Government-led living lab :
A case study of Magok Smart City living lab in Seoul

By

NAM, Yoojin

THESIS

Submitted to

KDI School of Public Policy and Management

In Partial Fulfillment of the Requirements

For the Degree of

MASTER OF DEVELOPMENT POLICY

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Approval as of August, 2021

Abstract

This paper discusses how stakeholders are participating in the government-led Magok Smart City Living Lab (MLL) in Seoul, South Korea. A living lab is a platform that invites multiple stakeholders to participate in solving urban problems together. The MLL is led by the Seoul Metropolitan Government and the Seoul Housing & Communities Corporation and aims to revitalize the Magok area. Through the case study of MLL, this paper examines how the living lab concept has been applied in the context of Seoul, a city that has been accustomed to mostly top-down governance. It explores the main characteristics of the government-led MLL and identifies the critical challenges and limitations.

Keywords: Living Lab, Seoul Smart City, Urban Governance, Korea Urban Development

ACKNOWLEDGMENT

First and foremost, I would like to express my deep gratitude and respect to my supervisor, Professor Yu-Min Joo, for her professional guidance, heartful encouragement, and insightful suggestions during all studies in KDIS and thesis. I would also like to thank my advisor, Professor Dong-Young Kim, for giving his time so generously, instructing and insight on this paper. Further, I would like to thank my friends, who have given precious memories, enthusiastic energy, and good thinking and cheering to complete the KDI School. Last but not least, I wish to thank my family, especially my mother for love and trust always with wisdom.

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Introduction

Due to the complex changes in the socio-economic environment of the 21st century, modern cities are facing numerous problems. In the past, the government played a primary role in urban development, but today, there are limits to the government's ability to solve complex urban problems. Therefore, urban stakeholders need to cooperate and negotiate complicated issues, which has led to an increase in the importance of urban governance as a network built by various actors (Kim & Dickey, 2006).

Seoul, which is making great efforts to become the Smart City, is a large urban conglomeration in South Korea with a high population density and about 10 million residents. For the most part, the South Korean government guided the development of Seoul. In particular, the modernization of the city progressed in earnest in the 1960s, when the central government's labor-intensive light industrial policy led to an influx of migration to the city. Since the 1980s, Seoul has been developed with key urban infrastructure and services, such as apartments, roads, public transportation, and a sewage treatment system (Seoul Institute, 2016). Beginning at the turn of the century, the direction of urban development began to change with the digitalization of the city's administration, alongside the development of IT and urban regeneration (Seoul Solution, n.d.). Before the 2000s, urban planning was centered on high-growth industries, and government coercion and rational policy developed by experts were considered important. However, government-led urban planning and top-down development are starting to show limitations in today's more complex and unstable society (Seo, 2008) as various social ills, such as regional imbalance and the marginalization of residents, have become increasingly noticeable (Jeong & Kim, 2011). As civic participation has increased in South Korea since the 1990s, the need for community design and deregulation has emerged. However, the central

government still plays a primary role in urban planning, and there is a need for new urban governance. Because urban governance should precede urban planning to manage collective interests (Healey, 2006). To this end, grassroots initiatives must be implemented by empowering citizens and fostering inclusive interactions (Wolfarm, 2017).

Ubiquitous City (hereafter U-City), the precursor of the current Smart City Seoul Strategic Plan, was criticized as being distant from the lives of citizens (Seoul Institute, 2018). Under the U-City, the government made substantial efforts to develop various technological infrastructures and integrate information and communication technologies into the urban environment. However, since this infrastructure-focused policy focuses on physical infrastructure without involving citizens in urban development, it has been criticized for being informationally closed and provider-oriented, thus demonstrating the limitations of government-led urban planning.

The launch of the Smart City Seoul Strategic Plan in March 2018 might have been a turning point for urban planning and governance. The change from U-City to Smart City suggests that the Seoul Metropolitan Government (hereafter SMG) is keen on embracing the smart city concept that is not limited to applying technologies in cities. Furthermore, in a smart city, citizens should not be subordinated to technology, but rather participate at various levels and become the subject of active urban governance (Hollands, 2020).

A living lab concept plays an important role in grassroots urban governance by serving as a participatory platform where citizens can directly become the subject of urban innovation (Seong et al., 2014). Living lab means “laboratory in our daily life” or “laboratory in our village”; it is a place where various stakeholders collaborate and gather ideas to solve social problems in the city they live in (Hossain, Leminen, & Westerlund, 2018). Moreover, the living

lab serves as a testbed for citizens, governments, companies, and research institutes to apply smart city technologies to solve specific problems in a city. In South Korea, the living lab is intended to improve Public-Private-People Partnership (hereafter PPPP) as a core competency to overcome the limitations of government-led urban development and create a new smart city innovation ecosystem.

The Magok Smart City Living Lab (hereafter MLL), which will be the main focus of this study, solves problems in the Magok based on the ideas of citizens. Furthermore, it was launched in 2019 by the SMG, which provides financial support to five selected projects every year. Currently, the living lab is planned to run until 2022. Recently, the Magok area in Seoul has been developed as a new town under a strong government initiative and is currently designated as the Magok Smart City pilot complex. It also hosts the Magok Industrial Complex, which aims to promote various high-tech R&D and eco-friendly industries. While Magok has favorable conditions to promote a smart city living lab, whether the MLL represents a possibility to foment new governance in Seoul remains to be seen.

