A demonstration case study on the use of living lab and governance for smart city construction and the establishment of a smart solution space

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Urban problems in rural small towns in Korea are manifested in various forms, such as the aging of the population, the smart gap, the departure of young people, and the inefficiency of urban space. Accordingly, the state and local governments are presenting various solutions to solve the above urban problems. Among them, the Ministry of Land, Infrastructure and Transport conducted a public competition project to develop and demonstrate technologies such as smart common cultural space creation, smart education support, smart crime prevention and safety, smart healthcare, and smart information plaza as a way to create a smart city. Based on the project selected in the 2021 public contest, this study collects the opinions of actual residents through the operation of a living lab before the actual smart solution space construction, and based on this, secures the direction for space composition and curriculum development, and applies local customized applications We tried to derive a method for To this end, a living lab was operated prior to the establishment of a smart solution space, and various opinions were shared and collected through the participation of experts in each field, local residents, and universities. Based on the convergence results, the present day problems and local issues of small towns were discovered and served as a test bed to solve them. In addition, in order to further secure the justification and feasibility of building a smart space, the opinions of local residents were actively collected through a total of three surveys. As a result of living lab and governance results and survey analysis results, the necessary services and solutions were built in the order of smart crime prevention, smart healthcare, convenience for living, education support, smart information plaza, smart shelter, and multi-purpose studio. Through this, it was possible to build a space that maximizes the sensibility of actual residents.

This study presented a methodology for how to build a resident-led bottom-up development model rather than the central government-led top-down development, and carried out actual demonstration. It is judged that this study can be provided as basic data to some extent in the design of a smart city customized for each region in the future to spread a similar public offering project. Smart cities and proptech following the 4th Industrial Revolution are an irresistible trend, and accordingly, they will become more sophisticated and concrete. Therefore, it is hoped that various results for actual verification through demonstration projects can be drawn, rather than looking at smart cities, living labs, and smart solutions only from an academic point of view, and various policy implications can be derived.

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1. Introduction

A smart city is a city that solves urban problems, improves the quality of life, and creates added value through the convergence of technological development in the era of the 4th industrial revolution such as ICT, IOT and SW [1]. In fact, smart city is also defined as 'integrated system software' that can optimize city functions through collective power[2]. Also, large companies are entering the market in various forms to secure profitability and data [3]. In particular, in Korea, smart cities are being promoted at the national level as an alternative to solving the growing information gap between regions along with the aging of the population [4]. To support this, the ability of residents to adapt is essential in the complex and diverse solution process between various urban problems and rapidly developing technologies [5]. In particular, the original purpose of the ultimate smart city will be achieved only when the resident sensibility that residents actually feel through their skin is improved. However, the ability to adapt is inevitably derived from a relatively low class, and the difference continues to increase over time [6]. When using existing smart devices such as large cities or teenagers, those with high accessibility can directly or indirectly acquire a highly informatized culture, but it is common for the elderly or local cities to show relatively insufficient trends [7]. This trend is called the digital divide, and it is recognized as a very important issue in the task of integration between regions or social classes [8]. Therefore, research is being actively carried out in various forms and methods in academia. However, the studies conducted so far are simply examining the simple reality of what level the digital divide is widening. In addition, verification that can compare before and after actual use in utilization and use of digital devices, etc. is quite insufficient.

In particular, there are practically no empirical projects or research to build solutions based on urban problems directly felt by residents, the stage before designing a smart city, and measure sensibility after actually using them.

Accordingly, the Ministry of Land, Infrastructure and Transport announced the "2021 Smart Campus Challenge Project" in accordance with Articles 9-2 and 27 of the 「Act on Smart City Creation and Industry Promotion, etc.」. The contents of the project are to demonstrate and commercialize the research contents of the university and the application of young and innovative smart solutions to campuses and regions through industry-university linkage. In other words, it is to compare and analyze before and after the introduction of smart solutions and build a DB to solve the digital divide, solve problems in local small and medium-sized cities, and secure an ecosystem to form a smart city foundation.

Therefore, in this study, among the consortiums selected for the project, the "Smart Venue Project Group (hereinafter referred to as the project group)" developed the entire city based on the opinions of residents through the Smart Campus Challenge project that was promoted in Yesan-gun, Chungcheongnam-do. It is intended to measure the sensibility of the residents through the conception and actual verification. Based on this, it is judged that it is possible to derive various policy implications, such as suggestions on the level of resolution of the digital divide and operation form through demonstration, improvement and diffusion measures, and post-war perception changes.

