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Value Recognition and Intention to Adopt Smart City Services: A Public Value Management Theory Approach

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Smart city, which employs information and communication technology (ICT) to resolve urban problems, is gaining more research attention in the innovation research. However, most previous studies regard citizens as merely passive accepters of the smart city services, focusing on individual private values. The present study aims to expand existing limited perspectives by applying public value management theory. Drawing from the literature review, we developed a dual perspective that a smart city service should encompass: private and public value. Then we set up a causal relationship between the value recognitions and intention to adopt smart city services. We further related antecedent variables to the dual value recognition in terms of citizens' characteristics: prior knowledge, personal innovativeness, and citizenship. Two case subjects among currently operating smart city services in South Korea were selected to empirically investigate our hypothesis. Results confirm the recognition of both public and private value is significantly related to the citizens' personal characteristics and resultant attitude towards acceptance and support for diffusion of the smart city services. This study is expected to provide useful implications for a new angle for the recipient of the smart city services, value orientation of the services, citizen's participation, and method selection for promotion.

Keywords: Smart City, Public Value Management, Citizenship, Participation, Innovation Diffusion

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Introduction

In recent years, smart city, which employs advanced information and communication technologies (hereafter ICT) to resolve urban problems, is drawing attention as a new innovation model (Holland, 2014; Lee, Hancock, & Hu, 2014; March 2016; Wiig, 2016). It is expected not only to solve various urban problems such as traffic and environment, but also to create new value added services for transformation of the industrial developments for the local community (Lee, Hancock, & Hu, 2014). Smart city offers different services including transportation, energy and environment, education and other areas throughout a city. Citizens recognize and evaluate various smart city services based on their experience, and formulate the attitude towards acceptance of the smart city services. Until now, research on accepting the smart city services mainly applied Rogers (2010)' innovation diffusion theory or Davis (1989)' technology acceptance model to understand the relationship between the perception of the values, such as personal usefulness and convenience of the services, and the intention to accept (Han, Kim, & Leem, 2014; Lee J., 2014b). Those existing research approaches are sensible and acceptable only for the private value perspectives while there is a need for taking a new theoretical perspective of citizens' accepting smart city services based on the public value perspectives.

Smart city services are provided but limited to certain recipients as well as those that all citizens can benefit and experience. Viewing it from beyond personal dimension as customers' perspectives, smart city offers social and public values (Cosgrave, Tryfonas, & Crick, 2014). There are certain services that citizens cannot experience themselves but are necessary to provide better services for whole citizens such as public utility management in energy and environment. If the beneficiary of the service is limited to a certain customer, evaluation may be distorted depending on the service types. Therefore, the question of how citizens perceive and evaluate the services publicly as well as privately becomes critical in determining the success of the smart city.

This paper, therefore, aims to examine the extent to which citizens recognize such public values for smart city services. Furthermore, this study attempts to take an exploratory approach to identify the individual characteristics of citizens used to evaluate the services when the perspective of recipient of smart city services expands from customer to citizen, and aims to differentiate the values, which are determined in the dual perspective as a private and public value. Based on public value management theory and other related theories, this study attempted to empirically examine how citizens recognize smart city services in terms of public and private value, and how this recognition leads to form an attitude towards acceptance and support for facilitation of the smart city services. To attain the research objective, some representative cases of a tangible service and an intangible service of smart city were empirically investigated. In the Theoretical Background section, we review main theoretical streams and continue discussion to develop research model and hypotheses in the next section. The last sections discuss methodology and the results of the empirical tests.

Theoretical Background

Smart City and Smart City Services.

Definition of smart city varies from academia to institution and industry, and the scope of its definition is broad and wide (Lee, Hancock & Hu, 2014). Lee (2017) defined smart city as ‘an ICT based digital transformation of urban spaces to deliver better quality life in a sustainable way and create new economy’. Nam and Pardo (2011) divided its dimensions into technical, institutional, and human. The concept of smart city shares common attributes with ‘Digital City’ and ‘Intelligence City’ in technical dimension; ‘Smart Growth’ and ‘Smart Community’ in institutional dimension; And with ‘Creative City’ and ‘Knowledge City’ in human dimension (Name & Pardo, 2011). In Europe, as ICT were applied to cities, which began with interest in environmental city, they call smart city 'Smart Sustainable City' while smart city would frequently be referred as 'U-City (Ubiquitous City)' or 'Digital City', and the term has recently been evolved to 'Smart City' in South Korea and elsewhere. ITU (2014) defined smart city to be ‘an innovative city that utilizes ICT, and improves citizen’s life quality, the efficiency of urban management and services, and urban competitiveness. At the same time, it answers the needs of the present and the future generations from economic, social and environmental point of view where its core themes are classified into four different dimensions: society, economy, environment, and governance. The goals of smart city proposed by various communities are largely discussed from economic, social and environmental perspectives (Khansari, Mostashari, & Mansouri, 2014). In short, the definition itself has evolved from a techno-centric perspective toward a socio-technical perspective to resolve various urban problems including social exclusion and sustainable eco-system (Lee, 2017; Tranos & Gertner, 2012).

Smart city provides various services to citizens by utilizing infrastructure based on ICT in order to resolve many urban problems related to cities such as traffic, environment, residence, facilities, etc. occurring in the city (Chourabi et al., 2012; Dameri, 2013). IBM also proposes the main areas of smart city services which can be categorized into smart buildings, urban planning, environment, energy and water, transportation, education, healthcare, social programs, public safety and government administration. In the smart urban space, citizens can access services without time and space constraints, and city managers can improve city competitiveness and citizen's quality of life by providing smart city services (Lee & Lee, 2014). Therefore, smart city service is one of the main components of smart city that citizens can directly experience and it can be seen as a medium to form a practical point of contact with citizens in the promotion process of smart city. On the other hand, the smart city service can be classified according to the inherent characteristics of the service itself. Classification according to the level, purpose, and type of service can be useful data for smart city business plan. An and Oh (2010) proposed classification criteria for smart city (u-City) service according to purpose and function, production subject, ease of technology implementation, degree of citizen awareness as shown in Table 1.

Innovation Diffusion Theory and Technology Acceptance Model (TAM).