Through the case study of Magok and its MLL, this research examines how the living lab concept has been applied in the context of Seoul, a city that has been accustomed to mostly top-down governance. What are the main characteristics of the government-led MLL, and what are its main challenges and limitations? Does it have the potential to initiate a more bottom-up style of urban governance?

The next section of this thesis discusses the living lab concept in more detail and situates it within the context of South Korea. Then, the methodology section explains why the qualitative case study method was chosen and how the case study was carried out. In the case study section, the examination and analyses of MLL will be presented, together with a brief

introduction to the development of Magok and its history as a smart city to provide a more contextualized understanding of MLL. Based on the Veeckman's living lab framework, this study analyzes MLL's environment, approach, and innovation results using the qualitative data. Finally, the thesis concludes with the implications of the case's to promotion a new, bottom-up urban governance in Seoul.

Literature Review

Smart City and Living Labs

Smart cities apply new advanced technologies—such as big data, artificial intelligence, and the Internet of Things (hereafter IoT)—to the problems of contemporary cities. Many cities are currently trying to transform themselves into smart cities (Seoul Research Institute, 2018). However, there are growing concerns that smart cities are too focused on the technological aspects. Consequently, scholars have started to emphasize the socio-technological aspects of smart cities (e.g., Meijer & Thaens, 2016; Verhoef et al., 2019). In addition, various central governments and international organizations, such as the European Union, advocate the smart city as a more livable, safer, functional, competitive, and sustainable city (Kitchin, 2014). Indeed, Hollands (2020) argues that real smart cities are not limited to the application of technology but require the participation and contribution of different groups of citizens. In other words, a smart city is not a place where citizens are subordinated to technology but rather one where technology can achieve various levels of active urban governance.

A living lab is a laboratory where various stakeholders, including citizens, collaboratively discover and solve a variety of urban problems (Hossain, Leminen, &

Westerlund, 2018). Real-life tests, experimental environments, and processes of innovation are all essential elements of a living lab (Romero Herrera, 2016). The term living lab was first used by William Mitchell and his team at MIT in 2004. To study a residential environment optimized for ICT (Information and Communications Technology) technology, Mitchell rented an apartment near MIT and experimented to observe the behavior of residents using sensors and cameras. Thus, the first living lab started as a testbed to experiment with technology in our daily lives (Quak et al., 2016)

However, as reflected in European definitions, the living lab concept began to shift its focus from technology to citizens (Leminen, Westerlund, & Nyström, 2012). While it is important to apply new technologies to the urban environment, the living lab is also recognized as a place for citizen participation to solve urban problems. For this reason, the European Network of Living Labs defines the living lab as an ecosystem that enables business and social innovation with users and producers working together and trusting each other (Tukiainen, Leminen, & Westerlund, 2015). Currently, living labs are not only applied in the company's production process to reflect users' voices, but also used in a wide range of urban development projects (Hossain, Leminen, & Westerlund, 2018). As cities increasingly become potential centers of knowledge, social and cultural diversity, as well as public infrastructure, are becoming more critical (Sassen, 2011).

At the same time, cities face various problems—such as climate change, resource scarcity, environmental pollution, and congestion—that call for urban governance and social cohesion so that citizens become one of the main pillars for securing ecological sustainability, cultural diversity, and redistribution of urban resources (Lyons, Duxbury, & Higgins, 2006). Thus, collaborative governance is an essential citizen-centric process that involves key

actors—namely, the public sector, citizens, companies, and researchers—to achieve smart city development goals (Tan & Taeihagh, 2020). Furthermore, the living lab has come to serve as a testbed for new products and services linked to the 4th Industrial Revolution, as well as a platform for collective innovation and development based on citizen participation (Almirall & Wareham, 2011). Finally, the living lab is an important platform for various actors to realize local problems (Seong et al., 2016), as its network can contribute to the new urban development of building design, green infrastructure, and low carbon technologies through co-creation of urban stakeholders (Evans, Jones, Karvonen, Millard, & Wendler, 2015).

How active and effective the various participating stakeholders are in the living lab has a strong influence on the success and failure of its outcome (Vos & Achterkamp, 2006). This is because the living lab is a place where various stakeholders participate, including technology suppliers, citizens, researchers, non-governmental organizations (NGOs), and governments (Rits, Schuurman, & Ballon, 2015). Depending on which stakeholder has the central role, the living lab can be divided into four categories: the enterprise-led "Utilizer-driven Living Lab," the central and local government-led "Enabler-driven Living Lab," the research institute-led "Provider-driven Living Lab," and the citizen-driven "User-driven Living Lab" (Leminen et al., 2012; Robinson et al., 2013).

The components and characteristics of living labs have a significant impact on their outcomes. Veeckman et al. (2013) categorize 11 characteristics based on the living lab's environment, approach, and innovation results. Regarding the living lab environment, the essential factors are the technological infrastructure that enables innovative testing, the ecosystem where various stakeholders interact, the community that leads the participation, and the "Real World Context" that reflects the natural environment of users. Regarding the living

lab approach, it is necessary to consider whether users can participate and evaluate the process at various stages (Veeckman et al., 2013). Furthermore, users' roles vary depending on the level of the living lab activity; they can act as information providers, testers, contributors, and co-creators (Leminen, Westerlund, & Nyström, 2014). Finally, the living lab's innovation results are influenced by the strategic intent and passion of the participants, by knowledge and technologies, by various other resources, and by the partners of the living lab's network (Veeckman et al., 2013).