2. Theoretical Background

2.1 Concept and characteristics of smart city

According to the International Telecommunication Federation, smart city has about 116 definitions and is used in multiple meanings[9]. In general, smart cities can be summarized as solving urban problems such as transportation, logistics, administration, energy, and housing welfare by using the latest ICT technologies such as the Internet of Things (IoT), big data, artificial intelligence, and big data[10]. The concept of smart city can be divided through the broad classification of end and means. Unlike general cities, smart cities are approached from the perspective of the overall spatial structure of the city and human-centered thinking. In addition, as the entire city builds a single platform, it is characterized by relatively flexible addition and change of new functions according to future technological development[9].

[Table 1] Classification of smart city concept

Smart City Classification	purpose point of view	A city pursuing smart growth	city perspective	A city where an independent unit of a city reaches a specific development goal
			Citizen's point of view	A city experienced by the constituents of the city
	Sudanese Perspective	A city that uses smart means	service oriented	A city that provides differentiated services
			structure center	A city with structural features as a platform

main. National Information Society Agency (2016), Smart City Development Prospects and Korea's Competitiveness, IT & Future Strategy.

This refers to a city that has been upgraded to a higher level by combining technology and technology from a city that has been generally known. Ultimately, this can be defined as a new level of infrastructure and data construction, securing the interrelationship of operated services, and a cooperative living lab [11]. Based on this, a general city and a smart city are classified as follows.

[Table 2] Distinction between general city and smart city

division	general city	smart city
flexibility	Difficulty in changing or adding new	Flexible city through platformization
Connectivity	Difficult to share functions due to segmentation	Organic connection possible through the convergence of the entire city
creativity	Continuous increase in input to solve problems	Solving urban problems using creativity and new technologies
organizing	Deliberate control through information asymmetry	Self-organizing city according to information sharing
people-centered	City center service by adapting to the city operating system	Urbanization by providing services tailored to the needs of citizens
data foundation	A process-based service that provides only predefined services	Citizen customized service through data-based service

2.2 General Status of Project Sites and Smart City Service Status

The project site is Yesan-gun, Chungcheongnam-do, with an economy of approximately KRW 736.1 billion and a population of 76,801. There are 7,087 industrial establishments and 37,131 housing units. In particular, this area is a local small town, and the proportion of the aging population is the highest in Chungcheongnam-do. In particular, it was judged to be a suitable site for the demonstration as it had problems such as accelerating population outflow and deep aging in the areas of resolution of the digital divide and resident sensibility related to this study. The current status of smart city-related services in the region is shown in the table below.

[Table 3] Smart City Service Status

Smart City Service Status			
service name	business information	business period	Construction Status

mobile health care	Provision of mobile-based health management services using ICT to transform into a target-oriented health management business	2021~2021	in operation
Yesan County CCTV Integrated Control Center	Implementation of city safety system through 24/7 video monitoring based on CCTV integration	2019~	in operation
smart city plan	Establishment of basic goals and promotion strategies for smart cities, etc.	2021~2022	Start of service (2021.03)
Naepo New Town Smart city construction	Promotion of 19 services in 7 areas	2012~2021	Steps 1 and 2 completed (Nepo new town self-network and CCTV installation, etc.)
smart security light	Smart security light installation	2020.11~2020.12	5 locations
Smart public wifi	50 public Wi-Fi installations	2021.3~2021.9	Installation under construction
National River Smart Flood management system establishment	26 places including the establishment of a water gate Wonkyung Fishing System	2020~2021	Installation under construction
Smart pipe network infrastructure construction business	Incorporating ICT into the entire tap water supply process, building a smart water quantity and water quality management system	2020~2022	Basic agreement signed
Smart Park Creation	Smart Human Rights Park	2018~2020	2 installations
Smart Garden Installation	Create an indoor garden (smart garden ball)	2020.1~ 2020.11	3 locations
Cheonan·Asan Smart City integrated platform Infrastructure project	Establishment of city safety net by providing CCTV images	2019.12~ 2020.6	in operation

3. Data Collection and Sampling Methods

Before the implementation of the project, a resident participation group was recruited to find out what kind of urban problems the residents had, and through this, various opinions were listened to. The Living Lab was composed of local governments, resident participation groups, and experts, and was continuously performed before and after the project implementation. In particular, it was conducted in the form of a discussion based on big themes such as housing, crime prevention, disaster prevention, environment, culture, tourism, leisure, and transportation, and a survey was conducted to secure and support the objectivity and logic of the Living Lab. In order to derive a sample, the survey modeled the total population of Eup, Myeon, Dong, and the number of copies allocated by gender and age in Yesan County first. The data used were derived based on the figures of KOSIS (2021)[12], a domestic statistical portal, and the method used is as follows.

