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The Seoul Institute
Annual Research Digest 2020

Miree Byun · Ji-ye Yoon

서울연구원
The Seoul Institute

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Editor's Note

Greetings from the Seoul Institute.

The Seoul Institute (SI) is a think-tank for the Seoul Metropolitan Government (SMG). Our institute produces policy proposals and recommend new programs for the SMG. More than 90 researchers with Ph.Ds in a variety of urban policy disciplines work tirelessly at the SI. The SI has now been about 30 years since the SI was established as the Seoul Development Institute in 1992. Since then, Seoul has been a dynamic city as the city has faced diverse challenges at different periods of time. The role of the SI has changed accordingly.

Seoul has come into spotlight as a city with innovative solutions to urban problems. Every year, officials from local governments in other countries or international organizations visit Seoul and the SI, interested in hands-on experience that Seoul can offer to cities around the world. They are also keen on original SI policy research studies. The SI has been active in sharing our research outcomes with other cities through international cities networks such as Megacity Think-Tank Alliance(MeTTA, http://global.si.re.kr/metta).

Here we offer English summaries of major research produced in 2020. This book contains 17 research studies chosen from over 100 that cover a range of fields in urban policy.

We hope this report provides a good reference to understand urban issues of Seoul and its innovative policy solutions with meaningful implications for cities around the world.

Miree Byun

01 Social Policy

Strengthening the Social Networks of Elderly Women Living Alone in Seoul

Ik-Hyun Jang · Mi-Yang Jeon · Jin-Young Moon

Key Message

There is a need to take policy action to prevent social isolation among older women living alone, classified as a "closed network" group. The Seoul Metropolitan Government (SMG) should provide customized support to female single-person households in view of the attributes of their social networks.

Women comprise 75 percent of single-person households[1] in Seoul. They are likely to be socially isolated due to limited financial resources

Changes in household composition, characterized by the growth of single-person households, is one of the sociodemographic issues faced by Seoul, together with low fertility rates and an ageing population. One of three households in Seoul are one-person households. The rise of elderly single-person households, combined with a graying population, trigger changes in welfare policies and policy demands in diverse sectors. As of 2017, female older adults living alone represented 72.8 percent (152,303 households) of all elderly single-person households—nearly three times the number of male elderly single-person households (Statistics Korea, 2017).

[1] A single-person household refers to a household made up of one person.

At the present time, women account for approximately 75 percent of all elderly single-person households in Seoul. Thus, it is to safe to say that an increase in one-person households means an increase in elderly women living alone.

[Table 1-1] Elderly Single-person Households in Seoul (by age)

Classification	Total		Female		Male	
	Households	Percentage	Households	Percentage	Households	Percentage
65 to 69 years	61,577	29.4	39,507	25.9	22,070	38.8
70 to 74 years	52,768	25.2	37,795	24.8	14,973	26.3
75 to 79 years	47,620	22.8	36,435	23.9	11,185	19.6
80 to 84 years	29,344	14.0	23,791	15.6	5,553	9.8
85 and over	17,931	8.6	14,775	9.7	3,156	5.5
Total	209,240	100.0	152,303	100.0	56,937	100.0

Source: Statistics Korea, 2017, Population and Housing Census

[Table 1-2] Elderly Single-person Households in Seoul

Classification	Female		Male		Total Persons	Percentage
	Persons	Percentage	Persons	Percentage		
Entire elderly population	599,378	-	760,523	-	1,359,901	-
Elderly single-person households	208,147	100.0	95,677	100.0	303,824	100.0
Recipients of Basic Livelihood Security benefits	38,692	18.6	21,080	22.0	59,772	19.7
Low-income elderly population (lower-middle income class)	13,904	6.7	4,760	5.0	18,664	6.1
Other elderly single-person households	155,551	74.7	69,837	73.0	225,388	74.2

Source: Entire elderly population- Statistics Korea & Ministry of the Interior and Safety (MOIS), December 2017, Statistics of Residence Registration Population in 2017
Elderly single-person households- Seoul Statistics, December 2017, Statistics of Older People Living Alone by Gender and Dong-district2

Many elderly women living alone in their last stages of life do not have sufficient income to attain financial independence, meaning there is a strong chance they are at risk of social isolation. Social isolation is directly linked to the threat to the right to life.

[Table 2] Demographic and Economic Features of Female Elderly Single-person Households in Seoul

Classification		Number of people involved in this study	Percentage (%)
Total		500	100
Age	65 to 69 years	140	28.0
	70 to 74 years	128	25.6
	75 to 79 years	114	22.8
	80 and over	118	23.6
Marital status	Married	6	1.2
	Widowed	438	87.6
	Single	3	0.6
	Divorced	53	10.6
Educational attainment	None	38	7.6
	Elementary school	136	27.2
	Middle school	154	30.8
	High school	166	33.2
	College or higher	6	1.2
Reasons for living alone	Proximity to work	2	0.4
	Death of spouse or separation or divorce	479	95.8
	Household members moved out	8	1.6
	Family trouble	3	0.6
	Personal convenience and freedom	5	1.0
	Other (Husband hospitalized, single, spouse living elsewhere for work)	3	0.6
Subjective assessment of health	Healthy	152	30.2
	Average	175	35.0
	In ill-health	173	34.6

[2] A “Dong-district” is the smallest level of urban-area division to have its own office and staff in South Korea. There are two types of dong: legal-status neighborhoods and administrative neighborhoods.

Classification			Number of people involved in this study	Percentage (%)
Financial status		Affluent	51	10.2
		Average	276	55.2
		Poor	173	34.6
Government financial assistance received		Basic Livelihood Security benefits	65	13.0
		Basic pension	381	76.2
		National pension	200	40.0
		Government employee pension	13	2.6
		Military pension	2	0.4
		Disability pension	6	1.2
Income	Average income	Average gross income in recent three months	1,164,900 (standard deviation: 64,840)	
	Income bracket	Less than KRW 500,000	32	6.4
		KRW 500,000 to 1,000,000	193	38.6
		KRW 1,000,000 to 1,500,000	140	28.0
		KRW 1,500,000 to 2,000,000	70	14.0
		KRW 2,000,000 or more	65	13.0

Thus, social networks are a vital element in their lives, not only to remedy social isolation but to enable active and energetic living out of their golden years.

This study examines the current status of the social networks of elderly women living alone in Seoul and measures the quality of those networks, which are classified according to variables that reflect this qualitative aspect. This study also analyzes how existing policies of the central government and the SMG are mirrored in each category. Through this analysis, the researchers present policy recommendations regarding each type of social network with an aim to strengthen the social networks of female elderly single-person households.

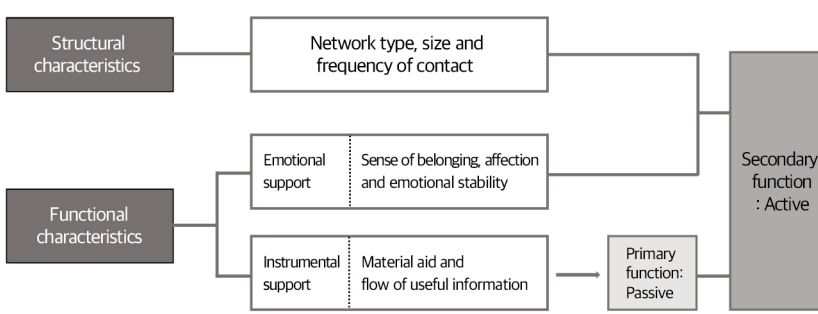
Elderly women living alone in Seoul lead life through broader and more intimate personal connections than family

What is important in an ageing society is that senior citizens actively live lives that support vitality instead of remaining passive welfare recipients as has been the

case in the past. An active lifestyle is critical to safeguarding dignity, enhancing quality of life, boosting social and economic activities and promoting a positive social atmosphere.

A wide range of definitions of social networks exist. Cobb (1976) defined them as relationships that cause a person to believe that he or she is loved, cared for and esteemed and a member of a network of mutual obligations. Social networks have structural and functional attributes (Cohen and Syme, 1985). Structural characteristics include relationship type (family, relatives, neighbors, etc.), network size and frequency of contact. On the other hand, as particular functions that networks serve for an individual, functional characteristics refer to flow of information, material aid, a sense of belonging and emotional stability. These characteristics are also divided into emotional and instrumental support. While emotional support refers to belongingness, affection and emotional stability, instrumental support refers to material aid and flow of useful information.

Functions of social networks are closely related to social network structure. In terms of the most properly functioning social networks, or those that function positively, they are large and dense and involve frequent contact. Besides these structural features, the types of persons forming social networks determine whether the social networks function adequately. The higher the proportion of blood relations and the more diverse the socio-economic backgrounds, the more positive functions the social networks serve.



[Figure 1] Definition and Functions of Social Networks

For this study, the researchers looked at social networks of 500 older women living alone in Seoul using egocentric network analysis. An egocentric network shows a unique set of each elderly woman's social contacts, not the entire network composition.

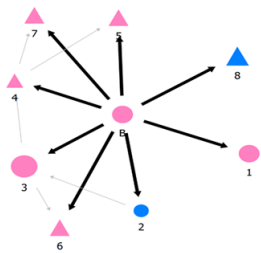
The researchers found that the average number of meaningful acquaintances with whom these elderly women could open up with about important matters was 4.99. Some had only one or two meaningful acquaintances, while others maintained close relations with 10 people. By relationship type, blood relations and personal relations such as friends and neighbors stood at 50.6 percent and 48.7 percent, respectively, constituting the largest part of the relationships they had. Service providers came next at 0.76 percent. Only half mentioned family members as significant acquaintances. The degree of reliance and dependence on meaningful acquaintances was 4.04 on average (of a maximum 5). This means that these people have gone through their lives building up a relatively broader network of personal relationships with non-related people they trust, rather than leaning on family.

The social networks of female elderly single-person households can be divided, based on their characteristics, into three groups—extended networks, mid-sized networks and closed networks

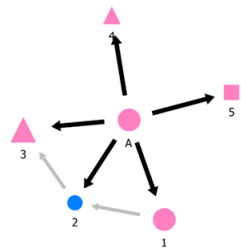
The social networks of elderly women living alone can be categorized into three groups according to the features of the social networks they have: extended, mid-sized or closed.

Extended networks are the largest of the three groups of social networks but the frequency of contact and degree of reliance on each person in that network are low. Conversely, the closed network is small but dense,[3] and degree of reliance and

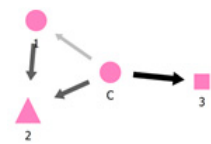
[3] Network density is the portion of potential connections in a network that are actual connections.



[Figure 2-1] Social Relations in Extended Network



[Figure 2-2] Social Relations in Mid-sized Network



[Figure 2-3] Social Relations in Closed Network

Gender	Female		Male
Relation type	● Blood relation	▲ Personal relation	■ Service providers
Relationship indicator	Arrows		
Frequency of communication/Degree of reliance	Thickness of the arrow		

frequency of contact are the highest of the three groups. Service providers, including life managers and care assistants, are identified as significant acquaintances in their social networks. Mid-sized networks lie between extended and closed networks with respect to their attributes. They are multi-layered groups that include a myriad of network types. Each network type is significantly related to age and the period of living alone. Those in extended networks experience shorter periods of being in a single-person household and are relatively younger. In addition, their educational level and income are higher. Their networks mainly consist of blood relatives. Most female elderly single-person households with the longest period of living alone and the highest average age are in closed networks. In general, people in this kind of network have lower education and income levels and are the most likely to evaluate their health as poor.

Policies are critically needed that take into account the varied needs of older women living alone

Most central government and the SMG policies on elderly single-person households are care policies targeting low-income, vulnerable individuals. The majority are about fulfilling the primary function, or passive functions, of social networks like confirmation of safety and material aid—food and drink or air-conditioning and heating equipment.

Elderly single-person households have different needs and characteristics depending on age, period of living alone and socioeconomic status. Notwithstanding this fact, people have a tendency to view them as a vulnerable class. Present policies focus on low-income, vulnerable senior citizens. Hence, it is difficult to support the secondary function, or active function, of social networks. Despite the fact that older adults need active livelihood assistance irrespective of income, the policy target group is limited in scope.

Currently, only seniors with dementia are eligible for public guardianship services. It appears that policies where diverse needs of female elderly single-person households are reflected are needed.

Closed networks: Make active use of existing policies to induce participants to engage in social gatherings

The SMG's first priority should be to lead female seniors living alone with narrow and limited networks to participate in social gatherings. Health is a major concern for these women. Accordingly, it is possible to persuade them to be involved in meetups through keep-fit classes and house-call services provided by nurses and doctors working at local clinics which can be run by community meetings. As they have lower income and education levels and their degree of participation in senior employment projects are high, social network projects can be

carried out in tandem with employment projects. In particular, community businesses play a primary role in restoring a sense of community. Hence, it is worth considering subsidizing the cost of programs such as vocational training (gardening, sewing and bead-craft) and table sharing.

Extended and mid-sized networks: Employ indirect policy measures, rather than direct support, to keep networks intact

When it comes to policy approaches to those belonging to extended networks or mid-sized networks and leading proactive lives, indirect policy measures might be more helpful than direct support. It is advisable to encourage them to stay in touch with meaningful acquaintances and develop organic relationships during a prolonged period of living alone rather than directly building networks or identifying those eligible for support through policies. Rendering assistance to programs ranging from leisure activities to humanities courses and offering spaces for communal activities can be included in such indirect support.

Analysis of Seoul's All-Day Care & Policy Measures

Hyesook Lee · Incheol Sin · Samhyun Yoo · Youngjoo Lee

Key Message

The Seoul Metropolitan Government (SMG) should expand childcare infrastructure based on estimates of the present supply of and existing demand for all-day care services for school-age children.

Now is the time for the SMG to formulate strategies on how to render all-day care services based on analysis of their present use and existing demand

Increasing all-day care for elementary school students has been a key policy objective of the present South Korean administration. The mayor of Seoul, directly elected through the 7th direct elections, has also pledged to do this. Along with an ordinance on support for the All Maeul Plan, the SMG devised a master plan on creating a framework for the Plan in the first half of 2019. With a vision of making Seoul a city whose citizens are free from concerns about childcare, the SMG has aimed to raise the proportion of public childcare centers of all childcare centers for elementary school students to 30 percent by 2022 (Data courtesy of the official SMG website, September 2019). From 2018 to early 2019, the SMG made the following efforts towards this goal:

(1) Organizing and running an "All Maeul Care Consultative Committee"[4];

[4] The "Community All-day Care Consultative Committee" is a metropolitan-level consultative committee on childcare that involves the SMG, the Seoul Metropolitan Office of Education and childcare experts. Its key purpose is to facilitate cooperation between the Seoul

(2) Appointing a civil servant to be in charge of childcare programs;

(3) Creating an institutional basis for after-school care services including enactment of a relevant ordinance;

(4) Ramping up the number of "Our Neighborhood Kium Centers"[5].

The SMG's plans to extend after-school care services for children of compulsory school age has received a positive response from parents. However, some cautiously voice concerns of the overlap where some students use more than one childcare program and existing blind spots. The volume of local childcare centers or after-school academies available to children has not been proportional to local demand, resulting in uneven distribution of local childcare providers across Seoul. What is more, it is difficult to adjust or negotiate provision of childcare centers due to a lack of connection between them (Lee et.al., 2018). Thus, a thorough examination of user demand for and use of all-day care services is necessary. This study aims to present mid- and long-term plans on provision of care and strategies for the SMG related to All Maeul Care services.

In 2019, the SMG eased eligibility requirements for all-day care services and built childcare infrastructure

Concerning the policy on all-day care, two major changes were made in 2019 - easing eligibility criteria and boosting the number of care facilities. The SMG extended the grade eligibility for the elementary school care classes[6] run by schools, from first and second graders only, to include third graders. Moreover,

Metropolitan Office of Education and care providers.

5 The "Our Neighborhood Kium Center" provides childcare after school and during vacations /public holidays. Children aged 6 to 12 are eligible.

6 Through elementary school care classes, care services are rendered by care staff, hired by Offices of Education or schools, during after-school hours in separate locations within schools.

towards ensuring nobody remains on the waiting lists for the programs, promises were made to gradually create 500 more elementary school care classes by 2022. As of March 2019, 251 new classes had been added. Upon revision of the SMG Ordinance on Support for Local Childcare Centers (September 26, 2019), all children in local communities are now eligible for the childcare services offered by the centers. The Ministry of Health & Welfare (MOHW) made changes to its own guidelines in 2019. With this revision, quotas can now be set of up to 30 percent of children eligible for local childcare centers (40% for children from islands or remote areas) in accordance with local circumstances. The SMG's childcare policy appears to be more advanced than guidelines on local childcare centers issued by the MOHW. Along with this, the SMG is going to operate a "Combined Center" to create a mutually beneficial business model for local childcare centers and Our Neighborhood Kium Centers (source: SMG). The SMG has accelerated its efforts to increase the number of Neighborhood Kium Centers to 400 by 2022, starting with test operation of 4 centers in 2018. As of late September 2019, 92 places in 23 autonomous Gu-districts had been designated, of which 26 locations in 13 autonomous Gu-districts are presently in operation.

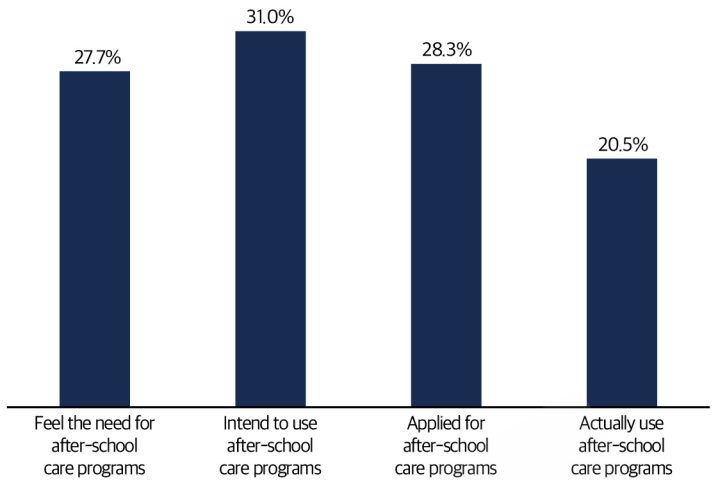
The researchers conducted a survey of parents in the interest of evaluating the current use of and demand for the SMG's all-day care services

To understand the current use of after-school care among elementary students in lower grade levels in Seoul, we conducted a survey during an approximately three-week period in June 2019. The subject of the survey was parents with children in first through third grades in Seoul at time of survey. Our survey population consisted of first through third graders in each autonomous Gu-district. The sample was equally distributed between a group using public after-school care (50 persons) and a group not using it (50 persons) across 25 autonomous Gu-districts. Statistical adjustments were made to survey data. Weighting was applied according to the

proportions of each group in the population of first to third graders of each autonomous Gu-district. The questions were mainly about the use of and the intention to benefit from all-day care programs. To be more specific, the survey was composed of questions regarding the current use of public and private care, forms of after-school care, desire to use public care and services required.

31 percent of survey respondents voiced "a desire to use public after-school care programs around the start of classes"

The desire of 27.7 percent of all respondents was for public after-school care around the start of classes in March 2019. While parents who intended to benefit from after-school care programs around the time constituted 31 percent, 28.3 percent of the number actually applied for the programs and 20.5 percent were using them at the time of survey. There was a significant difference in the level of need for public after-school care between dual-income and single-income families. Double-income families who feel the need to use care programs accounted for 67.2 percent while only 5.2 percent of single-income families felt the same; 71.6 percent of double-income families intended to use the programs while 7.8 percent of single-income families felt the same way; 68.6 percent of double-income families applied for public care, while only 5.2 percent of single-income families did the same. Care programs were used by 54.8 percent of double-income families and 0.9 percent of single-income families. The level of interest was higher than that of actual need. Children in double-income families were more likely to receive public after-school care, while children in single-income families were less likely.



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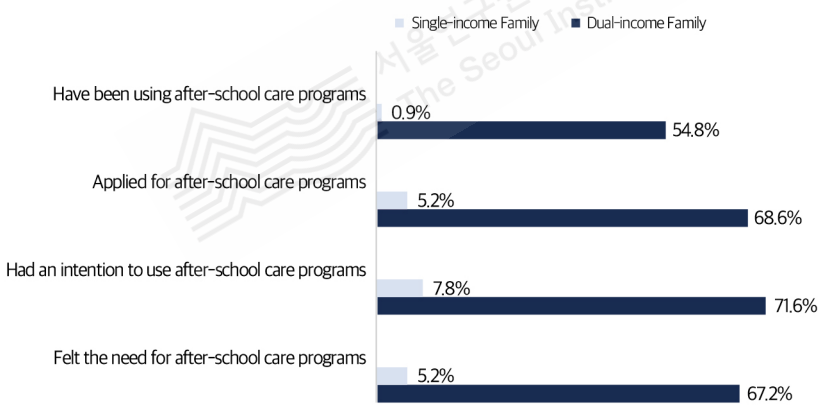

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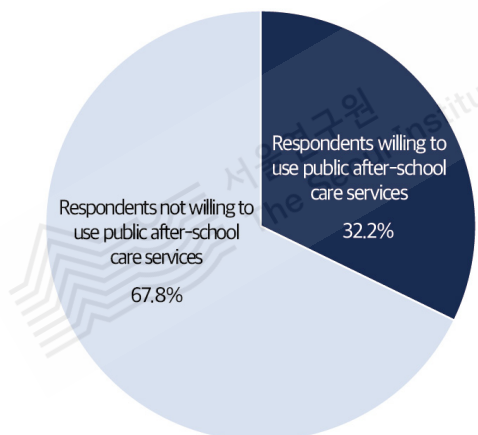
[Figure 3] Need for After-school Care Programs around the Beginning of The School Year

Parents interested in public after-school care represented 32.3 percent of all respondents. The deciding factors were access, safety and program quality

The survey found 32.3 percent of respondents “intending to use public after-school care”. Of those not interested in such services, parents looking after their own children constituted the greatest proportion at 60.6 percent. When it comes to the types of after-school care parents are interested in, elementary school care classes appealed to 29 percent, local childcare centers attracted 6.8 percent, and 7.7 percent were interested in other local care providers.



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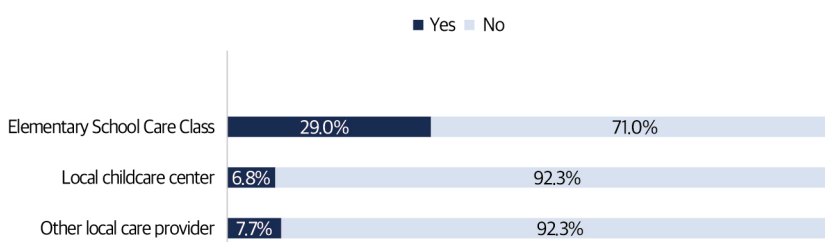

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[Figure 4] Interest in Public After-school Care Programs

Access, safety and linkability to other programs were given as reasons for the preference for elementary school care classes. An overwhelming percentage of parents with children already in the program (51.7 percent) mentioned “proximity and safety as they are held in schools” as one of the reasons. Those citing “being able to use the classes together with after-school programs” came to 12.6 percent. The reasons for not using public after-school care were “having someone available to help with childcare” (40.4%), “child(ren)’s choice not to go” (14.1%) and “ineligibility for the services” (8.3%). The most common factor taken into consideration when selecting a public after-school care provider was “quality of programs” (27%), followed by “facilities and spaces” (21.3%), and “access” (18.8%). “Specialized programs” were identified by 30.1 percent of all respondents as the most needed services, followed by “help with assignments and preparing materials for school activities” (27%) and “snacks offered” (16.2%). The main reasons behind the use of public after-school care and factors to be taken into account when choosing a provider can be summarized as follows:

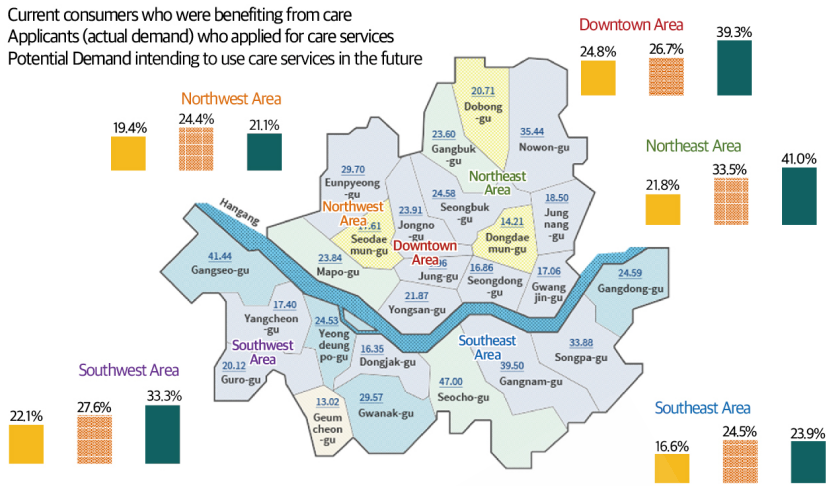
- The SMG needs to provide comprehensive services that are not only safe but also conducive to child development and learning.

As opposed to findings from previous studies, we learned that parents prioritized provider convenience over access throughout the survey. We believe this is reflective of regional characteristics such as Seoulites’ drive for their children’s education.

The estimated number of elementary school students and desire to use all-day care will vary from area to area between 2020 and 2024

Before predicting demand for all-day care services in Seoul, we projected the number of elementary school students in the entire area and major areas of Seoul over the next five years (2020~2024). Estimated school-age population and demand for all-day care programs based on the medium-variant projection are shown in [Table 3]. We calculated the percentages of parents living in the major areas of Seoul and intending to use all-day care on the basis of survey data. These percentages were applied to the projected number of elementary school students in first through third grades.

There will be a decline in demand for all-day care services among all students in lower grade levels residing in Seoul between 2020 and 2024, from 66,602 to 53,147. Let's take a look at data on demand for all-day care programs in each area in 2024. Estimated demand by area were: 2,734 (downtown core), 20,699 (northeast area), 4,093 (northwest area), 16,358 (southwest area) and 9,293 (southeast area). The expected slide in the number of elementary students in lower grade levels stemming from the city's low birth rate is mirrored in the data. Our assumption was that the ratio of students in each area in 2019 as well as the rate of reduction in all-day care provision would remain the same. It is worth noting that the future estimated interest in all-day care services is just that: a prediction for the near future. The children of respondents will leave the target group in the SMG's childcare policy (which is the focus of this study) over time as they grow up.



Data (map) courtesy of the official SMG website
Footnote: Five areas in Seoul

1) Downtown Core: Jongno-Gu, Jung-Gu, Yongsan-Gu
2) Northeast Area: Seongdong-Gu, Gwangjin-Gu, Dongdaemun-Gu, Jungnang-Gu, Seongbuk-Gu, Gangbuk-Gu, Dobong-Gu, Nowon-Gu
3) Northwest Area: Eunpyeong-Gu, Seodaemun-Gu, Mapo-Gu
4) Southwest Area: Yangcheon-Gu, Gangseo-Gu, Guro-Gu, Geumcheon-Gu, Yeongdeungpo-Gu, Dongjak-Gu, Gwanak-Gu
5) Southeast Area: Seocho-Gu, Gangnam-Gu, Songpa-Gu, Gangdong-Gu

[Figure 5] Interest in Using All-day Care (by area)-Survey Results

[Table 3] Projected School-age Population and Estimates of Demand for All-day Care Services in Major Areas of Seoul, 2020 to 2024

(Unit: Persons)

Category[1)]	2020	2021	2022	2023	2024
Entire School-age Population[2)]	206,390	200,003	192,386	182,631	164,694
Downtown Core	8,712	8,442	8,121	7,709	6,952
Northeast Area	63,143	61,189	58,859	55,875	50,387
Northwest Area	24,312	23,559	22,662	21,513	19,400
Southwest Area	61,474	59,572	57,303	54,397	49,055
Southeast Area	48,749	47,240	45,441	43,137	38,900

(Unit: Persons)

Total Number of People Using All-day Care Services (Demand) [3]	66,602	64,541	62,083	58,935	53,147
Downtown Core	3,426	3,320	3,194	3,032	2,734
Northeast Area	25,902	25,100	24,145	22,921	20,669
Northwest Area	5,130	4,971	4,782	4,539	4,093
Southwest Area	20,499	19,865	19,108	18,139	16,358
Southeast Area	11,646	11,285	10,855	10,305	9,293

note: 1) Future population according to medium-variant estimate.
2) Population of elementary school students in lower (1st to 3rd) grade levels in Seoul.
3) Estimates based on projected number of 1st through 3rd graders (according to Statistics Korea's medium-variant projection) and survey results on interest in using all-day care services.

According to forecasts of supply and demand, Seoul will continue dealing with a dearth of public all-day care services until 2022. These services acutely need an overhaul in preparation for future changes

Planned supply and estimated demand are synthesized in [Table 4]. It is predicted that Seoul will continue with a shortage of public all-day care programs until 2022. Demand outpaces supply in 2020 by 12,400 children. However, if all-day care programs are to be offered by 2022 as planned, the situation will reverse by 2023. Such forecasts are based on the assumption of a strong correlation between intention to use all-day care services and actual use. Thus, demand can fluctuate in accordance with shifts in public perception or circumstances surrounding public after-school care. Despite that, the results of this comparative analysis highlight the necessity of designing or revising plans on childcare programs based on a full examination of demand, by area, for care facilities.

[Table 4] Estimates of Supply and Demand for All-day Care Services, 2020~2024

(Unit: Persons)

Category	Planned Supply of All-day Care Program Spots[2]				Estimated Demand (B)[1]	Gap between Supply and Demand (A-B)
	Elementary School Care Classes	Local Childcare Centers[3]	Our Neighborhood Nurture Centers	Total (A)[4]		
2020	45,250	3,528	5,425	54,203	66,602	△12,399
2021	47,000	3,528	8,400	58,928	64,541	△5,613
2022	48,250	3,528	10,000	61,778	62,083	△305
2023	48,250	3,528	10,000	61,778	58,935	2,843

Notes: 1) Estimates based on projected number of children in 1st through 3rd grade (according to Statistics Korea's medium-variant projection) and survey results on interest in using all-day care services.
2) Estimates based on elementary school care classes (1st through 3rd graders), local childcare centers (1st through 3rd graders) and Our Neighborhood Kium Centers (1st through 6th graders).
3) Data on number of local childcare centers from a report on the current status of local childcare centers in Seoul (as of September 30, 2019). Five places (established under Article 50 of the Child Welfare Act) scheduled to open in the latter half of 2019 were included. Supply plans after 2019 were not in place.
4) The 2019 Guidelines on Elementary School Care Classes in Seoul states that class size is limited to 25 students. We followed this limitation when predicting supply at Our Neighborhood Kium Centers. When estimating supply at local childcare centers, the number of 1st through 3rd graders using local childcare centers in Seoul was applied (statistical data on current status does not provide information on grade levels of children using the centers. Therefore, we estimated demand by multiplying the proportions of students in 1st through 3rd grade on the basis of statistical data on local childcare centers in Korea-as of December 2016).
5) Separate plans for 2023 and 2024 were not in place so the supply plan for 2022 was applied.

Data courtesy of the Seoul Metropolitan Office of Education (SMOE), April 30, 2019 & the SMG (September 30, 2019).

The SMG should comprehensively manage supply of and demand for all-day care services, allowing for a decline in demand resulting from a decrease in number of students

It is cautiously predicted that demand for all-day care services will fall by degrees over the next five years coupled with the demographic cliff and a drop in

school-age children stemming from a declining birthrate. From experience, we have witnessed the need for further detailed review and planning of policies on supply of and demand for all-day care services.