In South Korea, living labs take the form of government-led Enabler-driven Living Labs. Because a variety of innovations and developments occur in projects that are formed with a specific purpose (Vos & Achterkamp, 2006), internal stakeholders are inevitably influenced by the purpose of the organization (Wagner, Mainardes, Alves, & Raposo, 2011). Additionally, the living labs in South Korea—of which Seoul's Bukchon IoT Living Lab was the first—are often government-led projects designed to apply the smart city concept. Therefore, the innovation network formed therein also depends on the organization's purpose (Ministry of Science, ICT, and Future Planning).

The open platform test based on Bukchon led to other developments, such as the SMG's "2016 IoT demonstration area expansion and operation" and the "Seoul City IoT Incubator Center operation" (Seong et al., 2016). Led by the Goyang Promotion Agency, Goyang-City in Gyeonggi Province also promoted a living lab that uses ICT technology to solve urban problems. However, this project was considerably lacking in public-private cooperation due to intermittent civic participation and one-time events (Kim et al., 2019). These examples indicate that government-led living labs in South Korea are mostly demonstrative projects that focus on technological development rather than civic participation.

Nevertheless, there are signs that a citizen-centered living lab might be possible in South Korea. For instance, the Seongdaegol Energy Self-Reliance Village, located in Dongjak-gu, Seoul, has been created by citizens who recognized the energy crisis after the Fukushima nuclear accident and searched for alternatives to become energy-independent, thus showing the potential of a grassroots living lab. The citizens involved in the project call each other "village researchers," and they actively organized the energy conversion council to manage the living lab's operation and played a role in coordinating opinions and receiving support from the government (Park & Yun, 2016). Currently, the case of Seongdaegol is influencing the cities of Jeju and Wanju.

Another bottom-up initiated living lab is Daejeon's Cross-U Living Lab, which was created to solve a fatal accident caused by heavy rain on a stone bridge near a supermarket (Homeplus) in Yuseong-gu, Daejeon-City. Citizens and students from the nearby Korea Advanced Institute of Science and Technology (KIST) and Chungnam National University came together to install the live camera and invented an app that sends alerts when the river is flooding, which allowed for the construction of an overpass that is safe to cross on rainy days (Seong et al., 2016). While the examples represent various possibilities of bottom-up living labs, the government-driven living labs are still predominant in South Korea. Therefore, it is important to understand the characteristics of the living lab in South Korea under the top-down smart city development that is centered on technological infrastructure.

Understanding the South Korean Smart City Context

To understand the context in which the living labs in South Korea are being rolled out, it would be worthwhile to discuss how the South Korean government has adopted government-led policies, laws, and systems to drive the smart city transition. Since 2017, the central government has formed a special smart city committee under the Presidential Committee on the 4th Industrial Revolution to promote smart city projects.

However, Seoul has already emerged as one of the world's most advanced smart cities because of various information and communication technologies. According to a report by the Singapore-based Eden Strategy Institute, in 2020/2021 Seoul took second place among the top 50 smart cities in the world (Eden Strategy Institute, 2021); Singapore came first, while London was third. SMG's smart city strategy has advanced through several stages to achieve this acknowledgment. Furthermore, the city has been developing master plans such as Digitalization (1999), Intelligent City Seoul (2003), U-Seoul (2006), Smart Seoul (2011), and Global Digital Seoul (2016) over the years (Joo, 2021).

A legal basis has also been established for smart city development, as Smart Seoul was promoted based on the Informatization Promotion Act and the Ubiquitous City Construction Act. The SMG enacted the Seoul Informatization Promotion Act in 1998 and implemented the Seoul Informatization Basic Plan in five stages. Then, in 2008 following the development of information and communication technologies, the Ubiquitous City Construction Act was passed, combining ubiquitous technology with urban space to provide information anytime, anywhere. Based on the 1st U-City Comprehensive Plan in 2010 and the 2nd U-City Comprehensive Plan in 2014, Seoul pushed ahead with the U-City policy until 2018 (Seoul Institute, 2019). Although the U-City policy—centered on technological development and

infrastructure—had several limitations, a number of laws and policies developed under the U-City became essential elements of the Smart Seoul.

Whereas SMG has shifted its focus towards citizens in its smart city plans beginning with the Smart Seoul plan, in reality, the government continues to play the leading role of main urban developer. This legacy of the Korean urban development model, which was led by the government, has mainly pursued economic growth. For instance, a brief look at the history of urban development in Seoul illustrates how the city has modernized under the strong government plans since the Park Chung-hee military government in 1961. In the 1960s and 1970s, top-down urban development was carried out in Seoul based on the Gangnam Development Plan (1970) and the Yeouido Development Plan (1971). In this era, government coercion and rational planning by experts were considered essential, while cooperation among citizens, social relationships, and participation based on social capital was considered secondary. Therefore, under the central government-led urban planning system, residents had no means of participation in planning (Kwon et al., 2004). Thus, South Korea's urban planning has been criticized for excluding citizens and strengthening the ties between central and local government officials (Jeong & Kim, 2011). For this reason, some scholars believe that urban planning in South Korea is absorbed in mannerism (Jeong et al., 1999). Conversely, according to Jeong (1999), new governance can be an alternative to overcome the existing challenges in South Korea. Therefore, participatory governance achieved through the living lab could be a starting point to bring about new urban governance.

