forestry Area	1,381	149(10.8%)	1,232(89.2%)	2,402	225(9.4%)	2,177(90.6%)
		Natural Environment Area	189	4(2.1%)	185(97.9%)	244	7(2.9%)	237(97.1%)
		Subtotal	36,493	6,126(16.8%)	30,367(83.2%)	63,065	11,238(17.8%)	51,827(82.2%)
	Unclassified		794	161(20.3%)	633(79.7%)	794	161(20.3%)	633(79.7%)

Source: Korea Industrial Complex Corporation, FEMIS raw data

High-tech industries used for this analysis fall into the manufacturing category, which in nature is different from the talents-intensive venture industries used for big data analytics. Nevertheless, the high share (over 50%) of the Seoul Metropolitan Area and major cities and a steady increase in the concentration in urban areas are consistent with the result of big data analytics, which proved the concentration of high-tech industries in the Seoul Metropolitan Area and metropolitan cities.

2.3 Spatial Proximity between Industrial Parks and Residential Areas

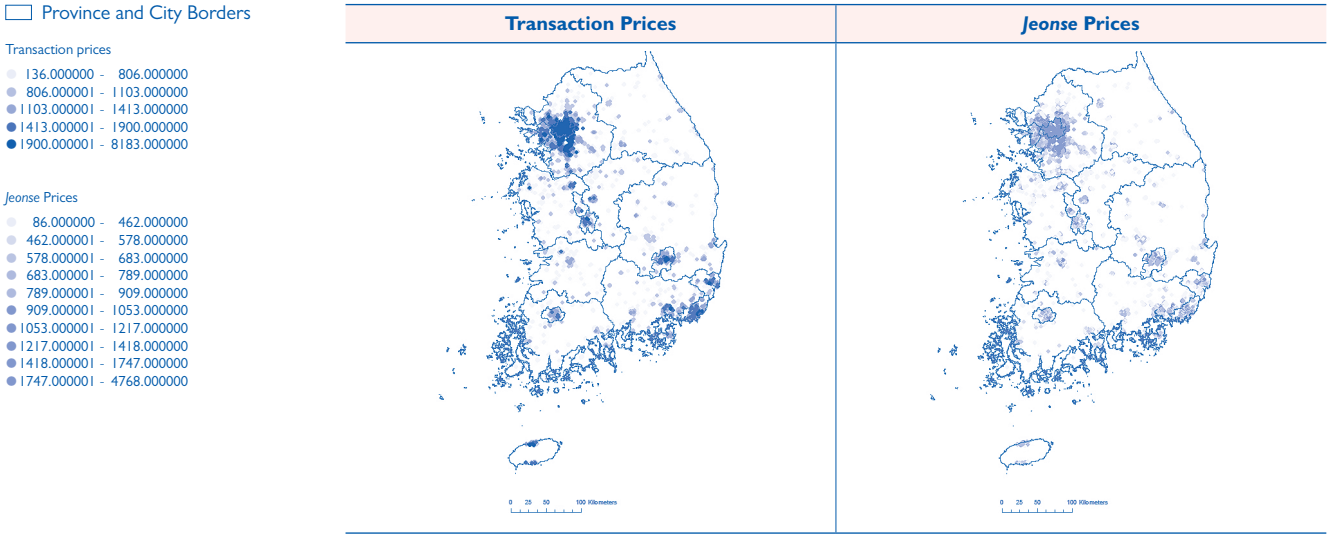
Big data analytics showed that an increase in single-person households and changes in family and social relations (trends in eating or drinking alone) affect proximity to employment. Accordingly, the Act on Industrial Locations and Development allows for apartments in supporting locations. Through revisions, said Act prescribes multi-purpose locations, relaxing regulations on residential facilities. The question is whether those employed in industrial parks live close to industrial parks, as the findings of big data analytics suggest.

Given the nationwide dispersion of more than 1,000 industrial parks and the lack of data sets on commuting patterns, it is virtually impossible to directly apply origin-destination data, which is often used for job proximity research. Instead, the study adopted a hedonic price model which derives the intrinsic value of a house by using distance between the house and a nearby industrial park as a variable. In the case that apartment projects located closer to industrial parks obtain higher prices, this study assumed that the price of houses close to an industrial park reflects a decline in commuting costs. As such, when apartment projects located closer to industrial parks obtain higher prices, it can be presumed that job proximity occurs. This method has limitations in clarifying job proximity between residence and a nearby industrial park. However, given the absence of data on commuting patterns and residence for those employed in industrial parks, this study thinks it is most realistic to presume that an increase in housing prices close to industrial parks is due to job proximity.

To overcome the limitations of precedent studies, this study established a GIS database based on the Ministry of Land, Infrastructure and Transport's data on the transaction and *jeonse* prices for apartments nationwide in 2016 and analyzed[05] the correlation between proximity to industrial parks and apartment prices by identifying industrial parks closest to respective apartments.

05. The purpose of the study is to analyze the correlation between residence and industrial locations in terms of spatial proximity, demonstrated by the big data analysis. As such, the study did not establish a hedonic housing price model but estimated the correlation coefficient using the distance between industrial parks and apartments.

Figure 15. Distribution of Apartment Prices Nationwide in 2016



As apartment *jeonse* prices reflect real demand, not speculative demand, *jeonse* prices provide a more accurate picture of the value of residential areas close to industrial parks than transaction prices do. Based on the distance from industrial parks (Y) and *jeonse* price ranges (X), this study plotted more than 20,000 cases of *jeonse* prices and found a positive correlation between the distance and apartment prices. Contrary to the findings of big data analytics, the closer an apartment is located to an industrial park, the lower its price. The correlation is attributable to the fact that most industrial parks are exposed to dust, air pollution, and noises. However, the positive correlation between apartment *jeonse* prices and distance to industrial parks differ from region to region by a wide margin. In the Seoul Metropolitan Area, which offers relatively better residential conditions, apartment projects located closer to large-scale national industrial parks, general industrial parks, and high-tech industrial parks obtained lower prices ($p<0.01$). This is attributable to the fact that compared to areas close to large-scale national industrial parks, Seoul and certain areas of Gyeonggi-do have a large number of apartments (e.g. Gangnam) with relatively better residential conditions.