We propose that the SMG draw up a mid-range plan on all-day care which is to be carried out over the next five to seven years. We considered designating the Community All-day Care Consultative Committee or "All Maeul Care Support Group" as a control tower for managing this supply and demand. To set up a demand-based supply management system where a decrease in demand is taken into consideration, content and timing of department-wide surveys on all-day care need to be altered. There is a need to find a way to estimate demand harnessing an online platform dedicated to all-day care services in Seoul which is set to be launched. It is advisable to lay out norms for the ratio of students to student-care employees, and reduce the ratio in phases or increase care facility sizes.

There is a need to come up with multi-dimensional measures to enhance the quality of all-day care, including offering customized services

In a bid to address the current imbalance between supply and demand for all-day care, it is of paramount importance to bolster not only the quantity but also the quality of services. To that end, the SMG should consider circumstances and user convenience to customize the related care services.

Due to regulations concerning selection of locations and difficulties in finding spaces within areas, some children have to attend Our Neighborhood Kium Centers that are a fair distance from their schools or homes. In light of this, we suggest that the SMG provide safe transport services for such children to expand access to all-day care. It is also necessary to offer assistance in finding and hiring teachers capable of developing programs for use in the centers and constantly augment care employee skills.

Loneliness as a Social Illness Needing Varied Community Support Programs Considering Social Relations

Incheol Sin · Jiwon Choi

Key Message

Loneliness is not just a personal problem, but a social illness.

1. It is time to provide a blueprint for the Seoul Metropolitan Government (SMG)'s countermeasures to prevent and combat loneliness among Seoulites

The late Member of UK's Parliament, Helen Joanne Cox, played a tremendous role in having loneliness recognized as a social problem and creating the UK's Ministry of Loneliness. She argued that "Young or old, loneliness doesn't discriminate". We all experience loneliness, to greater or lesser degrees.

In a way, loneliness which occurs every day is a personal matter, so we tend to overlook the seriousness of the emotional state involved. According to previous studies on analysis of the impact of loneliness on society, it carries health risks equivalent to those of obesity or smoking up to 15 cigarettes per day (Holt-Lunstad, Smith, Baker, Harris, and Stephenson, 2015). Moreover, lonely individuals are more than twice as likely to develop Alzheimer's disease (Wilson, Krueger, Arnold, Schneider, Kelly, Barnes, Tang, and Bennett, 2007). Loneliness has consequences not only in terms of mental health but also physical health, increasing the likelihood of mortality by 26 percent, high blood pressure and obesity.

Perceiving it as an issue that should be tackled through the concerted efforts of all its citizens, the UK government created the Ministry of Loneliness and appointed its first minister in 2018. In October of the same year, it announced a loneliness strategy for England entitled, "A Connected Society: A strategy for tackling

loneliness". These actions show how proactively the UK government has been working to address the problem of loneliness.

The SMG has yet to set policies specific to loneliness itself. Nonetheless, while it was rolling out countermeasures against lonely deaths, it has learned that loneliness is not only a personal issue but also a public concern. Thus, a consensus has developed around the idea that loneliness is related to social isolation but requires a different approach.

The main focus of the SMG policies and previous studies have been on the problems of social isolation and lonely deaths (Song, Gong and Park, 2018). To put it differently, there is a lack of basic research on loneliness. Under these circumstances, the SMG should devise strategies to alleviate loneliness by exploring its prevalence and categorizing the loneliness felt by Seoulites and clarifying areas that need social support.

It is important to analyze what loneliness is, how it is distinct from social isolation, how it differs by age group and strategies in advanced countries including the UK and Scotland. There is a need to use such analysis to elucidate the role of the SMG in preventing and combating loneliness among Seoulites.

2. More than half of citizens in Seoul reported in a recent survey that they “feel lonely in daily life”

Fifty-four percent of citizens in Seoul are “lonely in family life”. “Lack of communication” was felt to be the greatest culprit

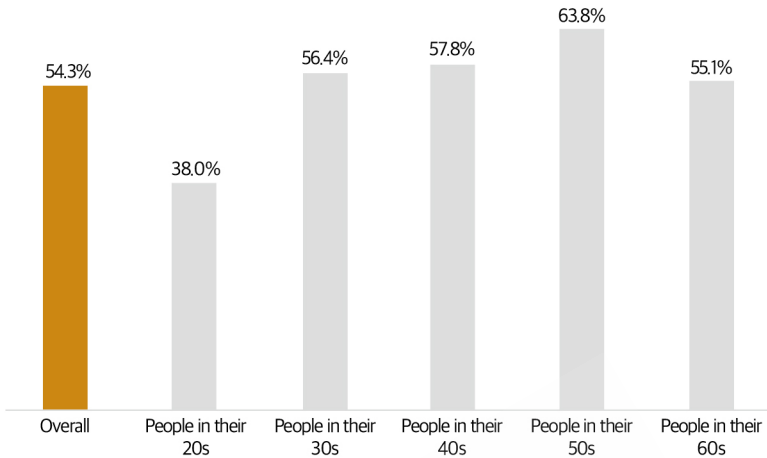
The survey revealed that 54.3 percent of respondents face loneliness in their relations with family.[7] People in their 50s felt loneliness the most at 63.8 percent, compared to 57.8 percent of those in their 40s, 56.4 percent in their 30s, 55.1 percent in their 60s, and 38 percent in their 20s.

Researchers asked respondents who reported feelings of loneliness an open-ended question about the reasons, then recategorized and summarized their answers as follows.

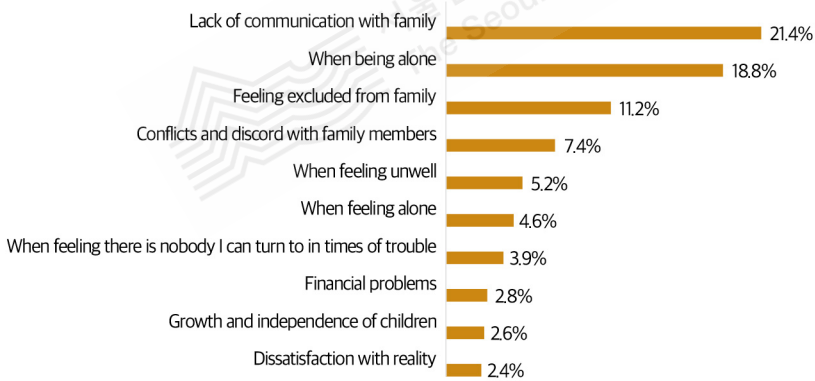
“Lack of communication with family” was cited by 21.4 percent as the major reason why they are lonely. This was followed by “When being alone” (18.8%), “Feeling left out by family” (11.2%), and “Conflicts and discord with family members” (7.4%).

[7] The following findings are based on data collected through a survey of 1,000 citizens in Seoul aged 19 to 69, entitled, “Omnibus Survey of Seoulites”, conducted by the Seoul Institute between July 29 and August 8, 2019. The survey investigated Seoulites’ perceptions of a range of topics such as loneliness, happiness, and age.

Loneliness perceived in family life



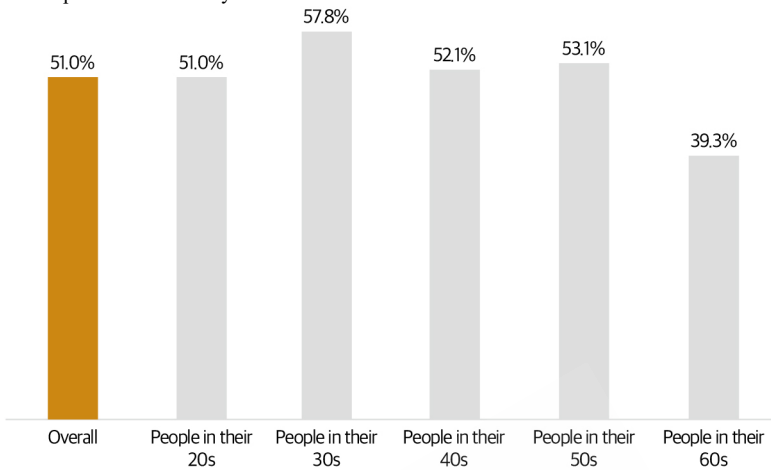
Reasons for loneliness perceived in family life



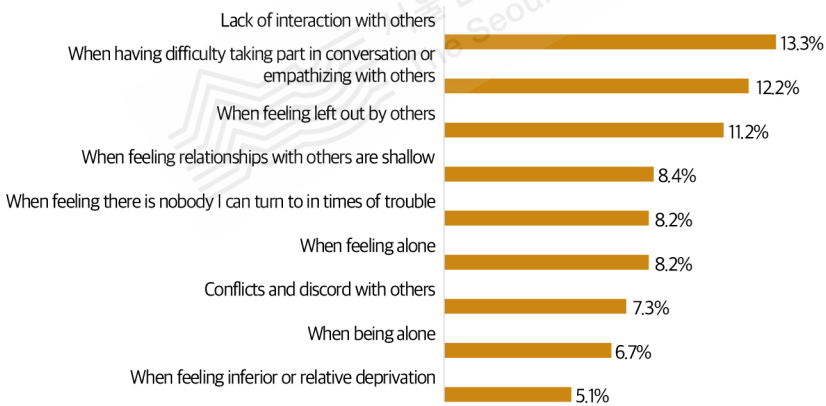
Source: <Omnibus Survey of Seoulites>, Seoul Institute, 2019

[Figure 6] Loneliness in Family Life and Perceived Reasons

Loneliness perceived in family life



Reasons for loneliness perceived in relationships with others



Source: <Omnibus Survey of Seoulites>, Seoul Institute, 2019

[Figure 7] Loneliness in Relationships with People Other than Family and Reasons

To sum up, social relations, rather than relations with family, increase the risk of loneliness in younger age groups. The older people get, the more their loneliness is influenced by family life than other social relations. “Lack of interaction with others” was most frequently mentioned as the reason respondents experience loneliness in social relations (13.3%). “When having difficulty taking part in conversation or empathizing with others” came next at 12.2 percent.

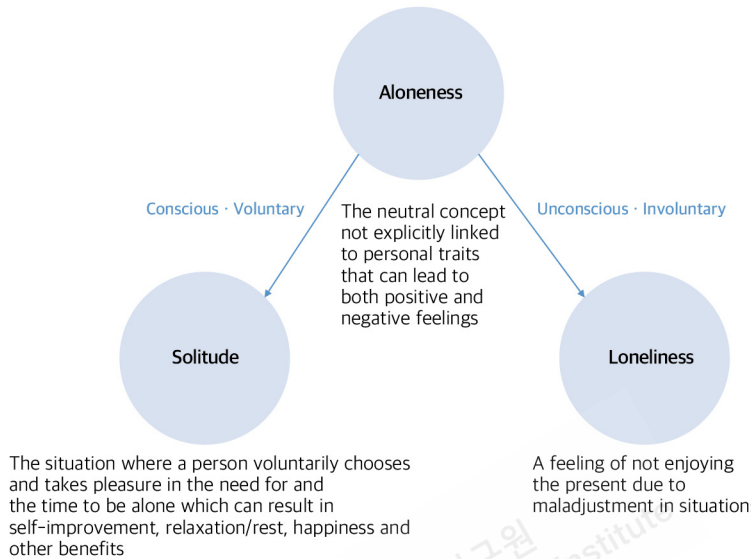
Fifty-one percent of Seoulites said they “Feel loneliness in relations with others”. The most commonly mentioned cause was “Lack of communication”

Although levels of loneliness in relations with people other than family was lower than those in relations with family, around half of respondents (51%) feel lonely in relations with people other than family. Unlike loneliness in relations with family, adults in their 30s—the age group that is most active in social activities—are the loneliest age group (57.8%). This group was followed by people in their 50s (53.1%), in their 40s (52.1%), in their 20s (51%), and in their 60s (39.3%).

2.1. Loneliness is the experience of maladjustment that occurs subconsciously, and differs from solitude and aloneness

Loneliness can be defined in a variety of ways and refers to the state of not enjoying the present due to maladjustment that has happened subconsciously. Although aloneness and solitude are similar to loneliness, there are differences between them.

“Aloneness” is literally the state of being alone. On the other hand, “solitude” refers to a situation where an individual willingly chooses and takes delight in the need and time for being alone.



[Figure 8] Classification of "Aloneness" according to Consciousness and Voluntariness

Proactive action should be taken to address loneliness, a social illness that anyone can experience

As highlighted above, loneliness affects mental and physical health, increasing the risk of premature death by 26 percent, as well as raising the risk of high blood pressure and obesity.

In recent years, the UK and other countries in Europe have considered loneliness a social ill, not a personal problem, and have taken steps to cope with it at the national level.

The SMG has also been vigorously responding to social isolation. But it needs a new approach and new measures in response to loneliness resulting from involuntary and subconscious experiences, unlike solitude, which is the result of voluntary choices.

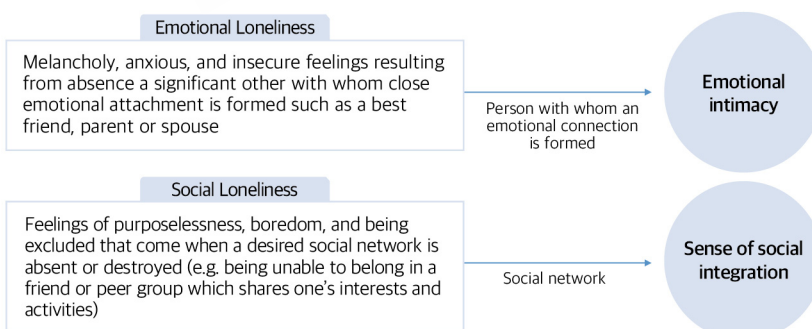
2.2 As the root causes differ for emotional loneliness and social loneliness, different solutions are needed

There are many ways to classify loneliness. Weiss' method of distinguishing between emotional loneliness and social loneliness on the basis of the social needs theory (1973) has long been an accepted way.

Emotional loneliness includes melancholy, anxious, and insecure feelings about the absence of a close emotional attachment such as with a parent, spouse or best friend.

Conversely, social loneliness is accompanied by feelings of loss, boredom and rejection, and arises when a desired social network is destroyed or simply absent, such as not belonging in a friend or peer group, or with neighbors who share similar interests and activities (Choi et al., 2016). These two types of loneliness need distinct solutions, as they have different contributing factors.

Weiss (1973) insisted that a solution to emotional loneliness, stemming from absence of an intimate figure or existence of a rocky relationship, is to restore or form emotional connections. In contrast, fostering individuals' sense of social integration by helping them recover their social relations is key to mitigating social loneliness, which is associated with a poor or ruined social network.



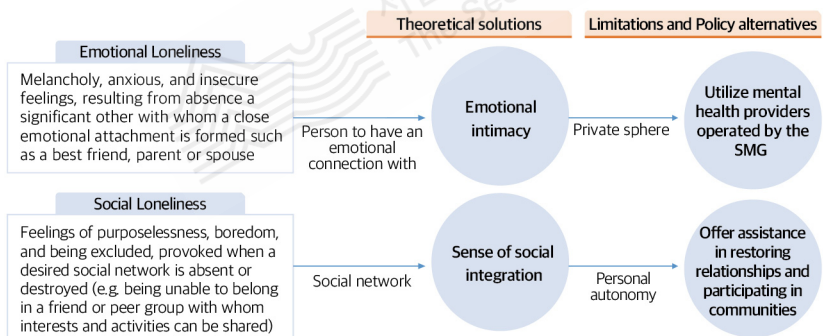
[Figure 9] Types of Loneliness

3. There are four basic directions for the SMG to head in making "Seoul a city where citizens overcome loneliness together"

A multi-level support system needs to be established that utilizes the myriad types of infrastructure the SMG already has

The SMG needs to make full use of existing infrastructure in its drive to help people overcome feelings of loneliness. Mental health services presently offered by the SMG are insufficient to cope with loneliness in the city.

This is due to the dearth of manpower in these services who are able to provide solutions. There is no manual on how to respond either. This situation necessitates securing sufficient personnel, publishing a manual, and providing aggressive funding.



[Figure 10] SMG Dual Support System to Address Loneliness

The SMG can lend support to communities in a meticulous and prudent way, considering the social relationships that citizens desire

Loneliness is not just attributable to the personal tendency towards creation of social relations. There is a fair chance that those experiencing loneliness may have endured social violence, like conflict or bullying, in their existing social relationships. Thus, it is imperative for the SMG to employ a scrupulous and careful approach when rendering public assistance.

The SMG's continued efforts in running face-to-face community support programs like the Seoul Community Support Program and the Neighborhood Community Service Center are paying off. Diverse measures including such face-to-face community support programs and online/offline communities of interest to people should be implemented to back communities.

Programs that tackle social isolation should be coupled with those tackling social loneliness, but a dual support system is needed

It is very likely that a great number of people who experience social isolation also suffer social loneliness. Hence, there is a need to link programs that seek to reduce the former with those that seek to reduce the latter. Having said this, they will need to vary in characteristics and approach due to the differences in these social ills—a key reason for the importance of varied approaches.

[Figure 11] Dual Support System for Social Isolation and Social Loneliness

As part of efforts to cope with social loneliness, a collaborative framework linking and involving the SMG, companies and local communities should be formed

Government efforts alone are not enough to solve social loneliness. In view of this, the SMG, private companies, and local communities have a variety of roles to play.

First, the SMG should create a division dedicated to mitigating loneliness in the city through an integrated support system which organically connects existing infrastructure and relevant projects.

Second, it is essential that companies recognize workplace bullying as a serious issue that can cause social loneliness by destroying social relationships and come up with measures to actively respond to it.

Third, the role of local communities is paramount. It is not appropriate to focus excessively on finding people experiencing social loneliness or intervening in cases of loneliness without considering the individual volition. Rather than that, a platform can be offered for social interaction and that encourages people to participate naturally, based on an understanding of intent and necessity.

02 Urban Administration

The Importance of a Structured Approach when Drafting "Well-Dying" Policies for Different Stages of the Human Lifecycle

Min-seop Hwang · Minyeong Lee

Key Message

To spread development of a culture that supports "well-dying", the Seoul Metropolitan Government (SMG) needs to overhaul its related policies.

1. With the increasing social and policy interest in "well-dying", now is a good time to develop a policy framework

South Korea has seen growing social and policy interest in "well-dying", which refers to finishing life well and enhancing the quality of the last moments before death amid a rapidly ageing population. A culture that supports this "well-dying" has quickly diffused and institutionalized across the globe. In South Korea, active discussions are underway in the five areas of hospice and palliative care, a system supporting decisions on life-sustaining treatment, improving the culture around funerals, organ donation, and education on death.

Along with population ageing, lonely deaths, deaths of persons whose remains have gone unclaimed, and other related social issues have surfaced. There is a need for local governments to be proactive in coping with these issues.

The SMG should establish a policy basis for instilling a "culture of well-dying" in a bid to help its citizens live out their golden years in comfort and die with dignity.

1.1 Well-dying is a term that denotes the process of actively preparing oneself for death in both a physical and psychological sense

"Well-dying", which is also known as "dying well", "dying with dignity", or "being prepared for death", refers to the process of proactively bracing oneself for death in both a physical and psychological sense. It is similar to the term "well-ending".

A society that supports well-dying facilitates its people approaching death beautifully spend their final days making preparations for their own passing in advance. A society that supports well-ending enables its people to go about their lives in their usual fashion as they await their upcoming death (Choi, 2018).[8] The two terms have been used interchangeably and there is no significant difference in their meaning. It is important to note that "well-dying", a situation where the quality of life is maintained, becomes an element in elderly wellbeing.

As death is distinctly perceived in late adulthood, the perception of how it will take place has the greatest impact on the overall quality of seniors' lives. In his theory of psychosocial development, Erikson (1959) proposed ego integrity as a task to perform during late adulthood. He identified quality of life remaining and "acceptance of death" as key elements in attaining ego integrity. He also highlighted that anxiety over death can be alleviated by recognizing that life can end with joy while retaining one's dignity as a human being.

Well-dying should be recognized as an aspect of preparation for later life but policy responses remain insufficient

In South Korea, the People's Movement for Well-Dying (an incorporated entity) was founded in December 2018 towards creating a culture of the end-of-life journey

[8] Choi, Seung-ho, 2018, "Implications of Japan's well-ending boom for Chungbuk", Chungbuk Research Institute.

being beautiful. This indicates a surge of interest in well-dying. The People's Movement for Well-Dying stipulates that a "good death" is one in which the dying person "prepares for his or her end, rather than prolonging life as long as possible", "parts from family on good terms", and "decides to end life". Moreover, it has presented a series of practice tasks for well-dying.

A "good death" is one in which an individual can obtain assistance during the dying process, and does not die a miserable and painful death (Chung et al., 2018). Thus, it should be considered part of later life planning.

The issue here is that policies regarding such planning have centered around maintenance of health, achievement of financial security, quality of interpersonal relationships, and the ability to participate in cultural and leisure activities. That is to say, inadequate levels of social interest and policy responses are directed towards "well-dying".

1.2. With Korea's increasing elderly population and average life expectancy, "well-dying", which focuses on quality of life and "ending life well" has come into the spotlight

The soaring rate of population ageing and average life expectancy have united attention to ways to ensure quality of life. As of 2019, there were 7.684 million people in Korea aged 65 or over, or approximately 14.9 percent of the nation's entire population of 51.7 million. This represents a five-fold increase since 1970 (3.1 percent), which is expected to reach 46.7 percent by 2047 (Statistics Korea, "Future population projections"). Average life expectancy has also been increasing, from 78.2 years of age in 2005 to 82.7 years of age in 2017.

Even though there is growing interest in quality of death, efforts have not been enough to significantly improve the situation. The UK-based Economist Intelligence Unit (EIU) has published a "Quality of Death" index twice, in 2010 and 2015. According to its 2015 index, the UK has the best score at 93.9, followed by Australia at 91.6 points and New Zealand at 87.6 points. South Korea ranked 18th with a score of 73.7 points, lower than Taiwan (83.1 points) and Japan (76.3 points).

1.3. Local governments need to be proactive in combatting the problems of the increasing incidence of lonely death as well as the number of deaths of persons whose remains have gone unclaimed

The growth in the number of single-person households and senior population rate present social issues like lonely deaths and deaths of persons whose remains have gone unclaimed. Aggressive countermeasures are needed from local governments. As of November 2019, Seoul's registered population of people aged 65 or older stood at 1.47 million, constituting 15.1 percent of the entire population in the city. Statistics Korea revealed that single-person households in Seoul numbered 1.17 million in 2017, with 280,000 (23.8%) occupied by people aged 60 or older—a number forecasted to increase to 46.4 percent by 2047 (Statistics Korea, "Special Estimate of Future Households by City and Province").

The number of lonely deaths in Seoul has increased around 23 percent over the five years of 2013 to 2017, from 298 to 366. The reason is that the number of people in their late adulthood who live alone has continued to climb due to a spouse's death or having become "silver splitters". Furthermore, the family caregiving function is weakening and social safety nets are tattering, resulted in these tragic increases in lonely death statistics and of those whose remains go unclaimed.

The situation is changing. The state and society need to shoulder the responsibility of providing comprehensive welfare services encompassing support for elderly people without children and preventing lonely deaths and facilitating later life planning. In a national survey carried out in 2018, 90 percent of Koreans agreed that both state and society should be responsible for taking care of seniors in the face of the nation's super-ageing society. There is a need to bear this in mind when designing well-dying policies.

"Death is the perfection of life". More and more people wish for death with dignity where the right to self-determination is respected

Lengthening old age has led to a long period of feeling death in a profound way (Chung et al., 2018).[9] People have become increasingly aware that death is not something to be afraid of but to be regarded as the completion of life. Furthermore, there has been a rise in the number of people desiring for the end of life through respect for their own volition, or death with dignity.

A dignified death is used interchangeably with dying with dignity (henceforth referred to as "well-dying"). The term refers to allowing terminally ill patients to reject futile life-sustaining treatment and accept natural death, or granting at least a minimum of dignity at times of death (Hahm, 2017).[10]

In reality, a great number of elderly people want to die in comfort and dignity without relying on mechanical or artificial means to extend their lives. The 2017 National Survey of Older Koreans, conducted by the Ministry of Health and Welfare (MOHW), found that 91.8 percent of respondents (all in the older population) oppose pointless life-sustaining treatment. However, many people still die in hospitals, among whom a considerable number with irreversible medical conditions receive life-sustaining treatment to extend their lives. According to Statistics Korea, there were 280,000 people in 2016. Of this number, 210,000, or 75 percent, died in hospitals. We analyzed that the vast majority received meaningless life-sustaining treatment when suffering from terminal medical conditions.

9 Chung, Kyung-hee, Seo, Je-hui, and Lee, Seon-hui, 2018, "Policy Measures for Well-dying in Korea", Korea Institute for Health and Social Affairs (KIHASA).

10 Hahm, Joon-soo, 2017, "What is death with dignity?", Korean Association of Internal Medicine's 68th Fall Conference.

[Table 5] View of Seniors (aged 65 and over) on Whether They Will Utilize Life-Sustaining Treatment

	Agree strongly	Agree	Neither agree nor disagree	Disagree	Disagree strongly	Total
Response	0.2 %	3.4%	4.5%	49.2%	42.6%	100% (10,073 persons)

Source: Ministry of Health and Welfare (MOHW), 2017, National Survey of Older Koreans.

2. In South Korea, the scope of well-dying policies and programs in their initial stages is limited

2.1. The central government, local governments, and the private sector are engaged in the operation of well-dying programs

Three main actors—the central government, local governments, and the private sector—administer schemes for well-dying in their respective areas.

First, the central government's MOHW (Ministry of Health & Welfare) runs a myriad of programs, taking charge of schemes concerning organ or tissue donation and transplant, medical care expenses, hospice & palliative care services, and bereavement allowances, as well as a system concerning decisions on life-sustaining treatment and funerals. The Supreme Court is responsible for registration of deaths.

Local governments establish ordinances on death along with well-dying, and work on diverse programs on the basis of such rules. Most local governments run programs relating to minimizing suicides and lonely deaths in accordance with ordinances they have passed. Gyeonggi-Do[11] was the first local government to enact an ordinance on creation of a culture of well-dying in 2016. There has been an upward trend in the number of such rules, with 55 local governments introducing ordinances along similar lines as of 2019. Gyeonggi-Do, Jeollanam-Do, and Busan

[11] "Do" is an administrative unit (similar to a province) in Korea. There are eight Do in South Korea, such as Gyeonggi-Do and Gangwon-Do.

Metropolitan City established ordinances on support for hospice & palliative care. Some local governments have dealt with provision of hospice care and fostering a culture of well-dying. Each local government has proceeded with education and counseling programs concerning preparation for death, together with a scheme for public health funerals.

The private sector delivers education on dying, counseling services, and courses on writing a statement in advance on life-sustaining treatment, in addition to one's will. Managing personal possessions of the deceased is also within the scope of the private sector's involvement.

2.2. SMG well-dying policies and programs, which have been implemented in a restrictive manner, need to be expanded by degrees

The SMG enacted an ordinance on creation of a culture supporting well-dying in January 2017. Since then, its Citizens' Health Bureau has pushed for programs towards creating such a supportive culture. For such a purpose, the bureau has founded and runs an expert advisory group dedicated to developing the SMG plans and policies. Its main responsibilities are to offer advice to the SMG on policy, following enforcement of the ordinance, and counsel on formulating short-, mid- and long-term plans for creating a culture of well-dying.

It is also in charge of providing education programs and promoting the culture of well-dying. Through a 'Well-Dying Experience Program', education and experiences on dying are delivered to employees of Gu-district[12] public health centers and local residents interested in the program. Education on developing a culture supporting dying well is also provided to community welfare centers and hospitals.

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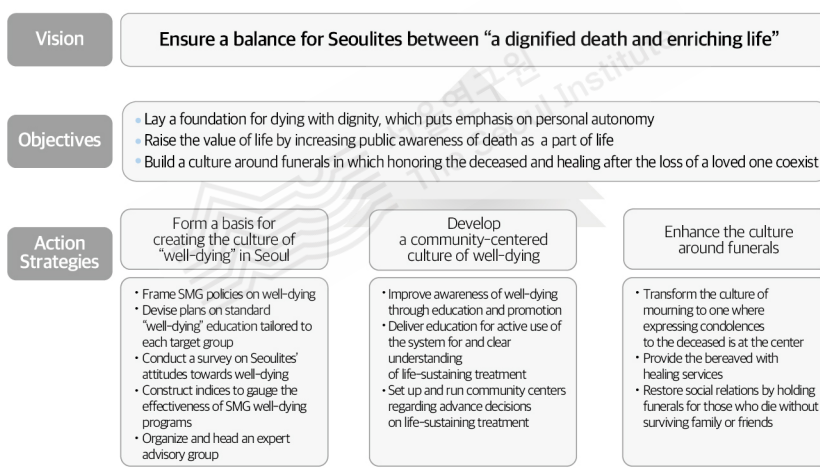
[12] "Gu-district" is an administrative unit in Korea. There are 25 autonomous Gu-districts in Seoul, divided into 425 administrative "dong" districts.

In May 2019, the SMG formulated a program action plan (which includes an experience program and promotion) aimed at fostering a culture of well-dying

The SMG drew up a program action plan to create and promote a culture of well-dying in its drive to build a society where the end of life can be comfortable and dignified. Details of the programs include: (1) Publicize and educate on a system concerning decisions on life-sustaining treatment, with health facilities and citizens the main targets; (2) Run experience programs and engage in promotional activities to increase public awareness on the importance of having a society that supports well-dying.



Source: 2019 SMG program action plan aimed at fostering a culture of well-dying

[Figure 12] 2019 SMG Action Strategies on Creation of a Culture of Well-dying

From June to December 2019, the SMG implemented a pilot program towards building a community-centered culture of well-dying in five autonomous Gu-districts.

Status: ① There is no negotiation platform through which well-dying policies can be carried forward by the SMG in a systematic and comprehensive manner

The Public Health Division within the Citizens' Health Bureau is dedicated to building a culture of well-dying. But only certain areas are covered by plans, such as designing education and experience programs. The Senior Citizen Support Division, within the Welfare Policy Office, frames policies on funeral facilities and fostering the culture around funerals.

A negotiation platform is sorely needed, where systemic, comprehensive progress on well-dying policies can occur.

Status: ② People in their later years and professional medical personnel at certain health facilities are the main focus of the most SMG well-dying programs

In South Korea, "well-dying" has just begun to garner attention. This is the reason the country has endeavored to lay legal and institutional foundations while focusing on the most urgent needs and areas. The same holds true for the SMG.

Having said that, it is more effective to expand target groups. Well-dying programs can be helpful in preventing suicide and the maintenance of a sense of respect for life among children and adolescents. They can also provide middle-aged and senior adults the chance to look back on their lives. While senior citizens should remain the priority, there is a need to increase the target groups.

Status: ③ There is a dearth of policy interest in psychological and social aspects

As mentioned above, the SMG's well-dying programs are of limited scope in their development of education and experience programs, as well as plans. It is particularly important to pay attention to the psychological and social aspects of the end of life.

The concept of well-dying concentrates not only on people facing the end of life but also the bereaved families and relatives. It is critical to recognize the need for services to families and other survivors. In addition, the SMG should lay the policy

groundwork to spread a healthy culture of mourning.

Local governments have been tasked with addressing things like hospice & palliative care, a system of decision-making on life-sustaining treatment, the culture around funerals, organ donation, and education on the end of life.

Policies should allow for these areas related to well-dying, which have thus far generated relatively little interest. There is also a need to find ways to support, through policy measures, survivors confronting or grappling with the loss of their loved ones.