In fact, Seoul has the potential to become a smart city with strong citizen participation. According to Pew Research statistics from the United States in 2019, South Korea's smartphone penetration rate among the population is about 95%—the highest among 27

countries globally (Pew Research Center, 2019)—and the average Internet speed and approach rate are also at the top of the list. As a result, many citizens are ready to voice their opinions through IT technology. According to a 2020 E-Government Development Index (EGDI) of the United Nations, Seoul's e-government, which began in the 1990s and led to the e-government smart city initiative in the 2000s, has become a model for the international community, occupying the top spot for five consecutive years over the past decade. As part of this initiative, the Seoul CCTV Integrated Control Center and the Seoul Data Center were built for the safety of citizens, and the mobile voting app m-Voting, the World Smart Sustainable Cities Organization (WeGO), and the Seoul Open Data Plaza were launched in the 2010s. These projects show the potential of systematic e-governance and citizen participation in Seoul. However, whether the citizen-centered living lab concept can take root in South Korea's urban context remains to be seen.

According to scholars, strong government-led policies have created top-down urban governance in South Korea (Seo, 2008; Kwon, 2004; Jeong, 1999). However, the limitations of top-down, technological infrastructure-oriented development seen in the U-City policy, as well as the need for multifaceted solutions to urban problems, both point in the direction of new urban governance. In particular, increasing citizen participation through smart cities and living labs is expected to be a significant turning point for urban planning in South Korea. Based on an in-depth analysis of the MLL case in Seoul, this study seeks to highlight the dynamics behind the living lab, including how actors participate and why, what processes take place, and what the main challenges are in pursuing a PPPP governance.

Methodology

To examine the MLL in depth, the case study was adopted as the main method. A case study is a methodology that provides an in-depth understanding of how a phenomenon occurs in a real-life context (Miller et al., 2021), and is useful because smart cities and living labs must be understood in a local context. Therefore, since a case study allows us to understand the overall context of the actors' communication means, the motivations and processes of the living lab participants, and the relationship with the urban context where the experiment takes place, it is crucial to examine the process of how MLL governance works.

A case study was conducted based on secondary data research and in-depth interviews with main stakeholders in the MLL. First of all, the literature review examined the local characteristics of Magok, including the Magok new town development, Magok U-City, Smart City, and the MLL. The secondary data used in the case study were official documents on urban development and policies issued by the government, data on smart city living labs, and prior research and articles on the Magok area. Furthermore, the data selected to study the government-oriented urban development policy and the characteristics of the public-led living lab are reports related to Seoul's smart city policy, papers by the SMG and the Seoul Housing & Communities Corporation (hereafter SH) that deal with redevelopment in the Magok area, and publications and webpages of the Seoul Industry Promotion Agency (hereafter SBA). In addition, based on previous research on smart city living labs, a study was conducted on how stakeholders participate in the MLL.

Through semi-structured, in-depth interviews, the opinions and perspectives of various stakeholders were collected and analyzed. These interviews, which were conducted from October 2020 to April 2021, sought to take a closer look at each living lab stakeholder and their

motivations for participating in, as well as their perceptions of, the living lab. The interview targets were organized into four main types: citizens, public sector, private companies, and living lab researchers. More interviews were conducted with citizens living in the Magok area to gain better insight into how the citizens participated in the living lab. Even if citizens had never participated in the living lab project, those interested in the living lab were also included. Furthermore, interviewees were recruited through an online community called Magok Love, where opinions related to many smart city projects—including the Living Lab—and information on the Magok region were actively exchanged. The manager of Magok Love was also selected as a key informant and companies participating in the living lab, most of which were active before the living lab, were interviewed. Moreover, ten start-ups participated in the MLL between 2019 and 2020 and a total of six were interviewed. There were no research institutes continuously participating in the MLL, though a few independently cooperated with companies in each project. Finally, interviews with partner research institutes were not possible.

possible.

< Table 1: Interviewee List >

Group A - Citizens (User)			
Name	Age	Job	Interview Date (2021)
A1. Jung Soo-yeon	48	Homemaker	4.9
A2. Jeon Mi-jeong	44	Homemaker	4.11
A3. Kim Moon-sook	54	Homemaker	4.11
A4. Miae Kang	38	Childcare Center	4.11
A5. Jinhyeok Joo	38	Worked in Magok	4.11
A6. Kang Chang-soo	47	Worker	4.11
A7. Eunji Lee	The 40s	Homemaker	4.13

Group B- Private Company (Provider)		
Company	Name	Interview Date (2021)
B1. Air Order	Anonymous	3. 3
B2. Oyster Able	Juyong yeom	3. 4
B3. Robotis	Lee	3. 4
B4. EXO SYSTEMS	Anonymous	3. 5
B5. Dash Company	Anonymous	4. 2
B6. Digital Seoul&Team Interface	Yurim Seo	4. 6

Group C - Institute		
Institute	Name	Interview Date (2020)
C1. Hope Institute	Jiho Park	10. 27

In Enabler-driven Living Labs, the public sector plays an important role. In particular, the MLL participants include the Southwest Region Project Division of the Seoul Regional Development Headquarters, the Magok Revitalization Team of the SBA, and the Gangseo-gu Office. The SMG is in charge of the overall Smart City Living Lab policy and the SBA conducts the real business. The SBA was established to strengthen the competitiveness of small- and medium-sized enterprises (hereafter SMEs) located in Seoul through comprehensive support projects in the areas of technology, management, and human resources, using laws for the promotion of SMEs (SBA, 2019). Furthermore, the SBA is the primary public actor participating in the living lab and is responsible for direct communications among the various actors. Unfortunately, both the SMG and the SBA were unavailable for interviews, so I looked into how the public sector participates in the living lab by consulting various secondary materials. In addition, through interviews with companies and citizens, I tried to infer how the SBA was working.

