Developing and validating a citizen-centric typology for smart city services

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ABSTRACT

This study proposes a new typological framework for classifying smart city services. Intentionally focused on citizen-centricity, away from bureaucratic perspectives that most typologies have taken, this typology is derived from marketing and service science literature. The proposed typology consists of four dimensions: mode of technology (automate–informative–transformative), purpose of service (hedonic–utilitarian), service authority (voluntary–mandatory), and delivery mode (passive–interactive). This typological framework is validated with a qualitative exercise of classifying inventories of actual smart city services in practice into the framework. Exercise results revealed that the categories provided are mutually exclusive and comprehensively exhaustive in general, and useful in further conceptualization of new services by identifying gaps in reality. In practice, this typology would be useful in positioning specific smart city service under development in terms of citizen-centricity. Urban planners and administrators may use this framework in understanding the pattern of their service development. Also, this framework may provide a useful guideline for service designer pinpointing the design characteristics of old and new smart city services from the perspective of users and customers of city services: citizens.

1. Introduction

Cities, used to be considered as part of local government, are now attract attentions as centers of governmental innovations as the number increases and the boundary expands worldwide. Urban population accounted for more than half of total global population as of 2009 and will be more than 60% by 2030, according to the global health observatory. Two trends are evident in city and urban management. First, urban areas worldwide are rapidly increasing in scope and city population is growing in a fast pace. Second, with rapid advance and utilization of smart information and communication technologies (ICT), smart city services are becoming a norm rather than exception in developing and managing city services for citizens (Layne & Lee, 2001; Lee, 2010; Lee, Baik, & Lee, 2011). On top of a variety of city services developed throughout the industrialization in the last centuries, new services are being conceptualized, developed, and implemented over the last decades across the globe in cities. Many cities are expanding their efforts to make their cities more competitive by becoming 'more digitalized,' 'more intelligent,' and 'smarter.'

In this context, the concept of smart city attracts strong attentions from academics as well as practitioners, these days. The focus of this newly coined term of smart city seems to be on the role of ICT played, but the definition is still not clear yet (Caragliu, Del Bo, & Nijkamp,

2011). Although smart city is a quite fuzzy concept, there are several descriptions of smart city. Hollands (2008) collected several examples of smart city definitions, and concludes that the smart city is a city that maximizes the "utilization of networked infrastructure to improve economic and political efficiency and enable social, cultural, and urban development." Caragliu et al. (2011) took this definition and enhanced into "a city to be smart when investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance." For a city to be smart, it is required to develop and manage a variety of innovative services that provide information to all citizens about all aspects of city life via interactive and internet-based applications (Kuk & Janssen, 2011).

As cities are managed by city government, these smart city services are the very basis of the smarter government movements. Citizenship implies relations between citizens and their government and these relations can be conceived in several ways. For example, Michel (2005) defined four different modes of 'electronic' citizenship management in cities: e-administration, e-government, e-governance, and the learning city. In the e-administration mode, citizens should be considered as interactive consumers and users of personalized services needed for administration of the public, while e-government refers to the policy instrumentation aspect of city government. In the e-governance mode, citizens are active political agents participating in policy formulation and other political agenda in city governance. As an ideal and future

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mode of local government, they suggested a city government involved in double loop learning adopting the concept of learning organization, in which citizens are allowed to trigger complex cybernetic mechanism of learning and feedback.

When it comes to smart city services, it was found that, with the advent of ubiquitous computing technologies, local governments in the Republic of Korea had conceptualized and implemented a variety of smart city services (ETRI, 2010; Gil-Castineira et al., 2011; Lee et al., 2011). In 2009, a national survey was conducted to inventory the smart city services, and came up with 228 smart city services, nationwide. Some are still being used while some are becoming obsolete as they are not used anymore. The 228 smart city services identified in this survey are now listed as an appendix to 'The Business Management Guidelines for the Construction of Ubiquitous Cities' published by the Korean Ministry of Land, Transport and Maritime Affairs. In the guidelines, 228 smart city services are classified and presented in eleven categories of administration; transportation; public health, medical care & welfare; environment; crime & disaster prevention; facilities management; education; culture, tourism, & sports; distribution; work & employment. This typology of eleven administrative categories is stipulated in the 'Ubiquitous City Construction Act' and is accepted as a standard typology for smart city service classification (Jeong, Moon, & Heo, 2009; Shin, Lee, Lee, & Kim, 2009).

Interestingly, a number of frameworks have been proposed as typologies of the smart city services, but none seems to have yet become prevalent in academics or in practice (Batty et al., 2012; Caragliu et al., 2011; Kuk & Janssen, 2011; Michel, 2005). This is because the proposed typologies primarily employ and maintain the provider's perspective rather than the user's. In smart city services, providers are predominantly the city administrators who can easily become bureaucratic.