Rogers' Innovation diffusion theory is a theory that helps understand and explains how a new innovative idea (a product or service) is adopted in a social system (Rogers, 2010). Rogers (2010) defined innovation determination process as "one in which an individual first recognizes innovation, forms an attitude toward it, and eventually decides to adopt or reject innovation, and performs his or her decision". The result of innovation should bring a positive change to the recipients of the innovation, or to other units of adaptation, which is expected to lead to the increase of productivity. Rogers' innovation diffusion theory has kept being studied in and applied to many different fields for a long time because it has provided a comprehensive range of variables that help understand the behaviors of adopting new innovations. In the ICT field, Davis (1989) proposed technology acceptance model (TAM), which explains the factors that have effect on information system user's adaptation of innovation, based on self-efficiency theory and innovation diffusion theory. These research streams see technology adoption and diffusion as closely associated with the value perceived by user, that is, users' belief, attitude, and intention on behavior (Nam, Kim, & Jin, 2013). Likewise, Coutelle-Brillet, Rivirere, and Garets (2014) called for a need to research value-based innovation adoption process. Furthermore, Kim, Chan, and Gupta (2007) argued that the Davis (1989)'s technology acceptance model (TAM) had limitations in explaining the acceptance of new ICT and had to recognize new ICT users as customers rather than just as technology users. We deduce from the above notion that the value of benefit and sacrifice that a customer recognizes determines the intention to adopt smart city services.

Table 1

Classification of smart city Service

Classification		Characteristic
smart city Service Purpose and Function	General Service	Services that are provided to an unspecified number of beneficiaries with essential services
	Specialized service	Services that are provided to a specific minority by a secondary service
smart city Service Provider	Public service	Services provided by the public sector with emphasis on equity, and consideration of social weakness such as digital divide
	Private service	services provided by the private sector with the aspect of efficiency, and securing stable profitability
Ease of Technology Implementation	Short-term implementation services	Services that can be implemented through short-term (within 3 years) technology development
	Mid-term implementation service	Services that can be implemented through technology development in the mid-term (within 5 years)

	Long-term implementation services	Services that require more than five years of technology development time
Civic Awareness	High awareness service	Services that are easy for citizens to experience and have high preference
	Low awareness service	Services that are difficult for citizens to experience and have low preference

Notes. From An, S. J. and Oh, D.H. (2010). A Study on the Classification Criteria of U-City based on the Characteristics of U-City Services. Journal of the Korean Urban Management Association, 23(3), 253-270.,

Public Value Management Theory and Social Exchange Theory.

Public management is 'an attempt to introduce the managerial method of private company to government sectors and means of performance-based administration management methodology' (Yu, 1995). It was in the 1970s that studies on public management began in earnest in academia. At the beginning, they started in two different directions: policy approach and business management approach. The former approach, which was mainly driven by economists, practitioners or political scientists, emphasizes the higher level of policy management than daily administration or strategic management of an administration institution. On the other hand, business management approach focuses on such issues as organizational structure, personnel management, and budget management (Yu, 2001). Public management has continued to evolve in the midst of criticism and reflection on the conventional public administration and new public management.

'Public Value Management Theory' emerged as an alternative to the new public management perspectives. The most contrasted with existing public management is its goal and direction in which the government pursues 'to create public values' and the urge to shift from existing management method (Hefetz & Warner, 2004; O'Flynn, 2005). Moore (1995) defined public value as 'not only giving benefit to the public, but also considering the common values needed for citizen, going beyond the narrowly defined economic value. He suggested that administrative managers aim to achieve the broader objective of creating public values than the goal of customer satisfaction or efficiency. As seen in Table 1, the changes that occurred with the stream of times led to a paradigm shift in approaches to the public service and the roles of public participation.

Tables 2

Paradigm Shift of Public Value Management Theory

Classification	Conventional Public Administration	New Public Management	Public Value Management
Definition of Public Interest	Defined by Politician or Expert	Aggregate of Personal Preference Based on Customers' Choice	Both Private and Public Preference Through by Deliberation Process Regarding Input and Opportunity Cost
Approach to Public Service Spirit	Public Sectors Monopolize Public Service Spirit	Pessimistic About the Spirit of Public Sector/Prefer Customer Service	It Is Considered Necessary Not to Monopolize Public Service but To Share the Value to Maintain Relation
Subject of Public Service	Client	Customer	Citizen
Roles of Public Participation	Limited to Representatives Elected by Voting	Limited, Except Customer Satisfaction Survey	Multifaceted (Customer, Citizen, Key Interest Parties)

The important line drawn by Moore (1995) between public value and private value is that public value is for all citizens to share and realize ultimately wanted value through public service, which is a tool of delivery, beyond subjective private value. In a similar context, Horner and Hazel (2011) and Hartley et al., (2016) argue that public value is co-related with private value and these two different values are often co-existed and generated through the same procedure (service) at the same time. This dual perspective on the value of the public service is incorporated in the main argument of the present study.

The social exchange theory (Homans, 1974) explains that exchange based on interactions results in social effect, economic performance, and positive exchange and settles down as a relational norm after repetition (Han et al., 2013). In the smart city context, social exchange theory explains that the local residents determine their political support depending on the trade-off of 'benefit' and 'sacrifice' in the dimension of public value. For example, social exchange theory was applied to study the attitudes of local residents toward tourism developments (Ju & Lee, 2015). Allen et al. (1988) and Perdue, Long, and Allen (1990) have demonstrated that local residents perform social exchange depending on their positive or negative awareness of the impact of tourism development, and determine their support in the future. At this time, the local residents' awareness of tourism resource development engages economic, social, and environmental impact, and this can be considered as public value regarding the impact of a local community, beyond private value.

Dual Perspective: Public Value vs. Private Value, Customer vs. Citizen.

Smart city is closely related to public services which are promoted according to the procedures of general public administration. More effective outcomes can be derived from the development of a smart city service based on public value management view. Smart city is a large-scale urban innovation project to lead economic, environmental and socio-cultural development of a city by establishing optimal services in a sustainable manner (Cosgrave, Tryfonas, & Crick, 2014). Therefore, applying public value management theory to smart city may be a feasible perspective to justify accountability, fulfilling public needs, and public trust (Cosgrave, Tryfonas, & Crick, 2014). Furthermore, it also contributes to understanding the value of ICT investment in smart city and elevating the possibility of introducing successful implementation. Breaking the boundary of existing theories that mainly focus on personal satisfaction with the smart city services, public value management theory may provide useful insights aiming for citizens to create public value.

