Public Design Method Based on Smart Service System Technology: Centered on the Cases of Bus Stops in Korea and China

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Abstract. As science and technology develops, the concept of urban design is becoming the center of new interest based on the fourth industrial revolution technology, mobile, internet, Internet of Things (IoT), Artificial Intelligence (AI), and big data. Accordingly, the study on urban public facility design is increasing. Therefore, it is necessary to study the semantic extension of the definition of public facilities and the direction of public facility design by referring to the citizens' perception of the area where the smart painter of public facilities has already been carried out. Therefore, this study was conducted in consideration of the functional aspect as a public facility, harmony with the surrounding environment, and its role as a place for cultural exchange. The purpose of this study is to examine the establishment of a new concept of public facilities, the public's perspective on the installation and operation of bus stops, the perception of public facilities, and the design direction of public facilities for bus stops in Busan, Korea and Beijing, China.

Keywords: Urban design, public facilities design, smart technology, bus intelligence system, intelligence transport system

1. Introduction

The change of urban design according to population density has an effect on the direction of urban design in many countries. Since urbanization began in the 1950s, urban population has rapidly increased, residential space and living space have changed into multi-functional forms, and much attention has been paid to pleasant life, safety, convenience, and resource utilization. As of 2018, the population ratio living in cities was 54%, up 24% from the ratio of urban population in 1950. By 2050, the proportion of urban residents among the world population is expected to increase to 66 percent (UN Population, 2014).

As the social environment changes like this are made, the concept of urban design is becoming the center of new interest based on the fourth industrial revolution technology such as mobile, internet, Internet of Things (IoT), artificial intelligence (AI), and Big Data, and the study on urban public facility design is increasing. (Dong-Kuy Kim, 2020) Therefore, it is necessary to study the extension of the definition of public facilities and the direction of public facility design by considering the citizens' awareness of the area where the smartization of public facilities has already been carried out.

Therefore, this study aims to derive the analysis results of bus stops in Korea and China by using the statistical package program SPSS Statistics Version 25.0 to study the design direction from the perspective of the new concept of public facilities and urban design through the theoretical background of public facilities and citizens' awareness and satisfaction, considering the role of public facilities as places of social gathering and as those of cultural exchange which are built on harmony with the surrounding environment.

2. Theoretical background

2.1. Public facilities

2.1.1. Definition of public facilities

Public facilities are a combination of 'public' and 'facilities.' They are facilities that have the concept of publicness. (Yang-Beong Lee, 2011) This means 'facilities for all people, not individuals, that is, a facility that is fair to anyone without any privateness or bias, namely, a facility for the use of all people, not individuals'. Publicity is 'the nature related to the whole members of the entire society, not to one individual or organization,' and 'public' can be described as 'the one related to the members of a state or society' (Ho-Jung Cho, 2008).

The Local Autonomy Act of the Republic of Korea defines public facilities as facilities built by the state or local governments to promote the welfare of people's lives. In his book, Public Administration Theory, Yoon Jong-young (2009) defined

public facilities as facilities or buildings commonly used by various people or organizations (Jong-Young Yoon, 2004).

In addition, there are analogous terms like 'street furniture' or 'sight furniture', 'urban furniture.' Among public facilities, street furniture refers to a facility occupying the street can convey to pedestrians the roles of convenience—like traffic sign, notice, resting places, aesthetics— welfare, safety, safety, information delivery, and induction of activities in urban space (Liu Fen & Jae-Cheol Kang, 2020).

Considering these laws and dictionary meaning, public facilities can be defined as a facility that signifies a facility that the state or local governments provide public services to promote the welfare of the people's lives, which is built, managed and operated by public resources. There may be various interpretations according to the subjects and objects that provide services on the concept of public service, but generally, it can be said that goods or services provided for the public benefit are essential services for the daily life of the general public due to their nature. Therefore, unlike private facilities that prioritize profits, it is installed and operated by public resources, and public interest is an important factor in the operation of public facilities aimed at promoting the welfare of the people (Debnath Bhattacharyya, 2018) (Hee-Dong Park, Song-Gang Kim, 2019) (Chungyun Kim, 2020) (Jung-Ha Park, 2019) (Daniel Yang and Saman Grice, 2018).

