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Impediments to Driving Smart Cities: a Case Study of South Korea

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Abstract Over the past two decades, smart cities have been attracting attention as a means of solving urban problems and as a model for securing urban sustainability. Many studies have been conducted in various fields such as conceptual definitions, classification, new technologies, case analysis, and civic participation of smart cities. In particular, applicable technologies and their importance have been highlighted so far. However, since a city is a complex and meta-systematic space, it is the overly optimistic prospect that technology, one of the smart city components, will lead to successful smart cities. This study elucidates the impediments to driving smart cities as a case study of South Korea, a leading country in smart technology and digital transformation. We examined three comprehensive national plans for promoting smart cities and conducted focus group interviews with experts in smart cities to analyze the obstacles to carrying smart cities. We classified the thirteen impediments into technological, industrial, governmental, and social factors as a result. Some of them are generic issues in policy establishment and enforcement, while others are specific to smart cities.

Keywords Smart Cities, South Korea, Impediments, Focus Group Interview, Technology·Industry·Government·Society (TIGS)

I. Introduction

While smart cities have been spotlighted for more than 20 years, and discussions on them are actively underway around the world, they have no set definition. Smart cities have been attracting attention in developed and developing countries, although the reasons for promoting them differ. In

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developed countries, smart cities are considered a way to solve various problems stemming from constant urban expansion. That is, smart cities are regarded as a solution to use urban infrastructure and address urban problems efficiently (European Commission, 2013). On the other hand, in developing countries, smart city facilities have been applied to construct new urban infrastructure to skip the technical steps needed (UNESC, 2016). As such, there is no common or agreed concept of a smart city, as its purpose varies depending on the circumstances/ situation of each country and city.

However, there are some common answers to the question, "why are smart cities important now?" In 2008, the population in urban areas exceeded the rural population (UNFPA, 2007). Regardless of the country, developed or developing, all cities encounter various risks, concerns, and problems, such as transportation, crime, environment and ecology, and safety (Nam & Pardo, 2011). Cities must meet the demands of sustainable consumption and production (Cohen, 2016). In addition, the outbreak of COVID-19 made the use of smart technologies more common and accelerated the transition to smart cities (Kunzman, 2020) not only in pilot cities but also in most cities. A smart city is a space for managing and solving urban problems, a model of urban sustainability, and a better city to live in.

In their early stages, smart cities involved building infrastructure and providing services to citizens by utilizing technologies such as information and communications technology (ICT). The predecessor to smart cities was the "ubiquitous city" (Weiser, 1991). Ubiquitous cities based on wireless networks evolved into smart cities as smart technologies such as big data, cloud computing, the Internet of Things (IoT), and ICT were developed. Smart cities consist of smart computing technology (Washburn et al., 2010), monitoring and response systems (Hall, 2000), and new technologies and data for urban management (European Commission, 2013). ITU-T (2014) analyzed 116 keywords used in smart city definitions and classified them as follows: 1) the means of smart city (ICT, data, infrastructure), 2) the goals (improvement of environment, economy, sustainability, quality of life), and 3) the subjects (citizens, governance, administration). Further, three major technologies are considered vital: digital technology, ICT technology, and data and intelligent information exchange among various subsystems (Lai et al., 2020). However, it is impossible to manage and solve urban problems by adopting various smart technologies in city spaces where complex factors intertwine. In this context, the concept of the organic integration of systems is relevant (Dirks & Keeling, 2009). In addition, human resource integration is highlighted as an essential component of smart cities (BSI, 2014; Lai et al., 2020). To avoid the criticism that a smart city is a "technical packaging" (Hollands, 2008), the concept of a smart city should be emphasized as an organic thing, including the purposes, objects, and participants of smart cities, and user-friendly technology.