[Table 4] Sample derivation method

division	Derivation method
Yesan County Total Population	Domestic statistical portal KOSIS, Resident Registration Population Number of Populations by Gender by Administrative Region
Eup, Myeon-dong, Yesan-gun Population	Domestic statistical portal KOSIS, registered resident population by administrative district (eup, myeon, dong) / registered resident population by age 5
Number of copies allocated by Eup, Myeon and Dong in Yesan-gun	150 copies for each eup, myeon and dong × ratio to population
Age ratio by Eup, Myeon and Dong in Yesan-gun	KOSIS, a domestic statistical portal, resident registration population status by administrative district (eup, myeon, dong) / registered resident population by age of 5
Eup, Myeon-dong, Yesan-gun, number of copies allocated by age	Final number of copies by Eup, Myeon and Dong × Age ratio

Based on this, the number of copies to be allocated by Eup, Myeon, and Dong of Yesan-gun finally derived is as follows.

[Table 5] Eup, Myeon-dong, Yesan-gun Age and gender allocation of copies

administrative division	final copy	0-19 years	20-34 years old	35-49 years old	50-64 years old	65 years or older	gender total number of copies
Yesan-eup	64	5	5	6	9	7	32
		4	4	6	9	9	32
Sapgyo-eup	20	1	2	2	3	2	10
		1	2	1	3	3	10
Daesul-myeon	5	0	0	0	2	1	3
		0	0	0	1	1	2
Shinyang-myeon	6	0	0	0	2	1	3
		0	0	0	1	2	3
Guangsi-myeon	6	0	0	0	2	1	3
		0	0	0	1	2	3
Daeheung-myeon	3	0	0	0	1	1	2
		0	0	0	0	1	1
Eungbong-myeon	5	0	0	0	2	1	3
		0	0	0	1	1	2
Deoksan-myeon	13	0	1	1	2	2	6
		1	1	1	2	2	7
Bongsan-myeon	5	0	0	0	1	1	2
		0	0	1	1	1	3
Godeok-myeon	9	0	0	1	2	2	5
		0	0	0	2	2	4
Sinam-myeon	7	0	0	0	3	1	4
		0	0	0	1	2	3
Oga-myeon	8	0	1	1	1	1	4
		0	0	0	2	2	4

4. Analysis result

The characteristics of the sample used in the analysis are as follows. First, in the case of gender, males and females each accounted for the same at 50%, and the age group of 50-64 years of age responded the highest with 36%, and the age group over 65 also reached 32.7% of the total, indicating that the aging rate is quite high. Could know.

[Table 6] Respondent age

Age	Frequency	Percent	Cumulative Percent
0-19 years old	12	7.3%	8.0%
20-34 years old	15	9.1%	18.0%
35-49 years old	20	12.1%	31.3%
50-64 years old	54	32.7%	67.3%
65 years or older	49	29.7%	100.0%

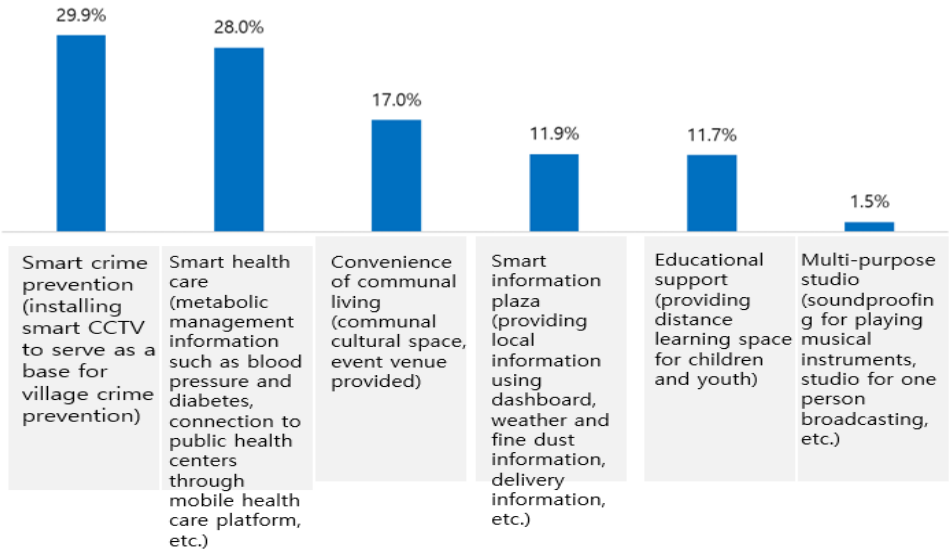
Also, in the case of the respondents' residence period, 7 to 10 years was the highest with 35.8% of the total, and the next highest period was 10 years or more, which corresponded to 33.3%. In other words, if you look at the period of residence itself, most of them are people who have lived for a long time, so it is highly likely that they have a clear understanding of the current urban problem, so the reliability of this analysis data is also expected to increase.