This study suggests that the concept of public facilities needs to be newly established before presenting the direction of public facility design. Therefore, the definition of public facility design revealed in the previous studies was analyzed and defined as public facility design to include all the following characteristics.

First, public facility design should collectively refer to the design for the establishment of public facility and its visual beauty. Second, it should include the external expression style such as language expression, symbol, or picture for delivering information to the public. Third, the comfort that aesthetic aspects provide to the public and the possibility of efficient application in daily life should be included.

2.1.2. Characteristicts of publicity

Recently, as interest in public design has increased, there have been many discussions on public design and its guidelines to improve the urban landscape along with regulations such as outdoor advertisements that harm the urban aesthetics. In addition, discussions on the improvement direction have been raised by considering the concept of publicness of public design, which is being conducted as a trend individually as a public road, and the social value of design.

As the importance of the city as a symbol of image and culture as well as the purpose and possibility of use has been focused on, the implementation of publicness through integration and utilization between democratic processes and design elements is getting important.

Publicness is a relationship experienced by humans from the perspective of communication, and space is formed through the interface between spaces and human experience, apart from the distinction between public and private areas. Therefore, publicness can be classified by subjects, values, norms, laws, policies, etc., which are responsible for the publicness of the general public, but it has multi-layered meanings that can not be defined as one of the concepts as seen before. And the meaning of publicness is not fixed, but it is constantly created, added, divided, and relocated. So, it has characteristics that are changed by current trends, subjects in charge of evaluation, and various surrounding situations.

2.1.3. Scope of the public domain

Recently, as interest in public design has increased, there have been many discussions Public domain is always open to users, which means it is a place where users can freely access groups or individuals.

As Figure 1 suggests, public areas and private areas are located in an urban space, which includes closed space and open space type respectively.

Among these types, open public space and open private space are called public space. Private property and its maintenance can also have the meaning of publicness. Physically, public space means a space connected with and created by streets such as the city's buildings, plazas, and open spaces. As historically representative spaces of city change into plazas and markets, the system of public areas is also changing. Agora, which was a center of politics, economy, and leisure in the past, has expanded to a place of public opinion such as plaza, and has developed into a space with the attributes of social solidarity and community life of citizens today.

2.1.4. Characteristics of public design

The importance of operating public facilities can be divided into six categories as follows.

First, operational efficiency can be maximized. When unnecessary waste factors are called off, profitability and value of facility are secured through the effort to improve the quality of public service, and utilization rate and preference is improved, public service can be provided to more users.

Second, it is possible to secure appropriate profitability. In order to reduce the burden on national budget, it is necessary to guarantee the minimum profit for the operation of public facilities within the scope of not hindering the public interest. In Article 2 Section 2 of the Local Public Enterprises Act, it stipulates that local governments may apply this Act to any of the following business as prescribed by municipal ordinances if such projects are managed by the local government-directly operated enterprises, local government-invested public corporations, or local public agencies, and not less than 50 percent of their operating costs are met by their ordinary revenues. The article suggests that the standards of the minimum secure income of the public facilities can be measured.

Third, the satisfaction of users can be increased. The quality of public services provided by facilities can be evaluated, managed, improved, and supplemented to maximize the promotion and satisfaction of national welfare in accordance with the purpose of establishing public facilities.

Fourth, the durability of facilities can be improved. The durability of facility can be increased by providing the comfort of the facility use and safety to users through the timely inspection about facility, repair, reinforcement, environmental maintenance, etc.
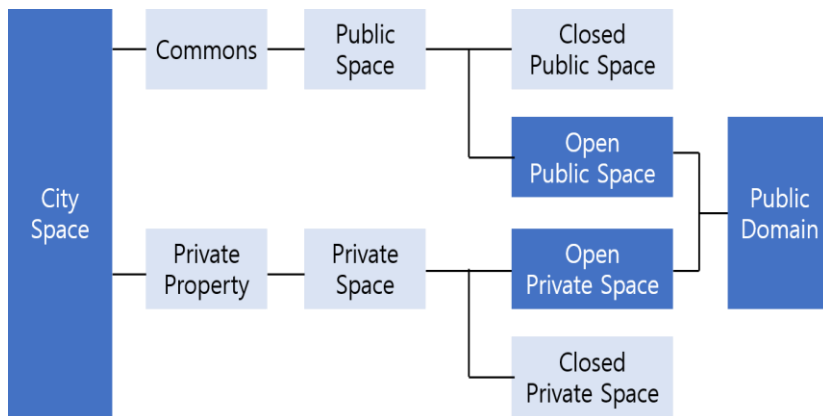

