



Establishment of the Legal System's Direction for Supporting and Activating the Smart+Building

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ABSTRACT

Purpose: Society is experiencing explosive growth amid the rapid development of technologies of the 4th Industrial Revolution, including AI, IoT, big data, robotics, autonomous driving, and UAM. Advanced smart technologies different from those of previous societies are accelerating the change to a new and convenient lifestyle and living spaces. This study aims to establish the institutional foundation necessary for systematic support of 'smart+building' as a new architectural space platform for applying 4th industrial revolution technology to buildings and activating new services, establishing the basic direction of the legal system for supporting and activating smart+building. **Method:** This study reviewed domestic and international prior research papers and research reports related to smart cities. Then, it investigated and analyzed the structure of similar legal systems such as the 'Smart City Act' and related laws to derive the basic direction of the legal system necessary to support and activate smart+buildings. **Result:** In accordance with the 'Smart+Building Activation Roadmap' presented by the Ministry of Land, Infrastructure and Transport, this study aims to utilize it as basic research data as follows: Establishing regulations on requirements for each policy promotion stage for the efficient expansion and distribution of smart+building in Korea; Establishing a smart+building certification system; Providing incentives for smart+building structures; Lifting related regulations; Training smart+building-related personnel; Establishing an institutional foundation for promoting smart+building's pilot projects.

KEYWORD

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1. Introduction

1.1. Research Background and Objectives

Technological advancements such as AI, IoT, big data, robotics, autonomous driving, and UAM have led to explosive growth in related markets. These advancements accelerate the transformation into a new and convenient way of life through advanced smart technologies. They are creating a shift in our daily lives and living spaces, marking a progression to a new dimension compared to previous societies.

The government is systematically fostering these new technologies and creating a related industrial ecosystem. It has identified these technologies as new growth drivers for developing national industries and enhancing national competitiveness. Efforts are being made to establish various national policies, improve related legal systems, and create a foundation for fostering the relevant sectors.

In the field of smart cities, based on world-class information and communication technologies and infrastructure, the "U-City" law was enacted in 2008 to foster ubiquitous cities. In

2017, the "Smart City Act" was established to systematically promote the creation and support of smart cities and lead the development of related industries[1].

Conversely, the architectural field, a core component of smart cities, has a relatively lower level of technological application and utilization than urban sectors that continuously build smart city infrastructure through advanced IT technologies and big data. While various technologies and new services of the Fourth Industrial Revolution are being offered on platforms, the development and implementation of technologies for application in architectural spaces, where people work and live, remain in the relatively early stages.

This study aims to derive the institutional foundation for systematically supporting the creation and expansion of "Smart+Buildings" and activating new services following the "Smart+Building Activation Roadmap" announced by the Ministry of Land, Infrastructure, and Transport, ROK in 2023[2]. It focuses on commercializing the technologies of the Fourth Industrial Revolution in buildings and developing new integrated space platforms. This study aims to explore and present the basic direction of laws and systems for supporting and activating Smart+Buildings.

Through this, the study aims to serve as basic research material

for establishing the institutional support foundation required for the efficient spread and dissemination of Smart+Buildings in Korea, as outlined in the “Smart+Building Activation Roadmap” announced by the Ministry of Land, Infrastructure, and Transport. This includes implementing policy steps, promoting a Smart+Building certification system, providing incentives for Smart+Building constructions, removing related regulations, fostering personnel for Smart+Buildings, and advancing pilot projects.

1.2. Research Methods and Scope

To analyze the laws and systems related to Smart+Buildings, this study reviewed literature from domestic and international research papers and reports on smart cities. It also investigated and analyzed the structure of related legal systems, such as the “Smart City Act,” and relevant regulations.