Recently, guidelines and standards for smart cities have begun to be presented, considering the organic nature of urban spaces. The BSI (2014) offered a variety of criteria for smart cities, such as "smart city terminology," "smart city framework standard," "framework for sharing data," "project proposals for delivering smart cities," "smart city planning guidelines," and so on. Eggers and Skowron (2018) emphasized innovative changes in six areas to promote a successful smart city: economy, environment and energy, government and education, life and health, mobility, and safety and security. Finally, Korngold et al. (2017) presented a smart city platform initiative with five areas: people, economic assets, infrastructure, enabling environment, and networking assets, covering 12 functional areas, including e-government, civic participation, judiciary, democratic procedures, start-ups and finance, and urban issues. In addition, it highlights the tolerance of smart cities for digital underdogs, such as the disabled and elderly.

However, various unexpected disruptions can occur during the promotion of smart cities. These factors differ from country to country due to different socio-economic and cultural contexts, but some obstacles are common. Bennett et al. (2017) pointed out the impediments caused by the United Kingdom's smart city drive: first, it is heavily swayed by the will of political leaders; second, it does not benefit everyone; and third, it does not provide top-down and bottom-up data. Gupta and Gupta (2018) indicated seven disruptions of India's smart city promotion. First, a lack of digital devices prevents many people from benefiting from smart cities; second, unreasonable plans that do not consider India's reality; third, the lack of human resources with adequate skills; fourth, privacy and security issues; fifth, the poor and poorly educated; sixth, distrust in the government; and finally, the absence of a policy on smart cities. In particular, privacy and security issues inhibit smart cities and have been constantly debated. Ijazetal (2016) highlighted the importance of developing appropriate solutions for these problems and presenting smart city applications and security methods using IoT technologies. Another common problem is the digital divide, which alienates some classes due to digital device proficiency. Colding et al. (2019) emphasized the importance of securing safeguard redundancy, noting that the generalization of smart services reduces the redundancy of service accessibility.

As such, smart cities face many impediments in the implementation process. This study aimed to derive policy implications for the successful promotion of smart cities through Korean cases by examining the obstacles that emerged in driving smart cities. The Republic of Korea (ROK) has strengths and weaknesses in its smart city components. It is considered one of the world's most powerful ICT countries. On the other hand, it faces various problems due to its public-led top-down promotion method, lack of practical policies, and weak relevant industrial ecosystems.

Globally, discussions on smart cities actively began around 2010, when the ROK had already established much of the institutional and technical infrastructure needed to build them. In 2008, ROK enacted the first laws to build smart cities (Ministry of Land, Infrastructure and Transport (MLIT), 2019). Smart cities can be initiated by corporates, the public, or by the government, and in the ROK case can be seen as a public-led top-down approach. Under governmental financial support, there have been successful patent applications and registration and technology transfer. ROK has been ranked best in the world for Internet access since 2005 (OECD, 2020) and digital innovation (Jamrisko et al., 2021), and second in telecommunications device production (MLIT, 2009). In other words, ROK meets the qualifications to implement smart cities in terms of institutional and technical aspects. The government expected to establish a smart city model and export it. As of 2021, however, it has evaluated smart cities' performance as insufficient, except for the construction of smart infrastructure. It is stagnant due to technical problems such as privacy issues, cybersecurity risks, and socio-economic issues such as an immature industrial ecosystem, rigid governance, and social resistance.

This study provides novel policy implications for smart city policies in other countries by discussing why ROK, considered a leading country in digital innovation, has impeded smart city development. While there are studies that pointed out the problems of smart cities from specific perspectives, such as required technologies (Washburn et al., 2010; Hall, 2000), 2) integration of relevant resources and systems (Dirks & Keeling, 2009; Lar et al., 2020), and guidelines/criteria for smart cities (BSI, 2014; Korngold et al., 2017), a comprehensive discussion on such issues is lack. We believe this could be a contribution to the readers in the related fields. The remainder of this paper proceeds as follows. In Section II, the national policies and strategies for smart cities in ROK are analyzed, including the first and second comprehensive plans for U-cities and the third comprehensive plan for smart cities. Section III summarizes impediments to smart cities in ROK generated through focus group interviews (FGIs). Section four discusses the policy implications of the barriers and the proper direction for driving smart cities. Finally, the conclusion recapitulates the key contents and highlights the importance of this research.