The MLL was selected as the case study because it systematically applied a strong government-led approach. Among the smart city living lab projects conducted by the SMG, the MLL has a long-term budget and specifies the methods for securing the living lab procedure. Moreover, while the Bukchon IoT Living Lab was only a one-time project, the MLL is planned to conduct five pilot projects every year from 2019 to 2022. If a project is selected, it will receive funding of between 70 and 100 million won (SBA, 2019). From the perspective of a start-up, this money can be sufficient motivation to participate. It is also interesting to note that civic participation was similarly encouraged; indeed, about 10% of the budget allocated to the chosen company was required to be used for involving residents in an effort to ensure their participation.

However, there are likely to be limitations and challenges to this government-driven effort to promote citizen participation. In this case study, I plan to find out what they are and highlight the unique characteristics of the government-led living lab in South Korea.

The Case Study of the Magok Smart City Living Lab

Magok Area

The Magok area, which has the characteristics of a new town created by strong government-led urban planning, is located in the southwestern part of Seoul and is a member of Magok-dong and Gayang-dong. The name "Magok" comes from the words for Cannabis sativa (Ma 麻) and valley (gok 谷), and the area is a flat lowland of more than 3.66 km^2 adjacent to the Han River. Until the early 2000s, it was the only place in Seoul where rice farming had endured for

about 700 years, making it the only large tract of undeveloped land in Seoul (SMG, 2014). Even when the Magok Station opened in 2008, a 500m radius surrounding the station was a wasteland. Consequently, the SMG contemplated on how to develop Magok for a long time (SH, n.d.), and in December 2005 the Magok Urban Development Project Initiative was announced. Since December 2007, Magok has been designated as an urban development zone. Magok is typical a new town developed by SMG and SH (SMG, 2014).

< Picture 1 – Magok in 1980 >

Source: Gangseo-gu Office

<Picture 2 –Magok development project in 2016>

Source: Gangseo-gu Office

<Picture 3 – Virtual picture after policy>

Source: SH

The urban development plan for Magok aims to attract growth engines, provide convenient transportation, and make it into a green city. Magok district is located within 2 km (5 minutes) of Gimpo Airport, 40 km (35 minutes) of Incheon International Airport, and 13 km (20 minutes) of downtown Seoul (SMG, 2014), and the Seoul Botanical Garden is nearby. In addition, Magok has major metropolitan roads connecting it to downtown Seoul and three urban railroads (Line 5, Line 9, and the Airport Railroad) passing through the district. Thus, it has the advantage of a convenient and widespread transportation network (Kim & Lee, 2020). Due to these geographical factors, Magok is expected to play the role of gateway city to Northeast Asia in the future (SMG, 2014).

< Map 1– Transportation Plan >

〈광역교통구상도〉

Source : SH

The SMG created an eco-friendly industrial cluster for new advanced technologies in Magok known as the Magok Industrial Complex. Large companies (e.g., LG, Kolong, Lotte, E-Land, and S-Oil) and SMEs are joining the Magok Industrial Complex. In total, about 120 companies, including high-tech and related businesses, large corporations, and SMEs have moved in (Kim & Lee, 2020). Furthermore, the Magok district is about six times larger than the Pangyo Techno Valley, where South Korea's representative IT companies are located. Therefore, the Magok district is expected to become the most significant R&D complex in South Korea and is referred to as the "M-Valley" (SH, n.d.).

Magok is divided into district 1 (residential complex), district 2 (industrial complex), and district 3 (park complex). Of the total area of 3,665,756m^2, residential complexes make up 29% (1,066,172m^2), industrial and business complexes 20% (1,902,963 m^2), and park complexes 19% (697,096 m^2). Housing units were supplied as a new town development at a

total cost of KRW 6,613.4 trillion. (SH, n.d.). The project was led by the SH, which aimed to supply a total of 16 apartment complexes (10,030 households) and "officetels" (offices plus housing) (about 15,000 units). In addition, the project included units for market sale, long-term rent with a lump-sum deposit (hereafter jeonse), and public rental units. Among them, 21% (2,494 households) were public rental units and 29% (3,513 households) were jeonse. Lastly, the first full-scale move-in of citizens into Magok started in September 2013 and continued until 2016.

The development of Magok was also part of the U-City project under the Ubiquitous City Construction Act (ICEE, 2018). One of the goals of Magok U-City was to create a high-tech R&D urban space. Furthermore, the U-City design was centered on technological efficiency, led by the government (Kim & Lee, 2020). According to Kim and Lee (2020), Magok was planned differently from other new town development projects because it was under the smart city agenda. Magok began advancing its industrial complex and promoting the transition into a smart city in the energy and information sectors (Seoul Institute, 2019). Furthermore, the SH signed a business agreement with Gangseo-gu and LG CNS to develop Magok into a smart city. This business agreement was created so that residents' convenience and technological developments, such as IoT and AI, are achieved together.

In the "M-Valley" part of the name of the Magok M-Valley Smart City Demonstration Complex Creation project, the "M" symbolizes not only the local identity of Magok but also the words *mega*, *much*, and *miracle*. The project has the ambition to develop Magok into an industrial complex similar to Silicon Valley. It also aims to establish an infrastructure for showcasing the 4th Industrial Revolution smart technologies from 2018 to 2022 and establish a sustainable smart city model that citizens can experience. An information city with high-

speed broadband communication infrastructure and energy-independent smart city projects are also in progress (SMG, 2014).