[Table 7] Respondent's period of residence

period of residence	Frequency	Percent	Cumulative Percent
less than 1 year	4	2.4%	2.7%
1 year to less than 3 years	4	2.4%	5.3%
3 to less than 7 years	28	17.0%	24.0%
7 to less than 10 years	59	35.8%	63.3%
more than 10 years	55	33.3%	100.0%

First, as a result of the survey before implementation of the project, the preference of this project was 'a necessary facility, good' was the highest at 64.0%, followed by 'don't know' 30.3% and 'unnecessary facility, it is not necessary' 5.7% in order. . A significant point to note in this result is that the percentage of respondents who answered 'I don't know' occupies a fairly high level, indicating that it is necessary to absorb this as a demand for steady information provision and actual demonstration in the future. Also, when asked about the most necessary services, 'Smart Crime Prevention' was the highest at 29.9%, followed by 'Smart Healthcare' 28.0%, 'Community Living Convenience' 17.0%, 'Smart Information Plaza' 11.9%, 'Education Support' 11.7% %, followed by 'multipurpose studio' 1.5%.

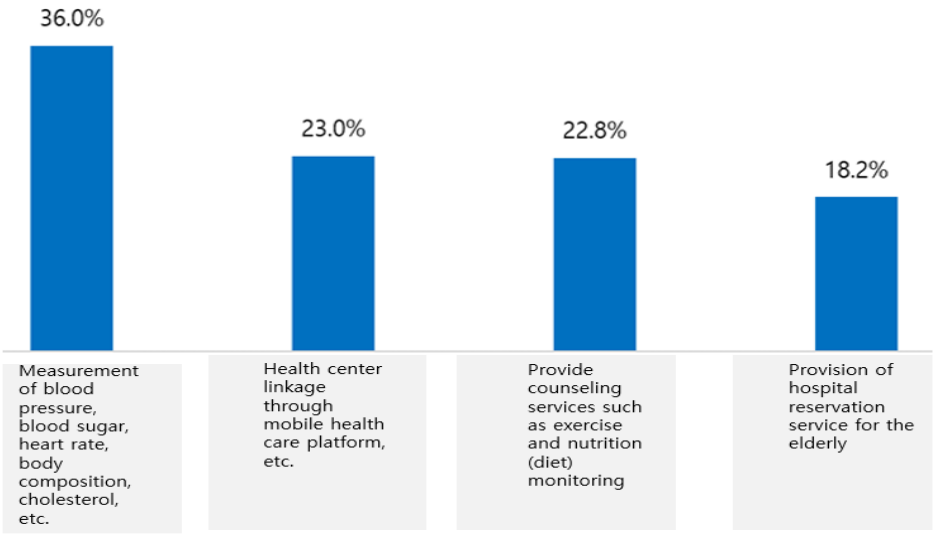
[Figure 1] Proportion of items derived as the most necessary service for Smart Venue



Among them, as the most necessary service among smart healthcare, 'measurement of blood pressure, blood sugar, heart rate, body composition, cholesterol, etc.' was the highest at 36.0%, followed by 'providing public health care services linked to health care through mobile healthcare platform' ' 23.0%, 'Counseling services such as exercise

