ISSN: 2288-7709 © 2021 KODISA & ICMA.
http://www.icma.or.kr
doi: http://dx.doi.org/10.20482/jemm.2021.9.2.11

A Study on Citizen Participation System based on Design Thinking, Design Science – Smart City case*

Eung-Kyo SUH**

Received: April 24, 2021. Revised: April 27, 2021. Accepted: April 28, 2021

Abstract

Purpose: The importance of creativity has been emphasized in the transition from industrial society to knowledge-based society. Recently, design thinking has attracted great attention as one of the ways to increase the creativity of the organization. From the perspective of solving urban problems through collaboration between technology and citizens, the active participation of citizens is indispensable for realizing smart cities. **Research design, data and methodology:** From the perspective of solving urban problems through collaboration between technology and citizens, the active participation of citizens is indispensable for realizing smart cities. **Results:** Therefore, the purpose of this research was to design a citizen-participation type system and contents using a specific space to realize a smart city. This system utilizes the concept of space as a tool to promote innovation activities with the participation of citizens and makes it easy for users of space to participate based on urban problems derived from living labs and the internal structure and user flow line have been designed. **Conclusions:** It was been also used voice recognition, artificial intelligence, the Internet of Things, and big data as important technologies for experiencing smart cities. The system and content were designed with an emphasis on allowing citizens to directly recognize and experience smart city technology, especially through space-based information visualization and multi-faceted stimulus elements.

Keywords : Design Thinking, Design Science, Citizen-participatory System, Content Design, Smart City

JEL Classification Code : R58, M15, L38,

1. Introduction

With the transition from an industrial society to a knowledge-based society, the importance of creativity is being emphasized. As one of the ways to increase the creativity of the organization, design thinking has recently attracted great interest. After publishing a special article on design thinking at Business Week in 2009 (Wong, 2009), the New York Times and Wall Street Journal focused on it and response and expectations are hot. The core concept of design thinking, ‘to create

* The present research was supported by the research fund of Dankook University in 2019.
[1] Professor, Graduate School of Business, Dankook University, Korea. Email: eungkyosuh@dankook.ac.kr

new values by solving human-centered problems' is being used in company strategies such as developing new products and improving services (Yang et al., 2015). In Korea, interest in design thinking is also increasing, with the Seoul Metropolitan Government establishing a specialized institution to educate and practice design thinking in March 2017 (Yonhap News, 2017). However, the response from the academic world is that some universities are offering related courses, but the influence in terms of research is insignificant.

Therefore, this study intends to present a plan to use this methodology of design thinking with design science to develop citizen-participated information systems and contents, especially user interface, for information system research. Many previous studies have studied information system development process and methodology. From an engineering perspective, software development methodologies such as waterfall model, prototyping model, and iterative spiral model that sequentially go through requirements analysis, design, implementation, testing, and maintenance were presented (Kwon, 2002), and user experience design from the HCI perspective were studied (Shin and Park, 2014). These methodologies are focused on developing information systems through processes that properly reflect the needs of users so that newly constructed information systems can be used well and are highly efficient for the time and cost (Yoo et al., 2009; Song & Lee, 2005). These are methodologies to effectively and efficiently develop a planned information system. On the other hand, design thinking is a process of inferring a solution to a given problem (Kang & Lee, 2014). Only a problem is given, and no direction or goal to solve the problem is given, so unexpected innovation may occur in this process. Design Thinking is a methodology that can deviate from the existing design framework and derive innovative and creative alternatives in information system design research.

Smart cities are understood as various concepts throughout the world, but the Ministry of Land, Infrastructure and Transport applies Information & Communication Technology to urban spaces to solve local and social problems faced by cities, and as a sustainable city that can improve the quality of life, this implies the space created by technology and the evolution of citizens' lives (4th Industrial Revolution Committee, 2018). Therefore, it can be said that in order to realize a smart city in the direction of linking urban space and the lives of citizens, the participation and role of citizens, the subject of this, are important.

Therefore, the purpose of this study is to design a citizen-participating information system and contents using a specific space to realize a smart city. The citizen-participating system utilizes the concept of space as a tool to promote innovation activities through citizen participation (Bergvall-Kåreborn et al, 2015). In particular, citizens can directly recognize, and experience smart city information technology based on offline spaces and designed with a focus on visualizing citizen to participate.

2. Literature Review

2.1. Design Science

As a field of applied research, information systems are often brought in theory from other research fields, and theories from various disciplines such as economics, computer science, and social science have been introduced to deal with various issues related to information technology within organizations (Peffers et al., 2008).