In terms of the correlation between national industrial parks and apartment *jeonse* prices, metropolitan cities provide an interesting contrast with the Seoul Metropolitan Area. Nationwide, apartment projects located closer to industrial parks obtain lower *jeonse* prices. However, that is not the case for the metropolitan cities, where apartment projects located closer to national industrial parks fetch higher *jeonse* prices ($p<0.01$).

In metropolitan cities, national industrial parks have a positive impact on the areas to the extent that drives up apartment *jeonse* prices, and the economy of metropolitan cities relies on national industrial parks. As those employed at national industrial parks in metropolitan cities prefer a shorter commute distance, *jeonse* prices appear to trend relatively high for the apartments close to national industrial parks, which have a sound residential environment. However, additional research is needed to clarify whether job proximity indeed matters in national industrial parks or the correlation is due to a mononuclear urban space structure unique to metropolitan cities, where national industrial parks are situated at the center.

Nevertheless, the high *jeonse* prices for houses close to national industrial parks indicate that the user value is high for residents and commuters. Should national industrial parks in metropolitan cities be prioritized in the supply of Happy Houses (project homes), rental houses, and affordable houses, it is expected to make a significant policy impact on job proximity.

Table 12. Correlation between Apartment *Jeonse* Prices and Industrial Parks

Type	Nationwide	Capital Area	Metropolitan Cities	Provinces
Total Industrial Parks	0.441 ***	0.424 ***	0.028 *	0.066 ***
National Industrial Parks	0.484 ***	0.610 ***	-0.240 ***	0.184 ***
General Industrial Parks	0.429 ***	0.374 ***	0.104 ***	0.032
High-tech Urban Industrial Parks	0.534 ***	0.565 ***	0.138 ***	0.115 *
Agricultural Industrial Parks	-0.019	0.971	-0.040	0.006

Source: Author
*** $p<0.01$; ** $p<0.05$; * $p<0.1$.

This study also analyzed the correlation between apartment prices and the distance to industrial parks. The analysis found that the apartments sold during January 2016 and August 2016 were mostly distributed within a 6,000 m radius of industrial parks with the maximum distance of 14 km.

As in the case of *jeonse* prices, the dispersion of apartment prices shows that the further apartment units are located away from industrial parks, the higher transaction prices are.

Figure 16. Correlation between Apartment Prices and Proximity to Industrial Parks

Source: Author

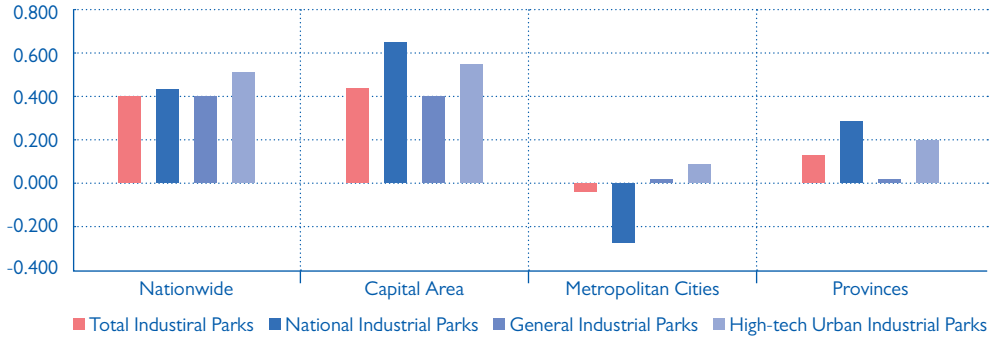


Table 13. Correlation between Apartment Prices and Proximity to Industrial Parks

Source: Author
*** p<0.01; ** p<0.05; * p<0.1.

Type	Nationwide	Capital Area	Metropolitan Cities	Provinces
Total Industrial Parks	0.405 ***	0.441 ***	-0.032 **	0.130 ***
National Industrial Parks	0.434 ***	0.650 ***	-0.267 ***	0.286 ***
General Industrial Parks	0.405 ***	0.401 ***	0.027 *	0.019
High-tech Urban Industrial Parks	0.513 ***	0.550 ***	0.096 ***	0.197 ***
Agricultural Industrial Parks	0.013	0.369	-0.220 *	0.027

2.4 Analysis of Profitability and Location Using Financial Indicators of Registered Factories

Given the concentration of unplanned locations in the Seoul Metropolitan Area and metropolitan cities, it is essential to demonstrate whether there is a correlation between location decisions and business performance by individual companies. Should companies closer to the Seoul Metropolitan Area and metropolitan cities generate higher operating margin or greater profitability, it is reasonable to assume that companies want locations in the Seoul Metropolitan Area or at the center of metropolitan cities to secure competitiveness. On the other hand, should companies prefer high-priced locations close to the Seoul Metropolitan Area or metropolitan cities, even if they do not generate significant operating profit or profitability, it implies that the location decision is not for business activities but for the realization of capital gains on rising property prices.

The study first established a database on factories registered as of May 2016 and matched business registration numbers based on FEMIS with corporate financial data (e.g. operating margin and ROA) from credit bureaus to analyze the correlation between

business profitability and location.

The operating margin, a key profitability indicator, is defined as the operating profit divided by revenue or the ratio of profits earned to total sales. In contrast, return on asset (ROA) is defined as net income divided by average total assets. The ROA measures the profit-generating capacity of total assets including production sites held by a company.

The operating margin ratio is an indicator of the ability of a company to make a profit from its current operations. The ROA ratio is an indicator of the firm's effectiveness in using all of the available resources including land to generate earnings.