Fig. 1: City and public area (Ki-Yoon Chang, 2008)

Fifth, it ensures disaster prevention and minimizes damage in case of disaster situation. When prevention, preparation, response, and recovery steps about various kinds of possible disasters such as fire, power outage, and flooding are appropriately made in terms of the facility operation, a damage reduction of human and material loss as well as the prevention of accidents is possible.

Sixth, energy saving can be maximized. The energy saving and subsequent effect of carbon emission reduction are expected through the operation improvement including the energy consumption management, the environment-friendly facility improvement and efficient operation of the public service etc.

2.2. Smart technology and the change of public facilities design

Public design refers to designs related to all areas and objects that are mainly used publicly, such as public space, facilities, and information. In this regard, it is distinguished from private designs mediated through the market mainly with individual consumer goods, and it connotes public nature—such as premises of buildings or outdoor advertisements—regardless of whether it is public goods or private goods. Therefore, public design is a sociocultural infrastructure that shows the quality level of a society and should be implemented as an essential element of public works (Kim, Kyung Sun, 2011).

It is obvious that future cities will be smarter as information and communication technology is converged in various public facilities of cities. (Min-Jun Cha & Kwan-Seon Hong, 2006) Bus stops are important public facilities that make up the city. Bus stops commonly presented in the Korean Local Autonomy Law and the Seoul Guidelines for Design are an item that must be considered in urban design from the perspective of public facilities.

However, transportation facilities with smart technology are showing various characteristics of cities in various forms as well as the function of road network connecting one city to cities along with information on traffic flow. This provides a more extended concept concerning the existing definitions of urban design. Among them, the bus information system (BIS) fused with information and communication technology is combining ITS technology which has already been developed and operated in Korea.

BIS collects vehicle operation information—such as location, the number of passengers, accident information, stop status, etc.—,databases the operation situation and provides information to users in advance and in real time by using satellite or wireless communication network technology, and others (Je-Gyeuong Kwon, 2008).

As the number of vehicles in the city increases rapidly in Korea, the BIS system, which provides information on the transportation of city buses and intercity buses, is becoming a very important means for the convenience of citizens. Korea's investment ratio for BIS accounts for about 10% of total ITS investment (Kang-Rib Chung, 2001). The reason why Korea has a high BIS investment ratio is that the urban population density is high due to urbanization, and it is necessary to have a form of public facilities, not a type of receiver that simply receives information. In addition, urbanization is accelerating in China. Therefore, the design of urban public facilities related to BIS is essential to consider in designing cities in the future.

In urban engineering, BIS should be focused on the accuracy and speed of information provision if it is emphasized only in technical aspects. However, the above functions are just basic for citizens using BIS. In order to meet the needs of people and the rising standard of living, it is necessary to bring about changes in aesthetic and life innovation aspects along with such functions.

Considering the design of urban public facilities, bus stops as one of the street furniture should be considered in terms of accessibility and convenience as cultural spaces containing artistic value through sculptures in surrounding spaces.

2.3. Utilization of smart technoligy for public facilities in Korea and China

Smart technology is something that digital technology representing the 4th industrial revolution technology is applied to mobile, Internet, Internet of things, and artificial intelligence. If the city is designed to make the city smart by introducing smart technology based on information and communication technology, citizens can live in

a safe, convenient and pleasant space with the ecosystem around them changing in a better way.