Two things that are always emphasized in business studies including information systems are the rigidity and relevance of the research. In the field of information systems, which suffered from a lack of rigor in research when the major was first introduced, the rigor of information systems gradually improved as the study matured, but the problem of practical relevance still remains (Lee, 2017).

Benbasat & Zmud (1999) pointed out that information systems research has a lack of relevance to practice, and explained the reason as follows. First, as major journals in information systems place more importance on the rigor of research than on practical relevance, researchers have somewhat neglected the practical relevance. Second, the cumulative research tradition is weak, so there is a lack of research models that can be confidently presented in practice. Third, because of the rapid development of information technology, there are many cases where academia subsequently verifies technologies that are already widely used in the industry. Fourth, it is because there are few opportunities for scholars to be exposed to practical experience, and finally, there are many universities that require empirical research based on theory as a condition of guaranteeing the retirement age of researchers. In addition, it was argued that this phenomenon was accelerated as researchers and major journal editors in the information system field emphasized the rigor of research over practical relevance. Behavioral science primarily develops and tests theories that explain or predict the behavior of people or organizations.

The two main paradigms of information systems research can be seen as behavioral science and design science. Behavioral

science primarily develops and tests theories that explain or predict the behavior of people or organizations. On the other hand, design science seeks to expand the capabilities of people and organizations by developing new and innovative artifacts (Hevner et al., 2004). Peffers et al. (2008) argue that the possibility and influence of presenting important values applicable to the field are gradually losing due to the excessive concentration of rigor in information systems research, and theories have been established and tested in the field of information systems. He emphasized that it is necessary to reconsider whether focusing on the behavioral science paradigm is essential and essential in information system analysis or information system design research. In addition, he explained that the engineering field accepts the research method of design science as a valid and valuable research methodology and recognizes that these research methods are effective and are a good way to present results that are highly relevant to practice.

From the late 1990s, it has been argued that design-based design science research methodology can also be applied to the information system research paradigm in the field of information systems research and can provide valuable results (Nunamaker et al., 1991). And it is said that design science research methods enable the creation and evaluation of information technology artifacts in the field of information systems (Benbasat & Zmud, 2003). In addition, the design science research method plays a big role in generating a wide range of socio-technical outputs, and can be especially applied in decision support systems, modeling tools, governance strategies, information system evaluation methods, and participation in information system change processes (Gregor & Hevner, 2013).

However, in the field of information systems research, it is divided into pros and cons as to whether design knowledge, which is the result of design-related research, can be called a theory (Weber, 2012), and research on this has not been conducted much (Hevner et al., 2004).

Looking at previous studies on design science research, Simon (1969) defined that "if social science and natural science aim to understand reality, design science aims to create something for humans." Walls et al. (1992) defined the design theory in the field of information systems as at a level similar to the theory establishment and demonstration handled in general social science-based research. March & Smith (1995) argued that design research is a more suitable research method to explain and solve the problems faced by practitioners in the field of information systems. In other words, while general information system research focuses on information technology outputs, design research focuses on human creations and the harmony between design and information technology outputs (Beck et al., 2013). Therefore, it is said that through design research, innovative variables that have not existed can arise due to human needs (March & Smith, 1995).

In some previous studies, a methodological process was established to theorize and normalize design research methods. First, Beck et al. (2013) stated that the process of design research method proceeds as the two most basic processes. First, the generation of information technology products and second, the evaluation of the generated information technology products. The creation process is aimed at creating something new, and the evaluation process is to solve problems in a better direction by receiving feedback on the results made in the creation phase.

In addition to that, some studies have presented opinions on design research methods and processes. Representatively, Gregor & Jones (2007) insisted that it should proceed consists of the stages of purpose and scope, variables, basic principles of form and function, deformability of the result, definition in design, evaluation in design, and detailed explanation. Hevner et al. (2004) suggested that first, the most important problem should be selected from among the problems to be solved, and the most appropriate problem should be selected from among them. After that, it was argued that the solution should be continuously improved through an iterative search process, and evaluation and discussion should be made on the solution drawn each time. In addition, many scholars have defined the research process of design science from their own point of view. Looking at the common process they propose, first, the definition of the problem and the investigation of the cause of the problem, second, the definition of the goal for the problem solution, and third, Design and development, fourth, suggestion of practical solutions, fifth, evaluation of solutions, and finally, presentation of evaluation results. This is summarized in more detail as follows (Peffers et al., 2008).