The study analyzed how profitability indicators of a registered factory change according to its linear distance to the nearest metropolitan cities, the Seoul Metropolitan Area, and provinces and the type of industrial parks. Given the characteristics of the Korean economy, where large corporations record disproportionately high operating margin compared to smaller companies, the study adopted the median value, not average value, for financial indicators.

A statistics t-test was conducted by the type and location of industrial parks. To address the problems of the conventional t-test using the average value, the study removed outliers of observations to ensure that the average value reflects the median value.

The analysis found that tenant companies in national industrial parks located in the Seoul Metropolitan Area yielded 0.21% higher operating margin than that of non-clustered companies in the same area with a confidence level of 95%. There was no statistically significant difference in operating margin between tenants of national industrial parks in metropolitan cities and in the Seoul Metropolitan Area. Notably, tenant companies in national industrial parks located in the Seoul Metropolitan Area yielded a 0.65% lower operating margin than non-clustered companies in metropolitan cities.

Table 14. Operating Margin of an Industry Park by Region

		Capital Area			Metropolitan Cities			Provinces		
		National Industrial Parks	General Industrial Parks	Others	National Industrial Parks	General Industrial Parks	Others	National Industrial Parks	General Industrial Parks	Others
Capital Area	National Industrial Parks	5.92								
	General Industrial Parks	6.01	6.01							
	Others	5.71 **	5.71 **	5.71						
Metropolitan Cities	National Industrial Parks	5.69	5.69	5.69	5.69					
	General Industrial Parks	5.73	5.73	5.73	5.73	5.73				
	Others	6.57 ***	6.57 ***	6.57 ***	6.57 ***	6.57 ***	6.57			
Provinces	National industrial parks	5.54 **	5.54 **	5.54	5.54	5.54	5.54 ***	5.54		
	General industrial parks	5.33 ***	5.33 ***	5.33 ***	5.33	5.33 **	5.33 ***	5.33	5.33	
	Others	5.73 *	5.73 *	5.73	5.73	5.73	5.73 ***	5.73	5.73 ***	5.73

*** p<0.01; ** p<0.05; * p<0.1.
Source: Author

As in the case with national industrial parks, firms located in general industrial parks in the Seoul Metropolitan Area posted a 0.56% lower operating margin than those in unplanned locations in metropolitan cities. Firms located in general industrial parks in the Seoul Metropolitan Area generated statistically significantly higher operating margin than firms in all types of industrial locations in provinces, but underperformed their counterparts in unplanned locations in provinces. Besides, tenant firms of industrial parks, which are planned locations supplied by the public sector, in the Seoul Metropolitan Area posted a statistically significantly lower operating margin than firms in unplanned locations in metropolitan cities. The gap indicates that current public policies on the supply and development of industrial locations and industrial parks do not make significant contribution to profitability improvement at companies.

The same is true of provinces, where the share of planned locations increases compared to nationwide. Looking at provinces, the study found that companies in unplanned locations posted statistically significantly higher operating margin than their counterparts in general industrial parks. Of course, firms located in provinces yielded lower operating margin than those in the Seoul Metropolitan Area and metropolitan cities due to relatively unfavorable locations.

As a result, the study ranked regions and the type of industrial park in terms of operating margin and found that non-clustered/unplanned locations in metropolitan cities (6.57%) topped the list followed by general industrial parks (6.01%) in the Seoul Metropolitan Area, national industrial parks (5.92%) in the Seoul Metropolitan Area, general industrial parks in metropolitan cities (5.73%), non-clustered/unplanned locations in the Seoul Metropolitan Area (5.71%), national industrial parks in metropolitan cities (5.69%), non-clustered/unplanned locations (5.73%) in provinces, national industrial parks in provinces (5.54%), and general industrial parks in provinces (5.33%). As big data analytics and SNA suggested, firms located in the Seoul Metropolitan Area and metropolitan cities generated relatively high operating margin. However, it should be noted that firms in non-clustered/unplanned locations in metropolitan cities generated exceptionally high operating margin that surpassed those in the Seoul Metropolitan Area. Most of all, future policy development should take into consideration that planned locations (including industrial parks) underperformed unplanned locations in terms of in terms of contribution to operating margin.

The ROI is an indicator of net return on a firm's investment assets and shows how efficiently corporate real estate contributes to generating net profit.

National industrial parks in the Seoul Metropolitan Area yielded a lower ROI than non-clustered/unplanned locations in the Seoul Metropolitan Area or in metropolitan cities, suggesting that unplanned locations boast a greater efficiency in the use of properties. The analysis arrived at the conclusion that national industrial parks in the Seoul Metropolitan Area generate a statistically significantly higher ROI than other types of industrial parks and non-clustered locations in provinces.

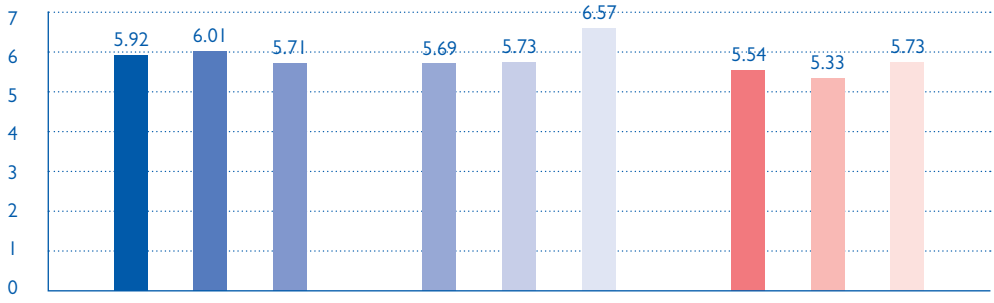
Firms operating in unplanned locations recorded a high ROI in metropolitan cities as well. That is, tenant firms of national industrial parks in metropolitan cities posted a lower ROI than those operating in non-clustered locations in metropolitan cities and provinces.