3. The SMG needs to set up an institutional basis for well-dying policies, including a revamping of laws and systems

A comprehensive institutional framework is needed that supports well-dying policies and improves laws and systems

There is a need for the SMG to vigorously push further ahead with well-dying policies, building a comprehensive institutional foundation and overhauling related laws and systems. The SMG ordinance on creation of a society that supports well-dying, which is the basis for policies on shaping such a society, should be revised to include operation of a permanent negotiation platform.

It is expected that public demand will grow in areas for which the central government is responsible, like hospice & palliative care and systems on life-sustaining treatment.

It is essential that the SMG work on policies related to such areas. Policy measures are needed that extend administrative services related to well-dying as well as develop professional counselors to create and offer education programs suited to each age group. Well-dying programs also need to be run in a tangible way so as to assist Seoulites in better preparing for the end of life and ending it well. Public awareness needs to be broadened on this issue and related education offered.

03 Urban Planning

Analysis of Shared Office and Tenant Firm Locations in Seoul

Sun-Wung Kim · Nam-Jong Jang · Eunjoo Oh · Gain Lee · Kyung-In Choi

Key Message

There has been rapid growth in the number of shared workspaces, with early-stage business startups[13] forming the majority of lessees. Related public services need to be revamped, including support with administrative matters and investment.

The number of shared workspaces jumped globally in the 2010s. Now is the right time to understand their geographic distribution and operational status

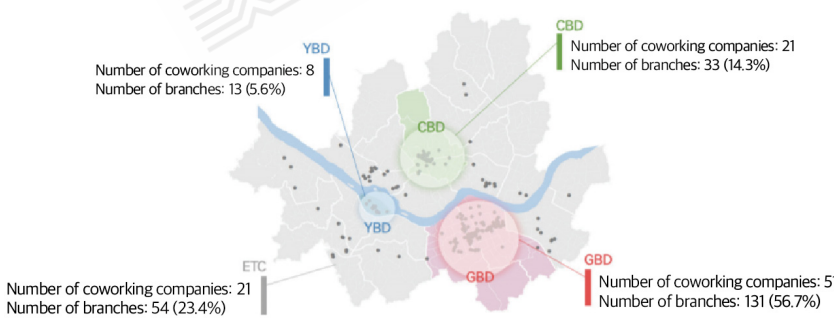
The number of shared offices which sprung up along with the sharing economy has sharply increased around the globe and Seoul is no exception. This upward trend has become more evident since the launch of WeWork in 2010. As a number of shared office spaces have been created in recent years, they have emerged as a major office tenant category, and their impact on the office market is forecasted to be great. This study sums up the definition, classification and factors behind the success of shared office spaces. Their distribution, operations and future demand

[13] According to Article 2 (2-3) of the Support for Small and Medium Enterprises Establishment Act, the term “early-stage business startup” refers to a small or medium-sized business entity for whom three years have not passed since that entity’s commencement of business operations.

are also analyzed. Moreover, the features of shared-office tenants and the reasons they chose shared workspaces are examined. The researchers suggest public policies that aid early-stage startups and firms in shared offices.

As of July 2019, 231 branches of 70 coworking space operators were located in Seoul

As of July 2019, the total number of coworking companies and their branches within Seoul reached 70 and 231, respectively. Of these, 177 branches, or 76.6 percent, were in business districts—Gangnam Business District (GBD), the Central Business District (CBD) and Yeouido Business District (YBD). By district, coworking space providers were mostly concentrated in GBD (Gangnam-Gu[14] and Seocho-Gu). Thirty-three branches of 21 such firms (14.3 percent) were dispersed across the CBD (Jung-Gu and Jongno-Gu), while 13 branches of 8 such firms (5.6 percent) were dispersed in YBD (Yeongdeungpo-Gu). Fifty-four branches of 21



[Figure 13] Distribution of Shared Office Spaces in Seoul

[14] "Gu-district" is an administrative unit in Korea. There are 25 autonomous Gu-districts in Seoul, divided into 425 administrative "Dong" districts.

coworking space operators were based in areas other than the three city centers (Mapo-Gu, Seongdong-Gu and Songpa-Gu).

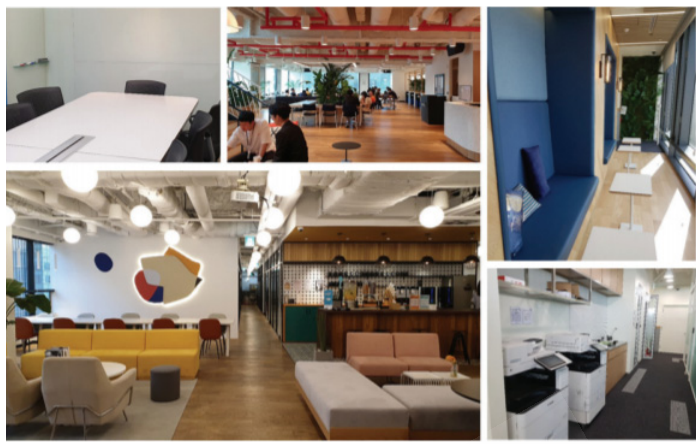
Shared offices can be classified according to the services they provide. Coworking spaces constitute the greatest share

A “shared office” refers to a large workspace shared by more than one business. Lessees have some flexibility in office size and lease terms. Their office spaces are composed of private offices (shared or private) and open-plan offices. Dedicated desks and hot desks [15]enabling people to work in open lounges are offered in an open-plan environment. Some shared office operators do not provide hot desks (which create an environment) where users can focus on their work.

Source: Photos taken during an office visit

[Figure 14-1] Workstations in Shared Offices -separate workstations, dedicated and hot desks

[15] A “dedicated desk” refers to a desk assigned to a person, while a “hot desk” refers to an unassigned seating.



Source: Photos taken during an office visit

[Figure 14-2] Common Areas in Shared Offices-lounges, meeting rooms and office equipment rooms

Functionally, active support is lent to users, ranging from offering access to common areas (lounges/meeting rooms) and opportunities to network with other leaseholders to helping attract accelerators or VCs (venture capital). The researchers categorized shared workspaces into three types by the scope of services provided for tenant companies: serviced offices, coworking spaces and coworking spaces rendering assistance to lessees.

A “serviced office” is a fully-equipped office space rented by several companies. The type of shared office where networking events such as seminars and parties are held on a regular basis is a “coworking space”. A “coworking space rendering assistance to lessees” fosters connections between lessees and investors or direct invest in tenant businesses.

By office size, shared office spaces, represented by WeWork and FastFive, make up more than half (51.5 percent) of shared office spaces. A substantial number of coworking spaces are situated in GBD and their numbers are expanding nationwide.

[Table 6] Attributes of Each Type of Shared Office

	Classification of services	Number of offices in Seoul	Representative operators
Serviced offices	• Assist with simple administrative tasks • Grant leaseholders access to conference rooms, copiers, common areas and equipment	26.3% of occupied area GBD > CBD > Guro-Gu (18.3%)	Regus and The Executive Centre (TEC)
Coworking spaces	**Serviced office** + **Networking opportunities** • Networking among tenants encouraged • Seminars held on business • Expert mentoring programs in operation	51.1% of occupied area Mainly distributed in GBD Has recently soared	FastFive and WeWork
Coworking spaces rendering assistance to lessees	**Coworking space** + **Investment & Incubation** • Function as business accelerator • Connect renters with venture capital firms • Directly invests in tenants	22.6% of occupied area Largely located in GBD Many are linked to conglomerates	MARU 180, Rehoboth and Sparkplus

Over half of tenants are early-stage business startups. Office space sharing firms have recently been leasing out shared workspaces to small and medium-sized enterprises (SMEs) and conglomerates

Originally, coworking chains targeted small startups. A survey carried out by the researchers for this present study shows that more than half of the respondents were early-stage entrepreneurs who launched their business less than three years ago, with small enterprises employing fewer than five people making up 61.6 percent of that number.

Shared office providers have begun to deliver tailored workspace services where corporate identities are reflected to make services available to SMEs and conglomerates. Large corporations account for a growing share of their clients.

Rationale behind selecting shared offices: ① lower facility management burden, ② lower office setup budget, and ③ flexible agreements

There are three major aspects that make shared workspaces appealing to businesses: (1) the convenience of facility operation and management; (2) the ability to cut office setup budgets; and (3) flexibility in leasing. Shared offices alleviate burdens related to interior decoration and facility management. They also cater to the needs of tenants with a range of business support programs. Second, lessees can reduce office setup costs (expenses associated with interior design and large deposits), unlike a traditional office. Third, flexibility is ensured when setting lease terms or office sizes so shared offices allow them to remain nimble as they change in size.

Rationale behind users' location choice: ① proximity to public transport, ② area recognition, and ③ ease of collaboration with related companies

The reasons renters selected the areas where their offices are located, as uncovered by the survey, can be summarized as: (1) "access to subway and other forms of public transit" (50.2%); (2) "area recognition" (13.7%); and (3) "ease of collaboration with related firms - peer companies, trading partners and businesses in similar sectors" (10.9%). Respondents cited "proximity to public transit" as the most decisive factor in their choice of area to set up in the future. In general, shared workspaces situated in areas with easy access to subway stations meet the needs of enterprises. Such a locational characteristic drives rental demand.

The shared office market faces a mixed outlook - "growth" and "saturation". The public sector is required to complement the institutional system

Since the shared office market is not very old, there is insufficient official data to understand it. Experts also hold differing views on market outlook. Both make it difficult to predict whether the market will tumble or continue its ascent. It is true that shared workspace firms have become a major renter in the office market in the past three years. But, due to a large dependence on location and low return on investment, whether the market will expand or diminish with time is uncertain. As the number of corporations utilizing shared offices is on the rise, the demand for them is expected to continue to rise. Having said that, some coworking businesses have stopped operating shared offices on account of financial hardships. Taking this into consideration, doubts exist that the market will soon become saturated.

There are two loopholes in the institutional system which need closing in a bid to resolve the difficulties encountered by early-stage business startups, who constitute the largest share of users.

First, tenants of shared office spaces find it hard to register their businesses due to the current business registration system lacking consistency. More specifically, some tax offices refuse to register firms renting open-plan offices due to the related difficulties of taxation.

Second, shared office operators have limited ability to handle administrative matters, which troubles entrepreneurs, who are often unfamiliar with the institutional system. Public sector institutional support is imperative for shared office providers who are often unfamiliar with the institutional system.

There is a need to improve the business registration system and share the public sector's investor networks

The following institutional improvements should take place for entrepreneurs who are the main customer base for shared offices. First, deliver public services helping firms launch and run their businesses as well as render administrative assistance in easily accessible areas that can become hubs in each district. Second, share the public sector's network of investors with the private sector to make it conveniently available to shared office providers and lessees. Third, create rules that specify that tenants of open-plan offices can register their businesses and tax offices must apply regulations in a consistent manner.

04 Economy

Growth Strategies for Seoul's Biomedical Industry Based on Locational Patterns & the City's Innovation Network

Eunjoo Oh · Seunghoon Oh · Jaeseong You

Key Message

There is a need to foster biomedical clusters, improve the innovative capacity of biomedical firms in Seoul and support creative collaboration between the various stakeholders involved in innovation activities.

With growing importance of the biomedical industry, it is time to examine the features of the innovation ecosystem and grasp changes in biomedical company locations in Seoul

The biomedical industry, a new industry, is in the limelight. The central government announced plans to spend KRW 4.4 trillion on healthcare and new drugs over the next five years as part of its aim to boost innovative growth. In its "Industrial Technology Innovation Plan", it revealed biomedical technology as one of the five sectors for strategic investment.

In January 2018, the Seoul Metropolitan Government (SMG) unveiled its plans to develop the biomedical industry as a promising area of growth.

It has particularly focused on creating a bio fund worth KRW 100 billion and a biomedical cluster in Hongneung, northeastern Seoul, known as the "Hongneung cluster". The SMG has already provided biomed startups with working space as well as laboratories through the Seoul Bio Hub established in Hongneung.

Construction of the "BT-IT[16] Convergence Center" and the "High-tech Medical Device Development Center" will soon be complete.

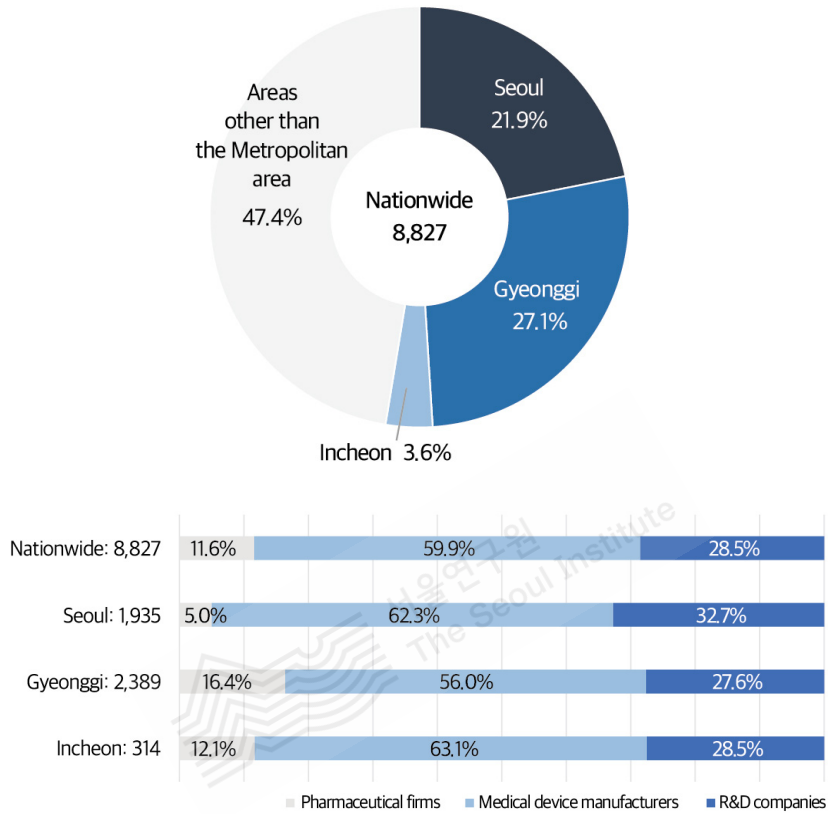
The biomedical industry is a high-risk business due to the long durations involved as well as the complexity of related R&D, strict medical regulations and the absolute value of investments required. Policy support acts as a buffer for a variety of these risks, a fact which heavily influences the industry. This study aims to offer basic data necessary to formulate the SMG policies, exploring changes in locations of biomedical companies in Seoul along with the innovation ecosystem and its characteristics. The biomedical industry is composed of three sub-segments: pharmaceuticals, medical devices and bio R&D.

Seoul is home to 21.9 percent of the entire nation's biomedical businesses, with bio R&D companies making up a substantial proportion of that number (32.7 percent)

Of all biomedical firms across South Korea, 21.9 percent are situated in Seoul while 52.6 percent are densely clustered in the metropolitan areas of Seoul, Incheon and Gyeonggi-Do. Of particular note is that Gyeonggi-Do is home to 27.1 percent of the total nationwide, and more biomedical businesses than Seoul.

Medical device manufacturers represent the highest portion (59.9%) of all business categories in Seoul, Gyeonggi-Do and Incheon. Bio R&D and pharmaceutical companies come next, at 28.5 percent and 11.6 percent, respectively. A relatively larger number of bio R&D firms are located in Seoul, than in the rest of the nation, including Gyeonggi-Do and Incheon, indicating that the capital has the characteristic of an R&D hub. Bio R&D businesses stand at 32.7 percent in Seoul-the national average is 28.5 percent, while they stand at 27.6 percent in Gyeonggi-Do and 24.8 percent in Incheon.

[16] BT and IT stand for biotechnology and information technology, respectively.



Source: Statistics Korea (KOSTAT), Data from the Census on Establishments (nationwide)

[Figure 15] Distribution of Biomedical Businesses (2016)

Hongneung has emerged as a hotspot for startup formation. Existing clusters in Gangnam and Geumcheon appear attractive to startup entrepreneurs

We created a 13-year (2004 to 2016) panel data set including raw data from the Census on Establishments (nationwide) to analyze whether biomedical businesses have relocated. Analysis showed that 94.1 percent of the biomedical firms in Seoul have not relocated to other areas, leaving only 5.9 percent that have moved to other

autonomous Gu[17]-districts or areas outside Seoul. This denotes that not many companies in the biomedical industry relocate from areas where they start. There are two attributes of spatial distribution of firms in the biomedical industry. First, biomedical startups have mainly established in four autonomous Gu-districts: Gangnam-Gu (10.5%), Geumcheon-Gu (9.0%), Seocho-Gu (7.1%) and Guro-Gu (6.7%). Startups based in these four areas constitute one-third of all startups. Second, medical device manufacturers and bio R&D firms are located in existing clusters like Gangnam-Gu, Seocho-Gu and Geumcheon-Gu. Similarly, a larger number of pharmaceutical startups are based in Gangnam-Gu (14.6%), Dongdaemun-Gu (12.7%) where Hongneung is located, and Seocho-Gu (10.9%). This means that Dongdaemun-Gu has become a prime destination for pharmaceutical startup entrepreneurs. That is to say, the efforts of the SMG to build the Hongneung cluster are paying off.

When engaged in innovative activities, biomedical firms derive information from peer companies and often partner with hospitals and a variety of other organizations

The biomedical industry is more innovative than others in that it involves constant R&D activity aimed at developing new products and services. To identify the characteristics of the biomedical industry's ecosystem and policy demands, we conducted a survey of 300 biomedical firms in Seoul. Fifty-eight percent of respondents said they have performed R&D activities over the past three years. There was an average of 4.3 patent applications per firm during the same period.

The most popular source of information is peer companies (55%) ahead of conferences, exhibitions or symposiums (34%), hospitals (29%), the Internet

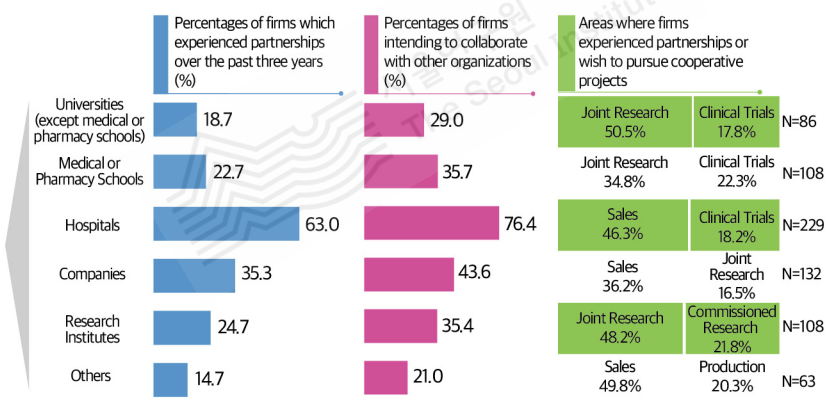
[17] "Gu-district" is an administrative unit in Korea. There are 25 autonomous Gu-districts in Seoul, divided into 425 administrative "dong" districts.

(18.3%) and related organizations (17.7%).

The survey found that biomedical firms forge partnerships with universities, hospitals, research institutes and other firms more often than businesses in other industries. Their main partner is hospitals.

Sixty-three percent of respondents said they have maintained cooperative relationships with hospitals over the past three years and 76.4 percent of them desire to cooperate with hospitals in the future. Areas where collaboration takes place vary, depending on the partners.

Partners	Areas of Cooperation
Hospital	Sales (46.3%), Clinical Trials (18.2%), other
Firm	Sales (36.2%), Joint Research (16.5%), other
Medical or Pharmacy School	Joint Research (34.8%), Clinical Trials (22.3%), other

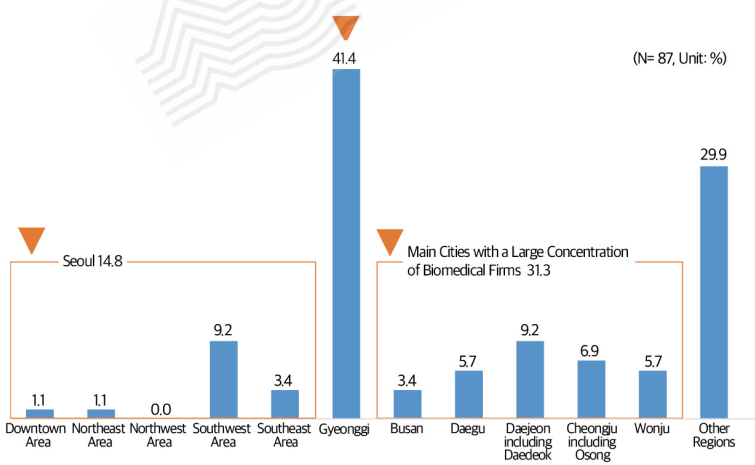


Note: Respondents were allowed to select multiple answers

[Figure 16] Past Experience with Partnerships and Areas in which Respondents Wished to Expand Cooperation

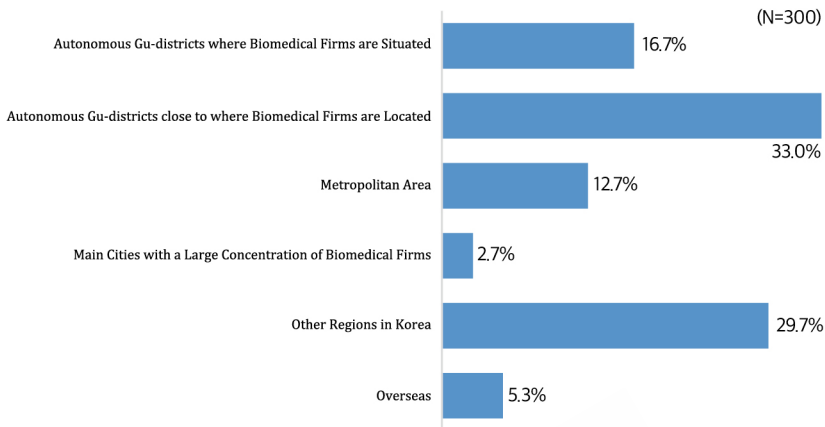
Biomedical companies based in Seoul have built nationwide networks, while 29% have branch offices

Biomedical firms in Seoul have been doing business through networks across Korea, beyond Seoul and the metropolitan area. The survey findings indicate that 29 percent of respondents run branch offices. Of all enterprises with branch offices, 41.4 percent have establishments in Gyeonggi-Do[18], while 31 percent ran branch offices in one or more of five cities housing a booming biomedical industry, like Osong. Partner companies of biomedical businesses also have nationwide networks. Understandably, those "located in autonomous Gu-districts adjacent to the biomedical companies they collaborate with" account for the greatest share of all partner enterprises, at 33 percent. Of partner companies, 29.7 percent are situated in "other areas of Korea". Biomedical businesses have branch offices in Seoul, the metropolitan area and five cities serving as centers for biomedical technology whereas their partner companies are located across the country.



[Figure 17] Locations of Branch Offices

[18] "Do" is an administrative unit (similar to a province) in Korea. There are eight Do in South Korea, such as Gyeonggi-Do and Gangwon-Do.



[Figure 18] Locations of Major Partner Companies

Three pillars for stimulating the biomedical industry are ① implementing both cluster and innovation policies, ② fostering partnerships between Seoul and other areas, and ③ realizing the creative convergence of diverse stakeholders

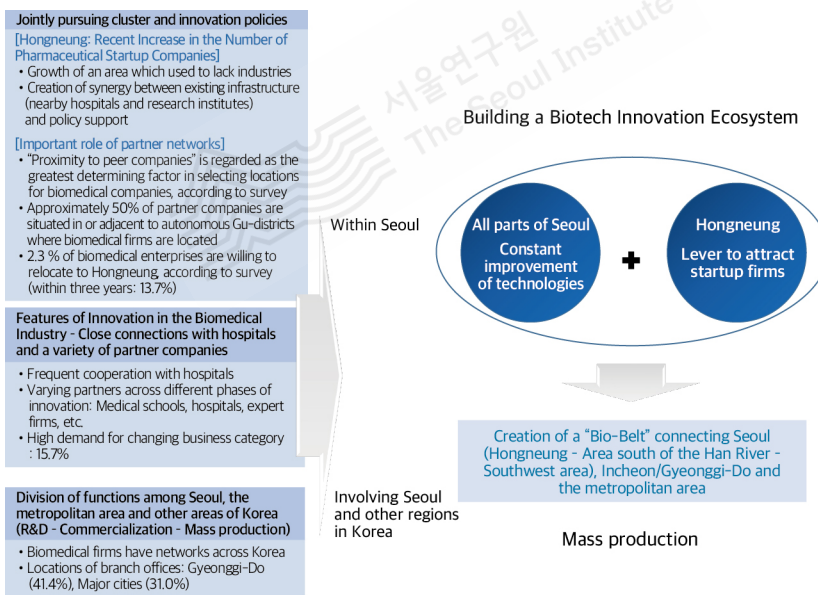
There are three directions for fostering biomedical businesses in Seoul - forming industry clusters and using policy measures to enhance the innovation ecosystem, promoting partnership between Seoul and other areas of Korea and supporting creative convergence of numerous stakeholders.

First, the SMG needs to build industry clusters to boost and nurture startups. It is also essential to cultivate the innovative capacity of biomedical enterprises using policy measures. The SMG should add hubs where bio startups and enterprises intending to change business category can develop new products and enhance the innovative capacity of biomedical firms in Seoul.

Second, powering the innovation ecosystem is critical to exchanges and collaboration between biomedical companies and a myriad of pertinent stakeholders. There is a need to actively nurture research firms to be spun off from research institutes (research institute spin-offs) or hospitals alongside biomedical R&D

companies. A cooperative relationship between such companies and hospitals or medical schools should be forged within the clinical trial field. Partnerships with specialized service providers need to be encouraged as well.

Third, the SMG should create collaborative networks between Seoul, the metropolitan area and other areas of Korea. R&D and mass production activities cannot be completed within Seoul for a variety of reasons. The process of R&D, attracting investment and marketing can be carried out in Seoul or Gyeonggi-Do. Clinical trials and production activities can be done in major cities with a large concentration of biomedical firms or some part of Gyeonggi-Do. It is necessary for the SMG to devise an administrative structure for effective coordination in view of the distribution of work across several locations.



[Figure 19] Direction for Reinvigorating the Biomedical Industry

Direction for Rejuvenating the Biomedical Industry #1

Set up a system for clinical R&D engaging general and university hospitals

Of the multiple partners in innovation, hospitals play a key role. Partnerships with them is an integral part of the biomedical industry. Many survey respondents view hospitals as the most desirable partners and seek greater cooperation in the area of clinical trials. Currently, major university and general hospitals in Seoul voluntarily run partnership programs with enterprises. It is imperative that the SMG support biomedical firms through promotion of existing cooperative programs, rather than launching separate ones.

(1) The SMG should build a portal system for the programs through which big data results, clinical services and specialized manpower are offered to firms;

(2) The SMG needs to increase the accessibility of such cooperative programs for venture firms by subsidizing consulting fees associated with clinical trials. At present, it is the users of such programs (biomedical enterprises) that bear all costs.

Direction for Rejuvenating the Biomedical Industry #2

Proactively incubate research institute spin-off companies and R&D firms to get more technology startups off the ground

The SMG will need to institute support policies that are different from those of other local governments. Seoul has a large concentration of biomedical R&D companies, an abundant, skilled workforce and advanced technology innovation capabilities. Research institute spin-off companies and biomedical R&D firms should be fostered to prompt more people to found technology startups. To help universities and research institutes diffuse and commercialize technologies, the SMG should assist them in working with intermediary organizations in universities. Along with this general support, it is critical to make a certain amount of bio funds available to research institute spin-off companies and biomedical R&D firms.

Direction for Rejuvenating the Biomedical Industry #3

Establish networks for collaboration between firms wishing to change business categories and various R&D organizations

Since the biomedical sector is still evolving, there are many cases where companies change business categories within the sector. Survey results show that 15.7 percent of respondents plan to convert business category. Firms attempting to do so have to change their physical infrastructure, human resources and technical expertise. It is essential for the SMG to offer programs for assisting technology searches, matching services and consulting services for research institutes and companies intending to switch business categories.

Direction for Rejuvenating the Biomedical Industry #4

Set up a nationwide collaborative framework involving partners specialized in clinical trials or production

The biomedical industry has a value chain more complex than other sectors. In the initial phase of R&D, hospitals, universities, public research institutes, giant pharmaceutical companies and venture firms participate. Hospitals, medical schools and enterprises with expertise in clinical trials such as contract research organizations and contract manufacture organizations[19] take part in the clinical trial process.

The issue here is Seoul has fewer CROs, CMOs and other specialized service providers that support clinical trials, production and sales. It is likely that CROs and CMOs, who require large yet affordable spaces, consider Incheon, Gyeonggi-Do as well as other provinces when choosing a location to set up their facilities. In other words, it is difficult to induce them to build their facilities in Seoul. The SMG should make information on locations of these expert partners available to bio venture firms and other organizations.

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[19] Contract research organizations and contract manufacture organizations are abbreviated as CRO and CMO, respectively.

Direction for Rejuvenating the Biomedical Industry #5

Have the Hongneung cluster serve as a platform for startups through which comprehensive support services are rendered

It is crucial to make the Hongneung cluster function as a platform for startups. To that end, the knowledge ecosystem, consisting of university hospitals, universities and research institutes, and the startup ecosystem, made up of biomedical companies, should be linked smoothly. Simply put, producers of technology in Hongneung and those preparing to launch startups and other consumers of technology need to be connected on the platform. We suggest this platform play the following five roles:

(1) Provide space to startups and enterprises intending to change business category;

(2) Offer space to such startups and enterprises intending to convert business categories to perform clinical tests on trial products;

(3) Make space available for housing and operating equipment for common use;

(4) Render matching services that enable startups and enterprises intending to change business category to develop collaborative programs with nearby university hospitals;

(5) Create programs for assisting technology searches which are easily accessible to startups.

It is important to not only offer space but also cover expenses associated with paying expert operators and technology coordinators towards allowing the space to function properly.

Founding a hub organization with the ability to execute is essential to assure continuous operation of the platform in Hongneung. The US city of San Diego and the US state of Massachusetts, which host top-tier biotech clusters, have hub organizations like CONNECT and Mass Bio. Such an entity in Hongneung would act as an umbrella organization for a range of institutions to form a pool of financial resources and devise joint plans.

Digital Economy of the Capital Region and the Software Industry in Seoul

Jaeuk Ju · Jongjin Yun

Key Message

It is necessary for the Seoul Metropolitan Government (SMG) to support early-stage software startups to allow for the spread of an innovation ecosystem. The SMG should build a skilled workforce and devise strategies suited to the characteristics of each software industry cluster.

There is a need to analyze the current status of the digital economy in the capital region and seek ways to stimulate the software industry in Seoul

The digital economy is an economy based on digital computing technology. Its scope can vary by different criteria. In this study, it includes Information Communications Technology (ICT) hardware and software and e-commerce. With advances in ICT and the proliferation of computers, the scope of economic activities that utilize digital technology has broadened. Thanks to recent developments in smartphones, firms offering diverse content and services using mobile technology have become global companies. The digital economy accounts for a substantial portion of today's economic activity.

A smart city is an urban area offering enhanced services with the use of advanced ICT. The SMG expects to improve urban services through creation of a smart city where technology-based enterprises will contribute to innovative growth through development of an industry ecosystem. Software and hardware companies and other firms in the digital economy play a highly instrumental role in the creation of

smart cities and an innovation ecosystem.