<Map 2 – Magok District Map >

Source : SH

The Magok Smart City Living Lab and its Main Challenges

The MLL is planned from 2019 to 2022 and is expected to both play an important role in overcoming the limits of the existing U-City and showcase the potential of new urban governance. The MLL also carries out various projects for its local residents, discovering local problems and applying technology in the city based on citizens' ideas (SMG, 2018). In addition, the MLL aims to promote R&D for smart city technology (Park, 2020). The living lab is expected to form a consortium of SMEs and social enterprises that can develop the technology and support user participation (SMG, 2018). After 2022, when the SMG's Magok R&D Center will be completed, start-ups will move into the Smart City Living Lab space dedicated to social venture companies (Park, 2020). Thus, it is evident that the R&D characteristic linked to the Magok Industrial Complex is strong in the MLL.

Five companies are selected every year from 2019 to 2022 and their projects last about 7–9 months, including intermediate and final reporting. The smart city advisory group judges the adequacy and suitability of the project, measuring the funding based on the project plan's excellence, feasibility, and utility. The funding is specified to be around 100 million won per project in 2019 and around 70 million in 2020 and 2021, and more than 10% of the project cost must be allocated to user participation. In 2019, the companies proposing the MLL project defined Magok's problem on their own. However, in 2020 and 2021, the SBA surveyed the problems and asked for proposals in health promotion, transportation convenience, and environmental improvement related to the 4th Industrial Revolution technology (SBA, 2019). This study takes an in-depth look at how residents' participation was formed in this process and what kind of challenges existed.

<Table 2 – Selected projects for MLL in 2019 and 2020 >

2019 selected projects	
Company	Project
Community Mapping Center	Magok Smart City Smell Community Mapping Project with citizens - Collecting local odor data and building a map, researching odor problem solutions.
Airorder	Barrier-free city pilot project for the visually impaired - Smart Order App that helps visually impaired people to walk conveniently and purchase goods
Digital Seoul & Team Interface	Building fire recognition system for residential area based digital twin technology - application for apartment fire detection
Robotis	Demonstration of outdoor delivery using autonomous robots in Magok Industrial Complex - Experimental study of autonomous driving robot
Dash Company	Station-based personal mobility operation experiment -Safe driving through IoT electric kickboard and station operation

2020 selected projects	
Company	Project
EXO SYSTEMS	Non-face-to-face musculoskeletal health care platform' for Magok citizens or employees
UNISON	Eco Artificial Intelligence Internet of Things (IoT) chatbot that informs environmental information collected by IoT sensors
Nine to One (Shared Bike Elecle)	The semi-dockless system that uses machine learning technology to provide incentives when parking shared bicycles in designated parking areas
Oysterable	Installation of recycling bins with IoT sensors
Happy and Good (Shabi-Sebi)	Installation of 'Smart Station' for parking, charging and sharing bicycles and electric kickboards

Retrieve from SBA (re-edit)

Before delving into the critical analysis of the MLL, its strengths and advantages should also be mentioned. Magok is simultaneously a new town and a leading smart city project, and its development, which started under Seoul's urban development plan, created a favorable environment in which the MLL can operate well. For example, the characteristics of the new urban development, which is designed for barrier-free living, make Magok a good place to apply new technologies, such as robots and autonomous driving (SH, n.d.).

<Picture 4 -Autonomous driving robots in Magok>

Source: Robotis

In addition, the Magok Industrial Complex provides an environment where multinational companies and start-ups can exchange ideas and create new industrial ecosystems within smart cities. Consequently, urban-tech companies and start-ups that provide city services through new technologies can play an essential role in creating smart cities by introducing new solutions to long-standing problems (Seoul Institute, 2019). Furthermore, from the perspective of small businesses and start-ups, the living lab is an important opportunity to acquire venture capital by sharing resources and knowledge with others (Eriksson et al., 2005). Since the Magok Industrial Complex is home to various SMEs and large enterprises, it is a suitable environment for nurturing start-ups and discovering new technologies. Finally, the SMG is paying attention to the living lab linked to the Magok Industrial Complex to apply smart city technology to the urban infrastructure.

Despite the advantages and strengths of MLL, major challenges have been identified during the interviews. For instance, there is a lack of awareness of the living lab among the stakeholders. During an interview with a company, the interviewee said that the majority of citizen participants did not know the meaning of the term *living lab* (B2, Personal Communication, March 04, 2021). Because citizens were not familiar with the living lab concept, collecting users' opinions was done by other means, such as through a survey or product use interview (B1, Personal Communication, March 04, 2021).

Furthermore, even though the companies applied for living lab projects, there were cases where they did not understand the living lab concept. These companies came to know about the living lab while participating in the MLL (B5, Personal Communication, April 02, 2021), and in some cases, a group study was conducted during the living lab to understand its system at the company level (B6, Personal Communication, April 06, 2021). However, the

living lab project was generally carried out without the company's awareness, which caused significant disappointment among residents. Citizens who participated in the living lab project for six weeks were asked to purchase a product or pay for an application to continue participating after the experimental period (A1, Personal Communication, April 09, 2021). In this case, even if citizens wanted to use the technology for a longer time, they stopped providing feedback due to the financial burden (A3, Personal Communication, April 11, 2021). Moreover, other government agencies collaborating in the living lab project were typically unaware; except for the SBA, other entities—such as district offices, community service centers, and the Ministry of the Environment—did not properly understand the living lab concept. Thus, it was challenging to request cooperation with the initiative (B2, Personal Communication, March 04, 2021).