1) Problem Recognition and Motivation: In the research phase of problem recognition and motivation, detailed research problems are defined and the value of solutions to problems is established (Nunamaker et al., 1991; Walls et al., 1992). The reason for defining the problem is to conceptually concise the problem to be solved by the design science methodology, and to efficiently present and develop the information technology output that is the solution. In addition, the reason for defining the value of a solution to a problem is that the researcher understands the problem, suggests a solution, and helps the reader to accept the result.

2) Defining the goal of the solution: In the stage of defining the goal for the problem solution, the goal is to establish a solution from the results derived from the previous problem definition stage, and to the extent to which the solution can be implemented is presented. At this stage, the proposed goal to achieve the solution should be reasonable in order to use the resource efficiently.

3) Design and development: The design and development stage is the stage of making information technology products, and many researchers have defined it as a key stage of design science research (Peffers et al., 2008; Eekels, 1991). Hevner et al. (2004) stated that the design and development stage is a stage in which an optimal output should be found through iterative search, and the output can be variables, models, and methodologies. Jarvinen (2007) suggested that it could be something of a new attribute utilizing technological, social and informational resources.

4) Suggestion of a solution: The product presented in the design and development phase needs a step to show how the content presented as an idea is used as a practical solution (Walls et al., 1992). Based on this, a more formal and valuable evaluation was possible (Hever et al., 2004; Nunamaker et al., 1991). At the stage of presenting a practical solution, the process of solving the problem is shown, and accompanying experiments, simulations, case studies, proofs, and other suitable methodologies can be used.

5) Evaluation of the solution: In this step, the degree to which the solution solves the defined problem is observed and confirmed. In the second step, the definition of the goal for the problem solution, the difference between the effect of the predicted solution and the result of the actual solution is analyzed. The method of analyzing the difference can be applied in various ways, but the difference can be confirmed through the cost of making a solution, the cost of the parts needed, the satisfaction survey of the solution through a questionnaire, feedback from stakeholders related to the actual problem, and simulation results.

6) Communication about the evaluation results: Finally, it is the step of conducting an overall check on the evaluation results. Communicate the usefulness, originality, appropriateness of design, and effectiveness to interested parties for the finally proposed solution. And, in the case of academic research, it is published in a journal and the results are shared with readers. In this case, it is advisable to do so if it can take the form of presentation of traditional empirical research.

2.2. Design Thinking

When it comes to design, it often comes to mind the aesthetic aspect, and the concept of design thinking that benchmarks the way designers work, not the aesthetic aspect, is being used for corporate innovation. This approach is related to the fact that the enterprise environment is very complex due to technological advances, and the development cycle of products or services is very fast. In addition, while the functional gap between products has narrowed compared to the industrial society, emotional aspects such as storytelling are emerging as an important competitive factor for products and services. Therefore, companies should focus on the user experience, especially the emotional side (Kolko, 2015). Kelley & Kelley(2013) argue that human-centered design research, which observes the behavior of customers and finds their hidden desires that even customers are not aware of, is the center of successful innovation, and the concrete methodology for this is design thinking.

According to IDEO's CEO Brown (2008), design thinking is “converting a company's viable strategy into consumer values and market opportunities and using the designer's sensitivity and work methodology to satisfy customer needs in a technologically feasible way.” He suggested empathy, integrative thinking, optimism, experimentalism, and collaboration as basic characteristics for design thinking. Empathy is an approach that puts people first. Until now, companies have focused on the collective and logical object of the market, but empathy is subjective and focused on people who feel pain. The diverse perspectives of different stakeholders, including clients, current and potential customers, colleagues, and end users, identify their needs, in many cases, hidden needs, and the insights gained can inspire innovation. Integrative thinking generally does not rely solely on analytic thinking to choose one of several alternatives, but to create novel solutions that go beyond existing alternatives by taking into account all the important factors that are confusing, sometimes even contradictory. For example, if there are usually 10 alternatives, and it's common to pick one or two of the best, Apple has a peculiar design rule. It is a rule of “10 to 3 to 1”, which refers to the process of combining 10 different alternatives into three and integrating them into one. Through this process, innovative products such as iPad were born (Ness, 2008). Optimistic thinking is the mindset that no matter how difficult a given problem is, there will be at least one better solution than it is now. The spirit of experimentation is simply asking questions in a completely new direction and rethinking constraints on the premise that meaningful innovation cannot occur through fine-tuning in the present state. Finally, in today's increasing complexity, it is far more effective to innovate in collaboration with multiple, knowledgeable employees rather than relying on a single isolated genius.