First, this study set the following laws closely related to Smart+Buildings as the research subjects: the “Basic Building Act,” the “Building Service Industry Promotion Act,” the “Smart City Act,” the “Urban Air Mobility Act,” the “Intelligent Robot Act,” the “Autonomous Vehicle Act,” and the “Green Building Support Act.” Second, by analyzing the contents of these existing laws, the study identified the key points included in each law and derived the basic direction of laws and systems needed for Smart+Building development and expansion by establishing the “Tentative Smart+Building Support Act.” Third, through this, the study aimed to provide basic data for the institutional foundation required to implement the measures outlined in the Ministry of Land, Infrastructure, and Transport’s Smart+Building Roadmap.

2. Theoretical Review of Smart Cities and Smart+Buildings

2.1. The Concept and Current Status of Smart Cities

With the advancement of new technologies in the Fourth Industrial Revolution, smart cities are defined from various perspectives. They respond to the need for city form and structure changes, moving away from the current urban shapes and structures. This shift is required for smart cities to play a central role in various urban sectors.

The smart city efficiently utilizes, and leverages ICT technology and the vast data generated in the city. In the case of the United Kingdom, a smart city is defined as “a city that is suitable for a comfortable life, resilient, and a process in itself, driven by active citizen participation, increased digital-based technologies, and various social infrastructure and capital.” In the United States, it is defined as “a city that prioritizes people in development,



Fig. 1. Smart city - national model cit, Republic of Korea (Sejong 5-1 living area & Busan Eco-Delta City)[1]

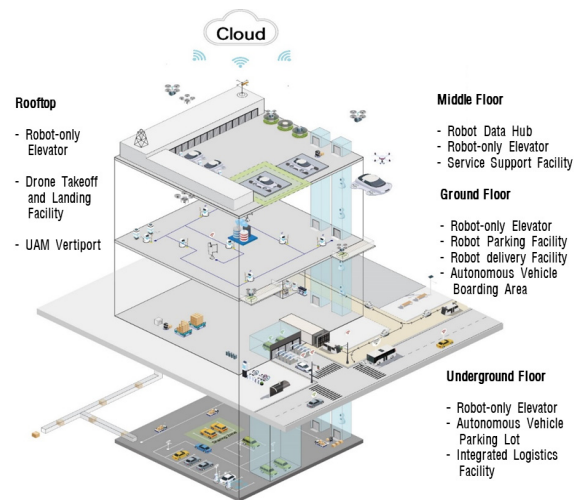


Fig. 2. Concept of Smart+Building, Korea (Source: Presentation Material-Smart+Building Revitalization Roadmap Announcement, MOLIT, Republic of Korea, 2023)[2]

integrating ICT technologies in to urban management and using them as tools to design effective information[3,4].”

Looking at the definition of “smart city” in Korea, it is defined as “a sustainable city that provides various services based on urban infrastructure built by integrating construction, information and communication technologies, etc., to enhance urban competitiveness and quality of life[5].” In particular, Korea began as a smart city led by smart technologies following the enactment of the “U-City Act” in 2003. It has progressed through the U-City construction phase (2013), the system integration phase (2014–2017), and the full-scale smart city phase, reaching the present day.

Currently, for spreading and disseminating smart cities in Korea, the “Sejong 5–1 Living District” and “Busan Eco Delta City” are being planned and developed as national pilot smart cities.

2.2. The Concept of Smart+Building

As mentioned earlier, through the “U-City Act (2008)” and the “Smart City Act (2017),” the systematic development of related industries and the expansion and creation of smart cities in Korea have been fully initiated. However, innovation in architectural

spaces for applying smart technologies, where actual living occurs, remains insufficient. In particular, as technologies from the Fourth Industrial Revolution, such as UAM, autonomous driving, and robotics, advance, and the expansion of related industries are required, there is a growing demand for the establishment of infrastructure that supports smart hardware and smart services in architectural spaces. Implementing services within buildings to use various mobility systems and robots in architectural spaces has become an essential requirement.

As a result, in line with the commercialization roadmap for UAM and autonomous driving, there is a growing need for architectural infrastructure that can support these technologies. Smart+Buildings, capable of utilizing smart technologies, have become increasingly essential, and their necessity and importance are being further emphasized.