Despite the lack of awareness, the incentives provided by the government were an important motivation for participation. Small incentives, such as gift cards or cash, triggered civilian participation, as residents said that they participated in the living lab simply because they saw an online community notice about rewards (A3, Personal Communication, April 11, 2021). Although the purpose of participating in a living lab is to provide opinions as users, citizens appreciated this compensation in exchange for their time and effort (A1, Personal Communication, April 09, 2021).

For companies, the greatest incentives were government funding, technology commercialization, user feedback, and business expansion. Thus, the MLL project was sometimes considered to have no meaning beyond being "a government project that gives a lot of subsidies" (B1, Personal Communication, March 03, 2021). In addition, companies have an advantage in commercializing their technology simply by participating in various government

projects, including the living lab. Therefore, in some cases, companies participated in the living lab to install their products with the government's financial support. For example, one company was interested in cooperating with Gangseo-gu Office before the MLL; since the district office wanted to use the company's technology but lacked the budget, the company could collaborate with the Gangseo-gu Office by applying for the MLL funds (B2, Personal Communication, March 04, 2021). This example shows that the various stakeholders participated in the living lab for different reasons than for the sake of the living lab itself.

Secondly, challenges exist because of the top-down governance—yet without strong government support or assistance—of the MLL. According to the interviews, the SBA was the only public organization in charge of administrative support and communication. However, it provided no more than an official letter encouraging participation (B3, Personal Communication, March 04, 2021), and in the case of projects that required cooperation with community centers and fire departments, it provided only contact information (B6, Personal Communication, April 06, 2021). When asked to participate, relevant public officials also felt the burden of increasing their work, which is the direct cause of the SBA's failure to request active cooperation from other agencies. The companies expressed their disappointment because when government agencies like the SMG and the SBA request strong cooperation, this can lead to more effective collaboration than when it is the company asking (B2, Personal Communication, March 04, 2021).

However, one should also understand the SBA's position, as its requests to participate could create interdepartmental pressures (B6, Personal Communication, April 06, 2021). There was also an opinion that systematic cooperation between departments related to smart cities—

at least, for the departments linked to the living lab—would be helpful (B4, Personal Communication, March 05, 2021).

Despite the lack of assistance, top-down governance was made evident in the evaluation process that was imposed on the participating companies. Since the MLL uses the government budget, evaluation was frequent. Furthermore, although horizontal and flexible communication is essential for the living lab, the evaluations of the MLL were carried out in a top-down manner. Companies shared the opinion that the period is too short for an interim review, which takes place only two to three months after the start of the project (B1, Personal Communication, March 03, 2021); they argued that more time is needed for the living lab results to reflect citizen participation and local needs. In addition, conflicts existed due to the vertical method in which professional judges unilaterally evaluated the companies. There was also the opinion that the fact that the judges reviewed the presentation materials and the company announced it in front of them was against the bottom-up spirit of the living lab (B6, Personal Communication, April 06, 2021). Because the living lab is an experiment, it is essential to derive the results or try the experiment regardless of the success or failure of the results. However, the method for evaluating the living lab and the viewpoint of the experiment were limited to either success or failure (B1, B3, Personal Communications, March 03, 04, 2021).

The third identified challenge is the living lab projects' lack of sustainability due to the short time frame imposed upon them. The MLL supports projects only for up to one year, and after this period is over, many companies withdraw and terminate the various experiments that they have installed because maintaining the facilities is costly (B2, Personal communication, March 04, 2021). Realistically, the companies participating in the living lab have no choice but to stop their business in Magok when the project is over. Therefore, for the living lab to be

significant, the duration of the project must change. For example, the time limit of the maximum period is set, and an environment where experiments can be conducted freely within that period should be created (B2, Personal Communication, March 04, 2021).

Citizens also pointed out that the living lab projects were not sustainable, as they were carried out within a fixed period of one year. According to the interviews, there was a case where the experiment was terminated after only two-thirds of the project was completed due to the deadline (A6, Personal Communication, April 11, 2021). In this case, residents were looking forward to its outcome, as the bad odor has been one of the major problems in Magok,but, they ultimately disappointed when the cause of the odor was not found due to the time limit (A3, Personal Communication, April 11, 2021).

Last, but not least, the MLL's main challenge that needs to be addressed is the fact that it is a testbed without the real-world context. Many projects lose the locality of Magok because they do not start with local needs and problems (C1, Personal Communication, Oct 27, 2021). Instead, the projects are more driven by companies' interest in applying their technologies in the new urban infrastructure of Magok. Furthermore, participating companies focused on the urban environment and infrastructure provided by the new town of Magok more than on solving the problems of the (B3, Personal Communication, March 04, 2021).

The companies participating in the MLL also preferred listening to the potential consumers' feedback rather than solving local problems (B2, Personal communication, March 04, 2021). According to some company interviewees, the results of the living lab impressed them because they could apply the new technology and use it for marketing purposes; in other words, by participating in the MLL, they can commercialize their technology and hear the voices of consumers while receiving subsidies (B1, B4 Personal Communication, March 03,

05, 2021). In addition, there were companies that, unlike R&D ones, were able to meet consumers and understand their needs, which helped them considerably with marketing (B2, Personal Communication, March 04, 2021). There were other cases where the living lab project was conducted to strengthen the overall convenience of all the consumers targeted by the company rather than solving specific problems in Magok (B3, Personal Communication, March 04, 2021).