In this regard, efforts are concerted, in this study, to develop and validate a usable and acceptable typology of smart city services from the users' and/or citizens' perspective via a systematic literature review and qualitative exercises. Four dimensions are identified as important in the typology of smart city services: mode of technology, service purpose, service authority and delivery mode. As ICT, by definition, is geared towards increasing the ease of use as well as efficiency of services, this citizen-centric typology would be helpful in developing as well as managing a variety of smart city services. Gaps among services can be identified through this typological lens, or new converged services can be developed by combining different characteristics of services in different categories, leading urban planners to think out of the box.

2. Literature review

2.1. Smart city services

The concept of smart city has many historical predecessors or synonyms, such as intelligent city, information city, knowledge city, digital city and ubiquitous city. Despite differences in wording and definitions, all of these terms imply the utilization of ICT in urban management and serving citizens. Differences in these terms originated from different perspectives taken and different foci changed over time reflecting advances of related technologies. For example, while the term ubiquitous city – fashioned about a decade ago – implies ubiquity of sensors and data, the most recently coined term of smart city reflects the recent and rapid infiltration of smart devices and intelligence pushed down to the edge layers of networks.

There are some similar terms to smart city in Korea; u-city and u-eco city. A u-city (ubiquitous city) can be defined as a city in which a variety of city services are provided through ubiquitous information and communication technologies, such as built-in sensor networks that collect and disseminate information and instructions (Lee et al., 2011). A u-eco city (ubiquitous ecological city) combines core u-city technologies such as integrated city management/operations and citizen services

with green technologies to increase convenience, safety, and quality of life while reducing carbon emissions—in short, a place where people, technology, and the environment coexist in harmony. IBM defines smart cities as (1) interconnected, (2) instrumented, and (3) intelligent (Greisinger, 2009) while some academic literature defines the smart city as a city well performing in a forward-looking way in six characteristics as follows: smart economy, smart people, smart governance, smart mobility, smart environment and smart living (Giffinger et al., 2007). In this sense, the smart city is a broader concept that may include other factors such as human capital and education as drivers of change, than the use of ICT itself.

In sum, the smart city is a city in which the city dwellers may access smart services regardless of time or place. City managers may enhance the city's competitiveness and citizens' quality of life via providing these smart city services. A smart city provides its citizens with services via its infrastructure based on ICT technologies. City governments are increasingly exploiting smart technologies, changing the ways to interact with citizens and providing novel and interactive services. In this regard, a smart city requires innovative services that provide information, knowledge and transaction capabilities to citizens about all aspects of their life in the city. In this regard, any services that used to be employed in a city can become smart city services. To avoid confusion, this paper uses 'smart city services' as referring to innovative services using ICT in city planning and management. From time to time, 'u-service' is used.

2.2. Various typologies of smart city services

A city is a complex entity that plays multiple roles in serving various aspects of citizens' lives. Various services are developed for cities since the industrialization of our society, as people gather around cities. City administrators are only now getting grips on issues concerning problems that cities are facing worldwide as the number grows exponentially with increasing population. Developing and managing city services requires political and managerial skills as well as the imaginations and willingness to adapt to the changes. Fairly little attention has been devoted to the typology of city services.

In most cases, city services are classified following administrative functions, such as transportation, facility management and medical care. This typology is developed as a functional decomposition structure for administrative conveniences by grouping functionally related services together. For example, traffic monitoring and toll collection handled by transportation department of city administration are classified as transportation services though one is related to financials while the other to pattern recognition.

As can be seen in Table 1, typical classifications of city services follow typical governmental functional structure. However, when it comes to smart city services in which ICT is actively utilized to enhance the service performance, different typologies are beginning to surface mostly in academic and consulting literature. Giffinger et al. (2007) suggested six categories for smart city services; people, governance, mobility, environment and living, while Kuk and Janssen (2011) adopted and applied e-business model framework of eight categories of service providers. Walravens and Ballon (2011) proposed four different types of service platforms.

Traditional typologies identified above maintain their bureaucratic perspectives following the administrative classification of functions. Though these functional classifications might be historically developed with citizens in mind, current classifications are the opportunistic outcome of administrative history. New typologies reviewed seem to be a little different from traditional ones deviating from functional specifications of government. However, these new typologies still maintain providers' perspective. In this regard, these typologies may not provide interesting and insightful classification of smart city services reflecting service characteristics or users' views (ETRI, 2010; Lee, Kim, & Lee, 2012; Shin et al., 2009).

Table 1
Typologies for city services.

Traditional classifications		Classifications in smart city services literature	
Michel (2005)	- e-Administration - e-Government - e-Governance	Walravens & Ballon (2011)	- Enabler platform - System integrator platform - Broker platform - Neutral platform
Quitzau (2010)	- Traffic - Oil - Food - Healthcare - Energy - Retail - Water - Supply chains - Weather - Countries - Regions - Cities	Kuk & Janssen (2011)	- Content provider - Direct-to-customer - Value-net-integrator - Full-service provider - Infra-Service provider - Market - Collaboration - Virtual communities
'Ubiquitous City Construction Act 2012' in Korea	- Administration - Transportation - Public Health, Medical Care, & Welfare - Environment - Crime & Disaster Prevention - Facilities Management - Education - Culture, Tourism, & Sports - Distribution - Work & Employment - Miscellaneous	Batty et al. (2012), Giffinger et al. (2007)	- Economy - People - Governance - Mobility - Environment - Living

First and foremost, these typologies are lacking the citizens' perspective. One of the issues around smart city service development is the financial responsibility. In some projects, there has been debate regarding how to make beneficiaries—most often, citizens—pay for new services. As smart services proliferate in cities with the advancement of technologies, this will become an important issue to be resolved and, in some sense, actual citizens should come forward as a stakeholder group to make these decisions. In that case, the typology would better reflect the perspective of users and citizens rather than that of providers.