South Korea's hardware industry—made up of firms manufacturing networking products, semiconductors, displays and other components, as well as electronic devices like smartphones and smart TVs—is globally competitive. However, this is not the case for its software industry. Of particular note is that late movers like China have started catching up. Therefore, South Korea's dominant position in the hardware market has come under threat in recent years. What is more, as the core of the digital economy has shifted from hardware to software, the nation's information and communications industry has faced unprecedented challenges. Seoul, home to the largest concentration of software firms in South Korea, is responsible for leading the software industry.

This study examines the current state of the digital economy in the capital region and explores ways to develop the software industry in Seoul.

Korea's digital economy is concentrated in the capital region. Seoul and Gyeonggi have the highest number of software and hardware businesses, respectively

Let's take a look at Seoul's digital economy. Nearly 27,000 enterprises employ 639,000 people and produce added value worth KRW 30.2 trillion. It represents 3.2 percent of all companies in Seoul and 7.2 percent of the city's employment. It is also responsible for 9.2 percent of the city's gross regional domestic product (GRDP). Software makes up half of this digital economy. Since the digital economy excels in creating new work opportunities and added value, it can contribute to the capital's economic growth. Software is a key driver of the digital economy.

[Table 7] A Breakdown of Industries in Seoul: Digital Economy & Non-Digital Economy (2015)

(Units: # of Establishments, # of Persons, KRW billion, %)

	Establishments		Employment		Added value	
Digital economy	26,663	(3.2)	369,089	(7.2)	30,228	(9.2)
Hardware	4,649	(0.6)	35,404	(0.7)	2,694	(0.8)
Software	12,608	(1.5)	205,340	(4.0)	13,424	(4.1)
Support services	1,900	(0.2)	25,624	(0.5)	1,632	(0.5)
Communication services	455	(0.1)	21,420	(0.4)	6,621	(2.0)
E-commerce	5,288	(0.6)	40,482	(0.8)	2,104	(0.6)
Broadcasting	1,056	(0.1)	25,237	(0.5)	2,853	(0.9)
Non-digital economy	793,995	(96.8)	4,739,739	(92.8)	296,845	(90.8)
Manufacturing	57,562	(7.0)	252,010	(4.9)	16,506	(5.0)
Construction	22,695	(2.8)	360,192	(7.1)	28,519	(8.7)
Customer services	426,283	(51.9)	1,562,503	(30.6)	69,924	(21.4)
Producer services	225,767	(27.5)	1,758,836	(34.4)	139,296	(42.6)
Public·Welfare services	61,048	(7.4)	790,213	(15.5)	39,473	(12.1)
Others	640	(0.1)	15,985	(0.3)	3,127	(1.0)
Total	820,658	(100.0)	5,108,828	(100.0)	327,073	(00.0)

The establishments, employment and added value in the capital region comprise 71.3 percent, 68.8 percent and 61.5 percent of South Korea's economy, respectively. Seoul and Gyeonggi/Incheon account for half of them, respectively. Seoul constitutes 33.7 percent of all digital economy businesses, 30.4 percent of employment and 15.7 percent of added-value generated across South Korea. All are higher in Gyeonggi/Incheon, where digital economy businesses comprise 37.6 percent of all such businesses across the country, 38.4 percent of all employment and 45.8 percent of all added-value generated.

Digital economy clusters have spread from Seoul to Gyeonggi/Incheon. Digital economy industries have seen rapid growth as well

In Seoul, digital economy clusters are located in Gangnam, Guro and Geumcheon. As for Gyeonggi/Incheon, such businesses are concentrated in Seongnam, Hwaseong and Paju. The annual growth rate of the digital economy clusters in Seoul is 2 to 3 percent, while it has surpassed the 10 percent mark in Gyeonggi/Incheon. Both hardware and digital economy industries have grown by leaps and bounds in Gyeonggi especially.

[Table 8] Changes in Digital Economy Clusters (2010~2015)

		Seoul			Gyeonggi · Incheon		
		Gangnam	Geumcheon	Guro	Bundang, Seongnam	Hwaseong, Gyeonggi	Paju, Gyeonggi
Employment in the digital economy	2010	9.3%	20.1%	18.5%	14.3%	12.2%	14.2%
	2015	9.6%	20.1%	16.4%	19.6%	14.3%	17.9%
Scale of employment created by the digital economy	2010	59,709	37,394	33,407	24,529	32,570	16,519
	2015	68,179	44,821	34,528	52,795	56,320	29,627
Annual average employment growth rate		2.7%	3.7%	0.7%	16.6%	11.6%	12.4%

As of 2015, 1,728 businesses in all industries moved 37,610 jobs from Seoul to Gyeonggi/Incheon. Of these, 260 enterprises relevant to the digital economy shifted 11,241 jobs, representing 14.6 percent of all firms which relocated from Seoul and 29.9 percent of total employment.

[Table 9] Outflow of Companies and Jobs from Seoul to Gyeonggi/Incheon (2010~2015)

Rank	Outflow path	Industry	Establishments	Jobs
1	Gangnam-Gu[20]	Software	24	3,328
2	Guro-Gu → Bundang-Gu, Seongnam-Si[21]	Software	10	1,213
3	Yeongdeungpo-Gu → Bundang-Gu, Seongnam-Si	Software	2	1,004
4	Geumcheon-Gu → Danwon-Gu, Ansan-Si	Hardware	3	846
5	Seocho-Gu → Bundang-Gu, Seongnam-Si	Software	10	786
6	Gwangjin-Gu → Bundang-Gu, Seongnam-Si	Software	2	442
7	Gangnam-Gu → Bundang-Gu, Seongnam-Si	Support services	3	289
8	Guro-Gu → Bundang-Gu, Seongnam-Si	Support services	1	261
9	Seocho-Gu → Dongan-Gu, Anyang-Si	Software	6	207
10	Yeongdeungpo-Gu → Hwaseong-Si	Hardware	1	146

Note: Ranked on the basis of employment size

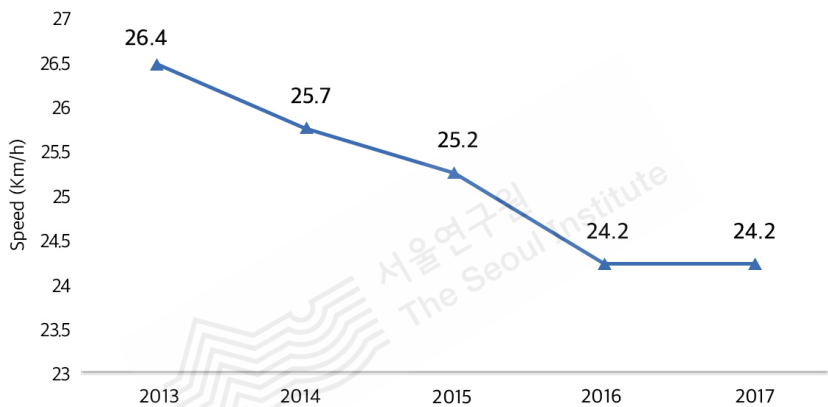
The software industry accounted for the largest share of all industries in the digital economy moving jobs from Seoul. More specifically, establishments in the software industry shifting jobs from Gangnam to Bundang comprised the most significant portion.

20 "Gu-district" is an administrative unit in Korea. There are 25 autonomous Gu-districts in Seoul, divided into 425 administrative "Dong" districts.

21 "Si" is an administrative unit (equivalent to a city) in Korea. Cities have a population of at least 150,000.

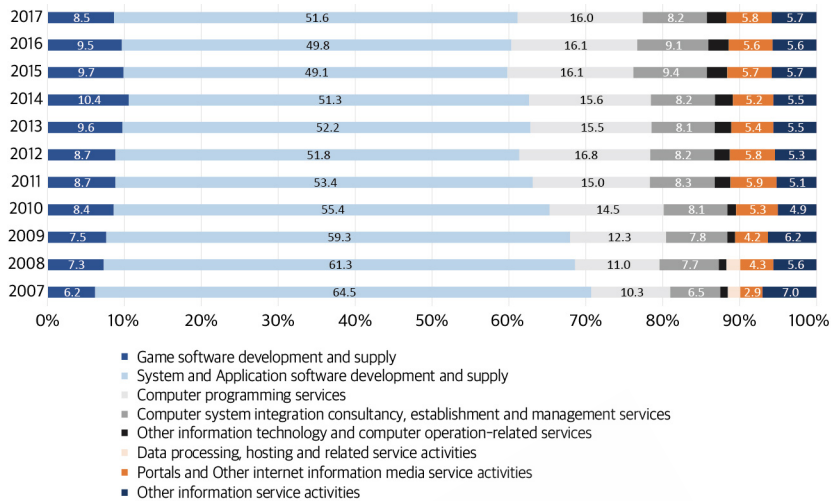
Seoul's software industry has been reorganized from B2C (business to consumer) such as games and package software to B2B (business to business) including system integration (SI) and support services

In Seoul's software industry, 226,000 people were employed by around 14,000 companies. The number of businesses and jobs increased by 8.0 percent and 4.1 percent, respectively, between 2007 and 2017.



[Figure 20] Number of Establishments and Employment Numbers in the Software Industry in Seoul

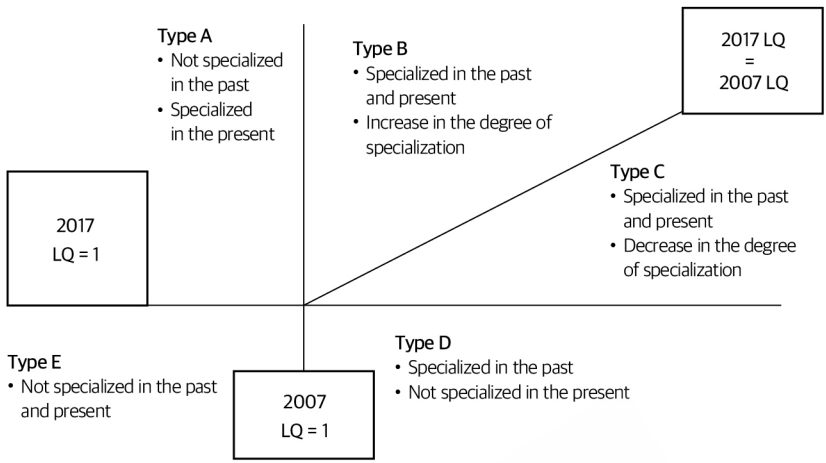
Although package software made up the greatest share of Seoul's software industry, the industry has diversified over the past 10 years. When it comes to change in percentage share held by subsectors of Seoul's software industry during 2007~2017, there was a decline in package (system/application) software (from 64.5 percent to 51.6 percent), while games, programming services and system integration/consulting/management all increased—from 6.2 percent to 8.5 percent, 10.3 percent to 16.0 percent and 6.5 percent to 8.2 percent, respectively.



[Figure 21] Share of Seoul's Software Industry Held by Each Subsector

Location quotient analysis shows that 10 software clusters are situated in Gangnam, Seongsu and other areas of Seoul

Location quotient (LQ) is an indicator that shows how specialized a region is in a certain sector. We used our analysis of location quotients to classify clusters into five categories, as Table 9 demonstrates. There were a total of 13 clusters, or 10 if excluding those that are very small or where related functions are not concentrated.



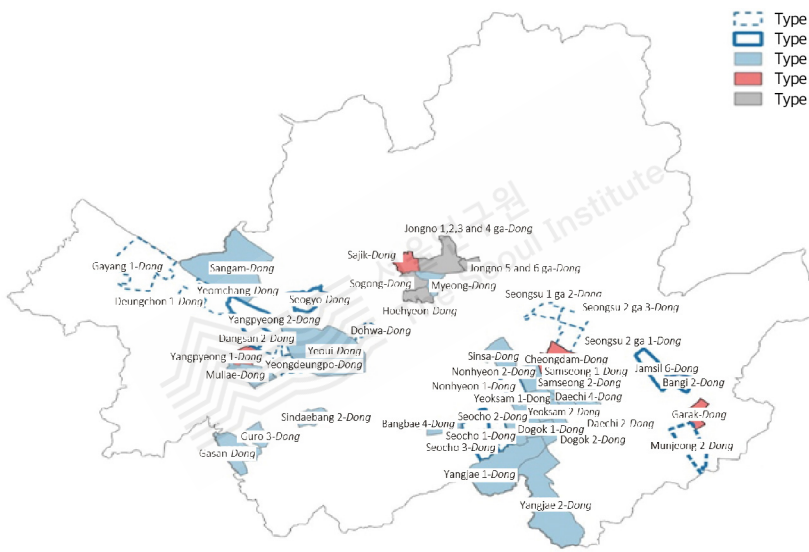
[Figure 22] Categorization of Clusters

The Seoul Digital Industrial Complex comprises 24.2 percent of Seoul's software industry. Employment, mainly by large conglomerates, as well as the number of startups are on the rise. Having said that, the average number of employees at small firms has dwindled so it is fair to say that the size of the cluster has decreased. Although the status of Gangnam, a traditional software cluster, has fallen due to relocation of several large conglomerates, a lot of startups have been created. This means that the area has still served as a startup cluster.

Seocho has geographical advantages as it surrounds Gangnam and a cluster in the area has thrived, centering around small and medium-sized IT services firms. In Yeongdeungpo and areas serviced by Seoul Subway Line 9,[22] a small and medium-sized package software business-centered ecosystem has been established. However, startups constitute a small share of total enterprises. The growth rate of Sangam Digital Media City (DMC) where a media and content cluster is located is high and small and medium-sized enterprises account for a large share of

[22] Yeomchang-Dong, Deungchon 1-Dong, Dangsan 2-Dong, Yangpyeong 1-Dong, Yangpyeong 2-Dong, Yeongdeungpo-Dong and Mullae-Dong are included.

employment. Seongsu has rapidly grown as an urban manufacturing area but the number of startups is relatively low. In Munjeong and Garak, businesses, particularly startups, have quickly expanded their presence and there is a great number of small companies. Since Seogyo and Dohwa are situated within close proximity to university campuses, they are preferred by the younger generations. Small firms account for most of the companies and game software providers represent a large portion of those.



[Figure 23] Types of Software Clusters, by Administrative Dong[23] District

[23] A "Dong" or "Neighborhood" is the smallest urban-area division to have its own government office and staff in Korea. There are two types of Dong: legal-status and administrative.

There is a need to help entrepreneurs in establishing software startups, develop talent and expand partnerships. Strategies tailored to the characteristics of each cluster should be mapped out as well

This study suggests the following policy directions for the advancement of Seoul's software industry. First, it is necessary for the SMG to facilitate the spread of the innovation ecosystem through support to entrepreneurs founding software startups. Seoul was the center of software industry growth in the early days. As large clusters have quickly grown in Gyeonggi, particularly in Bundang and Pangyo, the industry has geographically dispersed. Office rent in Gyeonggi is relatively cheap and the area has good accessibility and a good residential environment, making it attractive for mature software businesses to move in. Unlike Gyeonggi, Seoul—with a number of venture capital firms and a talented workforce—is an ideal place for entrepreneurs to start software companies. It is desirable that Seoul use this and other advantages to contribute to expansion of the ecosystem in collaboration with other areas.

Second, the SMG should work on developing skilled workers in a bid to tackle the shortage of personnel in and sharpen the competitiveness of the software industry. According to a regional employment survey, demand for highly-skilled workers is high but skilled young people keep leaving Seoul's software industry. This suggests that both strengthening of specialized training and improving the overall conditions of the relevant jobs are necessary. It is critical to continue monitoring the status and outlook regarding the supply of manpower. There is a need for the central government to invest in training because small and medium-sized companies see little incentive to do so. The central government should create an environment where better treatment and a variety of opportunities can be given to developers.

Third, there is a need to increase partnership opportunities with other industries and areas. With the evolvement of software technology, enterprises can improve their competitiveness by specializing in one field and collaborating with other

companies specializing in other fields. Such a cooperative culture between firms takes time. However, the central government can help expand partnership opportunities through providing partnership incentives when placing orders for public projects or supporting activities of regional developer associations.

Fourth, strategies tailored to the features of each cluster are needed. Seoul's software industry has a long history and it is the largest in the country, resulting in a number of clusters forming there organically or artificially. They vary in core business and firm size according to spatial characteristics and relations with surrounding areas. A significant need is for the SMG to come up with detailed strategies on clusters in view of the locational and industrial features of each.

Improving the Working Environment in Seoul's Small- and Medium-Sized Enterprises (SMEs) and the Implications of Related Policies

Jinha Kim · Min young Hwang

Key Message

It is necessary to encourage small- and medium- sized companies to voluntarily work toward enhancing their working environment and set up a system for occupational safety and health.

The majority of Seoul's industrial accidents occur in small- and medium-sized enterprises (SMEs) with fewer than 300 employees having a "fragile labor environment"

With the rising number of workplace deaths, the gravity of the issue has begun to be realized. Thus, the need for ameliorating working conditions related to workers' lives and safety has been highlighted.

According to statistics on industrial accidents for 2017 published by the Korea Occupational Safety and Health Agency (KOSHA), the number of fatalities from occupational accidents and workers suffering from industrial injuries each day was 2.6 and 246, respectively. The total number of deaths related to workplace accidents in SMEs with fewer than 300 employees was 902, comprising 92.9 percent of the total number of fatalities from occupational accidents (971) in 2018. Even though SMEs play a significant role in the industry and job creation, many industrial accidents take place. The same holds for Seoul. As of 2018, 93.8 percent and 85.2 percent of the total number of industrial accidents and deaths in Seoul occurred in SMEs, respectively. Seoul has had the fewest deaths from occupational accidents

over the last five years, compared to those in other local governments (metropolitan city and Do[24]). Thus, deaths linked to industrial accidents in Seoul have fallen at the slowest pace.

A significant number of businesses with fewer than 10 employees are in wholesale-retail trade and food services. They are susceptible to mental health issues as they deal with customers more often than other businesses in the service industries

Common risks faced by SMEs situated in Seoul, regardless of business size, are associated with repetitive actions and interactions with customers or patients. They are more significant threats to Seoul workers than any other risk factor, and employees in Seoul are more exposed to them than those in the entire country. Businesses in wholesale/retail trade, and food/beverage services, making up a larger share of those with fewer than 10 employees, directly interact with customers or patients more frequently than other businesses in service industries. Thus, they are more vulnerable to mental risks stemming from customer or patient handling.

Businesses in wholesale/retail trade and accommodation/food services are more likely to be influenced by physical and mental risks

Industries are broadly categorized into three sectors: manufacturing, construction, and service. In terms of the level of exposure to risks, construction is higher than the other two sectors because many construction tasks create high noise and dust levels. On the contrary, workers in the service sector are susceptible to both physical and

[24] "Do" is an administrative unit (similar to a province) in Korea. There are eight Do in South Korea, such as Gyeonggi-Do and Gangwon-Do.

mental risks. To be more specific, they are required to work in dangerous environments, such as areas exposed to low temperatures or high-risk materials, maintain postures causing fatigue and pain, move people, and perform the same actions repeatedly. Moreover, they need to cope with customers and patients. Although the service sector encompasses various service-related industries, many SMEs located in Seoul belong to industries like wholesale/retail trade, and accommodation /food services. This seems to be the reason why a string of risk factors pertaining to them have been identified.

Businesses in cleaning and security services are susceptible to extreme temperatures as well as chemical exposure. Firms in the urban manufacturing sector are seriously affected by vibration and noise

We examined the exposure to risks among businesses in wholesale/retail trade, accommodation/food services, courier/delivery services, cleaning/security services, personal care services (nail and beauty salons), and urban manufacturing (clothing/sewing, printing, jewelry/metalworking, and machinery). Workers in wholesale/retail trade, accommodation/food services, and cleaning/security services are exposed to high and low temperatures more often than other hazardous ambient factors. The reasons are as follows: (1) normal duties of their occupation are carried out outdoors, so they are more affected by changes in temperature; (2) even if their worksites are located indoors, they are required to cook food or not be able to use air conditioners or heaters while performing the duties of their job. In particular, workers in cleaning/security services and personal care services (nail and beauty salons) in Seoul are susceptible to risks linked to organic solvent or chemical agent handling than those in other areas across the country. Those in urban manufacturing, such as clothing/sewing, printing, jewelry/metalworking, and machinery, are in danger from vibrations and noise as well as risks arising from prolonged standing or repetitive actions.

It is critical to make contractors shoulder more responsibility in preventing occupational accidents and broaden the scope of the main body in charge

The Occupational Safety and Health Act covering working conditions in SMEs was revised entirely on January 15, 2019. Only workers defined in the Labor Standards Act were included in the previous version of the Occupational Safety and Health Act. With the recent extensive revision, the Act became applicable to persons in special employment types and delivery persons who are subject to the Industrial Accident Compensation Act. Furthermore, it put greater responsibility on contractors to prevent industrial accidents, widened the scope of the main body in charge, and granted workers the right to refuse dangerous work. Measures intended to ensure the effective exercise of such rights were imposed through the revised Act as well. It also strengthened the responsibilities of relevant parties in construction projects—owners and contractors—in keeping occupational accidents from happening. Contractors' accountability concerning minimizing hazards/risks was increased, and the penalties for law violations were strengthened by inserting an article specifying the duty to create and submit the Material Safety Data Sheets (MSDSs).

The Ministry of Employment and Labor (MOEL) and the Ministry of SMEs and Startups (MSS) have assisted SMEs in upgrading facilities related to the working environment as well as paying occupational accident insurance premiums and given education about occupational safety

The MOEL and the MSS have enacted the following policies aimed at improving the working conditions of SMEs: (1) expand facilities and provide funds for equipment; (2) render management consulting services and support SMEs to create jobs; (3) offer education about occupational safety; and (4) raise the number of

SMEs taking part in social insurance schemes, including industrial accident insurance. The MOEL has conducted training courses on operating tower cranes, ameliorated the dangerous workplace environment of small-sized establishments, certified businesses meeting standards for occupational safety and presented three safety tips on preventing heatstroke. The central government has enforced several policies designed to increase the number of companies joining social insurance schemes, such as industrial accident insurance. The "Duru Nuri[25] Social Insurance Support Program", a social insurance subsidy program, is one of them. The program has subsidized insurance premiums (employment insurance and national pension schemes) borne by employers and employees of firms with fewer than 10 employees.

The Seoul Metropolitan Government (SMG) has taken the lead in offering a safe working environment for its affiliated organizations by enacting a relevant ordinance and forming the occupational safety team

The SMG passed an ordinance to render assistance in preventing industrial accidents and ensuring occupational safety and health. Doing so has set up a system for creating a safe working environment in itself as well as its administrative agencies and public enterprises, and the organizations that it finances and their affiliated companies. In January 2019, it formed the occupational safety team within the labor policy division to prepare for the implementation of the revised Occupational Safety and Health Act and provide safe workplaces. Moreover, it has evaluated the working conditions for workers of enterprises specialized in safety, which are affiliated with it or public institutions under its umbrella, or subcontractors by conducting a survey. It has also pursued policies on workers' welfare to promote a safe working environment like the "Seoul-Type Paid Sick

[25] "Duru Nuri" means "all enjoy" in Korean.

Leave Support Project"[26]. The SMG's safety inspector team inspects construction sites to eliminate workplace hazards. The Office for Government Policy Coordination, the MOEL, the Ministry of Land, Infrastructure and Transport (MOLIT), the Ministry of Trade, Industry and Energy (MOTIE), and the MSS, along with the SMG and other local governments, have strived to reduce suicides, traffic accidents, and industrial accident deaths.

The governments of Gyeonggi-Do and Gyeongsangnam-Do have made small-sized businesses with fewer than 50 employees comply with their new ordinances

Several local governments, including the SMG, have supported social enterprises in paying premiums for four social insurance schemes: national pension scheme, national health insurance, employment insurance, and industrial accident compensation insurance. The governments of Gyeonggi-Do and Gyeongsangnam-Do adopted ordinances to render assistance in preventing industrial accidents and ensuring occupational safety and health. They have built an institutional foundation for providing a safe working environment in firms, including small-sized ones with fewer than 50 employees. The government of Gyeonggi-Do has rolled out policies and operated labor centers aimed at safeguarding the rights of vulnerable groups of workers. The governments of Gimhae-Si[27] and Gyeongsangnam-Do ran laundry stores that remove hazardous substances and grease on working clothes of workers of SMEs to preserve their right to health.

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26 The goal of the "Seoul-Type Paid Sick Leave Support Project" is to make health-care services available for vulnerable workers.

27 "Si" is an administrative unit (equivalent to a city) in Korea. Cities have a population of at least 150,000.

In Germany and Japan, employers are obliged to suspend work when a hazard issue is discovered. All workers get legal services in Saarland, Germany

In France, workers can stop work if they believe that there is a real and imminent danger to life or health. Contrarily, employers in Germany and Japan are the ones who have this duty to stop operations. It is worth referring to the case of Arbeitskammer des Saarlandes (Chamber of Labor of the Saarland) in Germany when framing policies. All workers employed in Saarland, including underemployed persons and foreign workers, must join the organization that offers legal services and education or training.

It is essential to run related schemes effectively by developing guidelines for all establishments about working conditions

Laying out guidelines about the working environment applicable to all businesses, including small ones where safety and health blind spots exist, is integral to enhancing SMEs' working conditions and preventing workplace accidents. The ordinance enacted by the SMG applies to itself and its affiliated organizations of different sizes with varying features. Hence, there is a need to draw up guidelines covering all firms, including small-sized ones where each industry type's characteristics are considered. It is crucial to carry out related schemes effectively by finding best practices for ensuring safe working conditions using the guidelines so that such best practices can be shared throughout the private sector. The SMG's honorary safety inspectors' role should be stipulated in the SMG's guidelines about working conditions. The details of their role are as follows: (1) encourage workers of small businesses to make an effort to minimize workplace accidents actively; (2) give consultation services to help management and labor establish a safety and health management system voluntarily and collaboratively; and (3) engage in determining the status of working conditions and formulating plans for creating a

system for keeping work accidents from happening concerning workers performing their duties outside workplaces. They will help induce small businesses to voluntarily endeavor to improve the working environment and boost the effectiveness of policies on preventing occupational accidents.

The SMG had better confer benefits such as subsidizing occupational accident insurance premiums to firms excelling in preventing work accidents and improving occupational safety and health

Micro companies with fewer than 10 employees are vulnerable to a dangerous workplace environment as well as physical and mental hazards. In contrast, health problems experienced by workers of small businesses with fewer than 30 employees correlate closely with their job. However, it is difficult to force small-sized establishments to do a risk assessment under the current Occupational Safety and Health Act. Furthermore, they do not have systems for selective monitoring of or preventing exposure to major risks. The SMG should select companies excelling in preventing work accidents and improving occupational safety and health as part of an effort to motivate micro and small businesses to alleviate working conditions. We also suggest the SMG state the benefits they will enjoy in its ordinance to urge enterprises to make their working environment safer. It is worth considering partial subsidization of occupational accident insurance premiums to ease the burden of insurance costs placed on small-sized enterprises and expand the safety net concerning occupational accidents.

There is a need to offer precautionary training and guidance on how to get support to workers in industries vulnerable to certain risk factors like wholesale and retail trade

Workers of businesses in wholesale/retail trade, accommodation/food services, urban manufacturing, personal care services (nail and beauty salons), and cleaning/security services are susceptible to certain risks and frequently involved in accidents at work. It is recommended to give information on main risk factors and precautionary training to them through community health centers. Health-care centers in autonomous Gu[28]-districts have run food hygiene training courses for food handlers. It is pivotal to impart information about how to purchase occupational accident insurance and related benefits to businesses exposed risks but not having occupational accident insurance. Discovering ways to lend assistance for industries vulnerable to hazards but not eligible for funds for equipment is also essential.

The SMG will be able to decrease occupational safety blind spots by partnering with community health centers.

It is essential to provide medical and legal services to couriers and delivery persons who have difficulty receiving assistance when they suffer accidents in their work

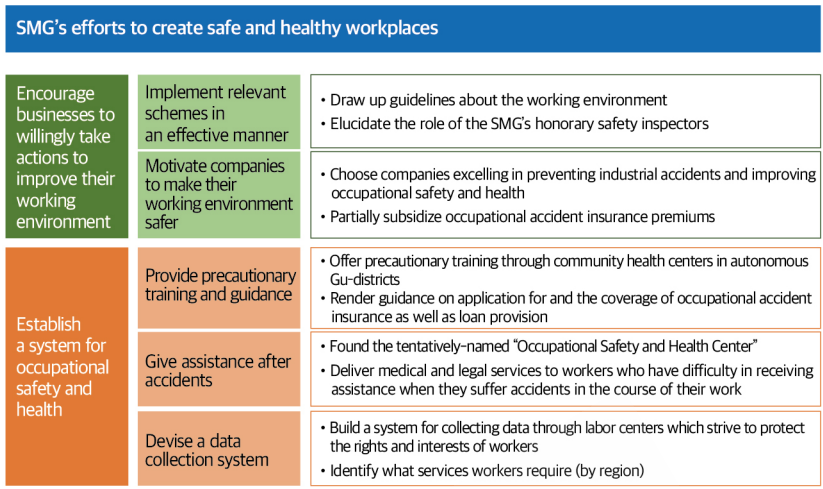
There is a need to render medical/legal services to workers who are relatively less protected by laws and face risks when working, such as couriers, delivery persons, cleaning persons and security guards, and micro-businesses' workers, who find it hard to apply for occupational accident insurance.

[28] "Gu-district" is an administrative unit in Korea. There are 25 autonomous Gu-districts in Seoul, divided into 425 administrative "Dong" districts.

We suggest the SMG establish the tentatively-named “Occupational Safety and Health Center”, modeled on the Chamber of Labor of the Saarland, to expand the scope of beneficiaries of and range of services delivered by shelters for migrant workers and fulfill the function of occupational safety and health. By jointly providing medical and safety/health-related services with the KOSHA, its preparation procedures can be simplified, and service delivery’s effectiveness can be increased.

There is a need to help formulate policies based on working conditions by building a data collection system through labor centers that endeavor to protect workers’ rights and interests

Creating a system through which data on the working environment and risk factors of enterprises in urban manufacturing and major service industries in each region is gathered by strengthening labor centers’ role is advised. The data amassed through monitoring of working conditions concerning safety and health in establishments located in each region will help provide services designed to enhance the working environment suitable for each industry type and business size. We expect the accumulated data about occupational safety and health in each region will be utilized as feedback on prevention policies and those about rendering assistance after industrial accidents. Accordingly, the effectiveness of such policies will be maximized.



[Figure 24] Overview of the SMG's Plan to Make Working Conditions of SMEs Better

05 Transportation Planning

Adoption of Smart Mobility Services in Seoul

Sangyeon Hong · Wonho Kim · Kyungsang Yoo · Sehyun Park

Summary

Large cities around the globe work towards solving urban traffic problems deriving from growing population concentrations. With the development of advanced Information Communications Technologies (ICT), smart mobility has become the center of attention as an effective means of tackling this issue. Due to the increased connectivity of people and transportation modes, the growing use of shared transport and diversifying transportation options, smart mobility is expected to bring about far-reaching changes to future urban transit systems. A variety of opportunities related to smart mobility are rising in Seoul's transportation environment. We assessed the usability of each mobility service. It is advisable to promote first the use of platform services that are highly effective and viable. For their utilization, there is a need to map out strategies to overcome the limitations of each service. In a bid to establish the groundwork for sustainable smart mobility, relevant regulations have to be relaxed and standards set that consider the potential adverse effects stemming from the easing of regulations. Strengthening the link with urban regeneration projects is also needed.

Findings from evaluation of smart mobility services indicate that platform services are very effective, marking them as a priority for promotion

To gauge the degree of usability of representative smart mobility services, we selected viability and effectiveness as indicators. We examined groups of services that are fairly effective and whose viability can be boosted according to implementation strategies. Based on the results, platform services were chosen to be delivered first.