As a result, in terms of the rate of return on an investment unit, the most efficient type of industrial location is non-clustered locations in metropolitan cities (6.15%), followed by non-clustered locations in the Seoul Metropolitan Area (5.61%), general industrial parks in the Seoul Metropolitan Area (5.28%), national industrial parks in the Seoul Metropolitan Area (5.19%), non-clustered locations in provinces (5.05%), general industrial parks in metropolitan cities (4.68%), national industrial parks in metropolitan cities (4.65%), national industrial parks in Dos (4.32%), and general industrial parks in provinces (3.91%).

The analysis shows that firms located closer to the Seoul Metropolitan Area or metropolitan cities generated higher operating margin or ROI, supporting the findings of big data analytics that firms located closer to major cities yielded higher profitability. Notably, non-clustered locations in metropolitan cities, excluding the Seoul Metropolitan Area, and provinces yielded relatively high operating margin. Non-clustered/unplanned locations in all areas including the Seoul Metropolitan Area posted a higher ROI than planned locations. That is, unplanned locations outperform planned locations, which are mostly industrial parks, in terms of ROI.

In sum, Korea's planned locations represented by industrial parks are not as efficient as non-clustered/unplanned locations in terms of operating margin and ROI.

Figure 17. Operating Margin by Region and Type of Industrial Location (%)



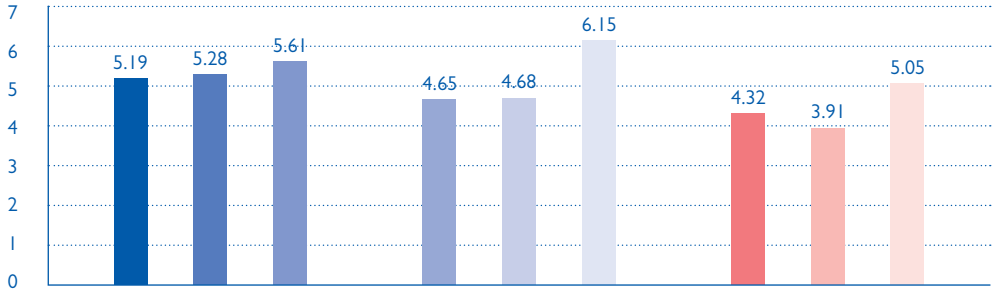
Source: Author

Capital Area
- National Industrial Parks
- General Industrial Parks
- Others

Metropolitan Cities
- National Industrial Parks
- General Industrial Parks
- Others

Provinces
- National Industrial Parks
- General Industrial Parks
- Others

Figure 18. ROI by Region and Type of Industrial Location (%)



In addition, the study also analyzed the correlation between profitability and proximity to city centers by measuring the distance between unplanned locations and the closest

metropolitan city or Seoul and calculating how operating margin and ROI change over distance. The study found that factories operating in provinces generate significantly higher operating margin, as they have a shorter distance to metropolitan cities (based on the centroid), displaying a negative correlation between distance and operating margin. That is, the closer a factory is located to city centers, the greater its profitability.

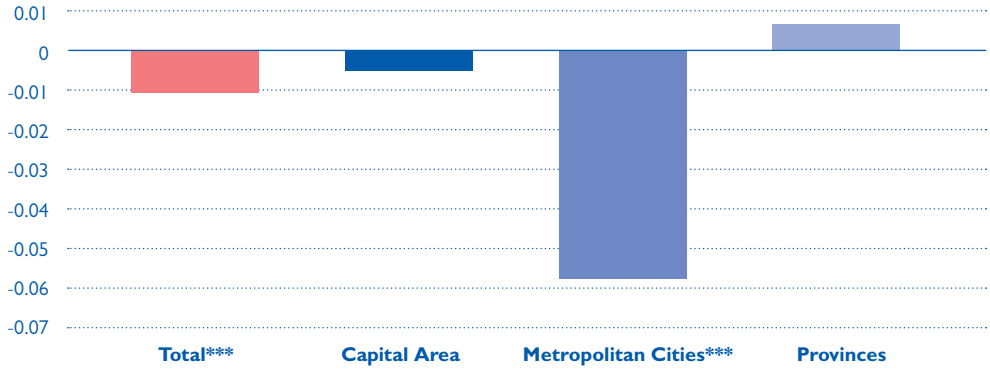
The analysis also supported the finding that unplanned locations yielded relatively higher profitability. Factories operating in non-clustered/unplanned locations close to metropolitan cities generated high operating margin, whereas factories operating in industrial parks did not exhibit a statistically significant correlation with the distance to metropolitan cities. That is, firms operating in non-clustered locations take the proximity to metropolitan cities into consideration when deciding locations.

Given that ROI also has a statistically significant negative correlation with the distance to metropolitan cities and the Seoul Metropolitan Area, the study concluded that firms in pursuit of profitability and investment efficiency prefer the Seoul Metropolitan Area and major cities.

Figure 19. Correlation between ROI and Proximity to Metropolitan Cities (by Region)

Source: Author

*** p<0.01; ** p<0.05; * p<0.1



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CHAPTER V.

Industrial Location Strategies and Policy Measures in Response to Socioeconomic Changes

1 Industrial Location Strategies in Response to Socioeconomic Changes

1.1 Greater Focus on Market-oriented Industrial Location Strategies

Korean manufacturers are facing intensifying competition to survive a global economic recession and changes in the sociodemographic structure. To overcome the challenges, businesses are keen to select locations that may help maximize profitability and are more inclined toward city centers than before. The concentration of businesses in city centers is an unavoidable key trend that determines industrial locations and is expected to persist for a considerable time.

The empirical analysis demonstrated that in the case of firms, which choose unplanned locations in pursuit of profitability, the shorter the distance to the nearest city is, the higher the operating margin or ROA (a measure of investment efficiency). In contrast, tenant companies in planned locations (e.g. industrial parks), are located further away from city centers, as the development of industrial parks is concentrated in low-priced suburban areas, rather than high-priced urban centers. This suggests that urban areas, which are preferred among companies, have a limited supply of available sites, and the current supply of industrial locations (e.g. industrial parks) have a spatial mismatch with the demand from profit-seeking individual companies. In other words, Korea's current industrial location policies are confusing and lack clarity between two objectives and related measures intended to 1) promote corporate growth and industrial development by providing companies with desired locations to maximize profits, and 2) promote balanced development, fair distribution and economic equality by supporting marginal companies[06] and provinces, which lag behind metropolitan cities or the Seoul Metropolitan Area.