In this regard, marketing or sales literature would be better references than public administration literature. Rather than being based on the perspective of service providers, a typology needs to adopt the service customer's viewpoint, so that the customer can easily identify what they are getting and what is designed for them.

Second, current typologies do not reflect the actual characteristics of services themselves. As a typology is a classification scheme that groups items with shared characteristics into a finite set of categories, it plays an important role in understanding the nature of current services and in strategically developing future services (Linders, 2012). However, current typologies are more like a list of functional government services in local governments. Administrative structures are devised for the convenience of administration, in that bureaucratic walls are built around authorities and agencies. One of the advantages provided by ubiquitous and smart technology is the possibility of services being converged across functional disciplines. A typology of smart city services would better reflect the characteristics of services beyond the administrative functionalities.

In this regard, current typologies may not be completely adequate in providing guidelines for selection and delivery of smart city services as well as for development of new services. When developing new services, urban planners and administrators need to take citizens' needs into consideration and most of citizens' needs are not to be confined by functional classifications of government structure. For example, if you are designing a new smart city service for elderly and ill citizens, you may need to take environmental sensing with transportation requirements and with medical aid services. A converged service may need to take characteristics into consideration that might belong to different government functions. Also, in selection and delivery of services, the structural wall shouldn't be barring urban planners to select from a pool of service irrespective of their structural affiliations in government.

In this regard, the interest of this paper lies in developing and proposing a new typology that identifies the citizen-centric properties of smart city services. Efforts were concerted to develop and validate citizen-centric typology of smart city services, geared towards servicing citizens' needs, as in this era of information revolution, citizens are the 'active customers of smart city services (United Nations, 2012)' in improving public sector governance systems as well as private sector business systems, and the quality of u-service in the public sector should be measured by the benefits to citizens and the technological complexity (Ancarani, 2005).

3. Development of a citizen-centric typology

To develop a reference typology for smart city services from the perspective of actual citizens, a staged approach is used for this study. (1) Service typologies currently used in marketing and sales are collected from existing research literature in those fields, as they are known to focus primarily and critically on the customer view. (2) Collected typologies are compared and the dimensions are reviewed, while similar dimensions are integrated via content analysis. (3) These dimensions are reviewed for usability with respect to smart city services and synthesized when needed. (4) A prototype typology is constructed using synthesized dimensions. (5) Against this prototype typology, a classification exercise is conducted using 228 actual u-services for verification of usability.

Because the study of typologies for u-services has a short history lacking theoretical support (Ki et al., 2009; Lee et al., 2012), typologies from other fields of studies will be helpful in developing a reference typology. In particular, service typologies from marketing and service science fields have substantial quality and quantity and are known to maintain the customers' perspective. Because typology references are abundant in marketing and service science, a methodologically rigorous review of previous research of service typology in marketing and service science seems to be in order. Because the terms typology, taxonomy,

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Table 2
Collection of service typologies.

	(Author, year)	Dimensions for sorting	Categories[a]
1	(Judd, 1964)	Ownership and tangibility	Rented goods services
			Owned goods services
			Non-goods services
2	(Shostack, 1977)	Degree of tangibility and intangibility of each good or service	
3	(Hill, 1977)	Services affecting persons versus those affecting goods	
		Permanent versus temporary effects of the service	
		Reversibility versus non-reversibility of these effect	
		Physical versus mental effects	
		Individual versus collective services	
4	(Chase, 1978)	Extent of customer contact required in service delivery	High contact (e.g. health care)
			Low contact (e.g. postal service)
5	(Thomas, 1978)	Mechanization of service processes and the service workers' skill level	Equipment based (automated, monitored by unskilled operators, or operated by skilled personnel)
			People based (unskilled labor, skilled labor, professionals)
6	(Mills & Margulies, 1980)	Information, Decision, Time, Problem awareness, Transferability, Power, Attachment	Maintenance–Interactive
			Task–Interactive
			Personal–Interactive
7	(Bell, 1981)	Tangibility, Customer involvement	Degree of tangibility and extent of customer involvement in goods
8	(Dilworth, 1983)	Nonmanufacturing operations: project/custom service/standard services	
		Manufacturing operations: unit/batch/mass production	
9	(Silpakit & Fisk, 1985)	The level of customer contact and involvement	Degree of customer contact and participation of each service
10	(Shostack, 1987)	Complexity: the number and intricacy of the steps required to perform the service	
		Divergence: the degree of freedom allowed or inherent in a process step	
11	(Haywood-Farmer, 1988)	Physical and procedural, Behavioral, Judgmental	Degree of labor intensity
			Degree of customization
			Degree of interaction
12	(Bowen, 1990)	Importance of employees, customization, Ability to switch firms, Employer/customer contact, Services directed at people or things, Continuous benefits, Difference	High contact, customized personal services
			Moderate contact, semi-customized, non-personal services
			Moderate contact, standardized services
13	(Wemmerlöv, 1990)	Service systems design and operations	Nature of customer/service system interaction
			Degree of routinization of the service process
			Objects towards which service activities are directed
14	(Silvestro et al., 1992)	Equipment/people focus (contact time, customization, discretion)	Professional services
		Few/many customers	Mass services
			Service shops
15	(Kotler & Armstrong, 1994)	Intangibility, Inseparability, Variability, Perishability	Type of service firm
16	(Karmarkar & Pitbladdo, 1995)	Market structure, Pricing, Contracting	Absence of finished inventories
			Joint production by supplier and the consumer
17	(Deborah L. Kellogg & Chase, 1995)	Communication time, Level of intimacy, Information richness	Sorting services according to degree or level of customer contact