There is a need to design strategies for implementation of each platform service based on analysis of service viability

When it comes to smart parking services, various forms of incentive should be provided to encourage people to use shared parking spaces. A system for offering such support should be created and related inconveniences minimized by cracking down on illegal parking and stopping. A variety of services will need to be developed before introducing MaaS (Mobility as a Service).[29] Toward that end, flexibility must be maintained in fare systems and criteria for calculation. Tactics must be adopted that are designed to ensure mutual benefit with existing stakeholders, liberalizing regulations on taxis and laying out criteria and requirements for ride-sharing services. A method of permitting/approving routes after forecasting transport demand in real time should be reviewed and consider areas of low passenger demand where public transport services are not sufficiently rendered. By doing this, an institutional framework for demand-responsive transport will be established.

[29] Mobility-as-a-Service (MaaS) describes a shift away from personally-owned modes of transportation and towards mobility solutions that are consumed as a service. This is enabled by combining transportation services from public and private transportation providers through a unified gateway that creates and manages the trip, which users can pay for with a single account, -Mobility as a service (transport). (2016, October 2). In Wikipedia. https://en.wikipedia-on-ipfs.org/wiki/Mobility_as_a_service_(transport).html

A foundation for sustainable smart mobility must be laid

To establish the groundwork for sustainable smart mobility, the Seoul Metropolitan Government (SMG) will need to ease regulations appropriately and set standards to mitigate or prevent side effects that come out of this easing. Exploration of the effects of new transportation services on the SMG's transit system will need to be preemptive to create an innovative development environment for smart mobility services. There is also a need for an organization with full authority related to data in order to lend assistance to data discovery, management and exchange as well as preventing invasions of privacy. The institutional conditions under which smart mobility services can be linked with urban regeneration projects are set. The SMG should encourage the use of smart mobility services in consideration of the transportation environment in target areas.

Ⅰ. Smart Mobility and Changes in Urban Transportation

Smart mobility is in the limelight as an effective solution to urban traffic problems.

As 4IR technologies evolve, a growing number of cities are embracing smart mobility options

○ The world's urban population has continued ballooning.

- According to the United Nations (UN) World Urbanization Prospects 2018 report, approximately 55 percent of the world's population lived in cities as of 2018. The report also projected that around 2.5 billion people would move to urban areas over the next 30 years.
- Increasing population following urbanization poses a myriad of challenges including traffic congestion, insufficient energy supply and environmental degradation.
- To address such issues, cities have actively invested in resources such as new infrastructure but face multiple limitations such as a shortage of funding and community conflict.

○ Big cities around the world place their focus on smart cities towards resolving urban problems in an efficient and effective manner.

- Up-to-date ICTs are incorporated into smart cities to address urban issues.
  - Thanks to advances in 4IR (4th Industrial Revolution) technologies like the Internet of Things (IoT), big data, cloud computing and artificial intelligent (AI), the foundation for utilizing ICTs is set.
- Each country has formulated and forged ahead with plans to create a smart city at the central government level. In South Korea, the national government has been proactive through enactment of the Act on the Promotion of Smart City Development and Industry.

[Table 10] Shifts in Ways of Eliminating Urban Issues

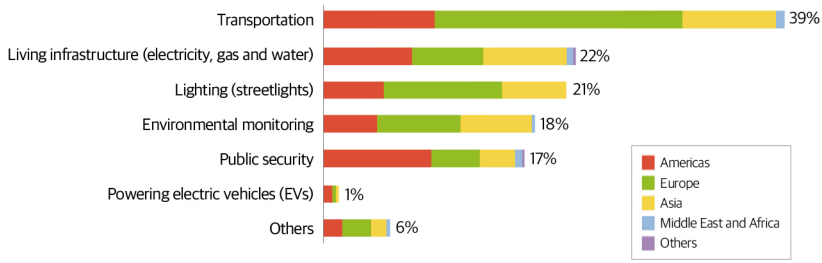
Existing	In a smart city
- Construct urban infrastructure - Traffic congestion → Expand roadways - Rise in crime rates → Increase police manpower - Surge in electricity consumption → Build energy plants	- Provide smart services - Traffic congestion → Offer information on alternate routes - Rise in crime rates → Real-time monitoring using closed-circuit television (CCTV) cameras - Surge in electricity consumption → Give information on electricity rates in real time

Source: Korea Research Institute for Human Settlements, 2015, Smart Cities: Trends and Implications, Policy Brief, No. 529.

○ Smart mobility is attracting attention in the transportation sector.

- Previously, governments depended on large-scale infrastructure building projects like roadways and subways to resolve traffic issues.
- However, problems (clashes of interest) were triggered by exorbitant investment costs, a lack of urban space and construction of infrastructure so governments have started embrace smart mobility.
- Smart mobility solutions allow governments to effectively resolve traffic issues by efficiently employing existing infrastructure or introducing cutting-edge infrastructure (low-cost investment options).
- By adopting a paradigm that has not existed before, new services and experience are offered. Consequently, the quality of life of citizens is improved.
- Thirty-nine percent of all smart city projects underway in the world are related to transportation, accounting for the highest share.[30]

[30] IoT Analytics, 2018, The top 10 IoT segments in 2018-based on 1,600 real IoT projects.



Source: Korea Research Institute for Human Settlements, 2018, Measures to Introduce a Next-generation Transit System for Smart Cities, Policy Brief, No. 666

[Figure 25] Status of Smart City-related Projects by region

Smart mobility will produce massive shifts in transit systems through provision of integrated transport services.

It is forecasted that smart mobility will dramatically change the transit system owing to the development of state-of-the-art ICTs

- The definition of smart mobility refers to effective solutions to traffic problems.

[Table 11] Definitions of Smart Mobility

Organization	Definition
Siemens (2015)[31]	A paradigm shift to a multi-modal transportation system highly flexible and convenient.
EU (2016)[32]	Systems or services that contribute to decarbonization of the transport sector and help address persistent problems of congestion and accessibility.
UNCTAD (2016)[33]	A more accessible, efficient and safer transportation system. New forms of services such as car sharing and carpooling.
Seoul Digital Foundation (2018)[34]	An integrated concept of future intelligent transportation services, which have become more intelligent and smarter with the convergence of existing transportation systems and the advanced functions of smart devices.

31 Siemens, 2015, Smart Mobility–A tool to achieve sustainable cities.

32 EU, 2016, Smart Mobility and Services.

33 UNCTAD, 2016, Issues Paper on Smart Cities and Infrastructure.

34 Seoul Digital Foundation, 2018, 2018 Q2 Digital Future Seoul Vol. 2 ”Smart Mobility.”

- This study defines smart mobility services as new forms of service through which traffic problems can be resolved in an efficient manner, particularly utilizing services that harness up-to-date technologies.

○ It is expected that IoT, big data, AI, 5G and other state-of-the-art ICTs will drive substantial shifts in the transit system.

- First, connectivity between humans, transport modes and services will be enhanced.
- Second, shared transportation will be used widely thanks to the development of cutting-edge ICTs.
- Third, transport modes and transportation options will be diversified.

1. Increased connectivity between people, transportation modes and services

○ With the distribution of mobile devices and the development of IT, online and offline connectivity has grown. Accordingly, service providers can promptly identify and cater to consumer needs.

○ Online to Offline (O2O) means that consumers search and purchase services online and use them offline.

○ As O2O services are developed in the transportation sector, human-to-human, human-to-transportation mode and transportation mode-to-transportation mode connectivity has improved.[35]

○ With the spread of taxi-hailing apps like “KaKao T” (previously “Kakao Taxi”), user convenience has increased considerably.

- In the past, taxis were mostly hailed from the roadside.
- After the advent of KaKao T, more than fifty percent are hailed from inside buildings, alleys and streets in residential areas.[36]

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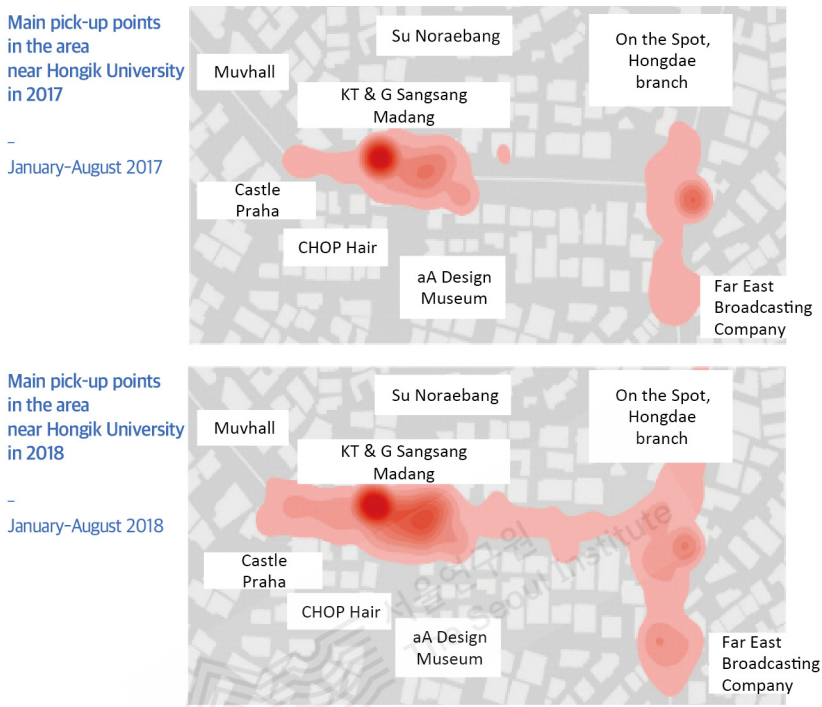
35 Korea Institute for Industrial Economics & Trade, 2016, Status and Policy Tasks concerning On-demand Transportation Services Essential for Livelihood, ISSUE PAPER 2016-409.

36 Kakao Mobility Digital Economy Research Institute, 2018, 2018 Kakao Mobility Report.



Source: Kakao Mobility Digital Economy Research Institute, 2018, 2018 Kakao Mobility Report.

[Figure 26] Changes in Pick-up Points since the Appearance of Kakao T(one example of a taxi app)

○ As shown in the example of Kakao T, O2O services have switched from service provider-centered to consumer-centered.

- Traditionally, users had to access transportation infrastructure or services on their own.
- Due to O2O, transport services are becoming more “on demand”, which means that services are delivered upon consumer request.

○ When on-demand modes of transportation are developed, customized transport services will be offered, which will in turn increase consumer convenience.

2. Shifting away from personally-owned vehicles to shared modes of transportation

○ As the sharing economy has taken the world by storm, diverse services have been produced in the transportation sector.

○ Transportation modes and spaces, for which the concept of ownership has been entrenched, are shared so benefits are yielded to many people.

○ By 2025, the market size of the sharing economy is projected to grow 20 times what it was in 2014[37].

○ The biggest transportation service in the sharing economy is ride-sharing, as exemplified by Uber and Lyft.

- The factors that differentiate ride-sharing services from taxis are flexible pricing and varied services.
- The South Korean government, except some services like 'Tada', has partially granted permission to operate ride-sharing services.
- Despite strong resistance from the taxi industry, ride-sharing services will inevitably be introduced, albeit in phases, on account of repeated demand from citizens as well as companies and the easing of regulations and other current trends.

○ Demand responsive transport services are rendered through the sharing of information on routes and timetables that vary by demand.

- Demand responsive transport is a cheaper alternative to ride-sharing services like Uber.
- In Seoul, the "Late-night Call Bus" service was launched in 2016, quickly gaining popularity with citizens. Due to opposition from related industries as well as a lack of supporting law, the service was halted.

○ O20 sharing-based services are expected to be seamlessly incorporated into the existing Seoul transportation system.

- Flexible provision of services is projected to generate demand for door-to-door services.

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37 PwC, 2015, The Sharing Economy, Consumer Intelligence Series.

- Owing to low punctuality rates stemming from traffic congestion and higher fares than public transit, the function and importance of the latter will continue.
- If fares are adjusted to a more suitable level and permission granted, shared O2O-based services will serve as a means of accessing mass transit or providing an alternative.[38]

○ Of all sharing economy-related projects in the transportation sector, the SMG has most vigorously promoted the shared parking program.

- Limited potential for conflict, relatively low input costs and positive public response are among the reasons.
- With substantial support from the SMG, more parking lot operators will participate.
- Having said that, improved efficiency in parking lots will lead to an increase in the convenience of using personal vehicles. There is concern that demand for personal vehicles may rise accordingly.

Source: Yeongdeungpo-Gu, Seoul

[Figure 27] SMG's Shared Parking Program

[38] Source: Korea Research Institute for Human Settlements, 2018, Higher Accessibility to Mass Transit via Shared Mobility: Focus on Metropolitan Travel within Seoul Capital Area, Policy Brief, No. 692.

3. Integrated transit system making travel easier

○ Traditionally, choices about routes and transport modes were mainly based on experience or information searches.

○ With the distribution of devices in vehicles and advancement of ICTs, information on myriad transport modes is generated and connectivity between them strengthened. As a result, the number of options regarding optimal routes and transportation modes has surged.

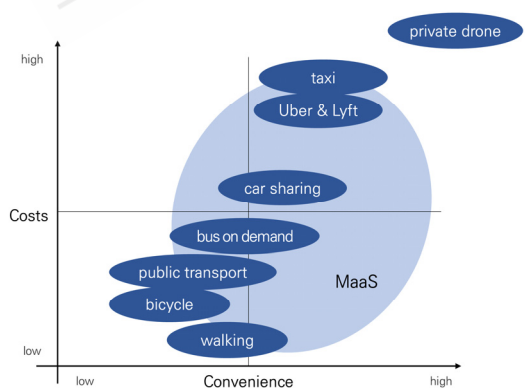
○ In these circumstances, the concept of MaaS was advanced.

- MaaS enables users to select optimal journeys via a single digital platform displaying information on various mobility options.

○ By integrating trip booking and payments, MaaS solutions offer seamless travel experiences for users.

○ As new transportation modes like Personal Mobility (PM) devices and ride-sharing services expand, varying combinations of routes and transportation modes are expected.

○ Development of a diversity of tailored-to-user mobility options is expected in view of travel time, cost and convenience.



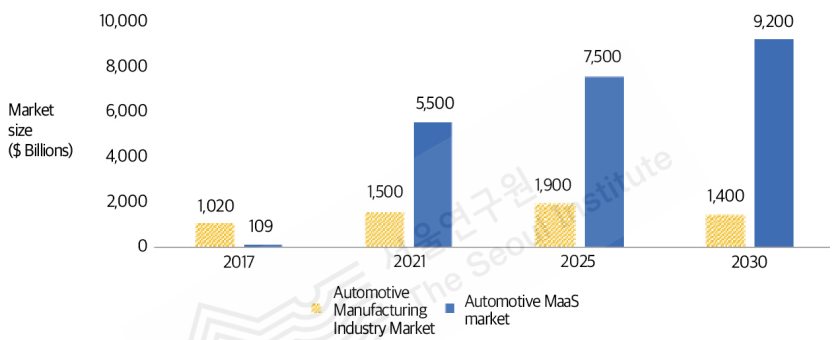
Source: Giesecke et al., 2016, Conceptualising Mobility as a Service, 2016 International Conference on Ecological Vehicles and Renewable Energies

[Figure 28] Classification of Transport Modes by Cost and Convenience

It is projected that Seoul's transit system will be upgraded with a focus on MaaS

○ MaaS' early stages will later become autonomous-MaaS, subsequent to commercialization of self-driving technologies.

- Despite commercialization of self-driving technologies, the price of self-driving cars will be high. Thus, it is predicted that the use of early autonomous vehicles will increase around their use in mass transit or taxi services, rather than private vehicle ownership.[39]



Source: ARK Invest, 2017, Mobility-as-a-Service: Why self-driving cars could change everything.

[Figure 29] Market Forecast: Autonomous MaaS and the Automotive Manufacturing Industry

- Autonomous buses and taxis will mainly be powered by electricity. Services can be delivered at low cost due to reductions of personnel expenses and fuel costs.[40] The majority of existing transportation modes will be replaced by self-driving services, whose role in a MaaS system will be strengthened.
- After commercialization of complete autonomous driving technologies, a MaaS system is expected to switch to an autonomous-MaaS system in which driverless cars are instrumental.

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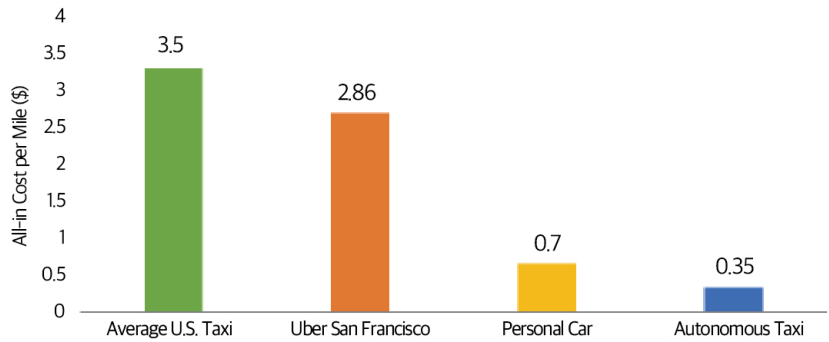
39 ARK Invest, 2017, Mobility-as-a-Service: Why self-driving cars could change everything.

40 Ibid.



Source: ARK Invest, 2017, Mobility-as-a-Service: Why self-driving cars could change everything.

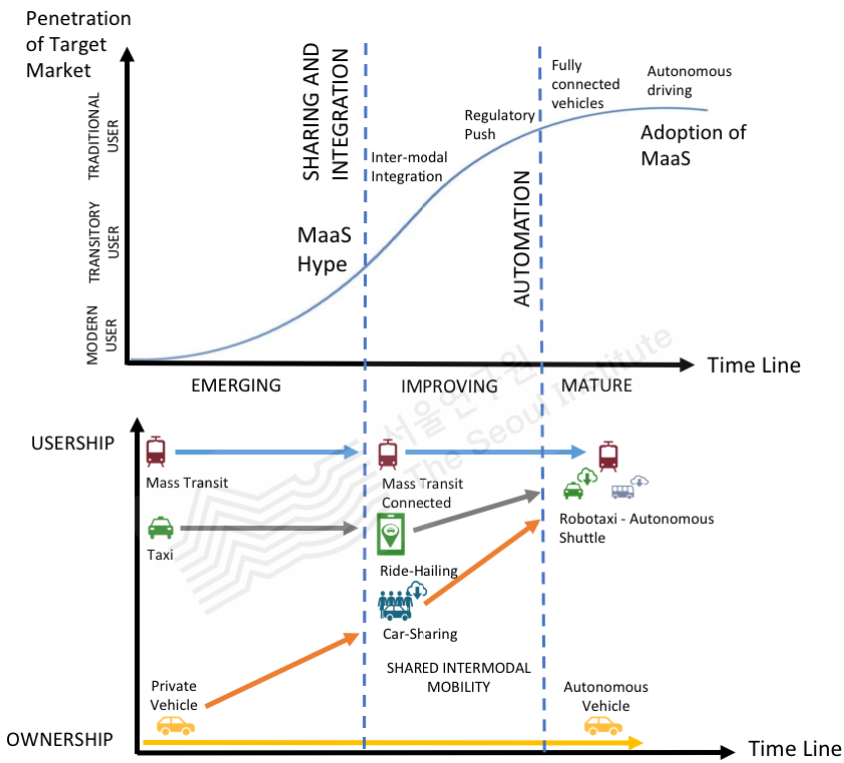
[Figure 30] Price Competitiveness of Autonomous Taxis

- As self-driving door-to-door services are competitive in price, a great number of people will use autonomous taxis and on-demand self-driving buses. A rise in demand for self-driving services will lead to greater traffic volumes on roads, aggravating congestion.
- Mobility and punctuality will be the benefits of subway systems, leading to prediction that MaaS solutions that mix existing mass transit and new services will be developed.

○ MaaS is at an early stage of implementation in Seoul. This is expected to be advanced through transport integration.

- In the current Seoul transit system, public transit fare systems are combined, one-stop fare purchases through a single platform are provided and data is integrated. In other words, Seoul is in the nascent stage of adopting MaaS. With the recent introduction of O2O sharing-based services, the city is moving towards faster adoption.
- New transportation modes and services are expected to be helpful in providing door-to-door accessibility and convenient connections between transportation modes. On the other hand, the significance of mass transit along with punctuality—the benefits of public transportation—will grow due to inevitable heavy traffic in large cities.

- In the long term, upon adoption of complete self-driving technologies, Seoul's MaaS will be converted to autonomous-MaaS, and include autonomous taxis and buses.



Source: http://baxcompany.com/insights/from-car-owning-to-ride-sharing-how-mass-could-change-the-way-we-travel

[Figure 31] Phases of Change in the Transit System

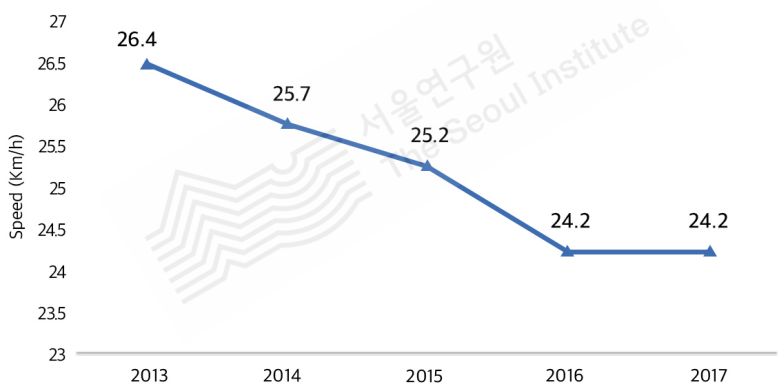
II. Diagnosis of Conditions surrounding Introduction of Smart Mobility in Seoul

As changes take place in Seoul's transportation environment, opportunities for taking up smart mobility solutions are expected to open up.

It is possible to reduce traffic congestion by revamping mass transit services and launching shared mobility services

○ In Seoul, traffic congestion is a perennial problem, a result of an imbalance between travel demand and road supply.

- Traffic speed has continued dropping over the last five years.

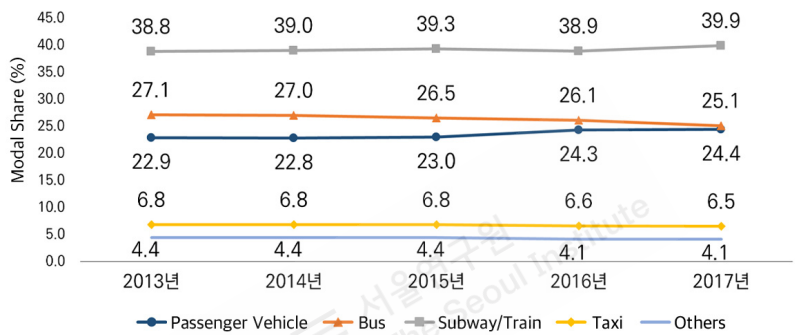


[Figure 32] Changes in Average Vehicle Speed over the Last Five Years

- Increasing the supply of roads is the most immediate solution. However, road plans, design and construction require large amounts of capital and considerable time, necessitating the creation of social consensus.
- When it comes to transportation demand, the population in Seoul has dwindled but the number of registered vehicles has grown during a recent five-year period. This denotes that per-person car ownership has increased.
  - Growth in per-person car ownership leads to a decline in the average number of passengers per car.

— As of 2016, the vehicle occupancy rate for Seoul was 1.20, down from 1.34 in 2010.

- In the last five years, there has been a steady rise in the use of passenger cars and a slight decrease in the use of mass transit. This means that passenger cars are preferred over public transport. The spike in car ownership and fall in vehicle occupancy rate has exacerbated traffic congestion.



Source: Seoul Open Data Plaza

[Figure 33] Shifts in Modal Split

○ Traffic congestion can be eased by enhancing access to public transit and making use of shared mobility services.

- Seoulites' preference for passenger cars and low vehicle occupancy rate are problematic.
  — Citizens of Seoul show a high preference for passenger cars due to their excellent accessibility and convenience.
  — Access to public transportation is more limited, as it runs according to fixed timetables and on designated routes.
  — Access can be improved through the expansion of public transport infrastructure, which involves substantial expenditures.
- An array of smart mobility services can be used as a means of accessing mass transit.

- ― It is possible to ensure better access to public transit with car-sharing, demand-responsive and shared PM (personal mobility) services.
- ― When means of accessing mass transit and MaaS apps are employed, more convenient services can be delivered.

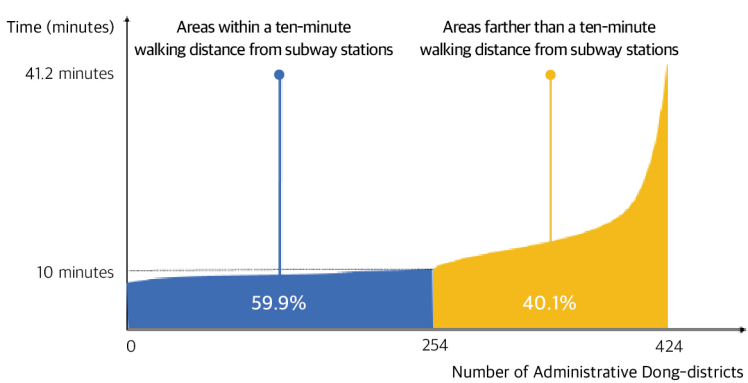
• Shared mobility services will increase the number of passengers per car.
- ― Thanks to the proliferation of smart phones and advances in ICT, the connection between supply and demand will tighten.
- ― O2O sharing services will allow users heading to similar destinations to share vehicles, thereby alleviating traffic congestion.

The SMG can overcome the disadvantages of public transport with the use of new transport modes, shared mobility services and MaaS

○ Public transportation is still less competitive in terms of accessibility and convenience.

• Mass transit in Seoul retains a competitive edge over other transportation modes owing to relatively low fares and transfer discounts.

• The issue here is that areas within a ten-minute walking distance from subway stations only account for 59.9 percent of the city's 424 administrative Dong-districts.



[Figure 34] Accessibility of Subway Stations in Seoul's Administrative Dong-districts

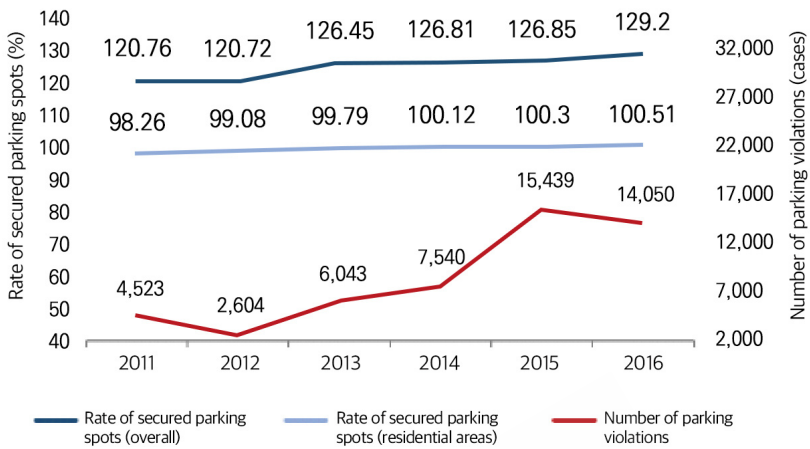
○ The likelihood has grown that new services can be developed by combining different transport services using PM, shared mobility services and Maas.

- PM offers greater convenience over walking and cycling due to the irrelevance of topography.
- If shared O2O services are utilized as a means of accessing public transit and mass transit is used as the main transportation mode, public transit will make travel more affordable and convenient.
- It is expected that products with a variety of features depending on number of transfers, transportation modes and costs will be developed by making use of MaaS.

Shared parking and other associated services will enable the SMG to resolve the shortage of parking spaces

○ Increasing the supply of parking bays is of limited use in addressing parking issues.

- The SMG uses a “rate of secured parking spots” (dividing the number of single parking bays by the registered number of motor vehicles) as an index for determining if more parking space is needed.
- There are wide variations in the demand for parking in different areas and at different times. Hence, the SMG is limited in its ability to examine the problem with static indicators like the rate of secured parking spots.
- In reality, the rate of secured parking spots has already exceeded 100 percent but the number of parking violations is on the rise.



Source: Seoul Open Data Plaza

[Figure 35] Rate of Secured Parking Spots and Changes in the Number of Parking Violations

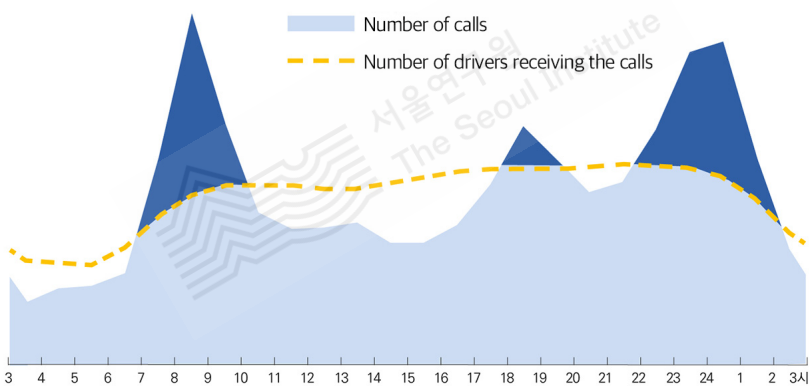
○ A diversity of services can be developed using parking data.

- It costs between KRW 40 million and KRW 100 million to install a single parking bay in Seoul's CBD (central business district).
- If booking and payment services are rendered through collection of real-time parking data with the uptake of IoT, the SMG will be able to incentivize citizens to make use of the shared parking program. This will also enhance the utilization efficiency of parking bays.
- When parking data is added to MaaS in the future, the SMG can deliver a myriad of services through which parking demand can be distributed.
  - ㅡ The SMG can induce drivers to park their cars in areas with low parking demand and create mobility services connecting such areas with final destinations.
  - ㅡ It is expected that the transition to shared mobility and mass transit services will be helpful in curbing travel demand in congested areas.

The SMG can avoid mismatch of supply and demand for taxis by introducing shared mobility services

○ In spite of an oversupply of taxis, a shortage of demand occurs during specific time slots.

- According to a report entitled “Third Calculation of the Total Number of Taxis in Seoul”, unveiled by the SMG in 2014, the city needed at least 60,340 taxis. But the city actually had 72,171 taxis at the time, which means supply outstripped demand by 11,831 taxis.
- Despite this, there was insufficient supply during specific time slots.
  - The margin between supply and demand was the widest during commuting hours (7 a.m. to 10 a.m.) as well as the late-night hours (10 p.m. to 2 a.m[41].).



Source: Kakao Mobility Digital Economy Research Institute, 2018, 2018 Kakao Mobility Report

[Figure 36] Supply of and Demand for Taxis in the Seoul Metropolitan Area (by time of day)

○ When there is an excessive supply of taxis, flexible services reflecting the changing characteristics of travel patterns should be offered.

- Time slots when the gap between supply and demand is the largest are commuting hours and late-night hours.

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[41] Source: Kakao Mobility Digital Economy Research Institute, 2018, 2018 Kakao Mobility Report

- ㅡ One-off trips for occasional events, rather than regular trips, represent the majority of demand generated during these time slots.
- ㅡ When it comes to one-off trips, destinations vary. Thus, there are limitations in providing fixed routes.

- The majority of people using taxis during commuting hours ask drivers to ensure they arrive at their destination by a specific time. This indicates a need for demand-responsive services.
- Once such services are introduced and become reliable, the shortage of supply during commuting hours is likely to ease to a certain extent.
- In the late-night hours, demand for taxis soars because of a lack of alternatives.
- This supply can be supplemented by car-sharing services and demand-responsive bus services for a reasonable price.