The citizens that participated in the living lab emphasized the need for a project that benefits residents (A1, A2, Personal Communication, April 09, 11, 2021) and pointed out that the living lab projects were limited to "what kind of experiment should we do in Magok, as a testbed" (A2, Personal Communication, April 11, 2021). Because many projects are applicable to other urban area, not only Magok (A3, Personal Communication, April 11, 2021) Consequently, some residents were disappointed because the majority of the projects differed from the needs of the neighborhood (A6, Personal Communication, April 11, 2021), prioritizing start-up technologies. Even the projects that reflected local needs appeared to fall short of achieving meaningful outcomes for residents due to the policy's time constraints.

Despite these critical challenges, the MLL case has some features that can potentially initiate new governance in the Magok Smart City with the right strategies. An important aspect gauged through the interviews was that Magok citizens had several experiences of solving problems together when they moved to the new town. Furthermore, the online community created at this time became a platform to share their interests in the city and, due to the characteristics of the new town, residents have a great desire for community development, which has led to their participation in the living lab (A6, Personal Communication, April 11,

2021). Overall, residents were generally favorable to the living lab and hoped it would continue (A1, A4, A5, Personal Communications, April 09, 11, 2021).

Some citizens expressed that the MLL helps raise resident participation's potential to form a rapport among citizens (A3, A4, A6, Personal Communications, April 09, 11, 2021). At first, residents participated in the living lab due to the compensation they received, but the MLL quickly became a story for them to talk about. As a result, sharing what they felt while participating in the living lab was very positively received (A1, A3, A4, Personal Communication, April, 09,11, 2021).

In other words, the living lab seems to show the possibility of empowering Magok citizens through community participation because citizens felt that their participation in the MLL could be an opportunity to change the city. By participating in the living lab, they developed a new sense of community (A3, A4, Personal Communication, April 11, 2021). Despite the critical challenges and limitations, the MLL does not seem to have fully lost its hope of becoming a platform that brings citizens together to participate in local issues.

Conclusion

This article examines the limitations and possibilities of the government-led living lab located in Magok, Seoul, as well as how its inherent complexity and intricate urban policies affect its character. Despite the strong policy push for the MLL and the characteristics of smart city pilot areas, the MLL shows the limitations of the existing government-led urban development, which in turn demonstrates the challenges that policies manifest by forcibly inputting bottom-up urban governance through the living lab model.

In the government-driven MLL, the decision-making and evaluation processes take place according to the conventional top-down system. From companies' point of view, Magok is a suitable laboratory to test their technologies of the so-called 4th Industrial Revolution because there are newly created urban infrastructures, such as flat roads and apartments. The Magok Industrial Complex also provides a good environment for communication and cooperation related to smart city technologies and R&D. Both companies and citizens participated in the MLL not so much for solving local problems, but for obtaining various economic incentives. Furthermore, the fact that it is a project that uses the government budget greatly influenced the processes and the outcomes of the living lab. For example, there are show-like evaluations and announcements of results, a lack of communication among government departments, and local problems that cannot be solved due to one-off projects, thus the system still shows the limitations of top-down urban policies. In addition, the living lab had temporal and budgetary limitations imposed by the government. Therefore, even if the citizens wanted to apply the experimental results to the city and continue participating, they were not able to do so.

Unlike the ideal living labs, the main purpose of the MLL policy is to solidify Magok's identity as an R&D city. Oftentimes, technical testing and the gathering of market information are prioritized, rather than solving urban problems faced by residents or improving their quality of life. According to Veeckman (2013), there are three main steps in the living lab: the research step, the experimental step, and the evaluation step. In the MLL, the entities that define urban problems at the research step are mainly companies and, in very few cases, citizens. The government selects the project and companies usually carry out the experimental step. The citizens' role was usually limited to using the company's technology and providing feedback

under the companies' plans. If residents want to continue using the technology for the community, they cannot do so due to restrictions in budget and project duration. As a result, citizens who should be the primary actors in the living lab are excluded from participating in each living lab step and are demoted to the role of a show-off implement. The case study also illustrated how the short-term, top-down evaluation, led solely by the government, was problematic.

To overcome the limitations of top-down urban governance, it is important to create a shared vision with citizens. Grassroots governance, which is the process by which local residents make development proposals and embody them based on the common goals of the community, enhances citizens' sense of belonging and brings about urban innovation (Jeong, 2007). Additionally, awareness shared by stakeholders can facilitate living lab process. We can consider the Seongdaegol case as an ideal direction of living lab policies in Seoul, including Magok, to overcome the limitations because its citizens voluntarily and directly participate in each living lab step based on their awareness about new energy paradigms (Jong-Moon Park & Soon-Jin Yoon, 2016). As a result, residents are empowered as living lab researchers, which further leads to civic movement and the public sector's engagement to support the living lab. This is an important case of how the living lab driven by the residents' own voices led to participation in the public sectors and by other actors.

From this perspective, a living lab must be a platform where citizens can gather their opinions and reach their goals. While some of the interviews with the residents of Magok showed potential to promote more bottom-up governance in the MLL, the critical challenges identified in this thesis severely limit its potential to develop into a citizen-centered living lab. Consequently, the government, together with the citizens and the companies, should revisit its

current approaches to living labs and work towards finding creative and feasible ways to overcome the challenges.

Further study is required to see how MLL stakeholders will sustainably participate in the living lab process after 2022. Through in-depth understanding of the MLL, which is critical in developing the fundamental approach of a government-driven living lab in South Korea, we can consider the limits of government-driven living lab and how to overcome this challenge.

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