18	(Deborah L Kellogg & Nie, 1995)	1. Customer influence 2. Customization	1. Service process structure: expert service, service shop, service factory 2. Service package structure: unique service package, selective service package, restricted service package, generic service package
19	(Holt, 1995)	Purpose of action (Autotelic actions, Instrumental actions) Structure of action (Object actions, Interpersonal actions)	Consuming as experience Consuming as integration Consuming as play Consuming as classification
20	(Lovelock & Yip, 1996)	Nature of the process, Extent of customer contact	People-processing services Possession-processing services Information-based services
21	(Rust & Metters, 1996)	1&2. External (Customer Models) 2&3. Internal (Service Provider Models)	Customer behavior models: how customers react to service Service quality impact models: address the business consequences of service quality Normative service models: how organizations should organize and manage their service
22	(Licata & Mowen, 1997a)	Consumer behavior constructs	Can do myself services Need, but can't do myself services Low need, but can do myself services High experience, high need services Need, Can't do, bummer services
23	(Schmenner, 2004)	Variation in the customization and interaction/relative throughput time (a measure of productivity)	Service factory Service shop Mass service Professional service
24	(Cunningham et al., 2005)	Physical: the level of physical product component Contact: the level of the customer–employee contact Separable: the production and consumption of a service Riskiness: to choose a provider Switching: easiness to switch a new provider Person/object: service for person or object Relationship: between the service provider and the customer Service delivery: continuous or discrete transactions Customization: the level of customization of a service Judgment: the level of judgment for making service provision decisions Convenience: the degree of the convenience to obtain a service	
25	(Olorunniwo & Hsu, 2006)	Tangibility (the physical facilities and appearance of personnel) Responsiveness (response to customers' specific needs) Knowledge (knowledge and competence of service providers) Accessibility (the provider's ability to deliver the service)	
26	(Ng et al., 2007)	1. Service Delivery 2. Purpose	1. Collective–Individual 2. Hedonic–Utilitarian
27	(Paswan, D'Souza, & Zolfagharian, 2009)	Perceived environmental uncertainty (high or low) Service firm's strategic orientation (cost control or differentiation) Managers' market orientation (market or firm focus)	
28	(Glückler & Hammer, 2010)	Demand orientation, Knowledge intensity, Technology intensity	Operational consumer services Knowledge-intensive consumer services Operational business services Knowledge-intensive business services Technological knowledge-intensive business services

[a] A considerable number of typologies proposed factors or dimensions for classification but do not provide actual categories.

and classification schemes are interchangeably used in practice, all of these terms were used as keywords. A keyword search was conducted using the search phrase of "(typology or taxonomy or classification) and service" in the 2013 Business Source Complete database provided by EBSCOHost. The search returned 433 scholarly journal articles published since 1940. Compared with the current and recent short history of smart city, the literature in service science and marketing presents a variety of views. All the articles were screened for appropriateness and applicability to the smart city context. Some focus on the typology of firms, while others focus on the types of technical web services. Some maintain provider-centric views, while some are not clearly presented in detail or they simply repeat what others have already presented with little variation. Notably, Cook, Goh, and Chung (1999) provide a comprehensive review of service typologies and present a chronicle of service typologies from earlier times to the 1990s. Careful screening and review returned 28 typologies of services as shown in Table 2.

In the next stage, collected typologies are compared at the dimension level. Many dimensions are found to be somewhat similar. As listed in Table 2, a variety of dimensions were found from the marketing science literature: tangibility, benefits, contact, customer involvement, information, decision, time, attachment, reliability, mechanization, complexity, responsiveness, accessibility, innovation, participation, knowledge or technology intensity, and others. When these dimensions were critically reviewed, it was found that some dimensions were similar and even recurring. As these are mostly consumer-based typologies, they tend to have dimensions that focus on interactions between consumers and services.