The definition of a Smart+Building can be described as “a building that provides a space (HW) and platform environment (SW) that is compatible with Fourth Industrial Revolution technologies, responding to changes in the demands of daily life and technological services.” Smart+Buildings can accommodate the necessary smart technologies according to the needs of users and can be implemented in various types of buildings such as residential, office, transportation, healthcare, and educational facilities. This applies not only to newly constructed buildings but also actively encourages the transformation of existing buildings into Smart+Buildings through renovations.

A Smart+Building can be seen as “a building that actively responds to the demands of new daily life and changes in technologies/services, offering flexibility and inclusiveness[6].”

2.3. Theoretical Review of Previous Research on Smart+Buildings

A review of the related previous research on smart cities and smart buildings conducted so far shows that the focus has been primarily on studies aimed at implementing smart cities at the urban level.

This indicates that after the enactment of the “Smart City Act” under the “Act on the Promotion of Smart City Creation and Industry Development,” research has been concentrated on the concept of smart cities, various implementation technologies, certification systems, and related smart city services. The related previous research is shown in Table 1.

Research by Kim Seonghwan (2019) sought to expand and develop the smart city and the current intelligent building certification system by improving the legal system to activate smart buildings[9]. Additionally, Lee Eunseok (2020) examined the reform of the building certification system that includes smart architecture[10].

Table 1. Literature reviews of smart architecture

Research	Research project or research paper
T.Cho et al. (2015)[7]	Advancing smart architectural space into the next ubiquitous environment
W.Kim (2018)[8]	Analyzing smart buildings and applied smart technologies to understand the smart architecture
S.Kim (2019)[9]	Establishment of laws and systems to revitalize smart buildings for the construction of future cities
E.Lee et al. (2020)[10]	Deriving the direction of reform of the building certification system containing the contents of smart architecture
S.Cho et al. (2021)[11]	Research on planning and design methods of smart city services and technologies
J.Kim, et al. (2022)[12]	Based on the smart technology settings applicable to architectural space, the concept of smart architecture and the direction of new architectural plans for smart architecture are presented.
S.Yoon (2022)[13]	A research of analyzing the architectural planning characteristics of apartment complexes using smart technology
S.Nam et.al. (2022)[14]	Deriving directions for introducing and operating smart building certification

In the study by Kim Jinmo (2022), the direction for architectural planning to apply smart technologies to architectural spaces was explored[12]. Meanwhile, the research by Yoon Sunghoon (2022) analyzed the architectural planning characteristics of multi-family housing that applied smart technologies, focusing on the winning designs of the LH public housing design competition[13]. In addition, research by Nam Seongwoo (2022) has been conducted to derive the introduction and operational direction of the smart building certification system, along with partial legal and institutional studies related to the introduction of smart buildings[14]. Therefore, there is an urgent need for an institutional foundation to promote the spread and dissemination of Smart+Buildings, which the Ministry of Land, Infrastructure, and Transport is currently pursuing. As a result, research on the laws and systems related to smart buildings is critically needed.

2.4. Trends in the Promotion of Policies Related to Smart+Buildings

Since the enactment of the U-City Act in 2008, the Ministry of Land, Infrastructure, and Transport has been promoting various related policies to implement smart urban spaces at the city level. As shown in Table 2., with the announcement of the 2022 Smart+Building Activation Plan, the government officially began policies for the implementation and dissemination of smart technologies in architectural spaces, which serve as space platforms for providing and utilizing smart technologies and