Ⅲ. Assessment of the Possibilities of Adopting Smart Mobility Services in Seoul

The SMG needs to prioritize the use of platform services applicable to many situations.

Viability and effectiveness were selected as criteria for assessing smart mobility services

○ We divided the mix of smart mobility services into 20 services in seven categories.

- Numerous services are used at home and abroad that can be classified as smart mobility services.
- According to diverse plans and research, smart mobility services are offered in a variety of forms and scopes—platforms, systems, apps and infrastructure.
- Smart mobility services were classified according to the SMG's transportation sector-specific statutory plans and newly-invented concepts were sorted into additional classification items.

- Consequently, smart mobility services were categorized into 20 services in seven categories—operation of smart roads, smart mass transit, smart parking, eco-friendly services, integrated mobility platforms, shared mobility and smart logistics.

[Table 12] Classification of Smart Mobility Services

Category	Service	Category	Name/Description of Service
Operation of smart roads	Smart crosswalk systems	Eco-friendly services	Vehicle2Grid
	Emergency vehicle preemption systems		Uptake of electric buses
	School zone/Silver zone safety programs	Integrated mobility platforms	MaaS apps
	Smart intersection technology		Gate-free
	Guidance on detours using image analysis		Providing mobility disadvantaged persons with information on optimal routes to desired destinations
Smart public transport	Demand-responsive transport services	Shared mobility	Car-sharing services
	Self-driving shuttle buses		Public PM
	Pedestrian detection and stop notification services for mass transit	Smart logistics	Luggage delivery services at city airports
Smart parking	Guidance on locations of parking lots and free and pre-booking parking spots		Use of small logistics robots
	Smart traffic enforcement systems		Truck platooning

○ There is a need to conduct an assessment of smart mobility services using methods appropriate for the SMG.

- With advances in 4IR (4th Industrial Revolution) technologies and paradigm shifts like the sharing economy, a vast range of smart mobility services have emerged.
- Nevertheless, not all smart mobility services are suitable for Seoul and there is a substantial likelihood that reckless implementation of projects will result in sub-success or be confined to one-time events.

- Citizen and stakeholder confidence in SMG projects will then wane and its ability to drive innovative projects reduced.
- As the SMG firmly intends to offer smart mobility services, systematic procedures should be put in place to adopt such services.

○ To measure viability and effectiveness, a series of evaluation criteria were chosen.

- Viability criteria measure technological conditions, institutional conditions, interest, and infrastructure/information.

[Table 13] Viability: Evaluation Criteria and Main Considerations

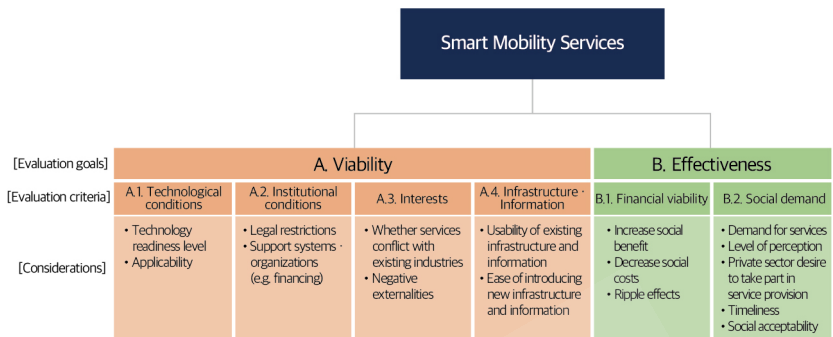
Evaluation Criteria	Main Considerations
Technological conditions	• Do service-related technologies exist? • Are service-related technologies immediately available for use?
Institutional conditions	• Are services feasible according to law? • Do support systems exist (e.g. financing)? • Do service-related administrative divisions exist?
Interest	• Will conflicts arise between services and existing industries? • Will any individuals or organizations suffer disadvantages due to the services?
Infrastructure/ Information	• Is it possible to use and improve existing infrastructure and information? • Is it easy to build infrastructure and obtain the information necessary to realize the services?

- Financial viability and social demand are used as indicators of effectiveness.

[Table 14] Effectiveness: Evaluation Criteria and Main Considerations

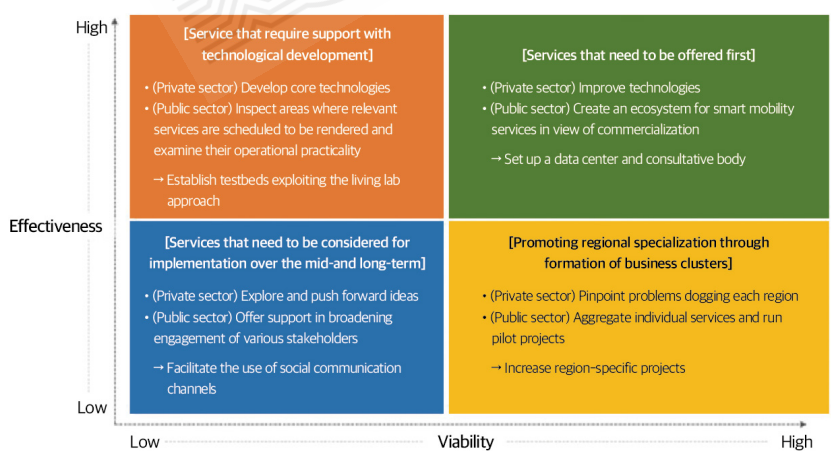
Evaluation Criteria	Main Considerations
Financial viability	• Do the social benefits outweigh the costs? • Can services reduce costs over existing services? • Will there be a ripple effect on other sectors?
Social demand	• Is there sufficient demand? • Are the services well-perceived, well-known and acceptable? • Is the private sector motivated to participate in providing the services?

- We asked a panel of 19 experts in transportation to measure the indicators of each service using a five-point scale.



[Figure 37] Assessment Indicators for Smart Mobility Services

It is advisable to assign roles to the public and private sectors and set the direction for launching smart mobility services by service type



[Figure 38] Roles of the Public and Private Sectors (by type of service)

○ Highly-effective, highly-viable services should be delivered first.
  • Setting up a public-led data center and consultative body is crucial to laying the foundation for offering smart mobility services.
    — The private sector should accelerate the realization of smart mobility services through development of core technologies.
    — The public sector must build an ecosystem for smart mobility services in view of their commercialization.

○ Support must be bolstered for development of technologies related to highly-effective, highly-viable services.
  • The SMG needs to improve the viability of smart mobility services through testbeds that exploit the "living lab" approach.
    — There is a need to provide the private sector with an environment for creating core technologies.
    — It is important for the public sector to inspect the spots where relevant services are planned to be rendered and examine their operational practicality.

○ There is a need to promote regional specialization through formation of business clusters for highly-viable services that are less effective.
  • The SMG should boost the effectiveness of such services through specialized projects combining individual services according to urban issues in specific regions.
    — It is necessary for the private sector to identify services needed in certain regions to address problems they are beset with.
    — It is critical for the public sector to aggregate individual services and try out pilot projects.

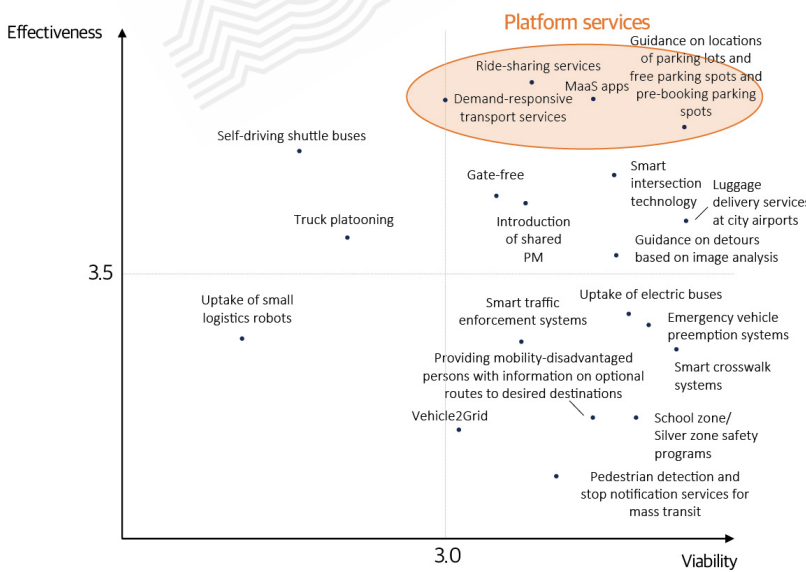
○ Services that are less effective and not as viable can be considered for implementation over the mid- and long-term.
  • The SMG should give shape to plans to provide services from a mid- and long-term perspective through the use of social communication channels.
    — It is important for the private sector to explore and push forward ideas concerning the services.

– There is a need for the public sector to concretely identify problems by soliciting participation of a diversity of stakeholders.

Highly-effective, highly-viable platform services were chosen to be offered first

○ It is critical to discover highly-effective services whose viability can be increased.

- We assessed a variety of smart mobility services (ride-sharing, demand-responsive transport services, MaaS apps and guidance on locations of pre-booking parking lots) as highly effective and viable.
- Most are platform-based O2O services (door-to-door services and information /reservation services).
- Platform services are regarded as a means to display the qualities of smart mobility -connectivity, sharing and integration,- in the most effective manner. It is advisable that the SMG map out detailed implementation strategies for services evaluated to be less viable.



[Figure 39] Results of Assessing the Possibility of Introducing Various S

Ⅳ. Introducing Smart Mobility Services into Seoul

The SMG is advised to draw up strategies for services that need to be adopted first and prepare the groundwork for sustainable smart mobility.

The SMG should devise strategies on how to bring in platform services according to analysis of service delivery viability

○ Persuading people of the need for smart parking services will be pivotal in their participation.
  • Institutional support is needed to actively run shared parking programs and to vigorously crack down on illegal parking and stopping.

○ It is necessary to strengthen cooperation and increase the SMG's role in improving communication on deployment of MaaS.
  • The SMG is required to facilitate communication and mediation towards establishing new fare/calculation systems for MaaS.

○ It is important to provide support to existing transport businesses and make car-sharing services operate within the institutional framework.
  • The SMG should liberalize regulations on taxis to an appropriate level and define standards and requirements for ride-sharing services.

○ Institutional flexibility is critical to successful launch of demand-responsive services.
  • The SMG will need to consider the method they will use to permit/approve routes after forecasting transport demand in real time and considering areas where public transit services are insufficient.

It is paramount to set the groundwork for sustainable smart mobility

○ The SMG should offer an unfettered environment, while upholding the public value of smart mobility services.
  • It is essential to foster development of services through relaxation of

regulations. At the same time, a mechanism for preserving the public value should be provided.

○ There is a need to create a data ecosystem and governance within MaaS platforms.

- It is recommended that the SMG support vitalizing a data ecosystem and set up a data governance body that will have full control over regulations.

○ Gaining a sustainable impetus will be critical. This can be done through linkability with urban regeneration projects.

- The SMG should think about introducing mobility services in consideration of the transportation environment in areas where urban regeneration projects are set to be carried out.

Key Strategies

Primary Tasks	Strategies
Work out strategies considering the viability of each platform service	• Support inducing people to take part in providing smart parking services • Strengthen cooperative system and increase the role of the SMG in improving communication on the deployment of MaaS • Provide support to existing transport businesses and ensure car-sharing services operate within the institutional framework • Bring in institutional flexibility so as to launch demand-responsive services
Set the groundwork for sustainable smart mobility	• Offer an unfettered environment, while embracing the public value of smart mobility services • Create a data ecosystem and governance within MaaS platforms • Gain sustainable impetus by linking with urban regeneration projects

Devise implementation strategies for each platform service in view of its viability

The SMG should help induce people to participate in delivery of smart parking services

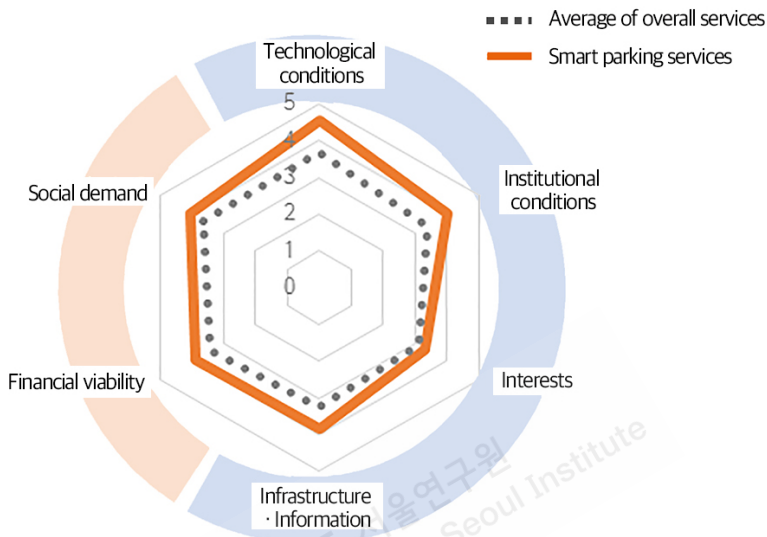
○ Overall conditions of smart parking services are good.

- Since it is easy to install and operate IoT (Internet of Things) sensors in parking bays and create service platforms, technological conditions have been assessed as “Excellent”.
  - ㅡ It is possible to form the foundation for services expansion using the SMG parking management system and “ModuParking”, a mobile app that provides information on parking spaces.
- As citizen participation in the SMG’s shared resident parking space scheme has continued broadening, we consider that there is enough social demand.
  - ㅡ As of 2018, 12.8 percent of all resident parking spaces were registered.
- It is expected that smart parking services will expand thanks to active institutional support.
  - ㅡ The SMG should provide incentives to applicants towards more extensive implementation of the shared parking scheme. Examples of these incentives include extending the period of validity for resident parking permits or awarding additional points during the evaluation process when allocating parking bays.

○ Systems must be revamped so as to encourage more citizens to apply for the scheme and prepare the groundwork service delivery.

- There is a low level of understanding among users of how to utilize shared parking spaces or make a payment, which limits operation of the scheme. Thus, the SMG should establish an effective shared parking management system by monitoring parking occupancy utilizing IoT and diversifying payment methods.
- If parking violations are not dealt with strictly, the number of applicants for the scheme will decrease and complaints increase from users of shared parking bays. The SMG should therefore stringently enforce parking regulations to

create a supportive attitude and environment where shared parking gains in use.



[Figure 40] Evaluation of Smart Parking Lot Services

A cooperative system and the SMG's role in improving communication should be further strengthened before deployment of MaaS

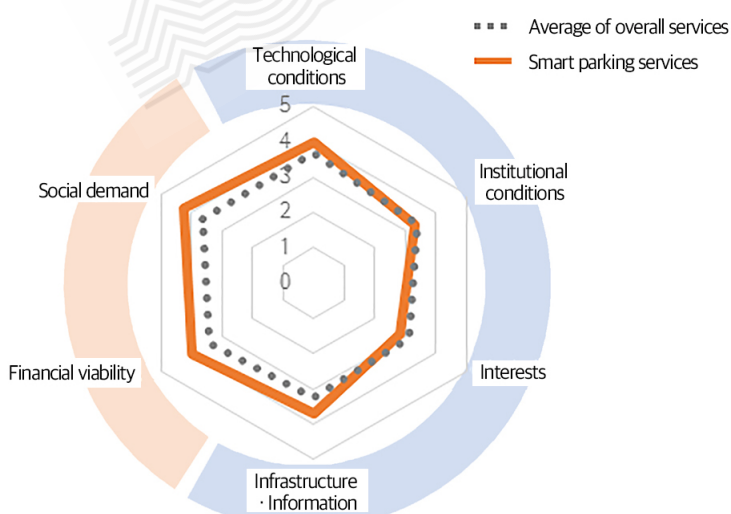
○ Overall conditions surrounding MaaS are good, but there is a lack of role sharing and efforts to align the interests of the public and private sectors.

- Since it is not difficult to develop platforms and apps, we assessed the technological viability of MaaS as good.
  - ㅡ It is possible to offer MaaS services by linking and expanding the route-finding function of Google, Naver and Daum.
- Diverse mobility solutions such as buses, subways, taxis, shared cars, public bikes and shared PMs are available in Seoul. Since an early form of MaaS has been offered in Seoul, infrastructure conditions for MaaS development were assessed as excellent.

- At present, there is strong social demand for unlocking the potential of MaaS led by automakers and telecommunications companies.

○ The SMG should serve as a communication facilitator as well as mediator to set up new fare and calculation systems concerning MaaS.

- There is a need to use an assortment of transportation modes possessed by the SMG and creative ideas held by private companies. Accordingly, it is paramount to create a public-private partnership framework for successful adoption of MaaS services.
- In a bid to build a variety of MaaS solutions, system flexibility should be ensured. Therefore, it is necessary to increase communication between Seoulites, local governments and transport service providers to forge social consensus regarding fare systems.
- The SMG should discuss ways to obtain data on trips and payment methods with stakeholders and identify ways to handle expected conflicts when constructing MaaS platforms.



[Figure 41] Evaluation of MaaS Apps

Support to existing transportation businesses needs to be significant and include car-sharing services in the institutional framework

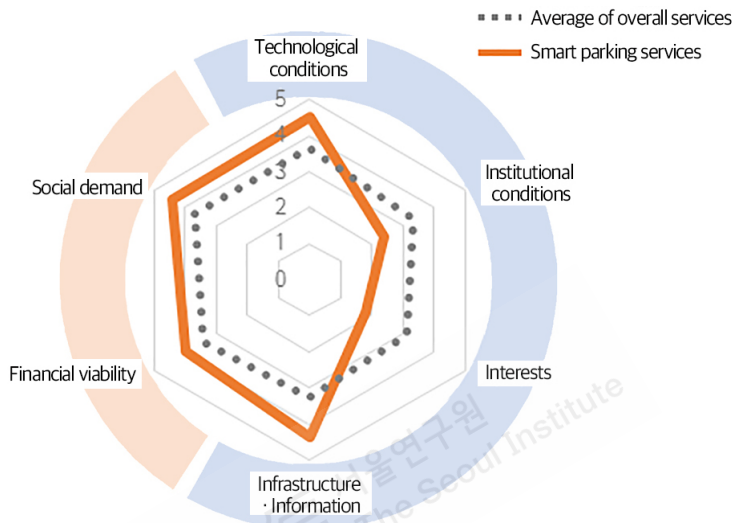
○ Technological conditions and social demand are excellent but there is a dearth of legal framework. Conflicts among stakeholders have escalated as well.

- Ride-sharing services can simply be accessed via smartphone and app and are being operated in many countries around the globe. Hence, the required technological conditions are met.
- Such services are expected to have far-reaching effects due to a decrease in single occupancy vehicles and improved user convenience.
- Limited accessibility to public transportation and a mismatch between supply and demand for taxis have driven the demand for car-sharing services.
- Both at home and abroad, social conflicts between existing transportation businesses and ride-sharing service providers have intensified, meaning the level of social acceptability is low.

○ There is a need to adopt mutually-beneficial strategies to reconcile the demands of existing transport businesses with those of ride-sharing service providers.

- The SMG should help existing stakeholders—like the taxi industry and others—forge harmonious relations. It is also critical to ameliorate institutional conditions in view of their relations.
- It is advisable to legalize car-sharing services through management of shared car drivers. To be more specific, the SMG should prohibit transportation of passengers with only a driver's license and issue business licenses as seen in foreign countries.
  - In France, interested drivers are required to complete the following application process to drive with Uber: 1) Present a driver’s license; 2) complete background checks (driving/criminal records); and 3) sit assessment tests, equivalent to those for taxi license applicants.
- It is essential for the SMG to support competitive services by easing regulations on taxis. The SMG should also gradually incorporate ride-sharing

services in the institutional framework to create a system for managing all mobility service providers.



[Figure 42] Evaluation of Car-Sharing Services

Institutional flexibility is needed to roll out demand-responsive services

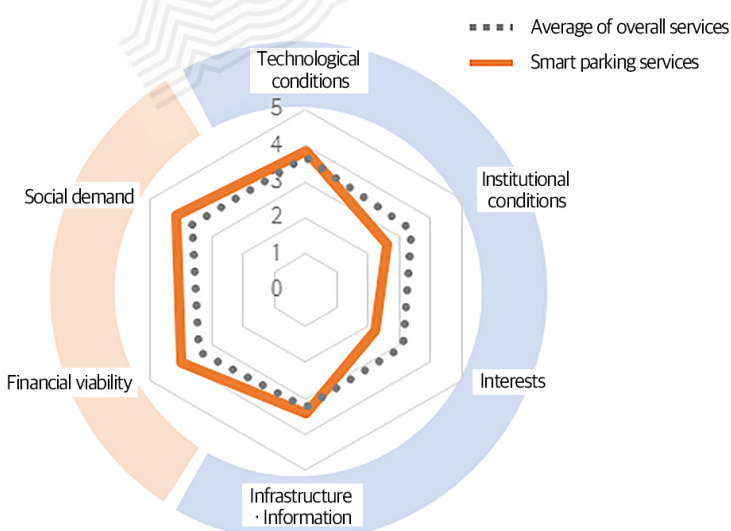
○ Although social demand and financial viability are high, there is a concern that conflict can occur among stakeholders and the legal framework is insufficient.

- Ride-sharing services connect drivers and riders on demand. Demand-responsive services determine the most efficient routes and operating strategies by matching multiple drivers and passengers so technological difficulties exist.
- Social demand for demand-responsive services is particularly high during commuting and late-night hours and in suburban areas with less access to public transport.
- Demand-responsive transport services are largely provided through the use of minibuses, accommodating numerous passengers. Under current law, such transport is allowed to operate only in rural areas and areas with limited access to

public transportation. This denotes that institutional conditions are insufficient.

○ The SMG should create an environment and prepare plans on how to lend institutional support for demonstrating demand-responsive services.

- There are not many cases where demand-responsive services are successfully delivered in large cities like Seoul. Thus, it is important to conduct demonstration projects using a regulatory sandbox.
  - ㅡ The SMG should run pilot projects after identifying problems and devising plans for improvement through such demonstration projects.
  - ㅡ There is a need to review ways to run pilot projects including estimating passenger demand and permitting routes in real time only in certain time slots and areas with poor public transport access under the current system.
- As mentioned earlier, the Passenger Transport Service Act stipulates that demand-responsive transport can operate only in certain areas. Amending the clause will be necessary to allow demand-responsive transport services to be rendered in metropolitan areas.



[Figure 43] Evaluation of Demand-Responsive Transport Services

- Through exploration of mutually-beneficial strategies with existing transport businesses, the SMG should be able to develop a mid- to long-term roadmap to enable demand-responsive transport operators to enter the market in stages.

It is advisable to form a foundation for sustainable smart mobility.

There is a need to provide a free environment and retain the public value of smart mobility services

○ With the relaxation of regulations, an innovative development environment for smart mobility services should be fostered.

- To deliver smart mobility, regulations need to be liberalized and relevant laws revised. Therefore, the central government has actively led efforts to do so.
- New methods, including a regulatory sandbox and negative regulatory system, are being applied. Hence, the development environment for smart mobility services is anticipated to improve.
- Liberalization of regulations is needed to develop varied and innovative smart mobility services. Having said that, the SMG should preemptively analyze potential impacts on the transport system in Seoul.

○ Because the major service providers will be from the private sector, measures are needed to protect the public value of smart mobility.

- Other traffic problems can surface after one traffic problem is resolved. The SMG should continue monitoring whether social costs will rise in such cases.
- It is imperative to ease regulations and formulate policy measures designed to minimize social costs from traffic congestion and traffic accidents.
- The SMG will need to guarantee the autonomy and creativity of service providers. But the “causer pays” principle should be the guiding concept when negative externalities occur.

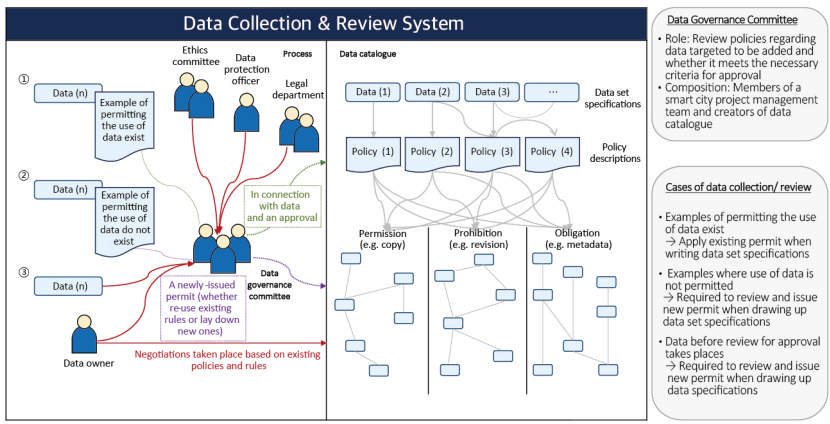
A data ecosystem and governance system are vital within MaaS platforms

○ There is a need to create a data ecosystem through support for data development, management and sharing.

- The SMG should foster an environment where citizens and the private sector can fully utilize data through development of diverse and precise data and enhancing the quality/value of existing data.
- A data-sharing platform will be critical to help invigorate the data market (data brokerage and data processing industries).
- There is a need to deploy data trading systems and set up an ecosystem where data can be freely shared. Through these systems, ownership of personal data can be ensured and benefits provided.
- When it comes to data use, the public sector should make decisions on policies based on various types of data and return part of the private sector's profits (generated from that data) to society.

○ A data governance body will be critical to ensuring full authority and control over regulations concerning data use.

- MaaS platforms can offer quality services when multiple players are involved so that data is integrated and fused.
- There is a need to avoid problems like invasions of privacy and facilitate systematic data sharing. To that end, the SMG needs to establish an organization that will have full authority over sharing and utilization of public data.
  - A data governance committee that grants permissions, imposes bans and sets requirements regarding data, on the basis of policies and regulations, was organized in Milton Keynes, UK.
  - The governance committee is composed of an ethics committee, a data protection officer and a legal department. It is responsible for gathering and examining data produced during the process of operating a smart city.



Source: Korea Agency for Infrastructure Technology Advancement, 2017, Revised Planning Report for World's Leading Smart City R&D Project

[Figure 44] Data Collection & Review System for Milton Keynes, UK

There is a need for sustainable impetus through coupling with urban regeneration projects

○ The SMG should consider adopting smart mobility services in a way that takes into account the transportation environment features in areas where urban regeneration projects are planned.

- The SMG has pushed ahead with urban regeneration projects in accordance with the Special Act on the Promotion and Support of Urban Regeneration.
- In terms of strategic plans or urban regeneration, regional framework plans reflect urban railway master plans and other metropolitan transportation plans. Plans for transforming Seoul into a "smart city" via urban regeneration using 4IR technologies are also included. Therefore, strategic plans on urban regeneration can serve as an institutional base for building a smart infrastructure in existing and deteriorating cities.
- It is critical to consider launching smart mobility services in a way that reflects the characteristics of the transportation environment in areas where urban regeneration projects are planned.

Microscopic Evaluation of the Quality of Public Transportation Service by Region in Seoul

Kyungsang Yoo · Seungjun Kim · Junhyoung Yeon · Jihan Kim

Key Message

It is crucial to perform a microscopic assessment of the quality of public transportation services in Seoul. There is a need to help formulate customized policies that consider the features of each region.

The quality of public transport services should be evaluated by a unit smaller than the administrative neighborhood[42] first

Seoul is referred to as the home of an excellent, world-renowned mass transit system. The city, constituting only approximately 0.6 percent of South Korea's land area, is served by more than 10 urban rail routes and 600 bus routes. Thus, passengers can relatively easily and conveniently use public transport services anywhere in Seoul. However, some areas lack access to public transport facilities, such as bus stops and subway stations.

Residents in some regions with such facilities also have limited access to mass transit due to a lack of available options or infrequent bus service. It is essential to shape policies tailored to each region's unique needs, like adjusting or creating routes and constructing infrastructure. To that end, a microscopic analysis of units smaller than administrative neighborhoods should be carried out rather than a macroscopic analysis of administrative neighborhoods. A macroscopic analysis of

[42] A "dong" or "neighborhood" is the smallest urban-area division to have its own government office and staff in Korea. There are two types of dong: legal-status and administrative.

mass transit services by zone, autonomous Gu-district[43], and the administrative neighborhood has limitations in that the weaknesses of public transport services in regions with good public transport cannot be identified.

There are a number of regions with poor access to public transport across Seoul. The level of accessibility to public transit varies significantly between regions

By computing accessibility to mass transit at a 100-meter grid-cell scale, the researchers discovered regions with restricted access to public transit. They were not revealed in an analysis of administrative neighborhoods. There were regions with poor access to public transportation in Seodaemun-Gu, northern Jongno-Gu and the outskirts of Gangnam-Gu and Seocho-Gu meant that they are broadly distributed across Seoul. Even in core centers[44] like Gangnam or Yeouido having quality public transit facilities, accessibility blind spots existed. Our analysis also indicates that people experience difficulty using mass transit in areas like central parts of large apartment complexes or Hangang Parks having many residents or visitors. The reason is that the areas are distant from public transport networks.

By zone and autonomous Gu-district, the Southwest area has the most limited access to public transport, compared to other zones. Furthermore, residents in Geumcheon-Gu, Gwanak-Gu, Yangcheon-Gu, Seodaemun-Gu, and Jongno-Gu are most likely affected by limited access to mass transit. To sum up, the level of accessibility to public transportation markedly differs from region to region.

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43 "Gu-district" is an administrative unit in Korea. There are 25 autonomous Gu-districts in Seoul, divided into 425 administrative "Dong" districts. Two types of "Dong" exist: legal-status neighborhood and administrative neighborhood.

44 The three core centers refer to the Gangnam district, the central business district, and Yeongdeungpo or Yeouido. The Seoul Metropolitan Government (SMG) has designated and developed these three areas as core centers.

The mobility of public transport varies by region. Travel time-wise, passenger cars have a competitive edge over mass transit

We analyzed the public transit mobility in output areas within Seoul. The results demonstrate tremendous variation in how far it can go per unit of time in each region, meaning its mobility differs by region. To put it more concretely, it can travel from areas served by multiple subway lines and bus routes like those near Seoul Station or express bus terminals to most areas in Seoul within one hour. Conversely, it can cover only 30 percent of built-up areas in the city when it departs from communities on the outskirts of Seoul or is blocked by mountains with a limited number of subway lines and bus routes such as Silllim-dong, Gwanak-Gu, and Wirye-dong, Songpa-Gu during the same period.

Public transport mobility varies substantially by region according to the number of transfers. In many regions, residents having better mass transit mobility concerning travel time suffer inconvenience because they have to transfer twice or more.

We also compared public transportation and passenger cars in terms of competitiveness with respect to travel time. In most areas, the former is less competitive against the latter. It takes longer to travel between Gangnam Station with excellent public transportation mobility and different city parts by mass transit than by passenger cars. In particular, the number of areas that people in regions with poor public transport mobility can get to within one hour by mass transit is less than half the number by private cars. This denotes that public transportation is far less competitive than private vehicles.

Residents in areas with poor mobility of mass transit have trouble accessing hospitals and other essential service providers

The outcomes of our analysis show that people in areas where public transport mobility is limited find it challenging to use essential services such as large grocery stores, hospitals or clinics, and cultural facilities. There are relatively few large facilities, including supermarket chains, markets, department stores, and general hospitals, compared to other facilities. People who live in areas with better mass transit mobility have about two times greater access to such facilities than those in worse mass transit mobility. They also have four to five times higher access to small facilities, like theaters and hospitals or clinics, than those residing with worse mass transit mobility areas. We assume that the reasons are that theaters and hospitals or clinics are not evenly distributed across Seoul and primarily located in areas with a dense resident or daytime populations. Furthermore, people residing in areas with high transit connectivity to three core centers make use of way more essential services. On the other hand, people in areas with low transit connectivity to the core centers have difficulty using such services.