Brown (2008) proposes three stages of inspiration, ideation, and implementation as a concrete methodology for design thinking. Kelley & Kelley (2013) furtherly subdivided into inspiration, synthesis, ideation and experimentation, and implementation. In the case of Stanford University's design school (d.School, 2013), it was classified into five stages: empathize, define, ideate, prototype, and test. The classification of Stanford School of Design is a practical method that suggests specific actions to be performed at each stage, so this paper will follow this classification.

1) Empathy: Empathy, the first step, is the most fundamental in the people-centered design process. In order to properly understand users' behavior, a more in-depth and cultural anthropological approach is needed than simple surveys or statistics. Therefore, stakeholders can empathize with what users feel by observing their behavior in the natural state of their living space, conducting interactions and interviews, and immersing themselves in the situations the users experience. The reason for divergent thinking by collecting information by mobilizing various methods such as observation and interviewing is to derive correct questions. Design thinking is not a logical thinking to confirm the facts we already know, but a search process that searches for facts that we have not yet known. When we throw away our prejudice and look at the user from a new perspective, we can find the real problem of the user, not the problem we are looking at.

2) Define: In the definition stage, the findings collected in the empathy stage are deduced what is the urgent requirement and the real problem, and this is converted into a specific and meaningful challenge. This process is a step in which a design problem statement that will serve as a guide for later steps is determined, and convergent thinking is required.

3) Ideate: The idealization step is to derive radical alternatives to solve the design problem defined above. Again, through expansive thinking, a broad range of solutions can be explored by presenting somewhat rough and unrefined ideas conceptually and consequently. What we pursue at this stage is quantity rather than quality, and diversity of ideas is also very important. Innovative solutions can be derived from a wide variety of ideas.

4) Prototype: Prototyping is the physical embodiment of ideas created in the head of the previous step. A prototype can be anything physically implemented, such as role play, objects, spaces, interfaces, and storyboards.

5) Test: The final step is to improve the solution through feedback on the prototype. Broan & Martin (2015) said that even with an in-depth, cultural anthropological approach, it is almost impossible to predict the user's reaction, so it is very important to receive feedback from the initial product or service development through a prototype with minimal functionality Based on this feedback, a new prototype that reflects the product or service is quickly re-created at a low cost, and the feedback is received again, and this process is repeated until the user is satisfied. Companies like IDEO have had very successful results with this rapid prototyping approach.

2.3. Combining Design science and Design thinking

From the point of view of information systems research, design science and design thinking are both very similar in that they generate and evaluate information technology artifacts. Design science identifies a problem and defines the goal of a solution, designs an information technology product, presents a solution, evaluates it, and publishes the result. Design thinking also collects information, identifies problems, considers various solutions, creates a prototype, and completes the final solution through continuous improvement. In terms of processes, the two methodologies are very similar, but design science suggests a normative process for research, but does not suggest a specific methodology for designing information technology products. However, design thinking provides specific methodologies and tools for designing solutions for information technology products. Therefore, if a concrete design method of design thinking is combined with the normative process of design science, new and innovative information technology products as a solution can be designed more easily. In particular, in the empathy stage, the first stage of design thinking, by collecting qualitative data such as observations and in-depth interviews and reflecting them in designing information technology products, qualitative research can be conducted to increase practical relevance. By conducting empirical research based on theory at the stage of evaluating after product creation, it will be possible to combine more rigorous empirical research with qualitative research.

In this study, as a detailed goal for realizing a smart city, we tried to solve the urban problem through citizen participation. In addition, in order to help citizens, understand the data linkage and flow of smart city, the citizen participation system design and contents planning using the experience space was conducted. First, a citizen-participating system was constructed in a direction to draw more citizens' opinions and participation through a space called “experience space.” To this end, four major urban issues (traffic, safety, traditional markets, and vulnerable groups) derived from the Living Lab project conducted from March to December 2020 were used, and communication from the perspective of inducing participation more easily. The internal structure design of the box space and the user's movement were constructed. Core technologies for smart city implementation include voice recognition, artificial intelligence (AI), Internet of Things (IoT), and big data. Smart city services are more easily recognized and experienced. In this study, in constructing a spatial tool called a experience space, we tried to induce citizens to participate in various innovation activities through the process of interacting with the system and contents designed by themselves.

2.4. Citizen participation in Smart City

In order to implement a citizen-participating system in a smart city, this study is based on a study on information visualization according to the connection of smart city data, a prior study on the acceptance of technology by citizens in implementing a smart city, and a theoretical review on the citizen participation system. The system and contents to be configured in the experience space were viewed in three dimensions.