Table 2. Progress of the government's policy on Smart+Building

Government's policy on Smart+Building	
2022.08	Announcement of Smart+Building Revitalization promotion plan, MOLIT, Republic of Korea
2023.02	Launched 'Smart+Building Alliance', a privateled and government-supported cooperation system, MOLIT, Republic of Korea
2023.12	Announcement of 'Smart+Building revitalization roadmap', MOLIT, Republic of Korea

services. In February 2023, the "Smart+Building Alliance," a privateled and government-supported cooperation system, was launched to foster and collaborate with related industries systematically. Through this, in collaboration with industry, academia, and research institutions, the value and policy direction of Smart+Buildings were concretized, and a roadmap and Smart+Building guidelines were established. Currently, to ensure the smooth implementation of the content outlined in the roadmap, the Ministry of Land, Infrastructure, and Transport is promoting research planning projects for developing key technologies related to Smart+Buildings. In December 2023, the "Smart+Building Activation Roadmap" was announced to innovate and implement architectural spaces by integrating smart technologies. In line with the era of mobility, including Urban Air Mobility (UAM) and autonomous smart logistics, it is essential to establish building standards that enable buildings to serve as mobility-friendly infrastructure. This includes promoting the relaxation of floor area ratio and building coverage ratio and providing benefits while responding to continuously evolving technological changes.

It is also planned to advance building design, construction, and maintenance technologies and to promote the development of a building platform that integrates and manages various technologies[2].

3. Analysis of Relevant Laws and Systems for Setting the Basic Direction of Laws and Systems to Support and Activate Smart+Buildings

As mentioned earlier in this study, we analyzed the relevant laws to derive the basic direction of laws and systems to support and activate Smart+Buildings, focusing on three areas: the expansion of mobility-friendly spaces linking UAM and autonomous driving with buildings, the creation of logistics-friendly spaces using robots in architectural spaces, and the creation of environmentally friendly spaces through the

Table 3. Establishment of national plans and committee proposed by other laws

Classification	Establishment of national plans proposed by other laws
Related to Architecture	· Architectural Policy Master Plan, · Master Plan for the Promotion of the Architectural Services Industry · Green Building Master Plan
Related to Smart City	· Smart City Comprehensive Plan
Related to Mobility	· Urban Air Traffic Master Plan · Intelligent Robot Maser Plan · Master Plan for Autonomous Driving Transportation and Logistics

integration of buildings with AI, IoT, and other technologies, as outlined in the "Smart+Building Activation Roadmap" by the Ministry of Land, Infrastructure, and Transport in 2023. First, to provide the necessary basis for establishing detailed plans for the policy direction and support of Smart+Buildings, relevant laws closely related to Smart+Buildings were examined. These include the "Basic Building Act," the "Building Service Industry Promotion Act," the "Smart City Act," the "Urban Air Mobility Act," the "Intelligent Robot Act," the "Autonomous Vehicle Act," and the "Green Building Support Act[15]." This study analyzed these laws as its focus. It is essential to ensure consistency and legal connectivity in the content defined by each law and to establish a systematic implementation plan for Smart+Buildings while also creating an institutional foundation to support and activate their development.

3.1. Implementation Plans and Decision-Making Bodies Defined in Relevant Laws and Systems

Each law establishes a basic plan to pursue its objectives, practically conducted through implementation plans. Therefore, the contents of national planning outlined in the relevant laws mentioned earlier are as follows.

Table 3 summarizes the contents of national plans established and implemented according to the basic plans defined in the current laws in architecture, smart cities, and mobility. The "Building Act" also establishes the Architectural Committee, the Central Architectural Committee, and local architectural committees.

Under the Basic Building Act, the "National Architecture Policy Committee" is established, and the "Public Architecture Review Committee" is formed based on the legal grounds provided by the "Building Service Industry Promotion Act." The "National Smart City Committee" is established under the "Act on the Creation of Smart Cities and Industry Promotion," and the "Mobility Innovation Committee" is established and operated

Table 4. Establishment of national plans and committee proposed by other laws

Classification	Establishment of national plans proposed by other laws
Related to architecture	<ul style="list-style-type: none"> · Intelligent building certification system · Green building certification system · Building energy efficiency rating certification system · Zero energy building certification system
Related to smart city	<ul style="list-style-type: none"> · Smart city certification system · Smart city service certification system (currently not in operation)
Related to mobility	<ul style="list-style-type: none"> · Outdoor mobile robot operation stability certification system · Autonomous cooperative driving certification system to ensure the stability of autonomous vehicles

under the “Act on the Support for Mobility Innovation and Activation.”