Methods and results of a microscopic analysis of mass transit services can be utilized in diverse ways

The methods adopted for evaluating public transit accessibility/mobility and analysis outcomes will be useful for various purposes. They can be used when exploring public transport equity between regions, adjusting or adding routes, delivering paratransit services, doing mass transit-oriented urban planning or land-use planning, offering information on public transport services, and setting public transportation objectives policies.

The following information contains more details regarding how the methods can be utilized:

(1) when considering extending subway lines into regions having poor access to public transport;

(2) when contemplating offering paratransit services, such as bike-sharing programs, shared personal mobility solutions, as well as shuttle buses and demand-responsive bus services for accessing blind spots in areas within immediate access to public transportation;

(3) when coming up with a myriad of improvement measures for regions with mobility challenges arising from travel time or number of transfers, including making adjustments to bus routes, increasing transfer facilities, and establishing direct routes;

(4) when deciding how to use land and floor area ratios, housing density, and the number of parking bays, depending on the level of accessibility to public transport services and mobility in each region;

(5) when providing a web service through which information on accessibility to public transport services and mobility in each region to citizens is imparted;

(6) when developing objective indicators for and appraising public transport policies that can be easily perceived by Seoulites.

Using Big Data to Analyze Pedestrian Accidents in Seoul

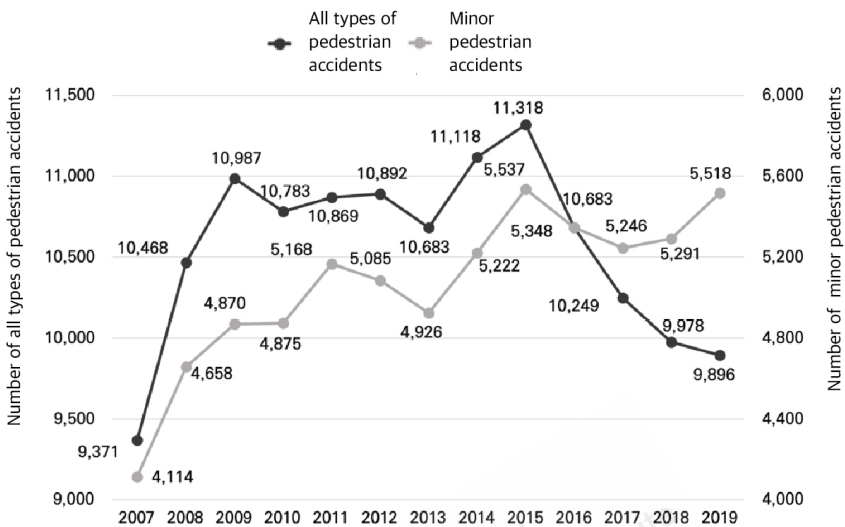
Youngjun Han · Hasik Lee

Key Message

The walking environment in Seoul has changed. It is possible to use big data and deep learning to predict pedestrian accidents but many tasks remain undone.

With changes in the walking environment, Seoul has seen a sudden surge in the number of minor accidents. For this reason, pedestrian accidents are decreasing at a slower rate

The Seoul Metropolitan Government (SMG) has rolled out a variety of pedestrian-friendly policies, resulting in the number of pedestrian accidents falling since 2015. But, with a sudden surge in the number of minor accidents, this downward trend has slowed recently. As many people are using smartphones while walking, their walking patterns have been altered. Seoul's walking environment remains poor owing recently to the increasing use of electric scooters on the sidewalk and delivery motorcycles continuing to do the same thing. The combination of these two factors is the reason behind the increase in the number of minor pedestrian accidents. Minor pedestrian accidents are, as obvious in the use of "minor", less severe than major ones. However, the potential remains for serious injuries or even fatalities. Hence, the issue of increasing minor pedestrian accidents should not be overlooked.



[Figure 45] Total and Minor Pedestrian Accidents in Seoul - 2007~2019 trends

The details of pedestrian accidents differ widely in terms of severity, location and age. However, there has been an increase in the proportion of people in their 20s involved

This study's researchers collected data on 137,000 pedestrian accidents over the last 13 years to identify any changes.

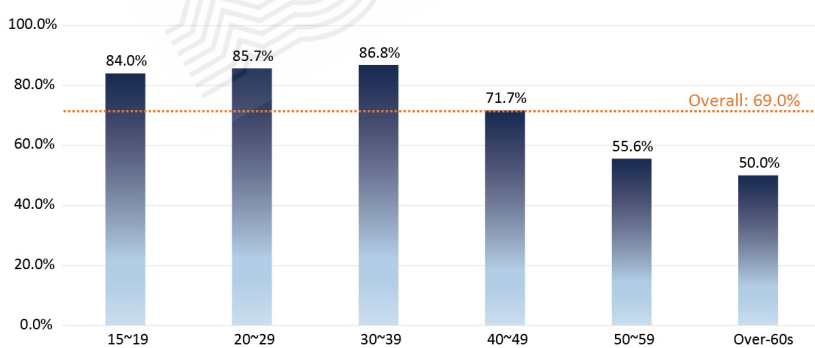
They vary in severity, location, time occurring and ages of both those at fault and those not. Of particular note is that the number of accidents involving people in their 20s has gone up. It appears that their active use of smartphones (and related technology) and the continued presence of motorized scooters operating on the sidewalks are major factors in this increase.

Survey results show that 69 percent of all pedestrians in Seoul use a smartphone while walking, with this being the case for more than 85% of those younger than 30

The researchers conducted a survey of 1,000 citizens in Seoul to detect shifts in Seoul's walking environment and analyze walking patterns.

Sixty-nine percent of Seoulites use a smartphone while walking on the sidewalk, but this number increases to about 85 percent when only including people younger than 30. In this age group, a large number of respondents engage in distracting activities like playing game apps and watching videos or reading online comics while walking.

Most survey respondents answered that they had nearly collided with or been surprised by someone looking at a cell phone while walking down the street. This indicates that smartphone use while walking has a negative impact on the walking patterns of pedestrians and others



[Figure 46] Smartphone Use while Walking (by age group)

With the application of a "deep learning" model that enhances the accuracy of big data, it is possible to predict pedestrian accidents with precision

We compared a regression analysis model (a traditional statistical tool) with a deep learning model. When estimating the values of dependent variables, the latter was more efficient and accurate than the former.

The deep learning model especially outperformed in predicting pedestrian accident rate, excluding the influence of the de facto population, which correlates closely with the number of pedestrian accidents. This demonstrates the potential of deep learning models in analyzing pedestrian accidents. Big data was largely excluded when constructing the regression analysis model, while all data was available when building the deep learning model.

[Table 15] Comparison of Estimated Pedestrian Accidents Using Deep Learning and Regression Analysis

Dependent Variables		Model	R-squared(R^2)		Root Mean Squared Error (RMSE)		Mean Absolute Error (MAE)[45]	
			Test	Difference	Test	Difference	Test	Difference
Number of pedestrian accidents	All pedestrian accidents	Deep learning	0.87	+0.19	12.02	-6.51	9.50	-3.95
		Regression analysis	0.68		18.53		13.45	
	Minor pedestrian accidents	Deep learning	0.72	+0.08	6.10	-1.45	4.78	-0.80
		Regression analysis	0.64		7.55		5.58	
	Major pedestrian accidents	Deep learning	0.84	+0.22	7.81	-3.52	5.87	-2.39
		Regression analysis	0.62		11.33		8.26	
Pedestrian accident rate	All pedestrian accidents	Deep learning	0.57	+0.33	2.25	-0.54	1.76	-0.39
		Regression analysis	0.24		2.79		2.15	
	Minor pedestrian accidents	Deep learning	0.42	+0.16	1.09	-0.12	0.85	-0.09
		Regression analysis	0.26		1.21		0.94	

Dependent Variables		Model	R-squared(R^2)		Root Mean Squared Error (RMSE)		Mean Absolute Error (MAE)[45]	
			Test	Difference	Test	Difference	Test	Difference
	Major pedestrian accidents	Deep learning	0.60	+0.40	1.33	-0.36	1.05	-0.22
		Regression analysis	0.20		1.69		1.27	

The SMG will be able to implement policies in a preemptive manner through forecasting of pedestrian accidents. To that end, amassing data, employing different data analysis techniques and other tasks should be completed

The researchers predicted shifts in the walking environment and patterns using the pedestrian accident forecasting model.

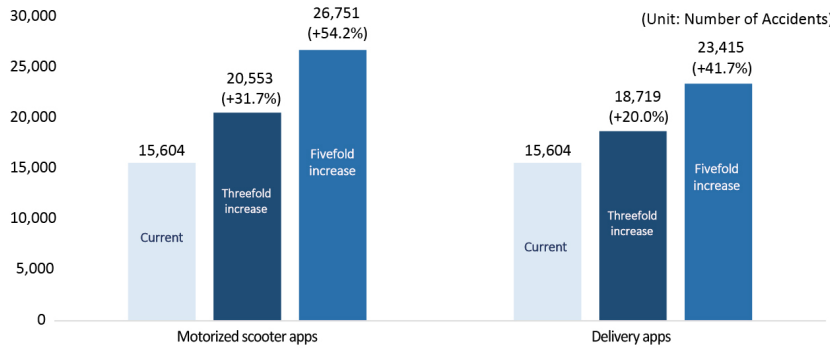
We estimated changes in pedestrian accidents under a scenario in which the number of motorized scooter app uses and delivery app users—both affecting the walking environment—rises. The results indicate that the number of app uses is proportional to the number of pedestrian accidents. Likewise, as the number of video and music app users grows, the number of pedestrian accidents also increases.

The SMG will need to come up with proactive pedestrian policies based on these estimated outcomes.

To improve the capabilities of the developed model, big data needs to be collected in a continuous and systematic manner. It might be necessary to use advanced algorithms that perform a comprehensive analysis of spatial-temporal data as well.

We believe the analysis framework presented in this study can be applied to a host of fields such as predicting traffic congestion in city centers and analysis of demand for public transport.

[45] R^2, RMSE and MAE metrics are used to assess the accuracy of regression analysis.



[Figure 47] Estimated Number of Pedestrian Accidents Associated with Increased Use of Electric Scooter and Delivery Apps

06 Environmental Planning

Management of Seasonal Particulate Matter (PM) to Prevent High-Pollution Events

Yu-Jin Choi · Ki-Chul Choi · Seungmin Lee · Hye-Jin Lee

Key Message

It is recommended that the Seoul Metropolitan Government (SMG) introduce a seasonal PM management system—a preemptive measure against the occurrence of dense fine dust. This will enable Seoulites to experience improvements in air quality.

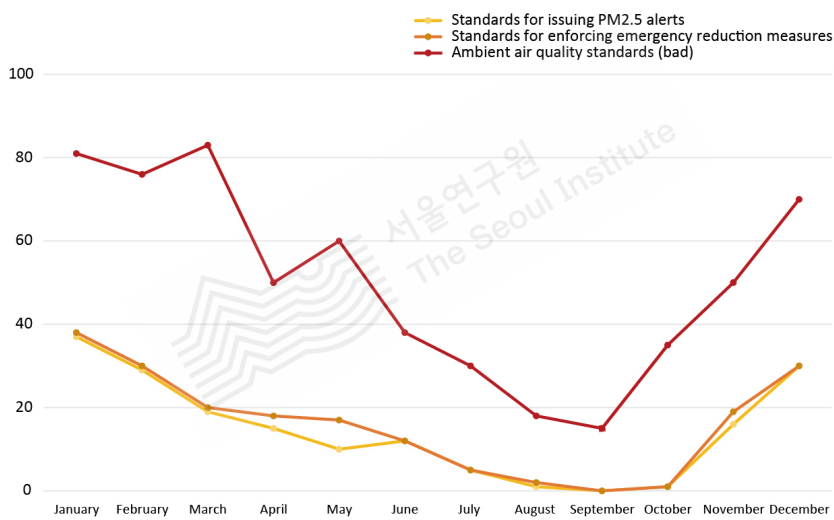
PM2.5[46] and PM10[47] events have occurred frequently in recent times, leading to residents feeling that fine dust levels have risen

It is true that annual average concentrations of fine dust (PM10) and ultrafine dust (PM2.5) declined after 2001, from 70μg/㎥ and 40μg/㎥ to 40μg/㎥ and 23μg/㎥, respectively, in Seoul. However, there has not been a noticeable drop in annual average PM10 and PM2.5 levels since 2012. The annual average PM10 and PM2.5 concentrations had been on a downward trend in recent years (2016~2018) but we need to see whether such trend continues for the long haul. Unlike this decrease in

46 PM2.5, classified as a first-degree carcinogen by the World Health Organization (WHO), refers to fine particulate matter (dust) in the air that is smaller than 2.5 microns in diameter.

47 PM10 refers to fine particulate matter (dust) in the air that is 10 microns or less in diameter.

annual average concentrations of PM10 and PM2.5, Seoul has seen a rise in the occurrence of high concentrations of PM2.5 in the ambient air. The city experienced an increasing number of days with daily average PM2.5 concentrations of 50μg/㎥ and over from 13 in 2016 to 20 in 2018. From January to May in 2019, the number of days with daily average PM2.5 concentrations of 50μg/㎥ and over was 23, exceeding that for 2018. Of particular note is that an emergency alert for PM2.5 was issued for seven days in March 2019. Daily average PM2.5 concentrations recorded 135μg/㎥ (all-time high) on March 5.



Source: Cumulative data on concentrations of air pollutants, Seoul Research Institute of Public Health and Environment

[Figure 48] Number of Days Air Quality Exceeded Daily Mean Standards for PM2.5 in Seoul (2009~2018)

Seoulites assess air quality by observing changes in annual average fine dust levels as well as the frequency and number of consecutive days with high fine dust levels over a short time. Due to recent frequent occurrence of high concentrations of (ultra) fine dust, citizens in Seoul feel fine dust pollution has worsened and there is a growing demand for stronger action.

Now is the time for action against high fine dust levels that can overcome the limitations of one-off fine dust emergency reduction measures

Emergency reduction measures are put in place during short periods when ultrafine dust is predicted to reach a certain high concentration level. These measures are taken in accordance with Article 18 (Emergency Reduction Measures for High Fine Dust Concentration) of the Special Act on the Reduction and Management of Fine Dust, and have been enforced by the central government since 2018 to tackle (ultra) fine dust pollution. Existing emergency reduction measures based on short-term forecasts include shortening or adjusting the length of operations of establishments/construction sites and driving restrictions that are announced one or two days prior to the occurrence of high fine dust levels. Hence, they are limited in that only the public sector is obligated to act on them. It is also known that the ratio of secondary PM2.5[48] formation to primary PM2.5 formation increases significantly when there are high concentrations of PM2.5 in the ambient air. Thus, chances are slim that secondary PM2.5 formation can be curbed during a short period of time with such short-term measures. Questions have been raised about the effectiveness of these short-term measures taken only one or two days before the occurrence of high PM2.5 levels. Accordingly, there is a need for new countermeasures against high concentrations of fine dust.

48 Secondary PM2.5 refers to PM2.5 formed in the atmosphere through chemical transformation of precursor gases, such as nitrogen oxides, sulfur dioxide and ammonia sometime after emission from a source.

Other cities, like Beijing, China impose tougher measures in phases during periods of high fine dust concentrations

The "Action Plan for Comprehensive Management of Air Pollution for Jing-Jin-Ji, also known as Beijing-Tianjin-Hebei, and Surrounding Areas in Autumn and Winter" is put into action from October through March. In 2017, Beijing's municipal government unveiled its "Action Plan for Comprehensive Management in the Autumn and Winter of 2017~2018", composed of 10 specific tasks. Its aims were to reduce annual average PM2.5 concentrations by at least 25% and the number of days of high air pollution levels by at least 20%, when compared with the previous year. Managing small places of business along with illegal emissions coming from manufacturing companies and controlling coal pollution are included in the action plan. Winter Emergency Measures have been applied since 2017 in Emilia-Romagna, a region in northern Italy, between October and March. Stricter measures regulating emissions sources are used during the period and even tougher measures are implemented in stages when high fine dust concentrations occur. On weekdays and the first Sunday of each month, only diesel vehicles complying with Euro 4 (or higher) emission standards, petrol vehicles complying with Euro 2 (or higher) emission standards and two-wheeled vehicles complying with Euro 1 (or higher) emission standards are allowed on the road. When PM10 levels in the ambient air exceed 50μg/㎥ for three or 10 consecutive days, an emergency smog alert is issued. Upon such alert, driving restrictions are further tightened on diesel vehicles.

[Table 16] Emilia-Romagna's Winter Emergency Measures - Urban Access Regulations

Time of implementation	Monday to Friday 08:30-18:30 *First Sunday of each month (Ecological Sunday)	Emergency smog alert	
		After three consecutive days of exceeding the PM10 limit 08:30~18:30	After 10 consecutive days of exceeding the PM10 limit 08:30~18:30
Permitted vehicles	Petrol vehicles (Euro 2 emission standards or higher) Diesel vehicles (Euro 4 emission standards or higher) Two-wheeled vehicles (Euro 1 emission standards or higher)	Petrol vehicles(Euro 2 emission standards or higher) Diesel vehicles(Euro 5 emission standards or higher) Two-wheeled vehicles(Euro 1 emission standards or higher)	
	Strengthened requirements in 2020 Diesel vehicles (Euro 5 emission standards) Petrol vehicles (Euro 3 emission standards) Two-wheeled vehicles (Euro 2 emission standards) **Strengthened requirements in 2025** Diesel vehicles (Euro 6 emission standards)	**Driving restrictions** 08:30~12:30 Commercial diesel vehicles (Euro 3 emission standards or lower)	**Driving restrictions** 08:30~12:30 Commercial diesel vehicles (Euro 4 emission standards or lower) 08:30~18:30 Commercial diesel vehicles (Euro 3 emission standards or lower)

Stronger action is recommended to cut emissions on a seasonal basis (December through March) when high fine dust levels are frequent

In South Korea, PM2.5 levels and the occurrence of high fine dust concentrations vary by season. Generally, high PM episodes occur between late fall and early spring and rarely in other seasons. The Seoul Metropolitan Government (SMG) should consider operating a seasonal PM management system to cope with high fine dust levels in view of these seasonal characteristics of high PM2.5 levels. Actions taken would differ from existing emergency anti-dust measures taken one or two days before the high fine dust levels and permanent measures aimed at

lowering annual average concentrations. Accordingly, this study aims to explore ways to establish a seasonal PM management system that will help the SMG deal with high fine dust concentrations in an effective manner. Implementation periods can be set at five to six months, with briefer periods at the beginning until residents become more used to it. Based on this principle, the researchers suggest a December through March period when high fine dust concentrations are often intense.

The purpose of such a seasonal PM management system is to limit the duration and intensity of high concentrations of fine dust through preemptive curtailment of emissions generated domestically

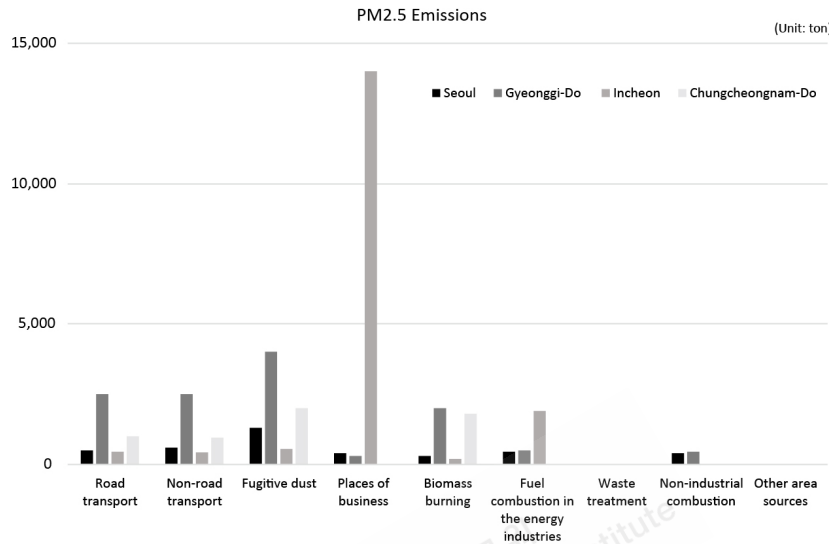
It is clear that a significant amount of fine dust is attributable to external factors, including China. Under this circumstance, bringing down the "extremely bad" levels of dense fine dust to "normal" levels by curbing emissions within South Korea is virtually impossible. Thus, many experts hold the view that the definition and goals of a seasonal PM management system should not be to drastically minimize the pollution that can be labelled as at "disaster" levels. Rather, they believe that preemptively decreasing the baseline concentrations of fine dust using stronger emissions reduction measures on days of high fine dust should be its definition and goal. We can expect that as baseline concentrations lessen, the intensity and duration of high fine dust levels will be limited even when South Korea is affected by the same levels of pollution coming from outside. Emissions reduction measures are to be taken during seasonal PM management system periods, even on days when dense fine dust does not occur. Hence, South Korea is likely to see days with ultrafine dust levels that are lower than those reported before system application. Some say that decreasing the average concentrations generate more health benefits than cutting the number of days with high fine dust levels. Therefore, the aim of the seasonal PM management system should be to simultaneously decrease the number of days with "bad" levels of ultrafine particles

(daily average of at least 35μg/㎥) and the average ultrafine dust concentrations during the same period.

There is a need for Seoul, Incheon and areas of Gyeonggi-Do[49] considered within the Seoul Metropolitan Region to concurrently impose seasonal measures. Countermeasures regarding the transportation sector should be joint efforts and those related to other sectors should be implemented separately in consideration of the features of each area

Air pollution is not limited by administrative boundaries. It directly and indirectly influences adjacent as well as distant areas. In other words, there is an acknowledgement that SMG efforts to manage emissions sources alone are not enough to clear up the problem of ultrafine particles in Seoul. Nationwide implementation of a seasonal PM management system will be most effective in lowering ultrafine dust levels in Seoul. However, there may be a range of practical problems stemming from the variance in readiness levels of local governments. Consequently, it might be difficult to carry it out on a national scale. For this reason, it needs to be operated within the Seoul Metropolitan Region, including Gyeonggi-Do and Incheon, at the minimum. Some say that it is critical for Chungcheongnam-Do to be involved in the system, if possible. This means that there is a need for local governments of areas subject to higher air pollution to join in. Many experts are of the opinion that local governments in air quality control areas should impose measures to manage mobile sources like limiting vehicle operations. However, we believe countermeasures against point/area pollution sources need to be prioritized according to the features of each area.

[49] "Do" is an administrative unit (similar to a province) in Korea. There are eight Do in South Korea, such as Gyeonggi-Do and Gangwon-Do.



※ Establishments=Production process + Industrial combustion
Source: National air pollutant emission inventory, National Institute of Environmental Research

[Figure 49] PM2.5 Emissions for 2016 (by sector)

According to these experts, as the effects will be minimal when only the public sector is required to participate, consensus should be built to require the private sector to join in.

The main measures will involve regulating the operation of Grade 5 emission vehicles and tightly controlling emission-generating businesses and other pollution sources

[Table 17] is a summary of the seasonal PM management system we propose. It is important to discuss further details—management indicators concerning objectives and benchmarks for measuring the attainment of goals. The researchers suggest December to March (four months in total) as the period for implementation. There is a need to consider running the system for the shortest period in the first year

of implementation and increasing duration in the second year. When it comes to target areas, it is desirable for local governments in areas with higher air pollution levels to implement these measures together, as emphasized from the beginning. To be more specific, we recommend running it in the Seoul Metropolitan Region (Seoul, Incheon and Gyeonggi-Do) and around point pollution sources in Chungcheongnam-Do in the first year. During the second year, target regions can be expanded to include air quality control areas across the nation. Solutions are needed that suit the characteristics of each area and that take into account its different emissions—for example, countermeasures against mobile sources, such as restricting vehicle operations being jointly imposed within air quality control areas. Meanwhile, measures need to be prioritized in relation to point/area pollution sources in a way that reflects the individual attributes of each area. It is essential for public sector participation to be obligatory. The private sector needs to be incentivized to participate through support policies during initial implementation, while working, in stages, towards compulsory participation.

[Table 17] Summary of (Proposed) Seasonal PM Management System

	Details
Definition	A preventative measure to decrease the intensity and frequency of high concentrations of fine dust pollution through tougher anti-dust measures during certain periods of high levels (seasonal) towards lowering baseline concentrations of fine dust
Goal	Reduce the number of days of "bad" ultrafine particle levels (daily average of at least 35μg/㎥)
Implementation period	December to March (four months in total) ※ Adjust implementation period through assessment after first year of implementation
Mandatory participants	Public sector (mandatory) + Private sector (to be obligated in phases)
Target areas	Air quality control areas in the Seoul Metropolitan Region (Seoul, Incheon and Gyeonggi-Do) + Point pollution sources in Chungcheongnam-Do (large air pollutant-emitting facilities) ※ Increase target areas—air quality control areas across the nation—later

	Details
Key measures (centering around the SMG)	• Transport: Ban operation of high-emission vehicles receiving the poorest emissions grade by the Ministry of Environment (Grade 5 emission vehicles) + Strengthen monitoring mechanism concerning private vehicle emissions inspectors • Places of business & construction sites: Devise real-time monitoring system and tighten control and supervision • Run watchdog organization for environment consisting of associations, universities and citizen participation groups

Coping with Emerging High-Impact Urban Disasters in Seoul

Sang-Young Shin · Kwonjoong Cho · Hang-Moon Cho · Jong-Seok Won · Chang-Woo Shon · Miree Byun · Sang-Gyoon Kim · Youn-Sang Lee

Key Message

The Seoul Metropolitan Government (SMG) should respond to the increasing number of new large-scale urban disasters using both structural and nonstructural measures.

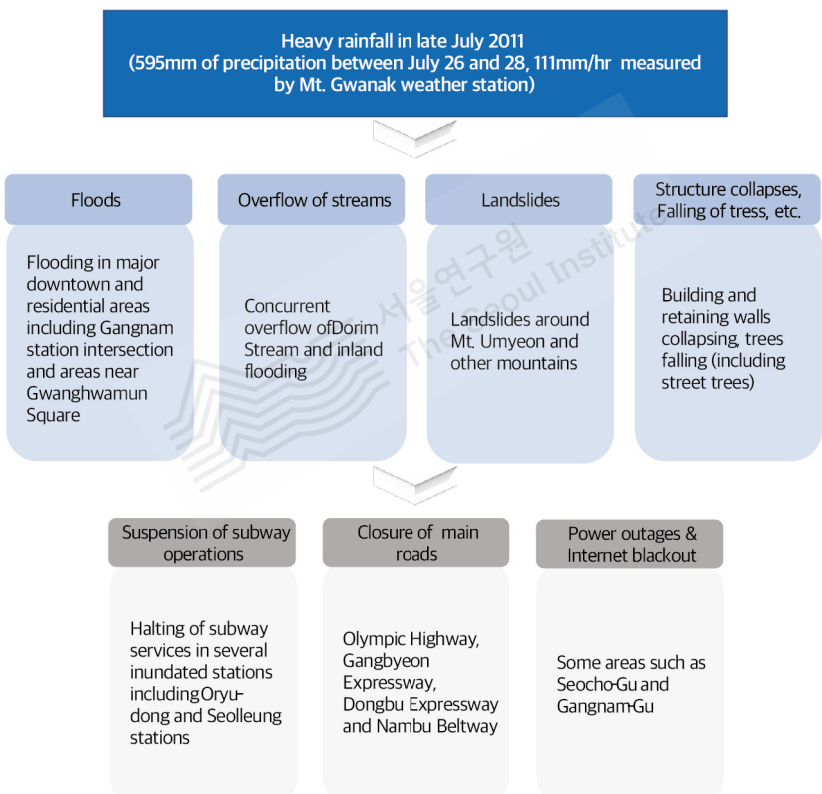
New large-scale disasters like the sinking of the Sewol ferry and landslides from Mount Umyeon have frequently unfolded in recent years

Huge or new types of disasters beyond the scope of prediction or attention, such as the Seweol ferry tragedy, landslides from Mt. Umyeon, the MERS pandemic, and the 2016 Gyeongju earthquake have been occurring recently with greater frequency. In general, new large-scale disasters are infrequent. But when they take place, they result in enormous damage. Precautionary measures are not easy as they can often be unpredictable (and their exact causes often uncertain), and the amount and scale of damage they cause increase the difficulty of effective response.

It is crucial to consider shifts in conditions surrounding Seoul such as those brought about by technological development, the socio-economic system, urban space, climate change and disasters in South Korea and elsewhere. The SMG can then handle new large-scale urban disasters more strategically by identifying and measuring the related potential risk.

In the past, fires, road traffic accidents, railway/subway accidents, heavy rain and floods have exerted tremendous impact on Seoul. The frequency of railway or

subway accidents, ground failures, infectious diseases, toxic spills on living environments, power outrages have dramatically increased in recent years. Seoul was battered by torrential rain in July 2011 (the 2011 Seoul floods). At that time, storm and flood damage ranged from inundation and landslides to complex results such as power outages, Internet blackouts and disruptions of traffic resulting in paralysis of urban infrastructure.



[Figure 50] Main Consequences of Heavy Rainfall in Late July 2011

Terrorist attacks, riots or aircraft accidents occur more often in large cities in other countries, than in Seoul

Massive disasters are relatively less frequent in Seoul than in huge cities overseas, but massive international incidents have implications on those that may emerge in Seoul. Seoul and other cities in South Korea by and large share major disasters, including intense rain/floods, fires and explosions. But the frequency of incidents involving hazardous materials or multiple vehicle collisions is higher in other cities.

Large cities such as New York, Los Angeles, Paris, London and Tokyo have seen a significant spike in large-scale climate phenomena like storms, heat waves, snowsqualls and cold waves. They have also experienced a substantial number of disasters including fires, explosions and widespread outbreaks of contagious disease.

But Seoul and these other cities are similar in that fires and railway/subway accidents have often occurred. Terrorist attacks, riots or aircraft accidents are less frequent in Seoul, however. Other cities have suffered severe damage from heat waves, heavy snowfalls, forest fires, air pollution or ship accidents.

“Future disaster events will be related to air pollution, yellow dust, infectious disease and suspension of information services”

We surveyed 1,344 Seoulites and 85 experts on their perceptions of the risk of disaster and both groups indicated that they feel Seoul is unsafe. Seoulites feel that the city will become more unsafe in the future. To be more specific, 14.6 percent feel the city is safe, while 56 percent said it is exposed to danger. Of the total, 36.3 percent expect it will become increasingly dangerous while 26.2 percent feel it will get safer.

Despite a slight difference in views between Seoulites and experts, both

perceived that the level of risk posed by air pollution, yellow dust, contagious disease epidemics, collapse and paralysis of information services or mass transportation is high. In addition, they believe there will be a further increase in the risk in days to come. Terrorist attacks, interruption in energy supplies, hazardous material incidents and toxic spills in living environments were cited as unfamiliar but substantial risks.

Increasing urban space, technological developments and climate change increase the probability of new large-scale disasters

Internal/external environments and trends including development of state-of-the-art technologies, global trends and climate change appear to contribute to the risk of new disasters and an increase in likelihood of large-scale disasters. Seoul underwent rapid growth and urban development in the 20th century, and many built-up areas in low-lying or hilly areas are readily susceptible to disasters. Seoul's buildings and urban infrastructure, mass-constructed during the city's development stage, have been deteriorating dramatically. On the other hand, deepening interdependence following densified, enlarged, high-rise, underground and networked urban spaces has heightened the risk of new massive disasters.