06. Marginal companies are those that are unable to service debts with operating profits due to their failure to adapt themselves to changes in the industry structure

Historically, governments around the world have pursued industrial location policies with two objectives: a market-oriented policy of supplying locations to support industries and a regional development policy of promoting underdeveloped areas by attracting industries. Governments tend to set a clear policy direction, according to the need of the time and national economic conditions.

From a pro-market perspective, industries and firms make a location decision by themselves in a way that maximizes profits, and therefore the government's intervention in the location decision by industries and companies would distort the market, which would eventually cause negative effects. That is, the government's intervention may risk market failures. Accordingly, the government's role in industrial location decisions should be limited to efforts to ensure a smooth flow of capital and labor force. Some pro-market scholars even argue that industrial location policy is not to spatially relocate industries but to support corporate policies to minimize union strength, to avoid taxes, to exploit new markets, and to maximize profits (Sugrue 2005, 11). That is, as profit maximization is the top priority, the scope of industrial location policies is deemed expansive, such as providing good locations, offering tax abatement for certain locations, and relaxing labor and business regulations.

In recent years, Korea has made a clear transition to market-oriented industrial location policies. In the past, under the Industrial Placement and Factory Construction Act, Korea implemented location policies, which enabled a forced relocation of certain industry facilities. However, the system was abolished. In addition, related laws such as the Industrial Site and Development Act stipulated support and benefits for businesses in the form of tax abatement and deregulation to ensure that businesses can maximize their profits through preferential supply of sites.

On the other hand, industrial location policies, characterized by regional development, first emerged in the UK in the 1930s and 1940s and since then served as a regional development tool that contradicts a market-oriented industry development policy. The UK government introduced the industry distribution policy in 1947 to disperse industries beyond the southeast and central regions to development areas and have pushed forward with the distribution policy since the 1960s. This is considered as equivalent to today's industrial location policy (Walker 1980, 106). However, not all countries pursue industrial location policies to achieve relocation and balanced distribution of industries. The US highlighted industrial decentralization for military purposes but did not have separate industry distribution policies as the UK did. Instead, the US government affected industry locations through limited and indirect ways such as highway construction and taxes. (Walker 1980, 112)

There is disagreement between researchers such as Cuthbert and Sparkes (1968) and Walker (1980) as to when the industrial decentralization policy was introduced in earnest in the UK and other western European countries. However, the general consensus is that decentralization began as part of efforts to regulate the concentration of businesses and industries in urban areas during the rapid growth stage.

Likewise, Korea has adopted an industrial location system to promote balanced national development by implementing the capital area regulation from the 1960s, and Article 2-8 of the Industrial Site and Development Act states "underdeveloped areas requiring the promotion of development" as a condition to be designated as a national industrial

park. The industrial location system has been used to prevent side effects of rapid concentration of industries in the Seoul Metropolitan Area and promote balanced regional development.

However, due to changing conditions such as a prolonged economy recession and intensifying global competition, countries (e.g. Japan and the UK) which used industrial location policies as a regional development tool are rapidly adopting market-oriented industrial location policies to emphasize the industry's own competitiveness and are implementing measures to enhance industrial competitiveness. In response to socioeconomic changes such as a protracted recession, population decline, and an aging population, Japan has rapidly changed its industrial location policies since the mid-2000s, departing from a traditional focus on regional dispersion of industries and shifting toward measures to enhance industrial competitiveness and support business locations (Park 2008, 82).

Metropolitan planning, which primarily concerns industrial relocation, is established in a regional context through cooperation between regional and central governments. With the policy focus shifting from regional development toward independence of a regional economy and global competitiveness, the Industry Relocation Act and Technopolis Act were abolished.

The UK, which was the first to introduce industrial location policies to promote balanced national development, recognized the economic impact of deregulation in the capital area and pursued a spatial development strategy to establish the Greater London area as the best big city on earth to tackle "globalization and the arrival of the knowledge-based economy" (Cho Sung-ho 2015). The UK has pursued the development of the Docklands and tech cities and established the London Plan to make the capital city globally competitive. As part of the London Plan, the government sought to accommodate an 8.1-million population and achieve 640,000 jobs, mostly in the services sector by 2016. Unlike in the past, France did not adopt the regulation and growth restrictions of the Greater Paris area, aimed to promote balanced national development, as part of its SDRIF2030 plans (Cho 2015, 22-28). In the past, France introduced traditional industrial location policies at a rapid growth stage to promote balanced regional development. However, with the arrival of the New Normal and a global economic slump, France is shifting toward new industrial location policies, which prioritize new corporate growth and industry development.

As the global economy recession coincides with a demographic cliff, a decline in working-age population, and the aging of the population, Korea may face more serious decline in industrial competitiveness and production capacity than the UK and Japan did. As mentioned, companies are fully aware of these risks and are flocking to the Seoul Metropolitan Area and metropolitan cities to develop more competitive products and technologies.

Industrial location policies are still the most effective and valid way to achieve balanced national development. However, the era of the New Normal, where infinite competition and slow growth are the norm, calls for a more strategic move. Industrial location policies aimed to promote underdeveloped areas are still needed but should not serve as an impediment to enhancing business growth and industrial development. In the Seoul Metropolitan Area and metropolitan cities, the relaxation of industrial location regulations needs to be considered, albeit to a limited degree, to facilitate the

development of new industries and business growth.