The public value management theory offers an idea that the public evaluates services from the dual perspective of a customer and a citizen. The primary assumption that service satisfaction cannot be simply derived from the desire of an individual customer, but from that of a citizen (Kwak, 2010). This indicates it is not sufficient to observe a customer's personal satisfaction as a service evaluation criterion, but necessary to examine public evaluation from a citizen's perspective. In public value management theory, 'delivery paradox' explains that the users of smart city services do not only simply expect personal satisfaction from them, but also want to exert their influence and create public value to some degree in the service development process (Horner & Hutton, 2011).

Citizenship, Value Recognition, and Participation.

In general, citizenship can be defined as "an intellectual ability to accurately understand and decide social issues as a whole including political ones" (Won & Park, 2010). Citizenship is also explained in consumer studies, where individual customers with citizenship are expected to behave reasonably in diverse consumption environment and make an effort to compare and judge the diverse products so that they can select optimal products good for a community (Lee & Yoon, 2016).

Citizen's participation in the process of creating public service is emphasized in the sectors of public administration (Castelnovo, 2012; Granier & Kudo, 2016; Sanborn, 2017). This change can be aligned with the assertion of Millard and Horlings (2008) as public value management theory states that citizens should participate in the creation of a public service and lead a new service. That is, a citizen can participate in co-creation of a public service with the government to increase the understanding of it and decrease cost (Yoon, 1992). Although there is a service that a citizen does not use and experience in person, his or her satisfaction with it is affected by such factors as how the service is used by others; who provides the service and how it is served (Kwak, 2011). Modern administration has been changing from 'provider-oriented' to 'user-

oriented'. It seems that provider-oriented service policy can no longer obtain voluntary support and participation from citizens (Kim, 2006), and therefore the need to research policy acceptance and diffusion to general citizens is increasing from public innovation perspective. Thus, how to pull citizens in the process of co-creation of a public service has become an important issue and meaningful to administrative managers, as well as a paradigm shift in the public administration of the central and local governments (Castelnovo, 2012; Granier & Kudo, 2016).

The value recognition for a service is a very important concept in service sector which turned out to be a critical factor to determine customer (citizen)'s purchase behavior and also an antecedent variable to satisfaction and behavior intention (Cronin, Brady, & Hult, 2000). Perceived value can play a mediating role between influence factors and behavior intention when an individual makes a decision (Kuo, Wu, & Deng, 2009; Kim & Lee, 2013).

In this study, value recognition on two dimensions of citizen's support for the smart city services was defined as holding two important constructs: intention to participate in the co-creation program and willingness to pay. Studies on the participation for co-creation maintained that the motivation always depends on the perceived service value, which is the outcome of customer(citizen)'s cost and benefit (Hsiuju, Kevin, & Wanru, 2004; Auh et al., 2007; Payne, Storbacka, & Frow, 2008; Vargo & Lusch, 2008; Handrich & Heidenreich, 2013). Next, literature on e-government revealed that the value of e-government services has a positive effect on user's intention to participate and user's willingness to pay (Byun, Park, & Kim, 2013; Kim, Yoo, & Joung, 2014).

Research Model and Hypotheses

Research Model.

The proposed framework is structured as shown in Figure 1. It is the overall conceptual framework to structure the impact of customer and citizen characteristics on the service evaluation, and finally to empirically test whether the evaluation of the public and private value of the service affects the policy support for services. Personal innovativeness and prior knowledge are set as the personal characteristics of an accepter or a diffuser of the smart city services, while citizenship was designated as the personal characteristic of a citizen. The perceived value of the services of smart city from customer's and citizen's perspective leads to different attitude and behavior depending on the two different perceived values: private and public.

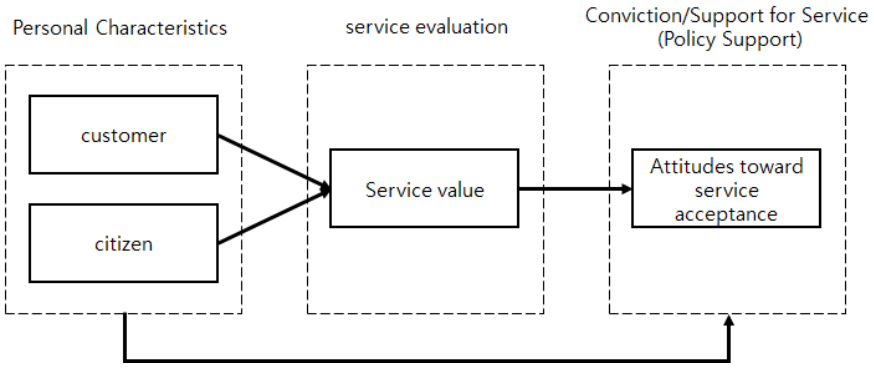

Figure 1. Conceptual framework

Hypotheses Development.

Personal innovativeness' refers to the ability to adopt a specific product more easily and quickly than others. Rogers (2010) found that customers with a high level of personal innovativeness searched for information about innovative products more actively than others (Hirschman, 1984), and better understood it through acquiring product attributes from advertisement and news. It indicates that personal innovativeness plays an important role in recognizing the values of a product, and the prior knowledge of a product or service forms positive information, experience, and familiarity with an innovative product (Venkatraman, 1991). 'Prior knowledge' is useful in knowing how well he or she knows about the product and service. In this study, prior knowledge is operationally defined as the understanding of the concept and business of smart city rather than technical knowledge of a certain service of smart city.

Many studies have empirically examined that 'personal innovativeness' and 'prior knowledge' have a positive effect on the value recognition of a product or service (Hartman et al., 2006; Qing, Dacko, & Gad, 2008; Park, Kwak, & Min, 2014; Noh, Runyan, & Mosier, 2014). On the other hand, a citizen with a low level of prior knowledge is likely to rely on external information or contextual factors more than information that he/she already has (Ha & Park 2000). There are also different groups of studies on the impact of prior knowledge on perceived value and the acceptance of a product or service was conducted in relation with innovation diffusion research (Park & Lessig, 1981; Brucks 1986; Kuo, Wu, & Deng, 2009; Yang & Choi, 2017). In sum, this study developed hypotheses as follows, mainly stating that a citizen with a high level of personal innovativeness and prior knowledge has a positive effect on private and public values of the smart city services.

H1: Citizens' personal innovativeness has a positive effect on their perceived private value.

H2: Citizens' prior knowledge has a positive effect on their perceived private value.

H3: Citizens' personal innovativeness has a positive effect on their perceived public value.

H4: Citizens' prior knowledge has a positive effect on their perceived public value.