For example, Kellogg and Chase (1995) focus on the degree or level of customer contact, while Kellogg and Nie (1995) emphasize customer influence and customization. Cunningham, Young, and Lee (2005) also argue for the importance of the contact level of the customer–employee relationship, the relationship between service provider and the customer, and the level of customization of a service. Licata and Mowen (1997a, 1997b) also provide a typology based on consumer behavior in respect to services. Thus, similar recurring dimensions were integrated after careful content analysis of actual usage in the literature. As a result, a total of 17 sub-dimensions surfaced as presented in Table 3.

As the next stage, these 17 sub-dimensions were subjected to a clustering analysis for simplification and reduction of dimensions. Four experts had conducted two separate sessions of card sorting exercise clustering these sub-dimensions. Four dimensions surfaced in both sessions: 'Mode of Technology,' 'Service Purpose,' 'Service Authority,' and 'Delivery Mode.'

'Mode of Technology' subsumes sub-dimensions that describe how ICT changes the shape of services: mechanization, complexity, divergence, routinization, knowledge, innovation, and nature of service process. This dimension is repolarized as 'automatic versus informative versus transformative,' reflecting the characteristics of ubiquitous information technology while maintaining the disposition of original typologies in marketing literature: innovation in service process itself. Since Zuboff (1988) introduced the concept of automate and informate to explain the nature of changes incurred by information technology, the

idea has been developed in a substantial number of studies. In particular, Schein (1992) classified the three strategic stages of changes incurred by information technology: automate, informate, and transformate. 'Automate' is the replacement of expensive, unreliable human labor by automating processes with technology. 'Informate' goes beyond 'automate' and creates information to empower management as well as to improve efficiency. 'Transformate' is the fundamental alteration of traditional processes and the providing of new services and systems. This polarization seems appropriate for the mode of technology dimension without losing the meanings of the original polarizations in marketing, such as mechanization, routinization, and knowledge, from the reviewed literature (Glückler & Hammer, 2010; Thomas, 1978; Wemmerlöv, 1990).

The purpose of services is found in the typologies of Hill (1977), Silvestro, Fitzgerald, Johnston & Voss (1992) and Ng, Russell-Bennett, and Dagger (2007). As service purpose is similar to the purpose of consumption in the marketing literature, the poles of these dimensions are set as 'hedonic versus utilitarian' (Holt, 1995; Ng et al., 2007). Herein, a 'hedonic' service means a service that gives pleasure or enjoyment to an individual citizen, such as services for leisure activities, while a 'utilitarian' service is defined as a functional service in terms of urban management to promote public interest.

Service authority, the third dimension, is the rephrasing of the autonomy of service customers (Glückler & Hammer, 2010; Silpakit & Fisk, 1985). The poles of this dimension are set as 'voluntary versus mandatory.' 'Voluntary' services are defined as services in which service beneficiaries can intentionally pick the time or contents of services. For example, citizens may or may not choose to receive services like 'childbirth and childcare support service' when they need such services. However, 'mandatory' services, such as 'speed violation enforcement service' or 'litter monitoring system service,' are provided regardless of the will of citizens.

The last dimension, delivery mode, is a rephrasing of the relationship between customer and providers. Most typologies in marketing science define this dimension as the level of interaction between consumers and service providers, such as contact, relationship, customer involvement, responsiveness, and customization (Bell, 1981; Bowen, 1990; Kellogg & Chase, 1995; Olorunniwo & Hsu, 2006; Schmenner, 2004; Silpakit & Fisk, 1985; Silvestro, Fitzgerald, Johnston, & Voss, 1992). Thus, the poles of this dimension were set as 'passive versus interactive.' A passive service is a service processed without the need to obtain any feedback from service consumers. For example, 'monitoring service for neighborhood security' does not need any feedback from citizen, while 'u-healthcare service' requires a customer's input and reaction in order to process the service.

These four dimensions of smart city services produce 24 different categories ($3 \times 2 \times 2 \times 2$). In order to validate this typology, classifying exercises were conducted using 228 services identified and inventoried in Korea. A panel of three experts sort 228 cards printed with service descriptions into these 24 categories.

During the initial round of the classification exercise, some services were found to be very simple automation of government services. For example, 'Electronic Payment Service' simply substitutes the collectors,

Table 3
Dimensions and categories.

Dimensions	Definition	Sub-dimensions found in the literature (N = 17)
	Categories	
Mode of Technology	*How ICT changes the shape of services*	Mechanization, Complexity, Divergence, Routinization, Knowledge,
	Automate versus Informative versus Transformative	Innovation, Nature of Service Process (N = 7)
Service Purpose	*What is the purpose of the service*	Benefits, Purpose, Purpose of Action (N = 3)
	Hedonic versus Utilitarian	
Service Authority	*How autonomous are citizens in using service*	Participation, Consumer Behavior, Customer Involvement (N = 3)
	Voluntary versus Mandatory	
Delivery Mode	*How services are being delivered*	Contact, Relationship, Responsiveness, Customization (N = 4)
	Passive versus Interactive	

Table 4
Dimensions and categories.