II. Analysis of Policies and Strategies for Smart Cities in ROK

1. History of Smart Cities in ROK

In ROK, the origin of smart cities is the U-city, a Korean model named after the ubiquitous city concept. It was promoted to cope with domestic and

international challenges, such as urban expansion, population growth, and environmental and technological changes (MLIT, 2019). Due to these concerns, the "U-Cities Act" (2008) was enacted to promote relevant technological development through R&D, institutional improvement, and integration of U-city services. However, public-led top-down approaches have several limitations: 1) low sustainability of business models, 2) low civic sentiment, and 3) limitations on expanding related industrial ecosystems. To overcome these issues, the government reorganized the U-Cities Act into the Smart City Act (2017), providing a basis for governance, differentiated approaches tailored to the stage of urbanization, and roles of the participants (Smart City Korea, 2021).

Changes in the type of smart city services are evident when moving from U-city to a smart city. While the U-city was mainly focused on infrastructure-building and proliferation-oriented projects, the smart city emphasizes data-driven platform construction. Changes in smart city services were also identified. By 2014, smart services were concentrated in specific areas, such as crime and disaster prevention (35%) and transportation (32%). However, since 2015, they have been expanded to the realm of everyday life, such as administration (15%), environmental/energy/water resources (15%), facility management (8%), and health/welfare (7%) (MLIT, 2019). In other words, with the creation of related (new) industries and the expansion of services and spaces, the concept of the smart city has also expanded into an "innovative space" and "urban platform" where various new technologies and urban infrastructure converge, and this convergence occurs.

2. Analysis of Comprehensive Plans Stage by Stage

2.1 The First Comprehensive Plan for U-Cities

In the first step, the government devoted itself to building infrastructure for the integrated management of cities and coping with urban problems by utilizing advanced ICT. The goals were to 1) foster new growth-engine industries, 2) facilitate efficient urban management, 3) improve quality of life, and 4) advance urban services. In addition, to support these goals, the government prepared some strategies, such as laying the foundation for related systems, developing core technologies, helping companies related to U-cities in the private sector, and creating U-services. However, although the government took the initiative to establish and coordinate a general plan, the top-down approach exposed various limitations such as difficulties in offering various U-city services, restrictions on independent overseas expansion in the private sector, and more. In addition, spatially, establishing U-cities centered in new cities deepened the digital gap between new and declining cities and hindered the spread of small and medium-sized cities in provincial areas. However, there were obstacles such

as human resource training and utilization and revitalizing policy deficiencies for the U-city industry.

2.2 The Second Comprehensive Plan for U-Cities

The second stage was the spread of U-cities. The demand for U-cities increased as the rates of aging and unemployment increased domestically and globally, and urbanization increased the damage caused by natural and social disasters (MLIT, 2014). Advanced ICT technologies have enabled the expansion of the technologies, spaces, and services of U-cities. Along with their spread, the government aimed to boost related industries and support overseas market expansion. Moreover, unlike the previous stage, the government attempted to transfer its authority and enhance governance by strengthening public-private partnerships and consolidating cooperation between central and local governments. As a result, various ministries and subjects were the main bodies. While participation from the private sector, including civilians, remains inactive, and U-cities still featured a top-down manner, the drive this time was not only led by MLIT, but also by the various ministries of the central and local governments. In this stage, the milestone was expanding U-city infrastructure throughout the country, but other achievements were sluggish.

2.3 The Third Comprehensive Plan for Smart Cities

Climate change, environmental pollution, and domestic social problems such as a low birth rate, a steep increase in aging, and low growth increase the importance of sustainable smart cities. The Moon Jae-in government, launched in 2018, announced the third comprehensive plan for the smart city. Since then, smart cities in ROK have been propelled in earnest. The third comprehensive plan set up three targets to overcome previous U-city limitations: 1) solving various urban problems based on spatial information and data, 2) inclusive smart cities considering all citizens, and 3) strengthening global cooperation through innovation ecosystems. Smart city strategies centering on new cities were divided into plans for pilot cities, existing cities, and declining cities. In addition, the new smart strategies encourage constructing integrated platforms and big data, introducing related regulatory sandboxes, and promoting R&D and human resource development strategies to create an innovative ecosystem for smart cities. Finally, the third plan actively utilizes Living Lab to enrich governance, which has thus far been lacking.