In this study, citizenship can be defined as the personal characteristics of a citizen who has support for the smart city services. A customer forms an attitude of choosing a product or service agreeable with public value he or she recognizes as a citizen, beyond simple customer's value in the process of adopting a product and service. This customer's civic behavior plays a critical role in determining the service creation (Bettencourt, Gwinner, & Meuter, 2001), and also affects customer's satisfaction (Schneider et al., 2005). Employing the organizational citizenship similar to customer's citizenship, citizenship has effect on the value recognition of the service when the workers help, cooperate with others, and take responsibility (Liao, 2015). Based on the above-mentioned studies, the ground for his or her political and social conviction and a belief that a person has as a citizen can be one of the critical factors that determine attitude toward the acceptance and diffusion of the smart city services. Thus leads the following hypothesis.

H5: Citizenship has a positive effect on citizens' perceived public value.

Citizens can also express their political support for the acceptance and diffusion of the smart city services by taking part in a co-creation program and paying for the services (Eskelinen et al., 2015). The policy support for public service is related to personal characteristics where citizenship can be considered as one that accepts and supports the expansion of smart city services. Citizenship is the fundamental factor that determines citizen's participation and that the first pre-requisite for active citizen participation is his or her inner factors such as self-government awareness and psychological confidence (Cunningham, 1972). Zhang (2014) also found that those with a higher level of citizenship showed more participation in both conventional and electronic public services in government-to-citizen (G2C) services in the Chinese e-government. This leads to the following hypothesis.

H6: Citizenship has a positive effect on their intention to participate in the co-creation program.

Citizenship is a similar concept to the awareness of and responsibility for public issues among public attitudes. Therefore, it can be said that those who have a high level of citizenship would accept the public duty and have a higher level of 'willingness to pay for a public service'. Also, Goldsmith and Newell (1997) and Goldsmith et al., (2005) found that those who have a higher level of personal innovativeness, among personal characteristics, are less sensitive to price and have a higher level of willingness to pay than those who don't. In sum, those who have a high level of personal innovativeness and citizenship would pay for smart city services in order to express their recognition of the service value and support for the expansion of the service.

H7: Citizens' personal innovativeness has a positive effect on their willingness to pay for smart city services.

H8: Citizenship has a positive effect on their willingness to pay for smart city services.

Lastly, perceived public value can have an effect on the intention to participate in co-creation or willingness to pay. This was proved in various studies of tourism resources development using social exchange theory arguing perceived public (economic, social, environmental) value has effect on the support of policy (Allen et al., 1988; Perdue, Long, & Allen, 1990; D Mello et al., 2015; Hwang, Song, & Jeoung, 2016; Shin & Kang, 2016). In this paper, the perceived public value of the smart city services can have a positive effect on the performance of such active public duties as the acceptance and support for the services expansion. Hypotheses were set out as follows.

H9: Citizens' perceived private value has a positive effect on their intention to participate in co-creation program.

H10: Citizens' perceived public value has a positive effect on their intention to participate in co-creation program.

H11: Citizens' perceived private value has a positive effect on their willingness to pay for smart city services.

H112: Citizens' perceived public value has a positive effect on their willingness to pay f or smart city for services.

Based on the theoretical framework and hypotheses building, the research model for this study was designed as shown in Figure 2. As seen in the research model, dependent variables are citizens' intention to participate in co-creation program and willingness to pay for smart city for services. Independent variables are citizen's personal innovativeness, citizenship, and prior knowledge. Citizens' perceived public value and private value are mediating variables between each dependent variable and independent variable.

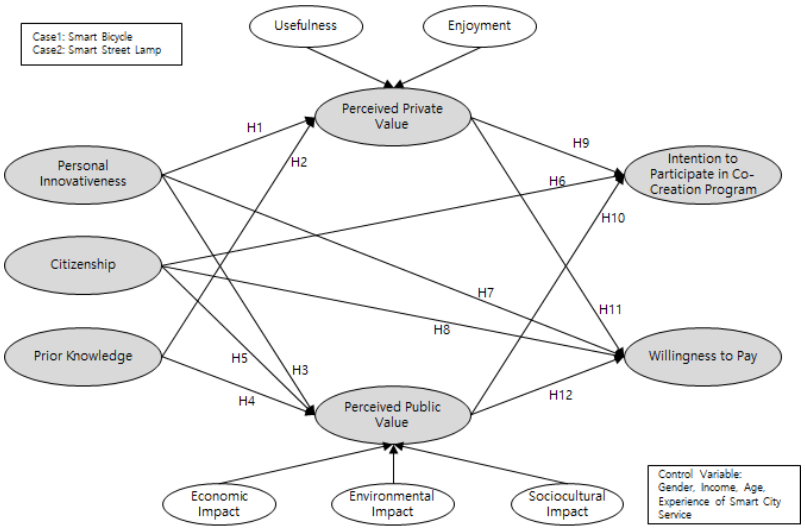

Figure 2. Research Model

Methodology

Case Selection.

The value of smart city is delivered through various smart city services, where citizens have experienced or are able to evaluate with certain levels of acceptance. Yoon (2010) categorized public services into public goods, quasi-public goods, and private goods according to their externalities and indivisibility. Smart city services can also be divided according to the participating economic entities. Since the present study is to examine the difference of the policy support for the service according to the difference of the citizen 's perceived private value and public value, we selected case study subjects only in the public and quasi-public services. The distinction between the two services is a civic awareness (Ahan & Oh, 2010). The former is a non-consensual service that is not well understood and the latter is a sensible service that citizens can easily access. The 'smart street lamp' service is selected in public service group, which is a type of infrastructure, but it includes various city management functions such as CCTV and air quality measurement sensing, but there are not many functions available to ordinary citizens. Next, the 'smart bicycle' service is selected in the quasi-public service group, which is rapidly spreading around the Korean metropolitan cities and can be seen as a service available to all citizens.