Through the legal foundations established by each law, the committees created are tasked with setting the policy direction pursued by the respective laws. They play a role in formulating national plans, improving related systems, and overseeing activities such as R&D, serving as bodies for deliberation and decision-making.

3.2. Certification Systems Based on Relevant Laws and Systems

The current status of the national certification system for Smart+Buildings can be summarized in Table 4. It is based on establishing national standards and criteria in each field outlined by the relevant laws and introducing a national certification system to promote and expand Smart+Buildings and foster related industries. Additionally, the certification system can strengthen the performance levels required by each certification according to the roadmap. In turn, various incentives are provided to encourage active private sector participation in projects and foster the development of related industries.

Currently, under the “Building Act,” the “Intelligent Building Certification System” is in place, and under the “Green Building Support Act,” the “Green Building Certification System,” “Energy Efficiency Rating Certification System,” and “Zero Energy Certification System” are being implemented. Additionally, under the “Act on the Creation of Smart Cities and Industry Promotion,” the “Smart City Certification System” and the “Smart City Service Certification System” (currently suspended) are being operated. Additionally, under the “Act on the Promotion of Intelligent Robot Development and Distribution,” the “Outdoor Mobile Robot Operation Safety Certification System” is in place, and under the “Act on the Promotion and

Table 5. R&D proposed by other laws

Classification	R&D
Related to Architecture	<ul style="list-style-type: none"> · Research and development of the architectural service industry · Research and development of building management · Research and development of green technology for the creation of green building
Related to Smart City	<ul style="list-style-type: none"> · Research and development of smart city technology
Related to Mobility	<ul style="list-style-type: none"> · Research and development of urban air traffic · Research and development of robot technology · Research and development of autonomous driving infrastructure and logistics system technology · Research and development of advanced mobility technology

Table 6. Demonstration pilot project proposed by other laws

Classification	Demonstration pilot project
Related to architecture	<ul style="list-style-type: none"> · Architectural design pilot project · Architectural service industry promotion point of view · Building management pilot project · Green building development pilot project
Related to smart city	<ul style="list-style-type: none"> · Smart innovation pilot project · Smart demonstration pilot project
Related to mobility	<ul style="list-style-type: none"> · Downtown air traffic demonstration pilot project · Robot Land development area pilot project · Autonomous vehicle demonstration operation area pilot project

Support of Autonomous Vehicle Commercialization,” the “Autonomous Cooperative Driving Certification System for Ensuring Autonomous Vehicle Safety” is being implemented.

3.3. Promotion of R&D and Pilot Projects Based on Relevant Laws and Systems

Analyzing the relevant laws and systems, the “Building Service Industry Promotion Act,” the “Smart City Act,” the “Urban Air Mobility Act,” the “Intelligent Robot Act,” the “Autonomous Vehicle Act,” and the “Green Building Support Act” each provide legal grounds for promoting public-led research and development. These laws aim to develop new technologies, establish design standards and criteria, set performance standards for related materials and structures, and create certification and evaluation systems to support the development of various technical aspects necessary for achieving the goals and key contents outlined in each law.

The research and development foundations outlined in each relevant law and system summarize the current R&D efforts being carried out in Table 5. Additionally, through the development process of various related technologies presented in each relevant law, it is necessary to apply, demonstrate, and

operate the research outcomes to implement the objectives and key contents each law aims to achieve. Therefore, it effectively raises public awareness of the benefits of the projects. Through active interest and participation from the private sector, the current staged pilot projects for technology development promoting the spread and dissemination can be summarized as shown in Table 6.