Table 1 summarizes the main contents of the first to third comprehensive plans for smart cities in ROK.

Table 1 Analysis of comprehensive plans for U-cities and smart cities

	The first comprehensive plan for U-cities	The second comprehensive plan for U-cities	The third comprehensive plan for smart cities
Period	2009–2013	2014–2018	2019–2023
Goals	• Promotion of new growth-engine industries • Improving the efficiency of urban management • Improving the quality of life (advanced urban services)	• Activating industries related to U-cities • Strengthening support for overseas markets	• Solving various urban problems • Creating inclusive smart cities • Establishing an innovative ecosystem • Strengthening global cooperation
Strategy	• Establishment of the institutional foundation • Core technology development • Supporting industries relevant to U-cities • Creating U-services for city dwellers	• Establishment of a national safety net for safe cities • Promoting U-cities and developing related technologies • Supporting companies in the private sector • Strengthening support for overseas markets through international cooperation	• Creating customized models • Establishment of a foundation for spreading smart cities • Creating an innovative ecosystem for smart cities • Strengthen global initiatives
Promoter	• The central government (MLIT)	• Cross-ministries and governments	• The Presidential Committee on the 4th Industrial Revolution
Evidence Laws and Strategies	• U-Cities Act (2008.03) • Partial amendment of U-Cities Act (2012.05)	• Partial amendment of U-Cities Act (2015.12) • Smart City Act (2017.03)	• Implementation Strategies for realizing Smart Cities (2018.01) • Partial amendment of Smart City Act(2019.04)
Target	• New cities	• New cities • Existing cities	• National pilot cities • Existing cities • Declining cities • New cities
Subject	• Construction of physical infrastructure (integrated operations center, communications network)	• Limited feature integration (compatibility, standardizing)	• Creating innovative spaces

Source: MLIT (2009, 2014, and 2019)

The 2nd and 3rd Comprehensive Plans were launched based on the previous plans' problems. However, similar problems still recur. Chapter Ⅲ

summarizes the impediments that continuously repeat despite the revisions of the comprehensive plans twice.

III. Impediments to Driving Smart Cities in ROK

1. Focus Group Interviews

We hosted FGI two times to explore the impediments to driving smart cities in ROK. They were held at the Korean Institute of Public Administration for about three hours on October 23rd and November 24th in 2020, respectively. The participants were luminaries who had executed ample research and/or had practical experience in the smart city field. There were two university professors, three researchers from government research institutes, and two public officials. In the first FGI, we provided literature review summaries and news article analyses to the participants to help brainstorm their experiences and ideas and narrow them down into a list of impediments to smart city promotion. We conducted an in-depth discussion of each impediment in the second FGI and structured the results into four areas: technology, industry, government (administration), and society (TIGS). The following summarizes the impediments to driving smart cities in ROK in each area.

Table 2 Information of FGI Participants

Participants	Position	Affiliation	Expertise
A	Professor	Yonsei University	Smart City Policy
B	Professor	Korea National University of Education	Smart City Policy
C	Deputy Department Head	Korea Land & Housing Corporation	Smart City project
D	Head of Department	Smart City Association	Smart City project
E	Research Associate	Korea Institute of Public Administration	Transportation Planning
F	Research Associate	Korea Research Institute for Human Settlement	Smart City
G	Senior Director	Jungdo UIT	Local planning