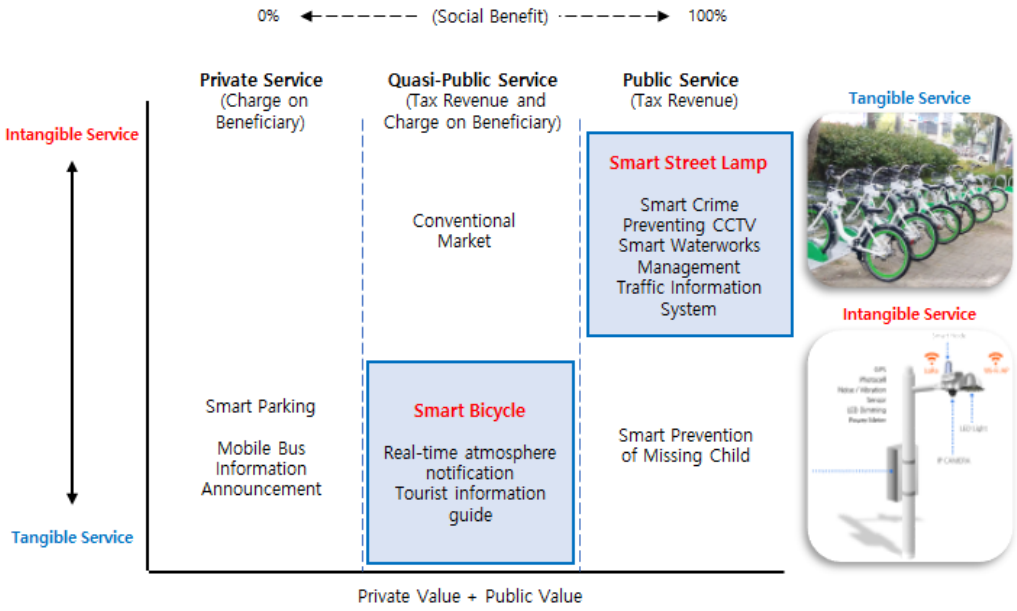

Figure 3. Selection of Research Subjects

Measurements.

We defined perceived private value and perceived public value as consisting second-order constructs. As discussed in section 2, perceived private value is operationalized as consisting

perceived usefulness and perceived enjoyment while perceived public is operationalized as consisting perceived economic, environmental, and socio-cultural value (Cosgrave, Tryfonas & Crick, 2014; Benington & Moore 2010; Basiago, 1999; Kahn, 1995). To measure five constructs and two high-order constructs, previous literature was reviewed to find measurement items and those items were modified to fit the contexts of smart city project (see Table 3).

Table 3

Measurements of Variables

Classification	Variable	Item to Measure	Reference
Personal Characteristics	Personal Innovativeness	• I look for a way to test a new information and technology very actively and first. • For friends and colleagues, I am sort of the first to test a new information and technology. • I am usually not hesitant to test a new information and technology. • I like to test a new information and technology.	Rogers (2010) Davis (2000) Goldsmith & Hofacker (1991)
	Prior Knowledge	• I have heard of smart city. • I am familiar to smart city. • I have a lot of information about smart city. • I feel comfortable with the term 'smart city'.	Rogers (2010) Bettman & Park (1980)
	Citizenship	• An individual cannot be free from the responsibility of solving the public issue of a local community or the society. • I better understand the problems of my local community than others. • I better understand the problems of the society than others. • I have more interest in the problems of my local community or society than others.	Heberer(2008)
Perceived Private Value [Second-Order]	Perceived Usefulness	• The services of smart city are of high value of use to. • The services of smart city are helpful for my life. • The services of smart city are useful to me. • The services of smart city are needed for my life.	Kim(2010)
	Perceived Enjoyment	• The services of smart city have a lot of fun services. • The services of smart city are very interesting to me. • I think it is pleasant to use the services of smart city. • I think using the services of smart city will make my life pleasant.	Kim(2010)
Perceived Public Value [Second-Order]	Perceived Economic Value	• I think the services of smart city will improve the changes of various economic activities in my local community. • I think the services of smart city will give economic benefit to small and medium companies and local citizens. • I think the services of smart city will increase the chances of various economic activities for my local community. • I think the services of smart city will create new jobs in my local community. • I think the services of smart city will activate local economy.	Benington &Moore (2010) Airaksinen et al. (2017) D Mello et al. (2015)

	Perceived Environmental Value	• I think the services of smart city will contribute to environmental preservation. • I think the services of smart city will contribute to improving the quality of air. • I think the services of smart city will contribute to cleaning and beatifying local environment. • I think the services of smart city will contribute to preserving natural environment and resources.	Benington &Moore (2010) Airaksinen et al. (2017) D Mello et al. (2015)
	Perceived Sociocultural Value	• I think the services of smart city will improve the quality of public services in a local community. • I think the services of smart city will contribute to improving the infrastructure of a local community. • I think the services of smart city will strengthen the image of a city. • I think the services of smart city will strengthen the affection to a local community. • I think the services of smart city will increase the opportunity of cultural and leisure activity for local residents.	Benington &Moore (2010) Airaksinen et al. (2017) D Mello et al. (2015)
Conviction/Support for Service (Policy Support)	Intention to Participate in Co-Creation Program	• I am interested in joining the citizen's co-creation program of the services of smart city. • I may join the citizen's co-creation program of the services of smart city. • I will join the citizen's co-creation program of the services of smart city. • Despite my busy schedule, I will join the citizen's co-creation program of the services of smart city by any means.	Handrich & Heidenreich (2013) Ajzen (1991)
	Willingness to Pay	• Given all various benefits from the services of smart city when they expand, do you think it is fine with you to increase a local tax? • When supposed that you have to pay a tax of 10,000won every year to sustain the services of smart city, do you think it is a reasonable cost? Please answer 'yes' or 'no'. • Please check the responses to the double price and a half price depending on the initial price, and then set a price to pay. * The initial price of 10,000won was set after reviewing related literature and based on the assumption that annual cost per household would be between 5,000won and 15,000won on average when considering annual budget for smart bicycle and the number of household in Seoul, and the annual budget for street lamp	Lee J(2014) Lee Y.K (2010)

Sampling.

As the purpose of this study is to examine the relationship between the recognition of service value and the acceptance and support for expansion of the services of smart city, those male and female citizens in their 20s in Seoul, Korea were set as population and survey was carried out with them. The survey was conducted for 2 days, from May 25th to 26th, 2017. A total of 318 questionnaires were collected. Of the respondents, 18 questionnaires were excluded for insincere response. As a result, 149 and 151 respondents were finally selected for research model 1 and research model 2, respectively. Judging from the demographic characteristics of the respondents, both male and female participants in research model 1 and 2 were evenly distributed and inter-group homogeneity was confirmed for age, monthly income, occupation, etc.