In addition, this study was aimed at designing a system and planning contents to ultimately induce citizen participation. To this end, the citizen participation system and detailed contents were constructed using a experience space based on the four themes of transportation, safety, traditional markets, and care for the underprivileged among the smart city services that city A wanted to promote.

Table 1: Literature reviews on Citizen Participation System

Field	Main content	Reference
Citizen Participation System	A study to analyze the trend and direction of smart city and to derive the direction of smart city model based on citizen participation	Ahn, Lee & Yu (2018)
	The concept of science and technology citizenship is summarized and the case of Sweden and Denmark is analyzed, and based on this, a citizen's policy participation-type environmental policy model is studied.	Choi (2013)
	A study on ways to induce citizens' participation to develop into a citizen-centered participatory smart city and to solve urban problems	Byun et al. (2018)
	As an information design methodology using knowledge, knowledge visualization is defined, and knowledge visualization process design and execution framework is studied.	Chang, Lee & Lee (2009)
	In the process of understanding the visualized information, a study on the level change that affects the user's understanding of information according to the main components and the difference in the degree of information understanding according to the number of interaction functions.	Lee & Lee (2017)
	An empirical study on how news expressions and interactivity affect the elaboration, understanding, and evaluation of article information	Kim (2014)
	An overview of information visualization and interaction visualization methods, and a study on traffic information visualization methods based on complex interaction methods through examples.	Kang & Nam (2012)

3. Research Methods

3.1. A Study on the Design of Citizen Participation Smart City Experience Space

A study on the design of a smart city experience space was conducted as a case study using design science and design thinking in the study of citizen participatory experience space and information system interface. In this study, the task of designing a smart city citizen experience space was adopted, focusing on the problem that citizens' experiences and experiences about the current smart city do not occur faithfully. The design science research method (DSRM process) of Peffers et al. (2008) is used to establish the entire research plan and procedure, and each stage of design science is conducted through workshops using the design thinking methodology to combine design science and design thinking was devised.

The part that combines design science and design thinking in this study is the first three stages of the design science research process, and the details are shown in <Figure 1>. In design science and design thinking, a solution is defined and designed until an optimal design is derived, and the steps of evaluating the solution are repeatedly performed until a satisfactory solution is found. In this case study, by forming multiple design teams for the same design task, the limitation of performing prototype evaluation only once was supplemented.

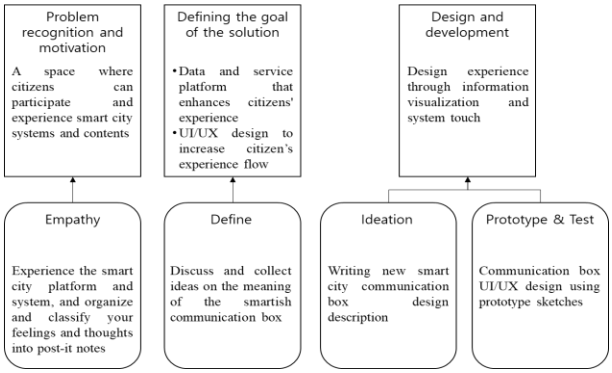

Figure 1: Stages of Smart City Experience Space Design Case Study

3.2. Design thinking workshop

20 citizens of City A participated in the Smart City Citizen Experience Space Design Workshop using the design thinking research method. Participants conducted the workshop in 5 teams of 4 people each during the week. In order to encourage participants to actively participate in the workshop, a workshop participation fee of 50,000 won was paid. Participants used the smart city platform and services provided by City A 3 days before the workshop and were given a preliminary task to organize their feelings and thoughts during the use process. This was given for raising awareness and motivation for problems with smart city platforms and services.

The design thinking workshop was conducted in two stages. Participants were aware of the role of spaces for expressing perspectives and opinions on smart city projects and smart city citizen experience spaces and argued for the necessity of a system that supports the pure functions of citizen experience spaces, such as reducing civil complaints complaining of citizens' discomfort.

In the second stage, the theme was to propose a new design by focusing on the system UI/UX design for citizen experience among the smart city citizen experience spaces. In this case study, the workshop process for UI/UX design was described in detail.

4. Results and Discussion

4.1. Citizen Participation System and Main Contents

From the perspective of solving urban problems through linkage between technology and citizens, active citizen participation for smart cities is essential, and the active role of the government and local governments has important implications (Seong and Lee, 2018). Therefore, the citizen participatory system connected to the physical space plays an important role in attracting citizens' participation and interacting.