2. Technology

2.1 The Gap between Smart Technologies and Services

The gaps between applicable smart technologies and technologies adopted in smart services are caused by various factors, such as security issues and the time it takes to make technology practical. For example, AI-based CCTV seems to

be very effective in sensing facial and behavioral characteristics in experimental situations but has lower recognition rates in practice due to many variables. The blueprint of a smart city is commonly described as the background of scientific fiction movies. However, it is far from the level of service provided to citizens in real life. The gaps between technologies and services make it difficult to persuade citizens and policymakers to support smart cities constantly. It can also be difficult to implement smart city policies or secure finances continuously. Moreover, some construction projects, such as digital twins, are impossible to achieve in the short term. It will not be easy to secure the sustainability of businesses if the government requires performance that meets investment goals and expectations from the early stages.

2.2 Privacy and Security

A smart city provides customized services based on personal behavioral data, which can cause information security problems. This issue can be largely divided into cybersecurity and privacy issues. Smart services are provided by connecting cyber systems and necessary urban facilities, such as transportation, water supply, and gas. Therefore, concerns have been raised that even trivial cyberattacks could cause physical damage through facilities directly connected to citizens' lives. However, practical discussions are sluggish, dominated by fear of such damage. In the meantime, the introduction of smart devices, facilities, and technologies has consistently expanded. As a result, unbalanced growth has occurred between physical growth and security.

On the other hand, privacy concerns have been raised because smart cities collect and use an enormous amount of information, including real-time personal behavioral information, to provide appropriate services. The Korean government was concerned about the possibility of personal information leakage from the very early stages of the U-city project. The first comprehensive plan stated that information should be collected, used, and provided in a systematic plan to a minimum extent. However, the overly cautious approach to personal information collection and use has resulted in delays in the preparation of related laws. The "Act on Smart City Creation and Industry Promotion" was enacted in 2018, 10 years after revising the U-City Act. The concept of "pseudonymous data" required to process and distribute personal information was added in 2020. During the decade in which relevant legislation was not in place, personal information was arbitrarily interpreted and used in legally uncertain circumstances.

2.3 Lack of Data Accuracy

Accurate data is essential for determining the quality of smart services. ROK is quick to create service delivery platforms, such as applications that offer the necessary information. However, there is a lack of accuracy in the data that

underlies the services provided by such platforms. For example, an application was swiftly developed and distributed in the initial stage of the COVID-19 pandemic to prevent a "mask crisis." It enabled citizens to check the stock status of masks based on the location of pharmacies and drugstores. However, the mask stock data did not match the actual inventory volume, which caused inconvenience and anxiety among the citizens. The services applied to smart cities require much larger and more complex data than the data used in that case, and it is not easy to correct them if the data for smart cities are inaccurate. Therefore, efforts to increase the accuracy of data, which is a key element of technology implementation, are as important as developing new technologies.

3. Industry

3.1 Non-Innovative Project Ordering System

Three major issues were discussed regarding the smart city project ordering system caused by the public initiative for smart cities in ROK. Project ordering system is a top-down project execution method in which the government and private companies enter into an order-bidding relationship, not a partnership, so the private companies compete on price to land smart city projects. First, a project ordering system for innovative projects is lacking. Since the current system was set up before smart cities, which combine innovative technologies with city places, there is no appropriate process or standard for introducing innovative technologies and services in city construction projects. Second, the system works based on cost efficiency. Existing businesses rely on cost-cutting outsourcing methods. It hinders improving the quality of smart cities and services in a cost-efficient way. Finally, there is a problem with the company selection system. In the case of public services, the performance of companies has mattered to select partnerships, which is inevitably advantageous for companies with high performance and capital, such as large companies. As a result, start-ups and innovators are prevented from entering the relevant industrial ecosystem to the detriment of the system.

3.2 Large and/or Platform Company-Oriented Industrial Structure

Large and/or platform companies chiefly run the smart city industry. With the problems of selecting businesses mentioned above, they have had a monopoly status because smart cities inevitably require the integration of various fields. As this situation has solidified, market shares and profits have increased. As service costs increased, the choices of citizens and users were restricted. As a result, small and medium-sized companies and start-ups lost their market opportunities and weakened their self-sustaining power.