In Korea, smart technologies such as Intelligence Transport System (ITS) technology to prevent smooth traffic flow and accidents of increased vehicles have been developed and exported overseas since 2003. ITS technology is very widely used not only for highway operation but also for monitoring local bus operation such as city buses. For this reason, the legal basis for urban design and urban construction that introduced smart technology in 2009 was implemented. (Ae-Young Yoon, 2010)

As an emerging country, China believes that using smart technology is the most efficient way to solve many problems caused by rapid urbanization. It solves problems caused by urbanization in a way of smartization of cities through conversion to renewable energy, improvement of aging urban structures, citizens' participation and interaction, and open public data (Eun-Young Lee, 2018).

In particular, Chinese government has invested about 182 trillion won in the new urbanization project introducing smart technology since 2015, and plans to invest about 10 trillion won in urban design R&D introducing the technology by 2050. (Yang Yoo, 2010)

3. Cases of design of bus stops related to design elements of public facilities

In future cities, bus stops will become important core facilities of smart cities as new public facilities where culture, technology, and art are fused.

In order to derive the public design elements of the bus stop, the study reviewed each element comprehensively based on the literature research of the public design of street facilities and bus stops. The related indicators in the previous studies of bus stops in public design street facilities are as follows.

Jeon Yoo-jeong(2009) mentioned three design elements of functionality, politicity and aesthetics in 'Study on the Outdoor Design of Seoul City Buses from the Perspective of Public Design (Yang Yoo, 2011),' and Park Jang-yeol(2008) mentioned three design elements of identity, integration, and regeneration in 'Study on Sustainable Public Design for Bosch Brands(Jang-Yul Park, 2008).'

In 'Walk on Public Design (Young-Geol Kwon, 2008),' Kwon Young-Gol(2008) mentioned beauty, comfort, harmony, identity, order, safety, usefulness, and readability. Lee Hyun-jun (2009) deals with mobility, location, comfort, culturality, symbolism, and connectivity in 'A Study on the Characteristics of the Environmental Composition Factors in Commercial Areas.' (Hyun-Jun Lee, 2009)

In 'Study on Design Plan of Public Resting Space in the City Considering User Behavior,' Lee Eun-Jeong (2008) mentioned accessibility, symbolicity, openness, comfort, aesthetics, and convenience. In 'Study on Application of Public Design for Improvement of Street Walking Space in the Urban Area(Eun-Jung Lee, 2008)' Kim

Seong-hee (2009) mentioned identity, connectivity, integration, functionality, and sustainability.

Shim Woo-kyung et. al. (2008) classified the elements of design into comfort, convenience, functionality, culturality and environment-friendliness in 'Plan for Small Park to Improving Urban Street Environment.' (Sung-Hee Kim, 2009) Jeong Jong-hee and Ko Young-joon(2008) dealt with the elements of comfort, ease of use, ease of information provision, and safety in 'Study of Design Direction of Multifunctional Bus Stop.' (Woo-Kyung Sim, Soo-Jin Kim, Young-Jin Choi & Hae-Joon Jung, 2008).)

This study aims to analyze the types of bus stops in Korea and China and to examine the differences in public facility design. The study was conducted on bus stops in Busan and bus stops in Beijing, China.

Haeundae-gu(District) with the highest population density, Jung-gu(District) with the lowest population density, and Seo-myeon(district) with the highest population mobility were selected as the target areas for empirical analysis. In Beijing, Wuhuan(5th Circle District) with the highest population density and Yihuan(1st Circle District) with the lowest population density were selected as sample areas.

In order to compare and analyze bus stops in Busan and Beijing, informativeness, safety and aesthetics of bus stops presented in previous studies were analyzed by measuring the bus stops in Korea and China.

Informativeness was analyzed by BIS function as the availability of various information such as bus arrival time, bus operation value, vehicle availability for disabled people, and fine dust concentration information.

Division	Busan	Beijing
Informative ness		

Fig. 2: Bus stops in Busan & Beijing current situation 1(Informativeness)

The safety was judged by whether the roadway was accessible, convenience of bus use by the disabled, bus and bus stops, and design considering efficiency and safety considering convenience of getting on and off the platform.