According to Cue-summation theory (Severin, 1967), information learning and cognitive behavior can be reinforced as the number of stimuli increases in a multimedia environment (Lee, 2017). It is also connected with the dual-coding theory (Paivio, 1986), one of the information processing theories. In other words, it is more effective in understanding and cognition through the interaction of information when combining other types of stimuli than combining the same stimulus as before with one stimulus factor such as hearing and sight, sight and touch. Based on this, this study designed contents so that citizens can experience the major services of Suwon's smart city in various forms by using ICT technologies such as big data, AI, and IoT. First, as content that allows you to experience life in a smart city in the most diverse forms, “Bixby,” a personal assistant application based on voice recognition, was used. The system was configured to experience multi-faceted stimulation by connecting such voice recognition-based urban information communication and customized information provision content with a touch display capable of horizontal-vertical movement. In the case of detailed contents, the information of various cities based on GIS (Geographic Information System) data such as surrounding air quality status, bicycle status, and intersection status information can be experienced in real time. In addition, by using a cloud platform, the connection with complex hardware is minimized, and by configuring the result value of information using voice recognition technology to be realized in real time on the touch display, various senses such as sight, touch, and hearing are used to It is designed to be able to experience the data.

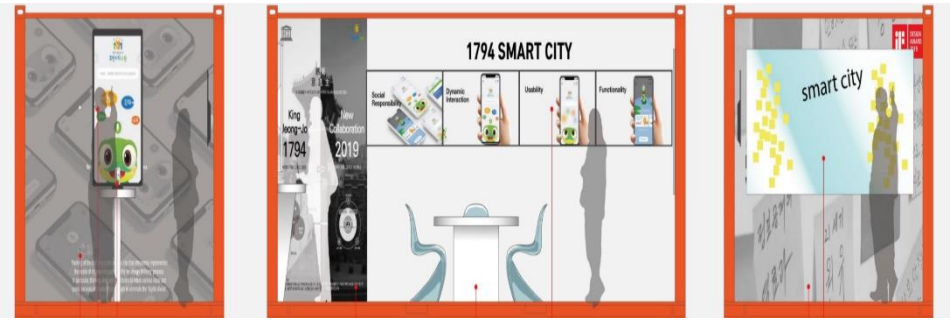

Figure 2: Overall structure of the citizen's participation system in physical space

Table 2: Citizen-participating detailed content design

Main content	Reference
City information communication based on voice recognition and content providing customized information	- Real-time life information search and provision such as traffic safety, weather, environment, health welfare and city administration based on voice recognition technology in connection with a smartphone (ex. Real-time traffic conditions (roads, accidents, etc.) and public transportation use information (bus, subway use information, etc.), weather and IoT-based real-time air quality information, CCTV in the current area, provision of public toilet locations, etc.) - Organized to experience a variety of visual, auditory, tactile, and visual multi-sensory information related to cities through the incorporation of various visual ICT technologies including artificial intelligence, big data, IoT, and voice and touch technologies. - Organized so that you can experience even a part of the smart city experience
Visual content based on video and infographic	- Content scenario composition based on cases of collaboration with various citizens on the directions of smart city policy and the four topics selected through the Smart City Living Lab (traffic, safety, traditional markets, and vulnerable groups) - Induce awareness of cooperative activities between the public, citizens and companies through content scenarios based on data flow and civic activity
Activity-based citizen participation content	- Organize a space for citizens' direct participation and opinion collection using post-it - Organized to visually express citizens' opinions and derived ideas on the four topics selected through the Smart City Living Lab (traffic, safety, traditional markets, and vulnerable groups)

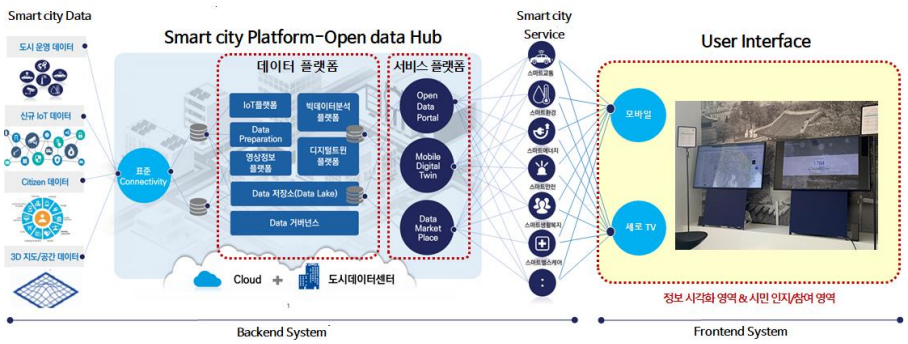

Figure 3: Overall structure of the citizen's participation system in physical space