Table 4

Demographic Characteristics of the Samples

Classification	Item	Case 1 Smart Bicycle Service		Case 2 Smart Street Lamp Service	
		Frequency	%	Frequency	%
Sum		149	100%	151	100%
Gender	Male	63	42.3%	71	47%
	Female	86	57.7%	80	53%
Age	20s	30	20%	29	19%
	30s	48	32%	56	37%
	40s	48	32%	42	28%
	50s	20	13%	21	14%
	60s	3	2%	3	2%
Monthly Income	Less Than 1 Mill. Won	24	16.1%	32	21.2%
	1 Mill. ~ 2 Mill.	24	16.1%	19	12.6%
	2 Mill. ~ 3 Mill.	27	18.1%	30	19.9%
	3 Mill. ~ 4 Mill.	27	18.1%	27	17.9%
	4 Mill. ~ 5 Mill.	23	15.4%	19	12.6%
	More Than 5 Mill.	24	16.1%	24	15.9%
Occupation	Managerial Post	5	3.4%	4	2.6%
	Public Servant	2	1.3%	1	0.7%
	Teacher/Instructor	6	4%	2	1.3%
	Other	4	2.7%	9	6%
	Undergraduate Student/ Graduate Student	1	0.7%	16	10.6%
	Not Employed	20	13.4%	8	5.3%
	Office Work	4	2.7%	57	37.7%
	Production/Technical Post	46	30.9%	9	6%
	Service/Sales Post	6	4%	7	4.6%
	Self-Employed	9	6%	3	2%
	Freelancer	7	4.7%	3	2%
	Professional	5	3.4%	13	8.6%
	Full-Time Housekeeper	10	6.7%	19	12.6%

Analysis and Results

Measurement Validation.

The research model of this study is designed to find the difference between two cases (smart bicycle service and smart street lamp service) when they are applied to the research model. For statistical analysis, SPSS 23 program was used for exploratory factor analysis, which is needed to test the validity of measurements and SmartPLS was employed for confirmatory factor analysis and structural equation model analysis. Because the same items to measure were set for two cases in the research model, reliability and validity tests of those measures were commonly conducted. Although most of the items in this study were based on the theoretical background, the first-order factor of perceived public value was analyzed through the exploratory factor analysis method because it is not a fixed measure of economic, environmental, and socio-cultural value attributes. The results of exploratory factor analysis show that the first-order factors of perceived public value were grouped within the same construct as initially set, as seen in Table 5. In addition, due to all the factors of perceived public value have factor loading higher than 0.5, it satisfied the recommended threshold.

Table 5

Exploratory Factor Analysis

Classification	Item to Measure	Component		
		1	2	3
Perceived Economic Value	1) Increase of changes of various economic activities in a local community	.701		
	2) Economic benefit to small and medium companies and local residents	.771		
	3) New jobs in a local community	.810		
	4) Activation of a local economy	.778		
Perceived Environmental Value	1) Contribution to environmental preservation		.836	
	2) Contribution to improving the quality of air		.809	
	3) Contribution to preserving natural environment and resources		.769	
	4) Contribution to cleaning and beautifying a local environment		.671	
Perceived Sociocultural Value	1) Improving the quality of public service in a local community			.807
	2) Contribution to improving a local infrastructure			.800
	3) Strengthening an urban image			.650
	4) Strengthening affection to a local community			.515
	5) Increasing the opportunity of cultural and leisure activities for local residents			.503

Notes. Kaiser-Meyer-Olkin Measures of Sampling Adequacy: .901, Bartlett's Test of Approx. Chi-Square: 2026.431, df: 78, Significance: .000, Extraction Method: Principal Component Analysis, Rotation Method: Varimax with Kaiser Normalization

The descriptive statistics of the main variables of this research model are summarized as the following table 6 and table 7

Table 6

The descriptive statistics of main variables

Variables	Case 1 Smart Bicycle Service		Case 2 Smart Street Lamp Service	
	Variable Average (M)	Standard deviation	Variable Average (M)	Standard deviation
Personal Innovativeness	4.5252	1.23427	4.4768	1.2953
Prior Knowledge	3.5805	1.43974	3.5	1.46202
Citizenship	4.5548	1.01609	4.5872	1.07062
Perceived Private Value				
Perceived Usefulness	4.9933	0.9051	4.6308	1.30953
Perceived Enjoyment	4.8557	0.94045	4.8146	1.12341
Perceived Public Value				
Perceived Economic Value	4.6057	0.93955	4.6507	1.00957
Perceived Environmental Value	4.854	0.91446	4.8924	0.98426
Perceived Sociocultural Value	4.9181	0.85583	5.0132	0.81443
Intention to Participate in Co-Creation Program	3.9966	1.25236	4.1341	1.27206

Table 7

The descriptive statistics of Willingness to Pay

Willingness to Pay	Case 1 Smart Bicycle Service		Case 2 Smart Street Lamp Service	
	Num.	Percent (%)	Num.	Percent (%)
No willingness to pay	21	14.1	0	22
0 ~ 2000 won	17	11.4	12	7.9
2,000 ~ 4,000 won	15	10.1	11	7.3
4,000 ~ 6,000 won	17	11.4	15	9.9
6,000 ~ 8,000 won	7	4.7	4	2.6
8,000 ~ 10,000 won	-	-	2	1.3
10,000 ~ 12,000 won	36	24.2	47	31.1
12,000 ~ 14,000 won	10	6.7	8	5.3
14,000 ~ 16,000 won	8	5.4	10	6.6
16,000 ~ 18,000 won	2	1.3	3	2
18,000 ~ 20,000 won	10	6.7	8	5.3
More than 20,000	6	4	9	6
Sum	149	100	151	100
Average of Willingness to pay	8,000 won (Appox. $7)		8,800 won (Approx. $7.8)	

Because the items to measure the first-order factors of perceived public value were confirmed to be properly constructed in exploratory factor analysis, they were placed and analyzed together with other variables. As for willingness to pay, the items to measure it were supposed to be measured by contingent valuation method (CVM), so no separate factor analysis was conducted on them. The results of confirmatory factor analysis showed that Item 1 of citizenship had factor loading lower than 0.5, therefore it was excluded. Re-run turned out to be the increased convergent validity of the construct (AVE above 0.5 and Cronbach alpha above 0.7).