Division	Busan	Beijing
Safety		

Fig. 3: Bus stops in Busan & Beijing current situation 2 (Safety)

The aesthetics were judged by various design colors, intensity of light on the display panel, design viewpoint of letter size and letter shape, interference phenomenon of solar light on the display panel, harmony with surrounding environment, space utilization, and pleasant feeling.

4. Empirical analysis

4.1 subjects and methods of survey

This study was conducted to verify the satisfaction with public facility design for bus stops in Busan and Beijing with people with various ages, occupations, and educational backgrounds living in Busan and Beijing. Based on the basic understanding of public facility design, the questionnaire items were developed and conducted for objective interpretation. In order to increase the reliability of the survey, face-to-face surveys were conducted so that the questionnaires could be answered based on the understanding of the evaluation items through question and answer.

The survey period was 31 days from July 1, 2021, to July 31, 2021. A total of 500 questionnaires were distributed and 377 questionnaires were collected. Final 352 copies were used for analysis except for the unfaithful response among the collected questionnaires.

4.2. Analysis of the importance of awareness about public facilities in Busan and Bejing

In Busan, public facilities are considered to be an important factor in determining the city image. This means that citizens living in Busan think that the design of public facilities determines the image of city brand and that public design is important (average value = 4.08). On the other hand, citizens living in Beijing think public facilities are important as facilities that deliver real-time disaster information (average value = 4.152). This is the result of the fact that citizens who have experience of natural disasters due to earthquakes or floods in China are demanding the design function of public facilities.

Division	Busan	Beijing
Aesthetic		

Fig. 4: Bus stops in Busan & Beijing current situation 3 (Aesthetic)

In Busan, it is required to design public facilities to solve safety blind spots as an urgent supplementation. (average value=2.76). Beijing is required to design in an efficient direction in protecting personal information and utilizing renewable energy when designing as a public facility. This shows that Chinese citizens are very aware of yellow dust and air pollution, so it is necessary to design the city so that they can control such problems (average value = 4.152). In particular, China was most concerned about the disclosure of personal information when approaching the design of public facilities (average value=4.182).

Table 1: Citizen's opinion survey on the introduction of smart technology and image and design of public facilities

Clause	Mean Value	
	Korea	China
Do you think that a specific image of the city you live in is necessary?	3.96	3.652
Do you think the city image you live in is satisfactory?	3.68	3.121
Do you think that urban images can affect citizens?	4.08	3.773
Are you satisfied with the public facilities in the area you currently reside in?	3.4	3.061
Do you think you are using smart technology (network of information sharing, intelligent transportation, intelligent environmental control, smart home, etc.) in your current urban public facilities?	3.54	3.273
Do you think it is necessary to make eco-friendly energy systems such as the construction of renewable energy systems in urban public facilities mendatory?	3.86	4.061
Do you think that smart disaster and safety services are needed for the urban public facilities you live in?	4.02	4.152
Do you think that the introduction of smart technology in public facilities affects the protection of personal information?	3.68	3.348
Do you think that a legal actin is necessary in introducing smart technology to urban public facilities in order to protect personal information?	3.92	4.182
Are you satisfied with the current urban public facilities and the harmony (visual aspects) with the surrounding environment?	3.46	3.091
Are you satisfied with the urban infrastructure, equipment, and installations in public facilities relevant to facility aging, slumming, and replacement time in your city?	3.28	2.97

Do you think it is necessary to improve the design of public facilities to alleviate the current city?	3.9	3.773
Are you satisfied with the safety of the current urban public facilities (CCTV installation and management of dark alleys, etc.)?	2.9	2.879
Do you think that minor offenses in urban public places including smoking and creation of social unrest, etc. are appropriately regulated?	2.76	2.682
Are you satisfied with the damage in public facilities (fire, violence, etc.) in the city where you live?	3.32	2.985
Do you think the introduction of smart technology helps prevent crime in public facilities?	3.82	3.758

Compared based on Figure 2, 3, 4 which was made by comparing bus stops in Beijing and Busan, it can be seen that in China, the station has only a function of sign rather than providing real-time information, so there is no function to warn disaster or catastrophe to the citizens. Therefore, a disaster warning system is urgently required for smartization of public facilities.