3.3 Public-led Smart Service Provision

Certain obstacles often arise when the public sector tries to supplant the private sector's role. If a company that provides smart services has difficulty performing its tasks, the government attempts to solve the problem by offering the services instead of it. While these approaches can help maintain service continuously, they lead to problems in two respects. First, service quality deteriorates. Civil servants cannot provide the services offered by private companies consisting of experts in smart technology and services. The decline in quality subsequently reduces user satisfaction, and eventually, the lack of demand can make it difficult to sustain the service. The other problem is that the public sector replaces the private's role, reduces the self-sustaining power of related industries, and solidifies the structure in which private companies are subordinate to the public sector.

3.4 Lack of Continuous Supply of Services

In Korea, smart city projects are mainly focused on the "construction" of smart infrastructure. In other words, the continuous "operation" of smart services provided by smart infrastructure is not considered. This issue impedes the promotion of smart cities in three ways. The first is the matter of responsibility for the service. The technology applied to smart city services can cause various unpredictable problems because emerging technologies applied to smart cities are developing. When related risks arise, it is common for the provider to assume responsibility and dispirit the entity's willingness to create new services. Second, the project ordering system lacks mid-and long-term operation and maintenance support, but it concentrates on technology development and infrastructure construction. Even if start-ups or small businesses create and provide innovative services, they will go bankrupt unless they have a sustainable profit structure. As a result, the infrastructure related to the service will eventually become useless. Lastly, there is no budget in place to continuously provide smart services. Generally, the budget for smart city projects is allocated for infrastructure construction, and maintenance costs must be met through the revenue generated through the operation.

4. Government (Administration)

4.1 Lack of Organization System and Capacity

Since 2019, the ROK government has encouraged local governments and businesses to propose smart city projects. Although having much authority to local governments, the central government is still deeply involved in all plans and decision-making. Since the central government monopolizes budget execution authority, local governments and private businesses have no choice

but to react sensitively to the policies and decisions made by the central government. Second, there is no dedicated smart city organization, which integrates and coordinates the smart city projects of various ministries and local governments. Ministries and local governments often carry out similar projects, resulting in cost inefficiency. As a result, these two factors form a vicious cycle where the central government plays more roles and weakens local governments and the private sector.

4.2 Insufficient System for Promoting and Spreading Smart Cities

Like most innovative technology-related services, smart city services require revisions of laws and relaxation of regulations. These procedures usually require approximately two years in Korea, while technology development is getting faster and faster. The technology to be applied to a smart service is already outdated after two years. Moreover, there is a lack of strategies for the scale-up growth and diffusion of successful smart city models. Even if innovative technologies or services are successful enough to be adopted, they are often utilized just once in a certain area and then disappear. This is because there is a lack of a scale-up growth strategy to discover successful cases and deliver and spread them nationwide.

4.3 Rigidity of Budgeting and Business Operations

The two major disruptions are as follows: First, smart cities were promoted as part of new town development projects from the first plan for a U-city. Since local governments did not have a sufficient budget, they could not take initiatives to promote and operate U-cities. The central government needs to choose the areas where development profits for participating companies are expected. As a result, there was a regional imbalance between old and new towns in the promotion of smart cities because the development profit of a new town was much greater. Second, the budget was construction-oriented, and the services were supposed to be provided through development profits. Short-term and one-sided budgeting resulted in a reduction or suspension of smart services. Despite the importance of maintaining smart cities rather than constructing them, the system for securing financial resources for operating smart cities is relatively insufficient.

5. Society

5.1 Inactive Citizen Participation

Inactive citizen participation can impede the promotion of smart cities. This issue arises in two main respects: citizens and the government. As users of smart

services, citizens are important stakeholders in driving smart cities. Recently, the government has actively encouraged citizens to participate by introducing the Living Lab concept. However, it is difficult to specify "citizens" who are the subject of participation because smart cities in ROK have been established in new towns. As a result, citizen participation has been abused as a channel for specific interest groups to privatize their development gains. From the government's perspective, civic participation tends to be treated as a formality. It is regarded as a one-time or formal process and is excluded from practical business progress. Due to these disturbances, citizen participation is repeatedly inactive as the expectations for effective citizen participation are low, and a vicious cycle of citizen participation is repeated.