1.2 Diversification of Industrial Location Policies to Achieve Objectives

Korea's industrial location policies pursue dual goals of stimulating industry development through a market-oriented approach and promoting balanced regional development through industrial park development and the regulation of the Seoul Metropolitan Area. However, industries tend to flock to certain areas, which causes a clash between industrial development and regional development. That is, the policy goal of rational industry placement and sustainable industrial development often comes into conflict with balanced national development through industrial decentralization. Countries around the world adopt different industrial location policy targets according to time and region. However, Korea's industrial location policies lack consistency across ministries in terms of policy targets and tools. For instance, under the Industrial Site and Development Act, the Ministry of Land, Infrastructure and Transport defines balanced national development as one of the objectives set by said Act. In contrast, the Korea Industrial Complex Corporation under the Ministry of Trade, Industry and Energy defines that the purpose of industrial location policies is to ensure that industries efficiently secure production and operating spaces and make sound location decisions (Industrial Location Research Center, 2016), emphasizing industrial production over balanced national development.

Aside from the lack of inter-ministerial coordination on industrial location policies, what is more problematic is that the Industrial Site and Development Act, a key industrial location policy, fails to present distinctive policy tools that serve its purpose. That is, the purpose of the Industrial Site and Development Act is to promote balanced national development and sustained industrial development through the efficient supply of industrial locations and the rational positioning of industries (Article 1). However, when it comes to institutional tools to achieve the purpose of industrial location policies, the Act classifies industrial parks into four groups, namely national industrial parks, urban high-tech industrial parks, general industrial parks, and agricultural industrial parks and falls short of coming up with alternatives regarding supportive measures and designation procedures. For example, pursuant to the Article 2, a national industrial park can be designated to promote national key industries, high-tech industries, etc. or to develop underdeveloped areas requiring the promotion of development. Despite the difference in the purpose of the designation, the Act applies identical designation procedures, development methods, and supportive measures, making it difficult to ensure the efficacy of industry location policies.

Accordingly, the first step to effectively fulfill the policy goals is to clarify whether respective policies set by industrial location systems are aimed to pursue industrial and corporate growth from a market-oriented perspective or to promote regional development or balanced national development. Then, it is imperative to take different approaches to different types of industrial locations, with regard to designation requirements, those authorized to designate industrial locations, designation procedures, and supportive measures. Industrial location policies include both unplanned and planned locations. However, differentiating policy targets and supportive measures should give a priority to industrial parks in the planned location category.

1.3 Optimization of the Industrial Location Supply System

In general, Korea's industrial locations are divided into planned locations and unplanned locations (Industrial Site and Development Act, Comprehensive Guideline for Industrial Location Development, Industrial Location Information System, FEMIS, Industrial Location Booklet). Institutions are structured in a way that enables demand forecasting for industrial parks, which represent the largest share of planned locations in terms of square meters, and subsequent supply planning.

The issue is that supply plans for industrial parks are established in advance according to supply and demand projections, but that is not the case for other planned locations such as free economic zones, R&D special zones, and science belts. Respective ministries supply these locations without conducting supply and demand projections or taking industrial park policies into consideration. Planned locations differ from unplanned locations in that the former are supplied according to government plans. However, contrary to what the name suggests, planned locations except for industrial parks are supplied without demand forecasting, due to the absence of a unified law governing the purpose of designation, designation procedures, or those responsible for designation, management, and development. Under the current laws, planned locations include industrial parks (developed by the Ministry of Land, Infrastructure and Transport), free economic zones (the Ministry of Trade, Industry and Energy), R&D special zones and international science business belts (the Ministry of Science, ICT and Future Planning), high-tech comprehensive medical parks (the Ministry of Health and Welfare), enterprise cities, new cities for provincial government office relocation, and innovative cities (Jang 2015). However, industrial parks are the only planned location that is supplied through demand forecasting and annual supply planning.

The problem is that ministries make uncoordinated efforts to supply project sites including industrial parks, making it impossible to supply, develop, and manage industrial locations based on demand/supply projections and thus risking excessive competition between planned locations and oversupply.

It is important to clearly define the purpose of industrial locations and take different policy measures accordingly. However, it is even more crucial to supply industrial parks and industrial locations where needed, when needed, and in the amount needed in order to improve policy efficiency. Most free economic zones such as the Yellow Sea Free Economic Zone are struggling with a lack of demand and failing to attract investments. Industrial parks in provinces are in a cut-throat competition with nearby free economic zones, R&D special zones, and food industry clusters. Only 4 km apart, the high-tech industrial park planned by the National Agency for Administrative City Construction and the science belt led by the Ministry of Science, ICT and Future Planning and the Daejeon Metropolitan City will likely compete for tenants by the time they open around 2020.

In the case of new development, which involves planning and land condemnation, it is necessary to coordinate supply plans in advance to prevent excess supply, reckless development, and exploitation of resources in the area and to achieve sustainable growth. On the other hand, in the case of "industrial districts," which do not require a development process, it should be free to designate and operate them in special districts in metropolitan cities and the Seoul Metropolitan Area. Such measures are expected to enable a steady supply of industrial locations to city centers preferred by high-tech

industries and highly skilled talents and promote urban renewal.

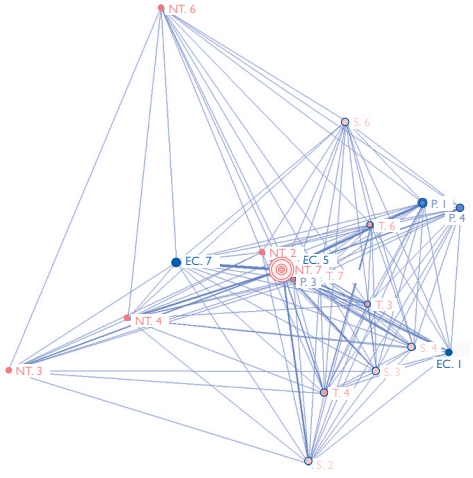
1.4 An Increase in the Supply of Shared Industrial Locations

Big data analytics and SNA results show that changes in industrial locations such as the concentration of businesses in major cities and a decline in commuting time are affected by corporate profitability and changes in the household structure and at the same time are related to the proliferation of the sharing economy.