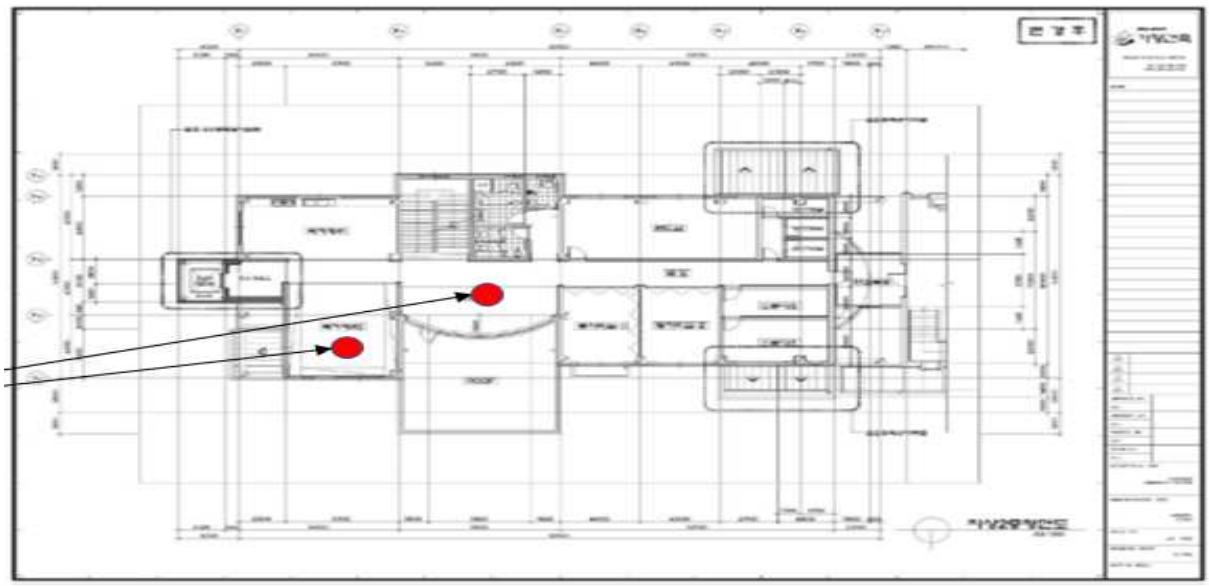
and diet monitoring,' 22.8%, and 'Provide hospital and clinic reservation service for the elderly' 18.2%. In the case of smart crime prevention, the ratio of AI CCTV was overwhelmingly high, and technical discussion related to whether it could be verified was additionally considered.

[Figure 2] Proportion of items derived as the most necessary service among smart health care services