Dimensions	Categories	Categories							Categories							
Mode of Technology	Automate	Informate							Transformate							
Service Purpose	Utilitarian	Utilitarian				Hedonic			Utilitarian				Hedonic			
Service Authority	Mandatory	Mandatory		Voluntary		Mandatory		Voluntary	Mandatory		Voluntary		Mandatory		Voluntary	
Delivery Mode	Passive	Passive	Interactive	Passive	Interactive	Passive	Interactive	Passive	Interactive	Passive	Interactive	Passive	Interactive	Passive	Interactive	Passive	Interactive
Categories	AUMP	IUMP	IUMI	IUVP	IUVI	IHMP	IHMI	IHVP	IHVI	TUMP	TUMI	TUVP	TUVI	THMP	THMI	THVP	THVI

and does not create new information or new benefits for customers beyond automation. Additionally, these cases of automation of services do not need any further classification because these fall into utilitarian, mandatory and passive categories. Therefore, 'automate' services belong to AUMP (Automate–Utilitarian–Mandatory–Passive). Forty-nine services were included in this AUMP category (see Appendix 1). As a result, total 17 categories were used for classification ($2 \times 2 \times 2 \times 2 + 1$) as shown in Table 4.

After 49 services are classified into AUMP category, the rest of the services are sorted using the mode of technology; 105 informate and 74 transformate.

Furthermore, informate services were classified by the service purpose, hedonic–utilitarian. And then, each service was sorted again according to other dimensions of service authority (voluntary–mandatory) and delivery mode (passive–interactive) (see Table 5).

Smart city services seem to be oriented towards more utilitarian than hedonic services. Considering that these services belong to passive domain, it is natural. 49 AUMP services are utilitarian while only 19 hedonic services emerge from 105 informate services.

3.1. IUMP (informate–utilitarian–mandatory–passive) & IUMI (informate–utilitarian–mandatory–interactive)

Among informate–utilitarian services, there are 34 services in IUMP category. IUMP services have both utilitarian and mandatory characteristics. For example, when you drive into a parking lot in a townhouse which provides 'Car Parking Linkage Service,' your car is automatically controlled by the service system (utilitarian–mandatory). The vehicle information within the parking lot is transmitted to the house linked with the car so that household members are notified whether the registered cars (of their family or guests) arrive or leave (passive). Like 'Car Parking Linkage Service,' 'u-Factory' is also a 'utilitarian' and 'mandatory' service because it provides some information about the production or facilities to the user (e.g. manager) when those information occurred (mandatory) for improving the effectiveness of control (utilitarian). Unlike 'Car Parking Linkage Service,' however, 'u-Factory' is 'interactive' rather than 'passive' because the service has to be adapted according to the types of products. So we distinguished these services as IUMI, and there are 20 services in this category.

3.2. IUVP (informate–utilitarian–voluntary–passive) & IUVI (informate–utilitarian–voluntary–interactive)

Informate–utilitarian–voluntary services are divided by delivery mode dimension. 11 services are passive ones (IUVP), and 21 services have interactive character (IUVI). In IUVP category, service users voluntarily access the services to obtain information useful to them passively. Using 'Campus Information Service,' for example, service users can obtain campus information (informative) whenever they want (voluntary). However, the service only provides information without retrieving user data or feedback (passive). On the other hand, if services can be adaptable for individuals, the services have the characteristic of being interactive. For example, in 'Online Education Service,' people can access subjects or courses without giving their individual information for customization (passive), whereas the curriculum is organized according to the educational purpose of individuals in 'Cyber School Service' (interactive). Therefore, 21 services belong to IUVI category.

3.3. IHMP (informate–hedonic–mandatory–passive) & IHMI (informate–hedonic–mandatory–interactive)

There are some smart city services with hedonic value; only 19 ones. In informate–hedonic section, there are a few services with mandatory factor. There are 3 services in IHMP category, for example 'u-Placard Service' can only display some information on screen (mandatory–

Table 5
Informate service categories.

Dimensions	Categories							
Mode of Technology	Informate							
Service Purpose	Utilitarian				Hedonic			
Service Authority	Mandatory		Voluntary		Mandatory		Voluntary	
Delivery Mode	Passive	Interactive	Passive	Interactive	Passive	Interactive	Passive	Interactive
	IUMP	IUMI	IUVP	IUVI	IHMP	IHMI	IHVP	IHVI
	(N = 34)	(N = 20)	(N = 11)	(N = 21)	(N = 3)	(N = 1)	(N = 6)	(N = 9)

passive) for convenience and fun of citizen (users). In other case, such as 'Smart Sickbed Service,' it provides convenient and enjoyable functions (hedonic) to patients who are confined to their sickbed (mandatory). Especially this kind of service can give a feedback to user, so we can call it an IHMI service.