5.2 Digital Divide

Smart services are provided through digital devices, and some classes find it difficult to access smart services owing to the differences in sociodemographic and/or physical conditions. For example, ROK has the world's highest smartphone penetration rate (95%) (Pew Research, 2019). However, for example, about 1.225 million 2G and 3G mobile phone users could not receive COVID-19-related texts. The government provides many administrative services based on smartphones; however, services for the absolute majority consolidate the digital divide. The spread of smart cities could exacerbate these problems.

5.3 Increased Conflict with Existing Industries

The expansion of smart services has led to conflicts with existing industries. Smart cities transform existing industries, businesses, and services effectively. Thus, when new businesses and services emerge, friction with existing stakeholders is inevitable. For example, Uber and Tada Mobility services faced strong opposition from taxi unions in ROK. However, the government was not prepared for conflicts. When Uber launched in 2013, conflicts related to the smart mobility industry occurred for the first time. Since then, similar conflicts have occurred in a series, leading to "Poolus (2017),"[1] "Carpool Crew (2018),"[2] and "Tada(2018)"[3]. Despite the repeated conflicts, the government has focused only on mediating apparent conflicts each time rather than finding fundamental solutions. If smart cities are carried out in earnest, various conflicts between emerging and traditional industries will be inevitable, which will impede the

1 Poolus is a company that provides on-demand carpool-based ride-sharing services that are matched in real time.

2 Carpool Crew is a shared mobility service that connects drivers and passengers by mobile so that users with similar or the same destination can travel together.

3 Tada is a mobility brand in ROK that operates affiliated call taxi services.

driving force of smart cities. Figure 1 summarizes the 13 impediments to smart cities by TIGS.

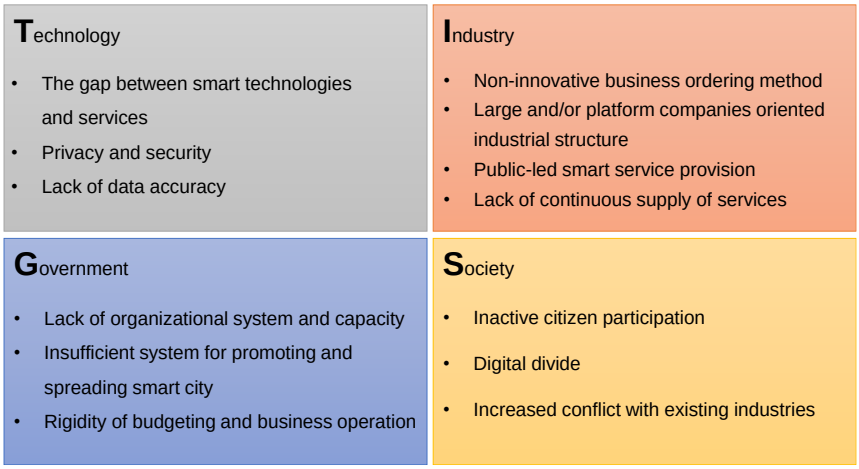

Figure 1 Impediments to driving smart cities in ROK

IV. Discussion

We found that many of the impediments in smart cities are the ones that generally occur in the course of any policy development and implementation. This is because the ROK government utilized the traditional urban development system to promote smart city projects. It requires a new system suitable for the new concept to avoid generic issues.

The gap between smart technologies and services is a time-consuming problem to solve. For example, artificial intelligence (AI), a key smart city technology, enables innovation in various fields. This technology requires a long-term approach based on AI's accuracy, sufficiency, and removal bias until it can be applied to provide public services through cities, which are systemic and complex spaces. In addition, even if it reaches a technically appropriate level, the safety of urban residents must be considered, and ethical and legal preparations should be discussed.