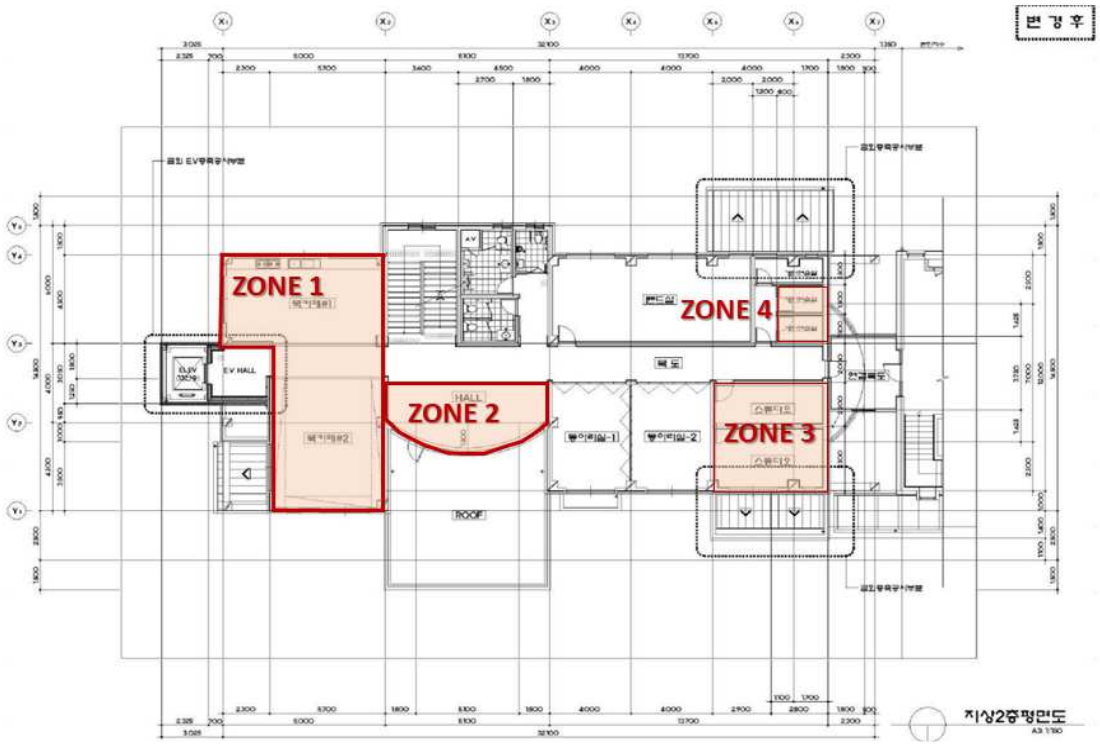


Based on the results of the Living Lab and the survey, a demonstration site was searched for, and it was decided to use the space and install it at the Budget Cultural Center, which is used the most by the actual residents and is highly utilized. Technical review and cost estimation were additionally carried out, and by actively collecting opinions from residents, a space for demonstration was established within the set budget. For the construction, the space of the Yesan Cultural Center was divided into four zones, and in the case of Zone 1, a dashboard, smart light bulb, gateway and AI speaker, AI CCTV, etc. were applied as a book cafe. Zone 2 is a smart healthcare space with folding doors, body composition analyzers, blood pressure monitors, height monitors, ZWIFT and ZWIFT monitors, and AI CCTV. Zone 3 is a multi-purpose studio, with broadcast recording facilities, dedicated PC installation, cameras, and chroma key screens applied. The last 4 zones are individual learning spaces, and a distance education space for one person was created. The app service developed along with it is loaded with hospital reservations, health consultation, and notification information.

[Figure 3] Smart Venue (Yesan Cultural Center) AI CCTV installation location

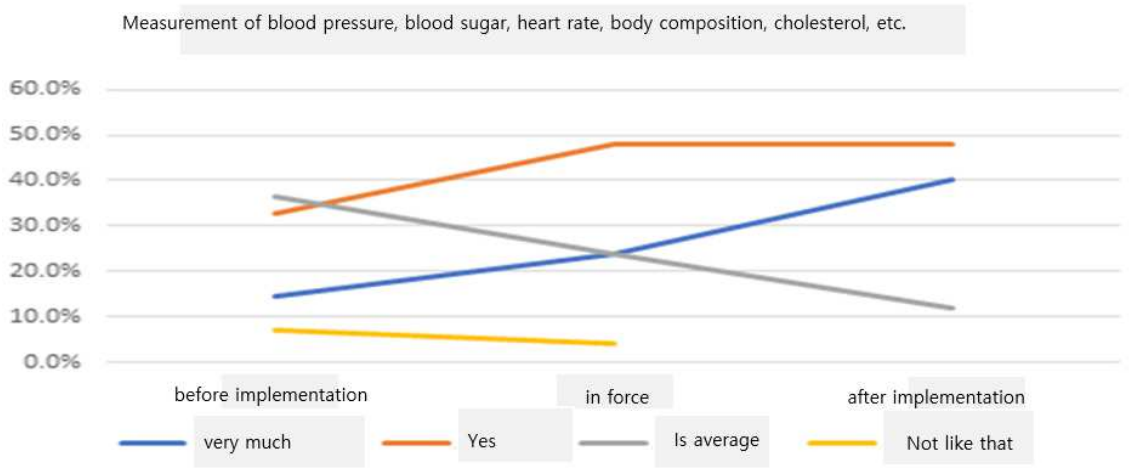


[Figure 4] Smart Venue (Yesan Cultural Center) solution and service design-space configuration