Seoul has seen an increase in its populations of seniors, women, single-person and low-income households, temporary workers, unemployed and foreign residents/visitors, accompanied by a widening income disparity. Such shifts in the demographic structure can be summarized as the growth of a population vulnerable to disasters. An increase in population susceptible to disasters means a rise in the number of holes in the social safety net, which may increase the level of anxiety and jeopardize safety.

Climate change will heighten the risk of extreme weather events such as torrential rain, high winds, heat waves, droughts and the resultant natural or human disasters. Ecosystems, crops, health, water resources and air quality will be directly

and indirectly affected in an extensive manner as well. With economic globalization, cross-border movement of goods and people has intensified, leading to heightened risk of transmitting infectious diseases across borders. Thus, disasters are not restricted to any particular city or nation any longer. What is more, volatile geopolitics in the Middle East, Africa and Europe can fuel terrorist attacks and other security threats. As we have seen from current social discussions on artificial intelligence (AI), new large-scale disasters will be strongly influenced by the advancement of new technologies. Information & communications technology and other new developments will open up opportunities to greatly enhance disaster management capabilities in terms of promptness, preparedness and accuracy.

However, an overdependence on technology can increase the chances of incidents linked to hacking, data leaks, cyberterrorism, incompleteness of technology, malfunctions or misinformation. It can also further expand systemic vulnerabilities resulting in economic loss, suspension of connected urban services and the rising likelihood of social disorder or unrest.

New large-scale urban disasters can be divided into two groups: continuous threats and disasters which will create new hazards

Phenomena and disasters that have occurred in past years are listed here, as are threats expected to appear or grow in Seoul:

- Climate-related phenomena: damage from storms, floods, heat waves, droughts and yellow dust;
- Air pollution caused by land subsidence, high concentration of fine dust and ozone;
- Health risks: waves of contagious disease, toxic spills in living environments and compromised food safety;
- Disasters related to facilities: fires, collapses, explosions;
- Railway/subway accidents and other large-scale traffic incidents;

- Halting of urban services including water or energy supply and information systems (cyber damage).

As circumstances change—shifts in urban space, technological developments, socio-economic trends and climate change—the threat posed by these hazards are likely to rise. As they occurred more frequently in the past and are expected to continue occurring in the future, they can be categorized as gray rhino[50] events.

The following are disasters or situations that could lead to disaster that have been rare thus far, but are predicted to play out as new threats when considering coming shifts in circumstances:

- Adverse effects or accidents following the diffusion of state-of-the-art technologies such as AI or biotechnology;
- New infectious diseases crossing borders;
- Toxic spills in living environments or compromised food safety following the use of new technologies and ingredients;
- Natural hazards, triggered by extreme weather events, combined with man-made disasters, called compound disasters (Natech accidents[51]);
- Large-scale earthquakes (magnitude 5 to 6);

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50 "gray rhino," referring to a highly likely yet ignored threat, was coined by Michele Wucker, speaker and author of The Gray Rhino: How to Recognize and Act on the Obvious Dangers We Ignore. She also spoke at the 2017 CFA Institute Annual Conference. - Nathan Jaye. 2017, November 13. Do "Gray Rhinos" Pose a Greater Threat Than Black Swans?. ***Enterprising Investor.*** https://blogs.cfainstitute.org/investor/2017/10/23/do-gray-rhinos-pose-a-greater-threat-than black-swans/

51 Natural Hazards Triggering Technological Disasters' or Natech refers to the interaction between natural disasters and industrial accidents. Natech accidents are technological side effects of natural disasters: a natural disaster leads to a cascading technological disaster, accumulating its consequences.
-*UNECE. The Industrial Accidents Convention and natural disasters: Natech*. https://www.unece.org/environmental-policy/conventions/industrial-accidents/areas-of work/natech.html#:~:text='Natural%20Hazards%20Triggering%20Technological%20Disasters, technological%20disaster%2C%20accumulating%20its%20consequences.

- Collapse of massive construction or facilities following dilapidation of urban space;
- Fires and risks related to new renewable energy;
- Disasters occurring in underground spaces such as underground roads;
- Aerial vehicle accidents including drones;
- Accidents involving self-driving vehicles;
- Paralysis of urban services attributable to complicated and growing interdependence of urban infrastructure;
- Terrorist attacks;
- Riots/public disorder.

Of particular note is that introduction of new technologies and increased complexity/interdependence of urban systems are two of the biggest potential causes of new disasters.

There is a lack of experience and knowledge around disasters of this type, which are highly unpredictable. Thus, they can be classified as black swan[52] events.

52 The black swan theory or theory of black swan events is a metaphor that describes an event that comes as a surprise, has a major effect, and is often inappropriately rationalised after the fact with the benefit of hindsight. The term is based on an ancient saying that presumed black swans did not exist − a saying that became reinterpreted to teach a different lesson after the first European encounter with them.
- Black swan theory. (2020, November 20). In Wikipedia. https://en.wikipedia.org/wiki/Black_swan_theory

Key Changes in Circumstances		Major New Large-scale Urban Disasters	
		Disasters in past years and continuing or growing threats	Disasters rarely occurring but predicted to pose future threat
Technological development (ICT, AI and biotechnologies)	Meteorological disasters	Storm and flood damage, heat waves, droughts and yellow dust	Compound disasters (Natech)
	Ground collapses	Ground failure	Earthquakes
Climate change (temperature and precipitation)	Pollution	Air pollution (fine dust and ozone)	-
Urban space (Deterioration, densification and deepening interdependence)	Spread of health hazards	Contagious disease, toxic material spills in residential areas and threats to food supply	New infectious disease coming across borders, toxic materials spills in residential areas or food risks following the use of new technologies/ materials
	Facility disasters	Urban and forest fires, collapses, explosions	Building collapsing due to dilapidation and fire/ hazards associated with new renewable energy
Geopolitics (Increased interdependent of economic systems and geopolitical instability)	Traffic disasters	Traffic accidents and railway/ subway accidents	Multiple vehicle collisions on underground roads, accidents involving self-driving cars and aerial vehicle accidents (airplanes, helicopters and drones)
	Paralysis of urban services	Halting of water/ energy/ supply, paralysis of information systems and cyber damage	Paralysis of urban services due to deterioration and compound urban services
Urban society (demographic structure and economic inequality)	Terrorist attacks & Complex hazardous incidents	-	Terrorist attacks and stampedes

[Figure 51] Summary of Shifts in Circumstances and Unforeseen Massive Urban Disasters in Seoul (Read on for more details)

Urban space needs to be made capable of dealing with new massive urban disasters in a comprehensive manner

Building the resilience of cities is integral to the response to new large-scale urban disasters. Resilience denotes the ability of systems to absorb shocks and stresses coming from external factors as well as fast recovery and the maintenance of normal functions.

New massive urban disasters are infrequent, but once they occur, extensive damage is involved. In addition, there is great uncertainty about all the factors behind them and our ability to predict them is low. Hence, the issue of new large-scale urban disasters should be approached in a comprehensive manner. Structural action focusing on traditional facilities are needed in combination with nonstructural measures related to various physical areas, crisis management systems and the socio-economic resilience of urban environments. Disaster management facilities and other entities will play an instrumental role in avoiding

adverse impacts of and safeguarding cities against disaster.

It is not only practically impossible but also ineffective to enhance the capacity or performance of facilities to prevent all types of disaster. But there is a need to assess the appropriateness of standards being applied in view of today's changing circumstances and the potential damage to facilities in the event of new large-scale disasters. Through such efforts, plans for facility improvement should be formed.

It is important to increase structural efficiency, durability and rigidity against shocks or stresses when reinforcing exit facilities or constructing new ones. Redundancy in preparation for dangerous situations beyond design criteria or disaster management capability should be ensured. In this way, the SMG will be able to quickly restore everything to its original state and continue providing services. There is also a need for flexibility so that facilities can be altered or expanded in response to future changes in circumstance.

The SMG should take into account the need for disaster management across all areas of urban space towards absorbing shocks and spreading out risk. Urban infrastructure irrelevant to disaster management such as roads/parks and controlling land use through city planning/construction serve as primary roles.

It is essential to strengthen the part roads, parks and other urban infrastructure can play in disaster management, and turn them into mixed use/multipurpose facilities through urban planning. For example, during the Japan Earthquake & Tsunami of 2011, an interregional highway running through affected areas acted as a buffer and mitigating factor against shocks from the tsunami. The network served as an escape route, temporary shelter and dispatch route for emergency response as well.

It is worth noting that disaster risks were not pondered in the process of city planning and construction of the majority of areas or facilities which have repeatedly experienced disaster. City and construction planning should fully embrace the concept of disaster management.

Most cities consist of existing built-up areas which are impossible to drastically redevelop. The SMG should take a long-term view and gradually revamp land use in the city as well as locations, structure and shapes of buildings/facilities. There is

also a need to limit excessive urban development that ignore disaster considerations and encourage the use of eco-friendly development. Overhauling is needed of the safety management systems of large-scale, multipurpose and special structures and underground constructions/facilities.

The SMG should set up a crisis management system encompassing disaster response and evacuation to minimize human and financial losses and facilitate quick recovery

It is essential to focus on identifying ways to limit damage and stimulate a rapid recovery in the event of new massive urban disaster events. A crisis management framework entailing early announcements/alerts, disaster response, evacuations and communications is a significant part of this.

To gain enough lead time for disaster response and evacuations, a system that recognizes warning signs and issues early announcements/alerts needs to be acquired. It is critical to strengthen permanent systems for detection of disaster warning signs and acceptance of citizen reports through real-time measurement, monitoring and forecasting along with analysis of big data using sensors and networking.

Within the SMG's current disaster response framework, each division is responsible for managing a disaster type. This framework is insufficient to deal with large-scale complex disasters which involve multiple divisions or new disasters. With an aim to increasing response capability in the face of massive complex disasters, it is necessary to divide the incident command system into single and unified structures, as is done in the City of New York, to better handle incidents and disasters.

The SMG has limited ability to address new, massive urban disasters due to their nature. Therefore, the formation of networks enabling numerous organizations/ main players to participate in and offer support as well as interactive and

cooperative risk governance is needed.

As a way to heighten the status and strengthen its function as a control tower, SMG's division responsible for disaster management must be under the direct control of the mayor, and granted more authority as well as strengthening both its position and expertise. There is a need to build a management system aimed at ensuring continuity of core city functions such as administration, key urban facilities and major companies.

It should be compulsory for private companies over a certain size to devise Business Continuity Plans (BCP) as entities in the public sector do. There is also a need to lend support to them. The City of New York has helped each division, affiliated public institution and private enterprise to form their own BCPs, while Tokyo has developed metropolis-level BCPs on massive disasters.

The SMG's current manual on disaster response presents plausible case scenarios developed on the basis of typicality of each disaster type. Towards improving the ability to effectively respond to massive urban disasters, the SMG should insert worst-case scenarios into the manual that go beyond predictability. Scenarios are needed that deal with new incidents such as new infectious diseases and accidents associated with household goods with new technologies or materials, and self-driving cars. Laying out of guidelines on preemptive safety measures is also required.

When massive disasters occur, it is likely that large-scale damage will result and a great number of people will suffer. Hence, the SMG should offer evacuation facilities and temporary accommodation for survivors and provide relief. Within the present management framework, evacuation facilities are managed by disaster type and division. There is a need to set a comprehensive framework that takes common and individual characteristics of the facilities into account. Management criteria for these facilities need to be established, including siting criteria for each type, requisites, and maintenance and operating systems.

With the rise of the Internet and social media, news on disaster events is delivered and shared in real time like sports broadcasting. Once the truth mixes with opinion,

they emerge as issues. Circulation of groundless rumors raises public concern and fear. For these reasons, disaster management has become more difficult and must be more sophisticated. The SMG should work towards active provision of information on disaster events and ensuring transparency, consistency, and expert handling, as well as taking on the responsibility for providing information.

It is paramount to promote participation or visits of citizens and experts during the disaster response process.

Recovery from damage wrought by massive disasters should mean more than just returning to the original state. Rather than that, it needs to be an opportunity to build long-term disaster resilience and enable sustainable development. It is advisable to refer to the cases of New Orleans (devastated by Hurricane Katrina in 2005) and the Tohoku region (including Sendai) which was devastated by the Japan Earthquake & Tsunami of 2011. In a bid to formulate restoration plans based on scientific and transparent investigations into the causes and consequences of disasters, the SMG should engage neutral institutions possessing the right expertise. There is also a need to have residents in affected areas participate in the process of investigation.

The SMG must collect data and promote research and development (R&D) on urban disasters. Coming up with scientific and efficient disaster prevention measures is essential

It is important to obtain data and enrich understanding about new large-scale urban disasters. To that end, there is a need to predict the possibility of their occurrence and assess their potential impact along with other risks on a routine basis. Through such efforts, the SMG should monitor the risk of disaster and use the data when formulating policies and providing information to city residents.

Moreover, regularly carried out surveys on awareness of urban safety and hazards among Seoulites are vital. Feedback through lessons learned should be

enhanced through the publication of casebooks alongside white papers on new large-scale urban disasters.

The dearth of data and empirical knowledge on new disasters (because they are so new), makes it difficult not only to analyze and evaluate risk, but also come up with appropriate measures. Wider support for R&D at universities and research institutes will allow the SMG to see increased knowledge and understanding of new large-scale urban disasters, including those associated with cutting-edge technologies and materials stemming from rapid technological development. The SMG needs to gather data and accelerate related R&D to reverse the lack of baseline data and knowledge about their risks, attributes, impacts and damage.

It is also paramount to encourage simulation and forecasting to facilitate effective, scientific measures intended to brace for and prevent extreme disaster events.

Improvements in Management of Underground Facility Safety in Seoul

Suk-Min Lee · Hyung-Mi Yoon

Key Message

Improvements are needed to the command center role of the Seoul Metropolitan Government's Underground Safety Team, which is tasked with safety oversight of underground facilities. There is also a need to foster cooperation with relevant organizations to prepare for better handling of complex disasters.

It is vital to identify ways to improve safety management of underground facilities, which is regarded as a typical example of safety blind spots in Seoul

Underground facilities are classified as part of the basic infrastructure directly linked to the lives of citizens in Seoul. Despite that, the Seoul Metropolitan Government (SMG) is limited in its role to handle accidents happening in those categories maintained by the private sector, such as telecommunications, electricity and gas. Of particular note is that over 50 percent of the underground facilities in Seoul are managed by entities other than the SMG, making it difficult to coordinate action in emergency situations. Responding during the initial phase of a fire that broke out in KT's cable tunnel in western Seoul was difficult due to a lack of structure to share data on the facility and due to the SMG's passive role.

Incidents in underground facilities in Seoul lead to the loss of life and property as well as secondary damage such as interruptions to water supply, power outages and network blackouts. In other words, they exert massive adverse impacts on daily life. Fires, explosions and other types of complex disasters happening in underground

facilities have the propensity to become large-scale disasters - road subsidence, fatalities and injuries. This is why it is critical to manage safety in underground facilities, which necessitates research on ways to carry out safety improvements and reduce the blind spots in management of these underground areas.

Accidents in underground facilities are likely to produce secondary hazards including network failures, with potential for wide-scale damage

Typical hazardous incidents in underground facilities in Seoul include gas explosions, heat pipe leaks, fires in electricity/cable/utility tunnels and sinkholes on the surface following damage to water supply and sewage systems as well as contamination of water supply. Broken pipeline networks in water supply/sewage systems often result in land subsidence so safety inspections should be continuous. When accidents involve telecommunications, electricity or gas, chances are high that secondary damage will occur following suspension of public services. Hazardous incidents arising in underground facilities damage not only the facilities themselves, but cause loss of life and property as well as secondary hazards like network blackouts and traffic congestion. Allowing for their far-reaching impact, they must be perceived as potentially large-scale complex disasters.

Take the gas explosion that happened in western Seoul in 1994. Gases which escaped through sewers triggered second and third explosions, making it a complex disaster. A series of remedial measures taken afterwards included enhancing safety controls for underground facilities, reporting on and management of excavation work, and drawing numerical maps of underground facilities. Safety improvements after the previously-mentioned fire on KT's underground network cable center in western Seoul in 2018 included creating network redundancy and upgrading firefighting systems. Joint safety inspections and training involving organizations working in utility tunnels and fire and police departments were reinforced.

Problems in the management system for utility tunnels was the main culprit

behind the fire that occurred in a utility tunnel in western Seoul in 2000. More specifically, the lack of firefighting systems underground made it difficult to extinguish the fire. Consequently, firefighting systems became mandatory in underground facilities through the Act on Fire Prevention and Installation, Maintenance, and Safety Control of Fire Fighting systems.

Clarification of the roles of the SMG's Disaster Management Division and provision of regular education and training are integral to improving safety in underground facilities

When hazardous incidents occur in water supply/sewage systems and other underground facilities maintained by the SMG, the SMG's Disaster Management Division functions properly. The issue here is that its role is unclear when it comes to accidents involving facilities operated by entities other than the SMG such as those related to electricity, gas, networks, and heat pipes. The SMG's Green Energy Division has control over management of accidents involving electricity, gas and heat pipes, while its Information & Communication Security Division manages those involving communication networks. Hence, there is a need to clarify their duties and assign greater responsibility to them.

The duties of the Disaster Management Division can be categorized into three groups: initial response, on-site response and disaster management.

The initial response phase consists of understanding, reporting on and disseminating information on incidents and holding meetings to gauge the situation. At this stage, the Disaster Management Division receives reports on an incident and circulates the information to the relevant divisions and other organizations. After assessing and determining the extent of damage, it reports the situation to the mayor, vice-mayors, directors of headquarters, the Public Relations Division and external upper-tier authorities. Then, the mayor, vice-mayors and the head of the Disaster Management Division decide whether to set up a Regional Disaster

Management Headquarters and a Consolidated Support Headquarters during meetings to appraise the situation. They also finalize the details of requests for assistance they will make to relevant organizations. During the phases of on-site response and recovery management, information on the situation is understood and shared, immediate response measures taken, an On-site Emergency Response Headquarters is set up and response/recovery actions begun. Efforts to identify the cause of the accident and gauge the extent of damage are made as well.

The Disaster Management Division should investigate the extent of damage at the scene and then distribute what it finds to relevant divisions. Moreover, it is significant to derive information pertaining to recovery plans from related organizations and autonomous Gu[53]-district offices.

Developing the capabilities of and offering education/training to the division are essential to enable its effectiveness in carrying out its activities of initial response, on-site response and disaster management.

It is important to construct scenarios and promote cooperation among relevant organizations through joint training/education on complex disasters

There is a need to foster cooperation among organizations maintaining underground facilities and related bodies to prepare for occurrence of a hazardous incident. To that end, partner organizations need to be expanded, as do the functions of the existing consultative body supporting safety improvements in underground facilities. In this way, the SMG will be able to increase the consultative body's effectiveness and level of mobility. It is vital for a consultative group comprised of working-level officials to carry out joint investigations, inspections, and maintenance. Discussions centered around safety management of underground

[53] "Gu-district" is an administrative unit in Korea. There are 25 autonomous Gu-districts in Seoul, divided into 425 administrative "Dong" districts.

facilities such as enhancing operations manuals should regularly take place within the group as well.

Furthermore, complex disaster scenarios need to be created to handle incidents in underground facilities in an efficient manner. Based on such scenarios, joint training and education with related organizations should also be provided on a regular basis.

Hazardous incidents in underground facilities cause secondary social damage including negative impacts on other facilities and limiting the provision of basic infrastructure services. Hence, it is critical to devise a training plan for disaster management in a bid to acquire competencies needed for personnel to serve key functions in the event of an incident in underground facilities.

Incidents in underground facilities should be defined as potential complex disasters and scenarios constructed accordingly. For that reason, a framework is essential in which all entities associated with this training can be involved in pushing ahead with it.

There is also a need to deliver education on the safety management system for underground facilities to members of the Disaster Management Division. It is imperative the circumstances surrounding each organization be taken into account when designing such education programs. They should be written in the following order: goals, types, time/date/cycle, targets, content. and assessment of results/feedback.

A comprehensive database needs to be set up and an accident history created

In terms of underground facilities, the SMG has its Urban Underground Information System, the Road Occupation and Access System and a system for sharing information on road excavation and restoration. However, information on the current status of underground facilities displayed in each information system varies owing to a lack of data sharing between the systems. Moreover, there are

issues related to compatibility, data outdatedness and location accuracy.

This makes it critical to establish a comprehensive database for data compatibility of information systems on underground facilities. Standardization of such data is also necessary to boost the efficiency of information exchange and use. Such a comprehensive database will allow the SMG's Road Management, Walking & Bicycle and other divisions involved with underground facilities to access reliable data. In addition, the links between relevant divisions will be strengthened and tasks will be fulfilled more effectively.

For the sake of greater efficiency, there is a need to exchange information on excavation work and accidents in underground facilities. A framework is needed that connects information systems for underground facilities where all organizations tasked with their management can upload and share information on the findings of safety inspections, on excavation work and on accidents. Through the sharing of information on each underground facility, the SMG will be able to maintain effective control of safety inspection records and outcomes, construction work and accidents. The private sector can recognize and avoid risks associated with such facilities in advance, making it easier to safely manage underground facilities.

The SMG should give the Underground Safety Team division status to increase its ability to act as a command center for safety oversight of underground facilities

Accidents in underground facilities create both direct and indirect forms of damage, and a central coordinating entity is essential to dealing with them.

At present, the SMG runs its Underground Safety Team under its Road Management Division in accordance with the Special Act on Underground Safety Management but complying with the Act itself is burdensome. Elevating the Underground Safety Team to a division will be pivotal to its ability to serve

collaborative, evaluation, inspection and intelligence functions as a central coordinating center.

Collaboration

(1) Head a consultative body supporting safety improvements in underground facilities;

(2) Provide joint training on safety management of underground facilities;

(3) Conduct on-site response activities in event of an incident.

By leading joint training on safety management of underground facilities, the SMG will be able to develop the capabilities of its Disaster Discovery Division and establish a collaborative form of governance over on-site response between itself and related agencies. It is paramount to strengthen the Underground Safety Team's role as a command center to have it engage in on-site response activities and handle large-scale incidents systematically as well as quickly disseminating information on ongoing situations in the event of an accident.

Evaluation

(1) Assess and distribute information on safety management rules;

(2) Publish operations manuals on on-site response;

(3) Construct complex disaster scenarios;

(4) Assess education/training.

Efficiency in management will be enhanced through an evaluation of safety management rules set out by organizations maintaining each underground facility and sharing of safety inspection methods/ assessment outcomes. Creation of disaster scenarios for joint training on safety management of underground facilities and assessment of training/education given on the basis of scenarios will be of significant benefit. Sending feedback on such scenarios and training/education should also occur. The Underground Safety Team should be responsible for reflecting the tasks of related bodies in terms of response in operations manuals through evaluation of revised scenarios and education/training programs.

Inspection

(1) Check whether safety inspections of each facility have been completed;

(2) Make safety checks in underground facilities.

The SMG can ensure preemptive safety management of underground facilities by strengthening the team's current role.

Intelligence

(1) Devise and operate an integrated information analysis system for underground facilities;

(2) Create new technologies for increasing underground safety.

The addition of an analysis function to the safety inspection/management functions will further facilitate safety management.

It is essential that the SMG raise the Underground Safety Team (currently under the Road Safety Division) to division level. This will grant sufficient authority to the team to better collaborate, evaluate, inspect and serve intelligence functions and as a command center in charge of the safety oversight of underground facilities.

07 City Diplomacy

The Seoul Metropolitan Government's Humanitarian Action Plan for North Korea

In-Chul Mun

Key Message

The Seoul Metropolitan Government (SMG) needs to conduct mutually-beneficial humanitarian activities for North Korea through use of the social economy and setting up a disaster management system.

The goal of the SMG's humanitarian activities for the North is to promote the welfare of residents in the two Koreas as well as all mankind

Human rights are inalienable, universal, and moral rights of human beings. The international community justifies humanitarian intervention in countries faced with extreme circumstances on the grounds of safeguarding human rights. It is a justified mechanism aimed at ensuring the welfare of all human beings based on the principle of protection of human rights. Thus, the SMG's humanitarian activities for North Korea are associated with the value of securing the welfare of the human race.

The SMG's humanitarian aid efforts contribute to bringing peace to the Korean peninsula and achieving unification

The SMG's humanitarian work for North Korea is a matter of humanity, going beyond boundaries, ethnicity, politics, economy and culture. Koreans are a homogeneous ethnic group, and the North is a country with whom the South should coexist for the sake of peace and unification. This requires local governments, citizens and other actors on the Korean peninsula—not just the central government—to bring peace to the peninsula and realize its unification. Therefore, the SMG's humanitarian activities for North Korea will be immensely helpful in creating an environment conducive to unification and peace.

The SMG's humanitarian assistance does not consist of generous cash handouts, but sharing what the South has for peace and unification

The act of giving something that remains unused is against humanitarianism. What is more, South Korea's per capita GDP is approximately 40 times greater than North Korea's and the South has a fairly stable welfare system. North Koreans, on the other hand, have suffered starvation and a range of diseases due to economic problems and food shortages.

The amount of humanitarian assistance for the North has been tiny compared to the size of the South's economy. The total aid provided in 2018 by South Korea to North Korea has been estimated at KRW 77 million, or a mere 0.004 percent of the South's GNI[54] of KRW 1.898 trillion. Furthermore, 4.5 million to 5 million tons of food waste is generated in the South, which costs the central government KRW 20 trillion a year in disposal costs. Some argue that humanitarian assistance for the

[54] "GNI" is an initialism for Gross National Income, a measurement of a country's income.

North is ladling cash to the regime but such an assertion only provokes wasteful political and ideological conflict. Rather, it would be better for South Korea to increase its humanitarian support.

The SMG's humanitarian work for North Korea is not the strong granting mercy to the weak. It is an act carried out for the purpose of preserving human dignity, a universal need, and living in harmony with the North. Living together on the Korean peninsula means pursuing peace and unification.

Humanitarian activities for the North are irrelevant to sanctions against the regime. Hence, the SMG should proactively implement related projects

Sanctions on North Korea imposed by the international community owing to the North's nuclear programs put limitations on most inter-Korean exchange and cooperation projects. In consequence, international and domestic humanitarian groups encounter difficulty in rendering assistance for the country in spite of its bleak humanitarian situation. However, humanitarian activities for the regime are not subject to sanctions. Items subject to humanitarian exemptions are explicitly specified in existing sanctions resolutions. In addition, the UN Security Council (UNSC) adopted Guidelines for Obtaining Exemptions to Deliver Humanitarian Assistance for the Democratic People's Republic of Korea on August 6, 2018.

The UN Security Council Sanctions Committee on North Korea granted 22 sanctions exemptions regarding humanitarian aid as of early 2019. In March 2019, the UN even pointed out the adverse impact of severe sanctions on humanitarian activities for the North. Since the aim of sanctions against North Korea is to denuclearize it, they do not act as an impediment to the SMG's humanitarian assistance for the regime. As Seoul is the capital of South Korea, it is essential for the SMG to become an example to other local governments. To that end, the SMG should more actively deliver humanitarian aid to the North.

The SMG's humanitarian activities for North Korea produce a myriad of benefits including improvement to inter-Korean relations

The SMG's humanitarian activities for the North will help further the progress of peace on the Korean peninsula, going beyond a love for humanity. They can serve as a starting point for enhancing and developing sustainable inter-Korean ties. The SMG engages in humanitarian activities on the basis of cooperation, rather than offering unilateral assistance. Accordingly, these activities will deliver economic benefits to both Koreas. They will also contribute to attaining and disseminating internationally agreed targets such as the UN Sustainable Development Goals (SDGs).

The SMG's humanitarian work for North Korea will serve as the foundation for non-traditional cooperation on security between the two Koreas in areas like poverty, epidemic disease, the environment and human rights. Stable inter-Korean relations are based on mutual trust. In this aspect, the SMG's humanitarian activities will be helpful in shaping a positive perception of South Korea among people in the North, enabling the two Koreas to build such trust.

They will also allow citizens in Seoul and across South Korea to better understand the North. The public aspect of unification and peace will be more clearly and readily perceived. Throughout the process, the role of local government will be strengthened, contributing to decentralized policies towards North Korea. Seoul, the capital of South Korea, will be able to spearhead the implementation of decentralized policies towards the North Korea.

Humanitarian conditions in the North have deteriorated due to food shortages and financial crises, urgently necessitating outside assistance

A great number of North Koreans are undernourished on account of financial difficulties and insufficient food. In the 2018 Global Hunger Index (GHI), the North ranked 109 out of 119 countries. The nation's food insecurity leads to chronic

malnutrition which is a major cause of a variety of diseases.

To make matters worse, restrictions on humanitarian aid to the North, set by the international community as a result of the sanctions against the regime, exacerbate the problem.

Environmental degradation is another factor affecting the dire humanitarian situation the North is in. So far, economic growth-driven development has damaged its environment. Nonetheless, its primary focus remains on economic development. The regime's failure to establish a suitable disaster management system in the face of prolonged economic hardship has become one of the main reasons behind repeated natural disasters. Economic downturns, recurrent natural hazards along with food shortages are intertwined with deplorable sanitation and hygiene. Infectious diseases are caused by water pollution resulting from poor water supply/sewage systems and soil contamination. North Korea has one of the world's highest rates of tuberculosis and the prevalence of multi-drug resistant strains is one of the greatest public health problems. To sum up, the overall humanitarian situation in North Korea remains precarious so aid from external sources are desperately needed.

The SMG should pursue a multi-pronged approach-humanitarian assistance, humanitarian cooperation, development assistance and development cooperation -a quadruple nexus

In terms of humanitarian activities for North Korea, the concept "quadruple nexus" captures the interlinkage between four areas of humanitarian assistance, humanitarian cooperation, development assistance and development cooperation. Each action serves as a pivot for humanitarian activities for the North Korea and interacts with one another so there is neither a linear relationship nor phases involved. Considering the urgency of the matter, they can be simultaneously or separately carried out and take various and complex forms.

It is necessary for the SMG to push for humanitarian activities for North Korea and divide them into bilateral and multilateral forms of aid

South Korea sent Jeju tangerines to North Korea, while the government of South Gyeongsang Province (Gyeongnam) ran a "Unification Strawberry program"[55] with the North. These are examples of successful humanitarian assistance, with reciprocity being the foundation of that success. It is pivotal for the SMG to undertake humanitarian assistance that caters to the needs of both Seoul residents and their counterparts in the North. Moreover, humanitarian activities founded on mutual benefit will increase their sustainability. The humanitarian activities for the North performed by the SMG can be divided into two forms: (1) bilateral assistance; and (2) multilateral assistance. Bilateral assistance is aid provided by a government indirectly to NGOs/international organizations or directly to organizations tasked with running inter-Korean projects in North Korea. Multilateral assistance is about creating governance for humanitarian activities for the North and can comprise the central government, local governments, civic organizations at home and abroad and international organizations.

When taking humanitarian conditions in the North and reciprocity into account, the SMG can deliberate over offering energy bars to enhance food diversity as well as cold-weather items/healthcare and hygiene products. Building video reunion facilities for divided families and a disaster management system can be considered as well. The SMG can also seek ways to encourage social economy enterprises in Seoul to engage in humanitarian activities for North Korea. Their participation will not only be of help to the socially vulnerable population of Seoul, but lay the groundwork for establishment of a platform for humanitarian aid to the North Korea.

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[55] Throughout its "Unification Strawberry project", the government of South Gyeongsang Province (Gyeongnam) lent aid to the growing of strawberries in the North, aiming to modernize cooperative farming in North Korea.

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