Table 8

Confirmatory Factor Analysis

Classification	Item to Measure		Standardized Factor Loading	AVE	Cronbach's α
Personal Innovativeness	- personal innovativeness 1		0.824	0.56	0.83
	- personal innovativeness 2		0.865		
	- personal innovativeness 3		0.843		
	- personal innovativeness 4		0.854		
Prior Knowledge	- prior knowledge 1		0.847	0.59	0.85
	- prior knowledge 2		0.964		
	- prior knowledge 3		0.919		
	- prior knowledge 4		0.812		
Citizenship	- citizenship 2		0.780	0.54	0.78
	- citizenship 3		0.801		
	- citizenship 4		0.793		
Formative Second –Order Perceived Private Value	First-Order Perceived Usefulness	- usefulness 1	0.809	0.66	0.88
		- usefulness 2	0.896		
		- usefulness 3	0.925		
		- usefulness 4	0.837		
	First-Order Perceived Enjoyment	- enjoyment 1	0.746	0.65	0.85
		- enjoyment 2	0.859		
		- enjoyment 3	0.871		
		- enjoyment 4	0.846		
	Formative Second–Order	perceived usefulness	0.829	0.80	0.89
		perceived enjoyment	0.970		
Formative Second –Order Perceived	First-Order Perceived Economic Value	- economic 1	0.669	0.51	0.80
		- economic 2	0.81		
		- economic 3	0.725		

Public Value		- economic 4	0.846		
	First-Order Perceived Environmental Value	- environmental 1	0.772	0.57	0.84
		- environmental 2	0.780		
		- environmental 3	0.723		
		- environmental 4	0.872		
	First-Order Perceived Sociocultural Value	- sociocultural 1	0.700	0.53	0.77
		- sociocultural 2	0.684		
		- sociocultural 3	0.709		
		- sociocultural 4	0.709		
		- sociocultural 5	0.709		
	Formative Second–Order	perceived economic value	0.664	0.74	0.89
		perceived environmental value	0.782		
		perceived sociocultural value	0.944		
Intention to Participate in Co-Creation Program	- intention to participate 1		0.762	0.62	0.87
	- intention to participate 2		0.903		
	- intention to participate 3		0.929		
	- intention to participate 4		0.872		

In addition, discriminant validity analysis was carried out on the items to measure based on Fornell and Larcker (1981)'s test, as seen in Table 7, and the results showed that the square root of AVE was higher than the cross loading value of the construct, which means the distinct difference between concepts.

Table 9

Discriminant Validity Test

	Personal Innovativeness	Citizenship	Prior Knowledge	Perceived Private Value	Perceived Public Value	Intention to Participate
Personal Innovativeness	0.56					
Citizenship	0.44**	0.54				
Prior Knowledge	0.29**	0.28**	0.59			
Perceived Private Value	0.21**	0.12**	0.14**	0.80		
Perceived Public Value	0.21**	0.19**	0.10**	0.73***	0.74	
Intention to Participate in Co-Creation Program	0.25**	0.22**	0.25**	0.32**	0.35**	0.62

Structural Equation Model Test.

The hypotheses were tested by partial least square (PLS) program 2.0. First, path coefficients were calculated through structural equation model analysis. To estimate the path coefficients, bootstrap technique (Tenenhaus et al., 2005) is often used to evaluate the significance of path coefficient in PLS path model. This study composed 500 bootstrap samples with 149 and 151 samples of research model 1 and 2, respectively, and tested the statistical significance of the hypotheses.

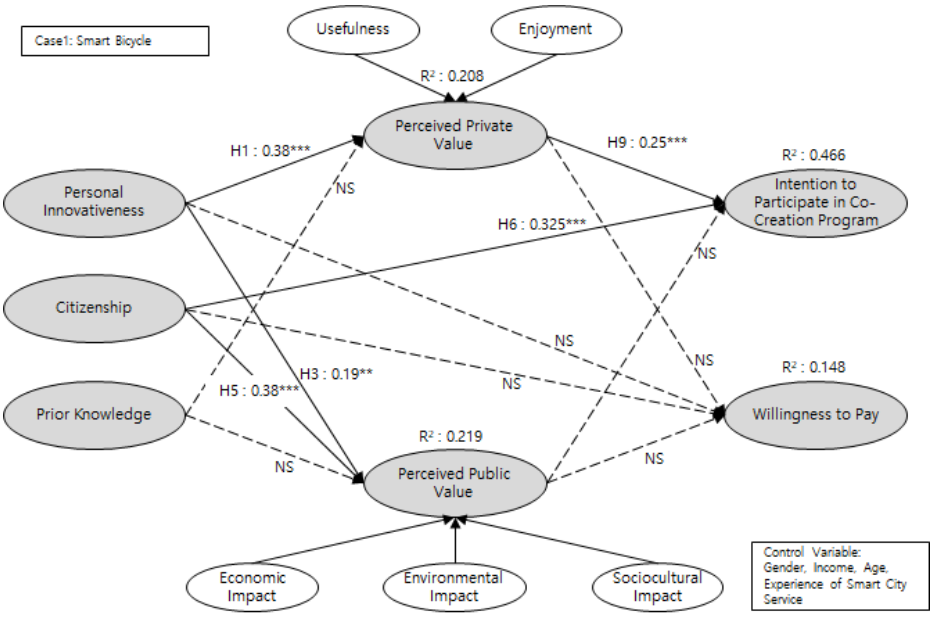

Figure 4. The Results of Hypothesis Test for Smart Bicycle Service

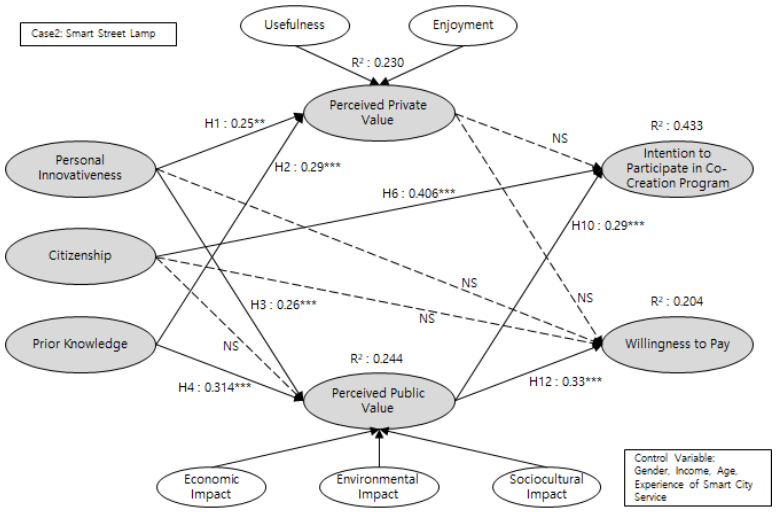

Figure 5. The Results of Hypothesis Test for Smart Street Lamp Service

As seen in Figure 4, in the smart bicycle service case, personal innovativeness and citizenship has significant effect on perceived public value (b=0.38, 0.19, p<0.01) and explain 21.9% of variance while only personal innovativeness has significant effect on perceived private value (b=0.38, p<0.01) and explain 20.8% of variance. For the dependent variables, perceived private value (b=0.25, p<0.01) and citizenship (b=0.325, p<0.01) has a significant effect on intention to participate in co-creation program (R2=0.466) while there are no significant antecedents to willingness to pay.