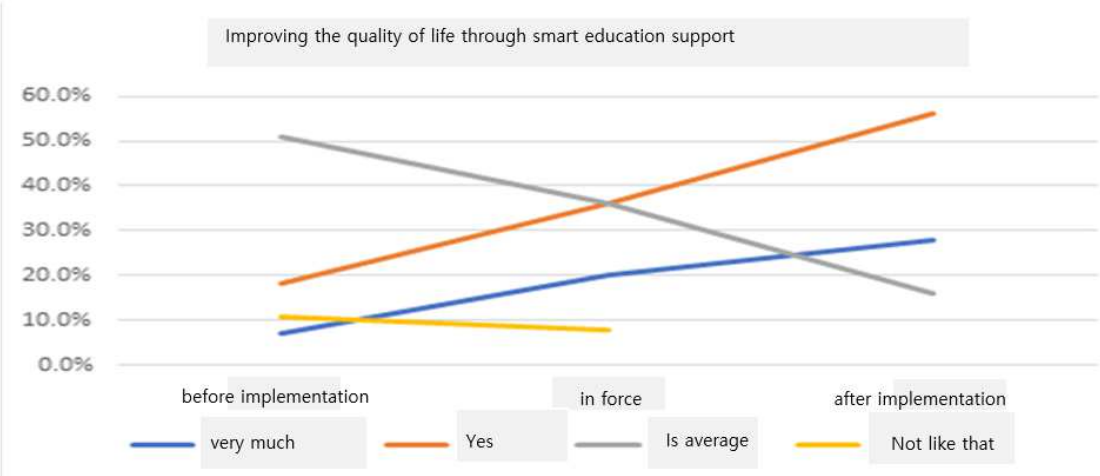
Based on this, the demonstration was carried out for about 4 months, and the results of the survey analysis on the sensibility of the residents before, during, and after the implementation of the project are as follows. First, a trend analysis was conducted by developing items to measure the effect of reducing medical expenses for the most established healthcare overall services in this study. As a result, in the case of 'very much' as to whether medical expenses would be reduced if continuous health status check through health care service was possible, it increased to 14.5% before the implementation of the project, 24.0% during the project, and 40.0% after it was implemented. In this case, it increased to 32.7% before the implementation, 48.0% during the implementation, and 48.0% after the implementation, and was kept constant. In the case of 'normal', it decreased to 36.4% before implementation, 24.0% during, and 12.0% after. there was no Therefore, as time passed, the number of positive responses significantly increased, indicating that the actual resident's sensibility was high.

[Figure 5] Medical cost reduction analysis graph through healthcare service



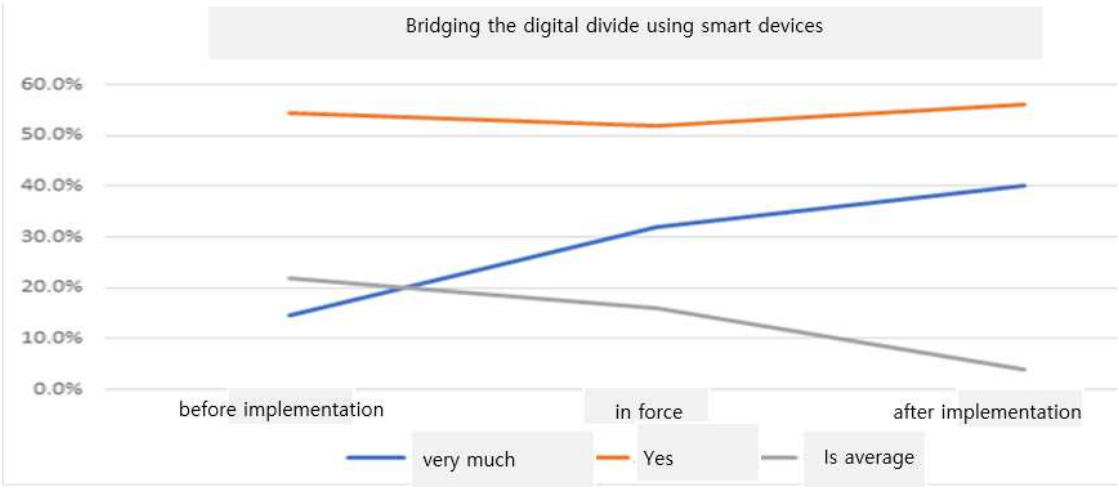
As a result of analyzing whether the support related to smart education will help improve the quality of life, 7.3% before the project implementation, 20.0% during the project implementation, and 28.0% after the project implementation. It increased to 18.2%, 36.0% during and 56.0% after. In the case of ‘normal’, it decreased to 50.9% before the implementation, 36.0% during the implementation, and 16.0% after the implementation. Finally, in the case of 'not at all', there were no responses during and after implementation except for 3.6% of responses before implementation. appeared to increase.

[Figure 6] Quality of life improvement analysis graph through smart education support



In particular, the target of this study is a local city with a high aging rate, and issues related to resolving the digital divide still exist. Therefore, a questionnaire was constructed and analyzed to understand how much the digital divide was resolved while using smart devices. As a result, in the case of 'very much', it increased to 14.5% before implementation, 32.0% during implementation, and 40.0% after implementation. On the other hand, 'normal' decreased to 21.8% before the implementation, 16.0% during the implementation, and 4.0% after the implementation. Therefore, it has been proven that, when conducting such a demonstration project, education to reduce the digital divide is essential.