In the direction of delivering the core of City A's smart city policy service, we tried to deliver information more easily and powerfully to citizens based on visual images and infographic according to Lang's (2000) limited capacity model. This is also

linked to Cognitive load theory (Sweller, 1988), another theory related to information processing, and because cognitive resources are limited in remembering information, it is difficult to recognize information when the amount is exceeded. It means that it can act negatively (Kim, 2014). Therefore, in order to introduce policies based on publicity and to improve understanding of the cooperative activities of the public, citizens, and companies, contents are composed based on the simplest form of video information. The main contents were designed based on the scenarios based on activities of one citizen.

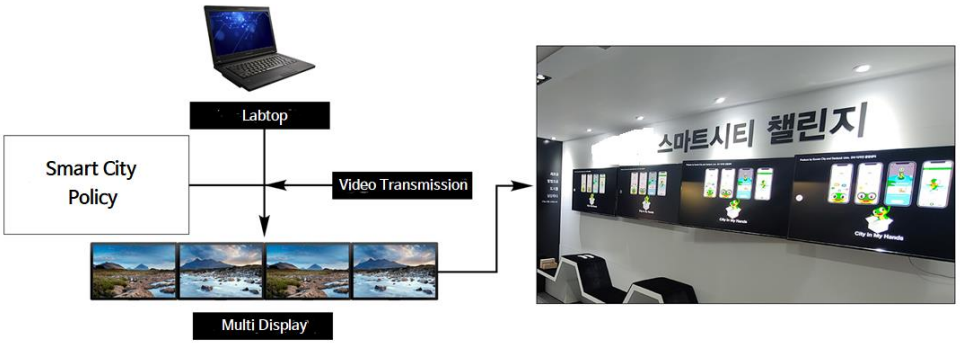

Figure 4: Overall structure of the citizen's participation system in physical space

Lastly, according to the characteristics of the experience space installed in an external space with a large number of floating populations, multi-displays were connected in a row of four to induce user immersion through visual expandability. In addition, according to the purpose of the detailed contents presented to citizens through a dedicated program for video transmission, the four multi-displays are used as independent screens, or the same video can be played simultaneously in a total of four. It was configured to work. In order to utilize the space practically, the installation of additional hardware is minimized by using a method of directly distributing video through the video transmission program in the server.

5. Conclusions

This study deals with the process of designing a system for citizen participation and contents in a direction to help citizens understand and participate in a smart city by using a specific external space called a smart city citizen experience space. However, since the design did not deal with the results of interaction with citizens, it is necessary to improve citizens' understanding of smart cities through subsequent research and differ in their achievements and implications for effective participation. In addition, in addition to in-depth theoretical research, detailed testing, improvement, and supplementation processes for each content are expected.

In spite of these limitations, if a specific space is systematized as a venue for citizen participation and exchange for urban problem solving, and the process of experience about the space is converted into data and applied to the contents, it can be utilized as a basis for a new citizen participation system.

For Conclusions, the main conclusions of the study may be presented in a short Conclusions section, which may stand alone. In addition, it can be said that this study presented a new perspective in the direction of developing more engaging contents in communicating information with citizens according to various characteristics of urban spaces in the future.

References

Ahn, Y. A. (2020). *A Study on the Effect of System Design Improvements on Seniors Intention to Use Non-face-to-face Services : Using the Technology Acceptance Model,* Master's dissertation, Seoul National University, Seoul, Korea.

Ahn, Y. J., Lee, S. H., Yoo, M. O., Jung, K. S., Yeom, I. S., & Ji, N. S. (2018), Establishing a smart city model based on citizen participation, *Daejeon Sejong Research Institute Planning Research, 2018-04*, 1-232

Almirall, E., Lee, M., & Wareham, J. (2012). Mapping Living Labs in the Landscape of Innovation Methodologies. *Technology Innovation Management Review, 2*(9), 12–18.