3.4. Other Provisions Defined in Relevant Laws and Systems

In addition, when examining the contents outlined in the relevant laws and systems, incentives are provided to offset additional costs and promote the spread and dissemination of technologies. It provides the basis for offering various incentives, such as relaxing regulations, strengthening administrative support, providing financial and tax support, and establishing funds.

Second, it contains the basis for supporting the development of specialized personnel to build the industrial ecosystem in related fields to foster sustainable technological development and enhance the competitiveness of these industries.

Third, various laws establish and operate certification systems to promote and expand related businesses and foster relevant industries. These policies provide the basis for establishing operational support agencies to ensure smooth support for the projects being implemented under these policies. Currently, support agencies established and operated under various laws include the "Public Architecture Support Center," the "Building Promotion Institute," the "Green Building Center," the "Smart City Association," the "Korea Robot Industry Promotion Agency," and the "Mobility Support Center."

4. Setting the Basic Direction of Laws and Systems to Support and Activate Smart+Buildings

4.1. Enactment of the "Tentative Smart+Building Support Act"

As mentioned earlier, it has been confirmed that various policies in fields such as architecture, UAM, robotics, autonomous driving, and green building provide the legal foundation for the continuous and systematic development and expansion of related businesses. With the advancement of smart technologies, it is urgently required to establish the "Tentative Smart+Building Support Act" to support the implementation of Smart+Building architecture and activate related services in response to these developments.

4.2. Basic Direction of the Support Act for Implementation and Activation

Through the analysis of relevant preceding laws and systems, it can be concluded that similar to various related fields such as architecture, UAM, robotics, autonomous driving, and green buildings, the basic direction that should be included in the law being enacted to provide legal support for the implementation and activation of Smart+Building architecture is as follows: The law should be passed in the form of two separate concepts: a "Basic Act" that defines the Smart+Building's concept, basic principles, and policy establishment matters, and a "Support Act" that includes the commercialization of technologies and support for related businesses.

1) Establishment of a Basic Plan and Implementation Plan

It is necessary to provide the basis for the establishment of a basic plan and implementation plan to systematically and gradually promote the matters outlined in the Smart+Building Activation Roadmap.

2) Establishment of Deliberation and Decision-Making Bodies and Support Agencies

Deliberation and decision-making committees must be established for various matters, including setting the policy direction for spreading and disseminating Smart+Buildings, formulating the basic and implementation plans, implementing and operating certification systems, providing incentives, and carrying out research and development and pilot projects. Legal grounds, scope of duties, and the establishment of related operational and support agencies must also be provided for these activities.

3) Implementation and Operation of the Certification System and Provision of Incentives

To ensure the fast and efficient spread and dissemination of Smart+Buildings, it is necessary to establish standards and guidelines for Smart+Buildings, introduce a certification system, and strengthen the performance of Smart+Buildings in line with technological advancements. Additionally, legal grounds should be provided to ease building regulations, such as floor area ratio and height restrictions, and offer incentives, including administrative support, financial assistance, and tax benefits.

4) Execution of Research and Development and Pilot Projects

The law should include the basis for research planning and the promotion of research and development related to the design standards and guidelines for Smart+Buildings, performance standards for related building materials and structures, smart

building management systems (BMS), and the development of relevant construction technologies, as outlined in the Smart+Building Activation Roadmap. Additionally, the law should provide the legal grounds to promote pilot projects that apply research outcomes, accelerate public awareness, and facilitate Smart+Building development through the demonstration process.

5) Strategies for Developing Specialized Personnel

The Smart+Building sector has an industrial structure integrating various fields such as architecture, UAM, robotics, autonomous driving, and green building. Therefore, to foster the continuous development of the related industrial ecosystem and strengthen technological capabilities, it is essential to define matters such as developing and operating training programs, introducing national professional certifications, and taking other necessary measures to establish specialized personnel. These provisions and the legal grounds for supporting them should be included.