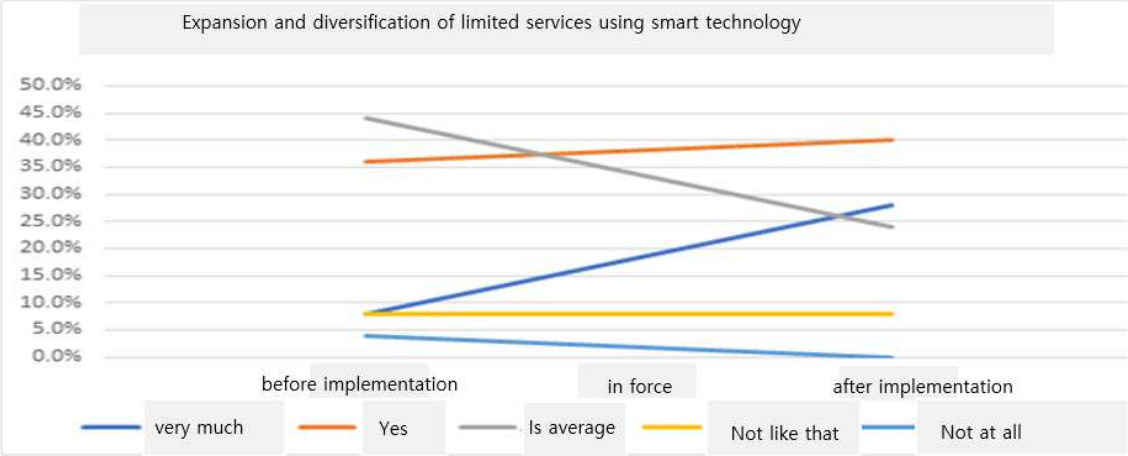
[Figure 7] Analysis graph to bridge the digital gap with young people through smart devices



Finally, in order to analyze the sensibility that residents feel in the scope of the spread rather than the demonstration of the project, an item on whether the expansion and diversification of limited services through smart technology

is possible was added. As a result of the analysis, ‘very much’ increased to 8.0% during implementation and 28.0% after implementation, and ‘yes’ increased from 36.0% during implementation to 40.0% after implementation. In the case of 'normal', it decreased to 24.0% after implementation, whereas it was 44.0% during implementation. It was 4.0% during the trial, but it did not appear after the trial. In other words, it was analyzed that most of the normal or negative opinions before implementation turned to a positive direction after implementation.

[Figure 8] Expansion and diversification of limited services through smart technology



5. Conclusion

This study was carried out to suggest alternative considerations for resolving the urban and digital divide through smart urban area planning in line with the 'era of land transportation change following the 4th industrial revolution'. To this end, the purpose of this study was to derive the technical demand for living services through actual demonstration, and to improve the ultimate sensibility of residents and the quality of life by improving the supply efficiency. Data collection and analysis were performed based on a regionally customized linkage model platform by deriving urban problems that residents have, and as a result, various fields such as AI CCTV and smart health care were demonstrated. Through this, it was possible to realize the optimal distribution of resource use and to improve the quality of life of local residents. As a result of confirming this through trend analysis as an objective number, when comparing before, during, and after the project in all fields, such as the effect of reducing medical expenses through healthcare services, the effect of smart education-related support, the effect of resolving the digital divide, and verification of the spread of the business It was found that the graph shifted to all positive answers. The results of such analysis can be used as basic data for establishing regional development policies considering regional characteristics and for introducing and improving projects. In addition, it is possible to provide information on regional types and regional characteristics analysis necessary for decision-making for urban and non-urban regional development policy establishment, and it is judged to be able to promote policy efficiency. As the purpose of this is to provide diagnostic data on the level of living service in the region, it will be possible to increase the utilization of education, culture, medical care, and welfare. Ultimately, if such data is accumulated, it is judged that it can have a great influence on the establishment of an integrated use system such as basic data of regional spatial units and data of regional development projects. This suggests that it is possible to utilize and apply to local sites by interlocking with the sensibility of the residents. It will be possible to establish an efficient regional development plan by analyzing the weak and strong elements of each region while securing the suitability and consistency of the policy. However, this study has a limitation in that it did not discover an operating model to secure sustainability. As it is essential to secure a rationale for sustainability to operate and maintain facilities in the future, to establish a dedicated A/S team due to the nature of smart devices, to manage and support, to organize and operate local governance, and to establish a system related to remote solution introduction, follow-up research If it is verified, it is judged that it can be reborn as a more desirable study.

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