Benbasat, I. & Zmud, R. W. (1999). Empirical Research in Information Systems: The Practice of Relevance. *MIS Quarterly, 23*(1), 3-16.
Bergvall-Kåreborn, B., Eriksson, I. C., & Ståhlbröst, A. (2015). Places and Spaces within Living Labs. *Technology Innovation Management Review. 5*. 37-47.
Brown, T. (2008). Design Thinking. *Harvard Business Review, June*, 84-94.
Brown, T., & Martin, R. (2015). Design for Action. *Harvard Business Review, 2015 September*, 56-64.
Chang, S. H., Lee, K. W., & Lee, J. Y. (2009). A Study of Information Design Methodology by Comparative Analysis between Information Visualization and Knowledge Visualization, *Info Design Issue, 17*, 19-30
Choi, H. K. (2013). Designing a Participatory Model of Environmental Policy Based on Scientific Technological Citizenship: Learning from the Swedish and Danish Cases, *Space & Environment, 45*(0), 5-51.
Gregor, S. & Jones, D. (2007). The Anatomy of a Design Theory. *Journal of Association Information Systems Online, 8*(5), 312-335.
Hevner, A., March, S., Park, J., & Ram, S. (2004). Design Science in Information Systems Research. *MIS Quarterly, 28*(1), 75-105.
Kang, M. J., & Lee, S. J. (2014). Abduction and Design Thinking -Theory and Practice of Creative Ideation-, *Semiotic Inquiry, 38*(0), 7-35.
Koh, G. H., & Kim, J. G. (2012). A Study on the Interactive space of Contemporary City - focused on interactive space of citizen. *Journal of the Korean Institute of Interior Design, 21*(5). 57-64.
Kolko, J. (2015). Design Thinking Comes of Age. *Harvard Business Review, 2015 September,* 66-71.
Kyung, J. I., & Lee, J. W. (2020). The Fourth Industrial Revolution Factors Affecting the Vitalization of Smart Information Technology in Urban Regeneration. *Journal of Real Estate Analysis, 6*(1). 81-100.
Kim, Y. W. (2014). *Effects of Infographics on News Readers' Information Processing: Moderating Role of News Readers' Prior Knowledge and Issue Involvement.* Seoul, Korea: Master's dissertation, Seoul National University, Seoul, Korea.
Kwon, H. Y. (2002). Research Trends in Software Development Process. *Communications of the Korean Institute of Information Scientists and Engineers, 20*(3), 6-14.
March, S., & Smith, G. (1995). Design and Natural Science Research on Information Technology. *Decision Support Systems, 15*(4), 251-266.
Ness, G. (2008). *Apple's Design Secret: 10-3-1*. Retrieved April. 20. 2021. from https://www.sundoginteractive.com/blog/apples-design-secret-10-3-1.
Nunamaker, J. F., Chen, M., & Purdin, T. D. M., (1991). Systems Development in Information Systems Research. *Journal of Management Information Systems, 7*(3), 89-106.
Peffers, K., Tuunanen, T, Rothenberger, M. A., & Chatterjee, S., (2008). A Design Science Research Methodology for Information System Research. *Journal of Management Information Systems, 24*(3), 45-77.
Simon, H. A., *The Sciences of the Artificial. Cambridge*, 1969, MA: MIS Press.
Sung, J. E., & Lee, Y. N. (2018). Smart City Living lab cases and Problems. *STEPI Trend and issues, 47*, 1-37.
Sweller, J. (1988). Cognitive load during problem solving: Effects on learning. *Cognitive Science, 12*, 257-28
Walls, J., Widmeyer, G. & ElSawy, O. (1992). Building an Information System Design Theory for Vigilant EIS. *Information Systems Research, 3*(1), 36-59.
Wong, V., (2009). *How Business Is Adopting Design Thinking*. Business Week. Retrieved May. 24. 2016 from http://www.bloomberg.com/news/articles/2009-11-03/how-business-is-adopting-design-thinkingbusinessweek-business-news-stock-market-and-financial-advice.
Yang, K. R., Moon, S. C., Han, K. H., & Park, S. H. (2015). EJIT Opinion Papers: The New Paradigm Shift, Design Thinking. *Entrue Journal of Information Technology, 14*(3), 7-24.
Yonhap News (2016). *Seoul City·SAP Creates an Innovation Culture with "Design Thinking" Education*. Retrieved March. 06. 2017 from http://www.yonhapnews.co.kr/ bulletin/2017/03/06/0200000000AKR20170306058700004.HTML?input=1195m.
Yonhap News (2019). *'Communication Box' introduced by Suwon City, selected as an excellent practice for national goals*. Retrieved April. 20. 2021, from https://www.yna.co.kr/view/AKR20191118043800061
Yoo, S. J., Kim, B. K., Choi, J. H., & Leem, C. S. (2009). A Study on the Primary Factors of Internal and External Competency for Improving Performance of Small and Medium Software Company, *Journal of the Korea Society Industrial Information System, 14*(1), 17-31