3.4. IHVP (informate–hedonic–voluntary–passive) & IHVI (informate–hedonic–voluntary–interactive)

There are fifteen voluntary services in informate–hedonic sectors. 6 of them are in IHVP category. u-Services in this category are the services that, according to individual desire, users are able to choose when to use them, as they are one-way and information-oriented. For example, 'Tour Information Service' is provided when service users want to use (voluntary) for their tour desire (hedonic), and the users simply accept (passive) the service that provides useful information (informative). 'u-Tour Service' is very similar to 'Tour Information Service' but it is not so much passive as interactive, because the service requires more active feedback from its service users to provide more customized services. Therefore, this service would be categorized as IHVI and there are nine services with those characteristics.

Transformate services provide new services or information which is processed, while informate service provides information which is just not refined or transformed at all. Using advanced ICT, services are able to fundamentally alter traditional ways of processing and provide new services and systems (transformative), such as 'u-Office Lease Service,' which offers intelligent workplace embedded u-technology and consulting services for management or legal issues. Lots of transformate services are also utilitarian rather than hedonic in character. There are 62 transformate–utilitarian services and just 12 services are transformate and hedonic ones (Table 6).

3.5. TUMP (transformate–utilitarian–mandatory–passive) & TUMI (transformate–utilitarian–mandatory–interactive)

There are 32 TUMP services and 14 services in TUMI category. u-Technology has brought about the invention of new services (transformate) such as 'Lateral Collision Prevention Service' and 'School Zone Service.' The difference between them is that the former is 'passive' while the latter is 'interactive.' 'Lateral Collision Prevention Service' automatically senses other cars or barriers that can be a crash threat to the car and controls the vehicle to avoid crashes (passive),

but 'School Zone Service' interacts with drivers in the service area by providing information and warning them (interactive). All of them provide some utilitarian benefits to users without user's intention.

3.6. THMP (transformate–hedonic–mandatory–passive) & THMI (transformate–hedonic–mandatory–interactive)

Similar to informate service category, there are just 12 hedonic services in transformate division. Especially THMP and THMI, each category only has one smart city service. Even though this study made great efforts to provide appropriate dimensions and sort services into these dimensions, it should be acknowledged that some ambiguity in the typology exists when a specific service is categorized. For example 'Media Board Service' gives amusement (hedonic): people can take a photo or play digital games. But it can also present important public-notices (utilitarian). In addition, a user walking along this street cannot help but be exposed to the service (passive–mandatory), but can also actively participate in this service (interactive–voluntary). In this case, we focused on its main, current use, thus we define 'Media Board Service' as THMP service, because 'Media Board Service' provides not only information but also new activities (transformative), unlike 'u-Placard Service,' which only provides information (informative). THMI service recognized only one, 'Digital Stepping Stone Service.' In this service, sounds and colors are produced with user steps (transformate–hedonic) when crossing a stream (mandatory–interactive).

3.7. THVP (transformate–hedonic–voluntary–passive) & THVI (transformate–hedonic–voluntary–interactive)

There are 4 passive and 6 interactive services in transformate–hedonic–voluntary division. Consider 'High Tech Street Experience Service' in THVP category. This service is a newly developed service based on ICT (transformative), and people receive an intriguing experience (hedonic) which is provided without interaction and customization (passive). Users do have a choice whether to use the system (voluntary). On the other hand 'u-Experience Service' is different from 'High Tech Street Experience Service' in terms of 'relationship between service and service users' (interactive), because, the 'u-Experience Service' users can more actively participate in the service, although both services are transformate–hedonic and voluntary in character.

Table 6
Transformate service categories.

Dimensions	Categories							
Mode of Technology	Transformate							
Service Purpose	Utilitarian				Hedonic			
Service Authority	Mandatory		Voluntary		Mandatory		Voluntary	
Delivery Mode	Passive	Interactive	Passive	Interactive	Passive	Interactive	Passive	Interactive
	TUMP	TUMI	TUVP	TUVI	THMP	THMI	THVP	THVI
	(N = 32)	(N = 14)	(N = 6)	(N = 10)	(N = 1)	(N = 1)	(N = 4)	(N = 6)

4. Conclusions and discussion

In this study, after systematically reviewing marketing and service science literature, a citizen centric typology that can be used in classifying the smart city services is developed, validated and proposed. Resulting typology consists of mode of technology, service purpose, service authority and delivery mode as four different dimensions of services. Mode of technology includes automate, information and transformate as categories referring to how the ICT is being used for smart city services. Service purpose includes utilitarian or hedonic as categories representing the goal of service use from the citizens' perspective. Service authority dimension includes voluntary or mandatory as categories while delivery mode includes passive and interactive as categories.

As most of the current typologies used in classifying smart city services are geared towards the provider centric view, the classification structure in these typologies is built around the governmental and bureaucratic functions, such as transportation, health, and welfare. However, in this era of information and communication, smart city services need to be developed across different governmental functions. For example, in case of car accidents, different bureaucratic functions need to be triggered in real time using information and communication technologies, such as transportation (routing traffics, changing traffic lights, notifying other vehicles via navigation system), health (fetching for ambulances, finding nearby emergency hospitals with rooms, fetching for victims' health records) and welfare (fetching for insurance information, notifying family members, securing child support if needed).