Results are somewhat different in the smart street lamp service case. As seen in Figure 5, personal innovativeness (b=0.26, 0.25, p<0.01) and prior knowledge (b=0.314, 0.29, p<0.01) has significant effect on both perceived public value and private value and explain 24.4% and 23.0% of variance respectively. For the dependent variables, perceived public value (b=0.33, p<0.01) and citizenship (b=0.406, p<0.01) has a significant effect on intention to participate in co-creation program (R2=0.466) while only perceived public value (b=.033, p<0.01) has a significant effect on willingness to pay.

Discussion.

The key findings from the analysis are summarized as follows. First, for the smart bicycle service, private value was more highly perceived than public value. Considering smart bicycle service is easily accessible even when people do not have enough knowledge of smart city, the prior knowledge does not affect the perceived value of this tangible service. The citizenship has a significant effect on the recognition of public value that smart bicycle service provides. It corresponds to the assertion of Bettencourt, Gwinner and Meuter (2001) that a customer's civil behavior pays a critical role in determining the creation of a service and recognizing the quality of the service. We also found that citizenship and perceived private value are the most important factors that have a direct effect on the intention to participate in the co-creation program of the smart bicycle service. This indicates that the successful promotion of smart city needs an attempt to improve citizenship and provide information and education program geared to help citizens understand and the public value of the smart city services.

Of the first-order factors of perceived private value of smart bicycle service, perceived enjoyment was found to have a significant effect on the intention to participate in co-creation program. However, there was no factor that influences over willingness to pay, so there must be a clear difference between direct use of the service and willingness to pay through fulfilling public duty. Though not statistically significant, it is too early to conclude that perceived private value has no impact on willingness to pay because path coefficient is marginal (0.16) and a considerable number of the respondents who have used smart bicycle before are included in the samples of his study.

Second, for the smart street lamp service, public value was more highly perceived than private value. Smart street lamp is a representative case of intangible service and the results of the analysis demonstrated that personal innovativeness and prior knowledge has a significant effect on both perceived private value and perceived public value of the service. This finding indicates that those who always have an interest in innovative products or more familiar with high technology, or who have heard of smart city, are well aware of the public value of a service as well as its private value (Venkatraman, 1991). Meanwhile, it is known that citizenship does not have association with the perceived public value of the smart street lamp service. It implies that a high level of citizenship such as having a sense of duty and responsibility for the problems of a local community doesn't necessarily have effect on the recognition of the public value of smart city services. Furthermore, smart street lamp service is an intangible service, so that citizens do not always experience such service and resultantly have a low level of prior knowledge of it, which can lead to the difficulty of recognizing what value it provides to a city. It is true that the promotional materials of smart city business currently in construction in Korea are hard for citizens to understand because they emphasize only functional aspects of service, which is hard to grasp, failing to communicate to them the values that the services can deliver and the effect that a service can have on a local community.

Compared to the case of smart bicycle service, citizenship is the most important factor having a direct effect on the intention to participate in the co-creation program of the smart street lamp service while the perceived private value isn't. But perceived public value is highly correlated with the intention to participate and willingness to pay for the smart street lamp service. This explains the principle of 'delivery paradox' of public value management theory that even if it is a service that is not easily experienced and directly used by a customer and/or a citizen, he or she can express a high level of support for the policy of expending the service by recognizing its public value.

Conclusion

Theoretical Contributions.

This study adopted public value management theory and social exchange theory as a research framework to identify antecedents of the acceptance of smart city services. Specifically, we paid

attention to the dual attitude of citizens' private and public value in the research model. Until now, discussion on public value management theory has been limited to normative dimension and thus empirical studies have been scarce. The present study finds its academic significance in its empirical test of the existing conceptual model. In addition, this study proposed to the research field of smart city providing a new perspective beyond existing studies on the acceptance of services by smart city services which mostly regarded a customer as the main recipient of the service and focused on the personal factors related to user satisfaction with the service. This study, however, identified the need to see the recipient of the service expand from a customer to a citizen who can recognize the public value of the services of smart city, and accept and support the policy of expanding the services, and developed measurement for the perceived public value.

Practical Implications.

For smart city projects that have been established so far, user's personal satisfaction has been used as a major indicator of business success. However, there are intangible services that are difficult for a citizen to experience in person but indeed help solve local urban problems, which are critical for the quality of life such as smart street lamps and traffic information system. This study attempted to evaluate this kind of service by measuring value recognition from a citizen's perspective.

Based on the public value management theory, this study demonstrated, for a certain service, there was a difference in the support for the policy of expanding it by public value recognition as well as private value recognition. These results lead us to classify types of the value recognition of the smart city service, and require us to develop customized promotion strategy. Our suggestion is to divide smart city service into four types of value recognition: (i) In case of obtaining both private value and public value, (ii) In case of obtaining private value, but not public value, (iii) In case of obtaining public value but not private value, and (iv) In case of not obtaining both private value and public value. This classification is expected to provide an implication to the local governments and businesses in implementation of smart city upon setting the perspective on recipient and service value.

Limitations and Future Research Directions.

This study has several limitations and expects further research to move into more areas of smart city. First, this study relied on the respondent's psychometric measurement on the recognition of the value and intention to adopt smart city services. In fact, public value management theory views overarching process by which citizen participates in the co-creation of a service, secure legitimacy, perceives its value, and finally expresses his or her policy support. However, this study did not measure actual participation in the co-creation program due to time and cost restrictions. Future research needs to conduct more in-depth field surveys or participatory study on the smart city context. Second, the private value and public value of smart city services are multidimensional constructs in nature. This study defined the second-order factors rather narrowly drawn by previous literature. Future theory building and empirical study is needed to gain a deeper insight and develop multidimensional aspects of public and private value.

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