Safety issues are linked to information security. A smart city is hyper-connected, consisting of computing, digital, big data, and physical infrastructure. It is necessary to avoid a biased approach to infrastructure construction and expansion. It is also important to secure security at the current level, rather than fearing vague dystopian technological situations.

Impediments to the industry category are related to the lack of systems. The non-innovative business ordering method resulted in the anachronistic system used to order urban planning projects before introducing smart cities. Without one department in charge of ordering, it is difficult to guarantee the innovation of smart cities because it is promoted by the agencies in charge of similar projects, such as the Ministry of Land, Infrastructure, and Transport.

Large companies and/or platform companies have an advantage over innovative start-ups, as the criteria for selecting companies are based on cost efficiency and performance. In these circumstances, increasing support for start-ups does not guarantee that the industrial ecosystem becomes healthy; it is crucial to provide the conditions for self-reliance and maintenance to support the early settlement of start-ups to solidify the industrial ecosystem.

The insufficient expert workforce causes the lack of organizational systems and capacity in the public sector. Moreover, most of them are concentrated in the central government, making it difficult for local governments to form dedicated organizations to develop smart cities. On the other hand, most smart city experts working for the central government are intellectuals, such as university professors, not practical or technical experts. To overcome this difficulty, bringing private experts into the public sector could be a solution. However, IoT or data experts' salaries are less than half the market level in the Korean civil service system, so there is no incentive for them. When hiring them as temporary public officials, it is difficult for them to return to the market after the end of the contract. Thus, to introduce a quality workforce to the public sector, a proper compensation system should be in place to attract them.

The following processes are required to mitigate the rigidity of budgeting and project operations. The budgets related to smart cities should be distinctly divided into construction and operating costs, preventing services from being reduced or discontinued due to an insufficient operation budget. In addition, smart city projects should offer smart services to declining areas to reduce the gap between new cities and existing cities.

Increasing citizen participation is important for successful smart cities. To this end, the opinions of citizens dwelling in the area should be actively reflected. Reflecting on the first comprehensive plan, the government pointed out the problem of inactive citizen participation and the limitations of the top-down approach. However, as the third comprehensive plan is being pursued, citizen participation is still inactive. There are various channels to participate, most of which are conducted passively, such as collecting opinions and accepting complaints. Living Labs were promoted in some cases, but these were regarded as formal events. The main reason is that the governments, the main body of smart city promotion, are not active in accepting opinions from citizens. This is because ROK has a short history of civic participation, and civic participation in the urban development process has been used to realize stakeholders' interests.

Citizen participation is expected to require more time and effort, as the maturity of civil society should be premised.

The digital divide in smart cities must be understood at a spatial level. This is not simply a matter of inequality depending on whether or not one has devices but is related to securing personal safety within urban spaces. In particular, the third comprehensive plan aims to establish inclusive smart cities. For this, it will be necessary to closely investigate and provide customized support for the digitally vulnerable.

In increased conflicts with existing industries, the governments need to respond more actively. As smart cities are expected to provide new services in various fields, such as transportation, logistics, and services, many profit conflicts will arise. At the cross-departmental level, governments must develop conflict management capabilities and strategies. Above all, understanding new urban spaces (smart cities), including smart services and new industries, is required.

V. Conclusion

This study focused on identifying the impediments to instituting smart cities in Korea, which is considered a leading country in digital innovation. The 13 impediments are divided into four sections based on FGIs: technology, industry, government, and society. The 13 impediments in this study that hamper the promotion of smart cities will help comprehensively understand the current state of smart cities in Korea, which have been carried out over the past 15 years.

Amid the big changes and innovations in the intelligent information society and digital transformation, it is expected that it will help achieve successful policy goals by minimizing obstacles to smart city implementation and presenting policy implications.

Finally, each impediment to smart city propulsion interacts with other obstacles rather than being completely independent. Therefore, further research is needed to explore the interactions among various impediments.

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