Also, as mentioned above, it will be helpful to insert yellow dust index or air pollution index into the notification function of bus stop for managing concerns efficiently about yellow dust and air pollution of Chinese citizens.

The most different in citizens' consciousness structure in Busan and Beijing was the question of whether they were satisfied with the image of the city they live in. Citizens living in Beijing were not satisfied with the design of urban public facilities compared to citizens living in Busan.

However, the importance of urban joint facility design is considered to be important in common with Chinese and Korean citizens. They expresses an positive opinion on the idea that the safety facilities that are currently inhabited are needed in an active way, and expect that smartizing the city will play an important role in making it safe and in lowering crime rate and improving quality of life.

4.3 The direction of design of public facilities that citizens expect

As a result of survey about the direction of expectation of public facility design, in Busan, 22.1% of the respondents answered 'improvement of convenience' and 'defense against relatively disordered spaces,' followed by 20.2% for 'crime prevention,' 16.3% for 'visual image improvement,' 11.5% for the prevention of 'man-made accidents or natural disasters,' and 7.7% for 'relocation of relatively

disordered spaces.' Especially, convenience of citizens' life and prevention of natural disaster should be considered in the design of public facilities. As shown in the survey results of Table 2, most citizens recognize that public facilities play an important role in reducing daily life problems.

Table 2: Expected direction of public facility design

Clause	Response			
	N (Busan)	N (Beijing)	Response rate (Busan)	Response Rate (Beijing)
Crime prevention	21	38	20.2%	15.3%
Relocation of relatively disordered spaces	8	44	7.7%	17.7%
Man-made accidents and natural disaster An Insight and Natural Accident Prevention	23	32	22.1%	12.9%
Facility maintenance	12	48	11.5%	19.4%
Improvement of convenience	23	49	22.1%	19.8%
Enhancement of visual image	17	34	16.3%	13.7%
Other	0	3	0.0%	1.2%
Total	104	248	100%	100%

As for Beijing, the result of the survey on the expected direction of public facility design showed that 'improvement of convenience' was the highest with 19.8%, 'maintenance of facilities' with 19.4%, 'relatively disordered space' with 17.7%, 'prevention of crime' with 15.3%, 'improvement of visual image' with 13.7%, 'prevention of man-made accidents and natural disasters' with 12.9%, 'others' with 1.2% in the order. Other opinions included that citizens expected additional public facilities around the places that are frequently encountered in everyday life in order to improve the quality of life and the image of city.

Busan citizens are demanding function of prevention of human-induced accidents and natural disasters as a priority in designing public facilities. When designing a public facility in the city, a design function should be secured so that it can fully prevent natural disasters or man-made accidents that may occur. In addition, it was expected to prevent man-made and natural disasters and improve convenience in the design of public facilities. Beijing citizens had high expectations for facility maintenance, improvement of convenience, and resolution of the existing disorderly

space utilization problems. This suggests that the public facilities in Beijing are considerably underdeveloped compared to those in Busan and that they should be developed in a way that complements shortcomings in the future.

4.4. The direction of expectation for design of public facilities that smart technology is to be introduced

The survey results of 'what is expected if smart technology is introduced to public facility design for Busan citizens' showed that 37.9% of the respondents said that 'it would improve qualitative satisfaction,' 34.5% said that 'it would make public facility system smoothly operated,' 13.8% said that 'it would improve the comfort that public facilities offer,' 9.2% said 'it would increase the utilization rate,' and 4.6% said 'it would provide a sense of safety.'