5. Conclusion

The research paper thus far has highlighted that, in the context of rapidly advancing smart technologies in architecture, UAM, robotics, autonomous driving, and other related fields, there is a growing demand for spaces that are compatible with smart technologies in response to the application of new technologies and changes in services. Therefore, to faithfully implement the “Smart+Building Activation Roadmap” newly presented by the Ministry of Land, Infrastructure, and Transport in 2023 and to derive the basic direction of laws and systems to support and activate Smart+Buildings, this study analyzed relevant laws and systems related to smart technologies.

Thus, the “Tentative Smart+Building Support Act” should provide the legal foundation for supporting and activating Smart+Buildings. The basic direction of the law to support and activate Smart+Buildings includes five key directions: first, the establishment of a basic plan and implementation plan; second, the establishment of deliberation and decision-making bodies and support agencies; third, the implementation and operation of certification systems and provision of incentives; fourth, the execution of research and development and pilot projects; and fifth, strategies for the development of specialized personnel. These five directions were derived and presented.

With the high national technological competitiveness in UAM, robotics, autonomous driving, and green building sectors, the importance of Smart+Buildings will become even more prominent as a key pillar for a significant leap toward becoming

a high-level smart city. To achieve this, continuous follow-up research should be carried out, considering the legal consistency, including the revision of existing related regulations, the establishment of Smart+Building architectural design and performance standards for different building uses, guidelines for new construction and remodeling, and the development of a Smart+Building certification system. This should also include research on evaluation indicators and systems and the provision of incentives to promote and accelerate the spread of Smart+Buildings. Additionally, with the increasing demand for Smart+Buildings, which serve as integrated space platforms for smart technologies, research on the standards for Smart+Buildings and international standardization for global collaboration and expansion is also necessary. The urgent enactment of laws and systems for Smart+Buildings and the active conduct of related research are required to support this.

References

- [1] Ministry of Land, Infrastructure and Transport, Smart city general portal, <https://smartcity.go.kr>, 2024.
- [2] Ministry of Land, Infrastructure and Transport, Smart Technology Mobility Builds 10,000 Smart+ Buildings (Press Release), 2023.12.19.
- [3] BIS (Department for Business, Innovation and Skills), Smart cities: Background paper, 2013.
- [4] IDB (Inter-American Development Bank), The road toward smart cities: Migrating from traditional city management to the smart city, 2016, p.16.
- [5] Korean Law Information Center, Act on the creation of smart cities and industry promotion, <https://www.law.go.kr>, 2024.
- [6] Ministry of Land, Infrastructure and Transport, Smart+ Building alliance steering committee report, 2024.
- [7] T. Cho et al., Advancing smart architectural space into the next ubiquitous environment, *Journal of Architectural Institute of Korea Planning & Design*, 31(2), 2015.02, pp.11-18.
- [8] W. Kim, Understanding smart architecture, *Review of Architecture and Building Science*, 63(12), 2019.11, pp.49-54.
- [9] S.W. Kim, Improvement of the law and system for the activation of smart building, *Review of Architecture and Building Science*, 63(12), 2019.11, pp.40-43.
- [10] E.S. Lee et al., An improvement direction for the building certification systems based on the smart building concept (Research report), *Architecture & Urban Research Institute*, 2020.
- [11] S.K. Cho et al., A research of planning & design methods for smart city services and technologies, *Architecture & Urban Research Institute*, 2021.
- [12] J.M. Kim, J.Y. Lee, S.H. Yoon, Theoretical review for setting the direction of architectural planning in response to smart technologies, *KIEAE Journal*, 22(4), 2022.08, pp.55-61.
- [13] S.H. Yoon, Analysis of architectural planning characteristics in apartment building that smart technology is applied -Based on the award-winning projects of the LH future architecture design competition-, *KIEAE Journal*, 22(4), 2022.08, pp.63-69.
- [14] S.Y. Nam, M.J. Oh, A study on the introduction and operating direction for smart building certification (Research report), *Architecture & Urban Research Institute*, 2022.
- [15] Ministry of Government Legislation, Korean Law Information Center, <https://www.law.go.kr>.