Source: http://urbanhybrid.co.kr/biz/c-azit/

- Economy(EC)
- Environment(EV)
- Politics(P)
- Society(S)
- Technology(T)
- National Territory(NT)

Figure 20. SNA of the Sharing Economy



National Territory 7: Sharing Economy
National Territory 2: Shorter Commute Time
National Territory 4: Concentration of Highly Skilled Talents in the Seoul Metropolitan Area

Figure 21. Changsin Azit based on a Sharing Economy

- Communal Space: Gathering Space (Shared Table)
- Design Studio: Shared Working Space
- Manufacturing Studio: Fashion Sample Room

The EgoNet shows that an increase in single-person households leads to higher residential mobility, prompting people to find jobs close to home. Notably, a slow economic growth is giving rise to a small-scale agglomeration economy, characterized by a decline in facility investments and synergy effects through joint production.
In this regard, shared industrial locations will provide a new model, which enables technology exchange, entrepreneurship, one-person production, and timely responses to changes in the market. As demonstrated by big data analytics, the development of a sharing economy is the most notable future trend in terms of national territory and industrial locations. Marshall's argument that industrial location hinges on agglomeration economies and externalities resulting from spatial concentration of knowledge, labor, and intermediary goods should become more compelling with the arrival of the Fourth Industrial Revolution that accompanies socioeconomic changes such as technology development, a slowdown in the global economy, and an increase in single-person households. The economy is expected to move beyond the agglomeration of technologies, labor, and intermediary goods toward the sharing of labor and intermediary goods, and sharing of inter-connecting and complementary transportation methods and residential and production facilities.

Indeed, Urban Hybrids' Changsin Azit in Seoul is operating as a shared factory, where around 10 sewing technicians work together with around 20 designers from different sectors such as textiles. Changsin Azit is recognized as a social venture and serves as a sharing-economy platform for designers and technicians to collaborate, produce, and do business. Going forward, Changsin Azit is expected to evolve as a new industrial location for a small-scale sharing economy.

In the manufacturing sector, factories are close to a shared production space in the sense that production and shipment of various components and products only proceed upon the receipt of orders. However, in the future, the sharing of factories is likely to grow beyond the production stage directed by a company or an individual to include the entire value chain encompassing planning, production, and sales. With the rise of one-person manufacturing, an increase in manufacturers, use of 3D printing technology, and the Fourth Industrial Revolution characterized by IoT, content, product planning, and customization should play a greater role in the production process than large-capacity factories, and the urban concentration of industries excluding large-scale production lines will likely accelerate. Unfortunately, compared to shared houses, cars, and other types of the sharing economy, only a little research is done on shared industry space and industrial locations. More research should be carried out as to how to effectively supply shared urban factories such as Changsin Azit and what incentives should be offered to innovative entrepreneurs and startups.

2. Industrial Location Policy Measures in Response to Socioeconomic Changes

2.1 Policy Measures to Differentiate Industrial Location Policy Measures

While maintaining the current system under which industrial parks are classified into national, general, agricultural, and urban high-tech types, it is necessary to clearly divide policy goals between regional development and industrial development and growth and apply different approaches, with regard to designation requirements, supply methods, and supporting systems. In the case of high-tech urban industrial parks, designated for the development of new growth industries, it is reasonable to operate them in a way that supports businesses and promotes industry development, rather than facilitates regional development or balanced national development. In the case of agricultural industrial parks, it is desirable to serve the original purpose of promoting the development of underdeveloped areas.

The Industrial Site and Development Act and the Comprehensive Guideline for Industrial Location Development apply identical rules to different types of industrial parks in terms of the ratio of production space, square meters of supporting facilities, the minimum plot size, and green space and provide for similar supportive measures, regardless of the location and the type of industrial parks. As such, it is virtually impossible to provide different support, by taking into consideration whether industrial parks are aimed to promote regional development (balanced national development)

or to stimulate industrial or business development and growth. In the case of industrial parks in provinces, which have lower accessibility than those in metropolitan cities or the Seoul Metropolitan Area, the construction of access roads should be considered in the context of reginal development, as under the current system. However, as evidenced by the empirical analysis, in the case of metropolitan cities, where the location of national industrial parks makes a significant impact on nearby housing prices, it is possible to pursue a different location policy by focusing on housing and residential facilities, rather than access roads. Currently, mini town projects, which connect industrial parks scattered nationwide, are underway. The Ministry of Land, Infrastructure and Transport is implementing plans to supply 10,000 units of affordable housings (a.k.a. Happy House) within industrial parks by 2017. However, the supply of such residential facilities should be prioritized for industrial parks close to urban areas to make it more efficient.

It is necessary to partially change the supply method of industrial locations, which is currently based on the cost of land development, which is cheaper than market place. Should greenbelt restrictions be lifted and designated as high-tech urban industrial parks that can accommodate new promising industries suitable for the Fourth Industrial Revolution or high-tech industries, it is necessary to revise up the creation cost to a realistic level in order to prevent companies with speculative purpose from reaping windfalls. According to the empirical analysis result and interviews with firms operating in unplanned locations in metropolitan cities, firms close to major cities report better financial indicators such as operating margin than their counterparts located in areas far away from city centers. That is, as companies close to city centers yield greater productivity and profitability despite relatively high location expenses, companies prefer proximity to city centers to attract highly skilled talents and create a value chain with related companies. Industrial location has rivalry and exclusivity in its nature. Companies must compete for a good location, and once a company wins the location, it is no longer available for others. Given rivalry and exclusivity unique to industrial location, locations with favorable conditions should be provided to companies with greater socioeconomic value. That is, such locations should be distributed to companies which can develop better technologies and generate greater profit so that they can make greater financial contribution to the central and regional governments and job creation and employment welfare. Under the current uniformed supply method based on creation cost, it is impossible to achieve efficiency in distribution of industrial locations. Given that high-tech urban industrial parks, which are located in the former green belt areas, have favorable locations and significantly lower creation costs than market rates, the cost-based supply method should be revised in a way that prioritizes companies with greater socioeconomic values.