Table 3. Expectations for public facilities with smart technology

Clause	Response			
	N (Busan)	N (Beijing)	Response rate (Busan)	Response Rate (Beijing)
Makes the public facilities system smoothly operated	30	51	34.5%	23.3%
Improves the comfort that public facilities offer	12	43	13.8%	18.9%
Improves qualitative satisfaction	33	52	37.9%	22.9%
Improves citizen utilization rate	8	42	9.2%	18.5%
Provides a sense of psychological stability	4	38	4.6%	16.7%
Other	0	0	0.0%	0.0%
Total	87	227	100%	100%

The survey results of what is expected if smart technology is introduced to the design of public facilities for Beijing citizens showed that the highest 23.3% of the respondents said that 'it would improve quality satisfaction,' 22.5% said that 'it would make the public facilities system smoothly operated,' 18.9% said that 'it would improve the comfort that public facilities offer,' 18.5% said 'it would increase the utilization rate of citizens,' and 16.7% said that 'it would provide a sense of safety.'

In Busan, there was a great demand for high quality life for the design of urban public facilities with smart technology. In addition, the positive response rate to the question of whether the introduction of additional smart technology will increase the citizen utilization rate for bus stops than before was significantly lower. This is because Busan citizens do not feel much inconvenience in using facilities using smart

devices due to the development of information and communication technology around them.

On the other hand, Beijing expects to use the public facility system smoothly. This implies that there are many obstacles to Beijing citizens' access to public facilities.

The most anticipated part of the civic survey of two cities in both countries is the area of mental stability. In this area, the ratio of Korea and China is 4.6% and 16.7%, respectively. About four times of difference appears. This shows that Chinese citizens think that the design of urban public facilities that incorporate smart technology will be more secure than before and play a big role in building social safety nets than Busan citizens.

5. CONCLUSIONS

In terms of the change of social environment, as science develops, the concept of urban design based on the fourth industrial revolution— technology, mobile, Internet, Internet of Things (IoT), artificial intelligence (Artificial Intelligence: AI), and Big Data— is becoming the center of new interest. So, studies on urban facility design are increasing. Therefore, it is necessary to seek an expanded definition of public facility and study the direction of public facility design by referring to the citizens' awareness of the area where the smart painter of public facilities has already been carried out.

This study examined citizens' points of view on the installation and operation of bus stops and the change in their awareness of public facilities in terms of urban public facility design in Busan and Beijing. In addition, the following results were drawn by comparing and analyzing the issue of how the BIS system functions in terms of information delivery as well as harmony with the surrounding environment.

Busan has already been familiar with the smartization of bus stops by most citizens due to the establishment of BIS system. Therefore, it was anticipated that it would become a culture complex that can reveal artistic sense and improve the quality of life about the design of bus stops in the future rather than expecting the smartization of the system itself.

However, in Beijing, although the population density is higher than that of Busan and it is a big city that plays a role of capital of China, smartization of public facilities is not common, and many citizens feel uncomfortable about basic functions. Therefore, expectations for the introduction of smart technology in itself were relatively high. However, despite these differences, both citizens in the cities had high expectations for the development of public facility design that the progress of smart system would bring.

Based on the results mentioned above, I reviewed the issues that should be considered when Busan and Beijing install BIS in urban public facilities. By expanding this into the concept of public facilities, it can be inferred that information

and communication technology is applied closely to our living space as well as a whole industry due to the spread of the fourth industrial revolution technology. Information and communication technology is an essential technical element for making cities smarter such as transportation machinery and intelligence buildings from personal life. Therefore, the concept of existing public design needs to be expanded and added more than the original concept, and the direction is as follows.

First, urban public facilities should be studied comprehensively from the perspective of urban design, which is based on information and communication technology as well as previous roles. For example, bus stops and transfer areas should have various functions ranging from original functions in its existing meaning to roles as a cultural space.

Second, it should move to a human-centered space that can be a place of giving psychological satisfaction and interaction. Even if the smartization of the city progresses, it should function to keep in mind that users are human and therefore to become a place of psychological satisfaction and interaction between humans.

This study is meaningful in that it investigated the awareness and necessity of citizens as a case of smart public facilities, especially bus stops, derived from the results of this study. Despite these implications, the limitation of this study is that the research cities were compared and studied only in Busan and Beijing, not in various cities. In addition, there is a limit to generalization in that the number of sample groups surveyed is not enough to fully represent each city. In future studies, it is expected that this study will be meaningful if the questionnaires are diversified based on this study and the research is conducted by increasing the number of survey areas and groups.

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