The concept of multi-purpose sites was recently introduced with regulatory revisions. However, regardless of the type of industrial parks and region, it requires that industrial facilities should account for a minimum 50% of the total square meters (Article 13 of Comprehensive Guideline), making it difficult to apply a different approach to industrial parks nearby major cities, which have high housing demand and attract high-tech industries, and industrial parks in agricultural areas specialized in the traditional manufacturing sector. Should minimum requirement for an industrial site be satisfied based on the total disposable land, it is desirable to give freedom to companies to take advantage of multi-purpose sites according to the purpose of industrial park development and their own location demand. Notably, the Comprehensive Guideline for Industrial Park Planning, applicable to industrial parks designated in accordance with

the Act on Special Cases Concerning the Simplification of Authorization and Permission Procedures for Industrial Complexes, also requires green space relative to the total square meters, without taking into consideration the type of industries or regions that attract small-scale industrial parks. Under such regulations, it is impossible to pursue a differentiated approach. Indeed, it is necessary to introduce a negative list system to keep requirements to a minimum and give greater discretion to developers, tenants, and local authorities to develop according to their conditions and the purpose of the site designation, rather than a positive list system, which imposes detailed and different requirements according to the objective of designation, the type of industrial parks, region, and square meters. Should the purpose of industrial location development be not to promote balanced national development but to stimulate corporate and industrial growth, it is imperative to gradually scale back regulations to enable developments in a way that fully meets market demand.

2.2 Policy Measures to Improve the Efficiency of the Supply System for Industrial Locations

Under Article 9 of the Comprehensive Guideline for the Development of Industrial Locations, those authorized to designate an industrial park should take into consideration the square meters currently occupied by industrial facilities and designate industrial parks in areas not in excess of 10 times the annual average of square meters needed for industrial facilities in the area. In other words, a single industrial park may supply an industrial facility site that is up to ten times larger than the annual average of square meters needed for industrial facilities in the area.

However, it may risk an oversupply, unless the development of a new industrial park takes into perspective the future supply of planned locations in the area and nearby areas such as industrial sites, new cities, innovative cities, corporate cities, free economic zone, science belts, and R&D special zones. To prevent oversupply, Article 9 of the Comprehensive Guideline for the Development of Industrial Locations makes it mandatory to undertake a demand verification procedure prior to the designation of a new industrial park. As such, the verification procedure makes it possible to take into consideration industrial park development plans that have been announced. However, once a new industrial park is designated, should other ministries seek to supply a large-scale planned location to the area or nearby area, there is no system in place that can prevent or coordinate the development.

Accordingly, in the case of the collective development of planned locations, it is necessary to introduce a legally integrated system which requires all ministries to estimate and identify new development demand according to industrial park supply and demand outlook published by the Ministry of Land, Infrastructure and Transport in order to prevent an oversupply of planned locations and reckless development. Specifically, it would be possible to prevent an oversupply and enable planned supply of industrial locations by introducing the Comprehensive Guideline for Efficient Supply of Planned Industrial Locations or related laws to oversee the supply of planned locations that are otherwise distributed across ministries and imposing them on ministries which seek to supply planned locations. That is, it is necessary to establish a legal framework under which the Ministry of Land, Infrastructure and Transport shall announce an annual supply plan for all planned locations nationwide, and those authorized to designate industrial parks as well as central government agencies should

make designations only after demand forecasting and development planning, according to the annual supply plan.

However, in the case of "district and zone type locations" which do not entail new development and are designated as large-scale districts, areas, or zones to stimulate corporate and industrial growth, they should be excluded from the planned location category, which require annual demand projections by the Ministry of Land, Infrastructure and Transport, to encourage renewal of the existing clusters, rather than new development, and support for companies doing business there.

2.3 Policy Measures to Expand the Supply of Sharing-economy Industrial Locations

Compact urban development, the wider introduction of shared residential and manufacturing spaces, and the development of digital technologies are expected to drive down the demand for cars and parking lots over the long term, making it possible to flexibly apply the parking lot law to multi-purpose industrial sites in cities.

In addition, it is necessary to allow small-scale shared industrial clusters (or collective areas such as a number of floors within a building or small buildings), which are aligned with urban renewal projects, to promote urban industrial locations. Article 45 of the Industrial Site and Development Act should be revised in a way that provide small-scale shared industrial clusters with tax benefits and facility support that are equivalent to those offered to industrial parks. Currently, designation of industrial parks is classified by national, regional, agricultural, and urban high-tech types. In the case of urban high-tech industries, the minimum area requirement is currently set at 100,000 square meters or smaller; however, designation of a shared industrial park should be allowed for select floors of a high-rise building, where related production activities are highly concentrated, or a district measuring 30,000 square meters or smaller, making them eligible for various incentives. Most of all, proactive and institutional research should be carried out in response to an increase in small-scale shared industrial locations resulting from the arrival of the Fourth Industrial Revolution.

Table 15. Forward-looking Industrial Location Policies

	Industrial Locations (As-Is)	Forward-looking Industrial Locations	
Socioeconomic Changes	Rapid economic growth	Slow growth, economic slump	- Location competitiveness - Business competitiveness
	Baby boomers (Low wage levels)	A decline in working-age population (a demographic cliff)	
	Competitiveness in land prices	Technology competitiveness	
	Large-scale industrial parks	City centers	
Policy Objectives	Dual purposes: Balanced national development and industrial development	Selective focus on balanced national development and industrial development	
Supply Methods	Standardization/large-scale supply	Efficiency/customization/major cities	
Policy Tools	Uniformed designation process/ supportive measures	Differentiated designation process/supportive measures	
		Procurement cost at a realistic level	
		Different standards for multi-purpose sites	
		Selective support for access roads/residential facilities	
		Wider supply of urban industrial locations based on a sharing economy	

Source: Author

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INDEX

Figure

Tables

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45

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