In the old days of industrialized society, these functions are optimized as separate department and functions, but in the information and knowledge based society, these functions need to be cross referenced and connected together, so that a service can be executed across different functions. In other words, smart city services would be better developed following the actual and precise needs of citizens. In these cases, the walls built among different government functions for optimization in the old times are becoming hurdles that need to be overcome.

Typology is a system of grouping objects and things according to how they share characteristics. Categories in a typology typically share common characteristics and representative characteristics are used as dimensions in a typology. In this regard, the typology works as a lens people use against the world. The typology proposed here is conducive to planning and developing smart cities because it can help guide priorities for providing smart city services.

Though a new typology for smart city services is presented here, this is just the first step in providing a new approach and perspective in developing and implementing smart city services. Also, this typology is developed from a systematic literature review and validated via a qualitative exercise of classifying actual services identified in a country. This typology is awaiting further empirical studies improving the typologies and ultimately improving smart services in cities.

Appendix 1. 228 Smart city services

11 Categories	70 Specific categories	228 u-Services
Administration	On the Spot Administrative Support	Litter Monitoring System Service
		On-the-spot Administrative Supporting Service
		u-Asset Management Service
	Urban Landscape Management	u-Placard Service
		On-the-spot Facility Occupation Management Service
		Roadside Trees Management Service
		Night Lighting Management Service
	Remote Civil Affairs Administration	u-Civil Complaint Service
		Remote Tax Noticing/Payment Service
	Amenity	u-Moving Service
		Land Information Search Service
		Neighborhood Information Portal Service
	Citizen Participation	Citizen Report Service
		Electronic Voting Service
		u-Public Hearing Service
Transportation	Traffic Management Optimization	Real-time Traffic Control Service
		Expressway Traffic Flow Control Service
		Wild Area Traffic Flow Control Service
		Traffic Control Information Provision Service
		Accidental Event Sensing Service
		Accidental Event Response Service
		Operating Ambulance Assistance Service
		Speeding Crackdown Service
		Exclusive-lane Violation Crackdown Service
		Lane Violation Enforcement Service
		Traffic Signal Violation Enforcement Service
		Stopping, Standing, Parking Crackdown Service
		Overloaded Vehicle Crackdown Service
		Traffic Pollution Management Service
		Vehicle Tracking Service
		Car-Free Day Crackdown Service
	Electronic Payment	Electronic Toll Collection Service
		Electronic Congestion Fee Collection Service
		Electronic Public Transport Fare Payment Service
		Electronic Parking Fee Payment Service (Public Parking Lot)

Appendix 1 (*continued*)

11 Categories	70 Specific categories	228 u-Services
Transportation	Traffic Information	General Traffic Information Provision Service
		Transport Information Management Link Service
	Optional Information Service	Car Traveler Transport Information Provision Service
		Vehicle Navigation Service
		Parking Information Provision Service (Public Parking Lot)
		Pedestrian Navigation Service
	Public Transport	Public Transit Information Service
		Public Transit Control Service
	High-tech Road	Vehicle Accident Auto Alarm Service
		Vehicle Forward–Backward Crash Prevention Service
		Vehicle Flank Crash Prevention Service
		Intersection Crash Prevention Service
		Railway Crossing Safety Steering Service
		Slow Down Zone Safety Steering Service
		Vehicle Safety Inspection Automatic Service
		Pedestrian Safety Support Service
		Driver Visibility Improvement Service
		Dangerous Driving Prevention Service
		Driving Distance between Cars Control Service
		Automatic Steering/Driving Service
		Vehicle Group Operation Service
	Taxi Call	Taxi Call Service
Public Health, Medical Care, Welfare	Health Care Service	Home Health Care Service
		Community Health Care Service
		Medication Administration Service
		u-Fitness Service
	u-Hospital Service	Hospital Information Service
		Medical Treatment Smart Card Service
		Smart Sickbed Service
		Hospital Asset and Patient Management Service
		Electronic Prescription Service
		Hospital Environment Management Service
	Remote Medical Service	Remote Medical Treatment Service
		Remote Cooperating Medical Treatment Service
		Visiting Patients Service
		Emergency Medical Service
	u-Public Health Care Service	Individual Health Information Management Service
		Prescription Medicines Supervision Service
		Food Supervision Service
		Blood Transfusion Management Service
	u-Public Health Center Service	Public Health Center Information Service
		Public Health Facilities Management Service
	Family Relief Service	Missing Children or the Elderly with Dementia Prevention Service
		The Elderly and the Infirm Monitoring Service
		The Elderly and the Infirm Mobile Support Service
		The Elderly Care Service
	Service for the Handicapped	Walk Support Service for the Handicapped
		Facility Guide Service for the Handicapped
	Multiculturalism	Multicultural Family Help Service
	Childbirth/care	Childbirth and Childcare Support Service
Environment	Contamination Control Service	Water Resources Contamination Control Service
		Land Contamination Control Service
		Air Pollution Control Service
		Environment Pollution Integrated Information Service
	Waste Management Service	Daily Waste Management Service
		Food Waste Management Service
		Noxious Waste Management Service
		Recycling Management Service
	Eco-Service	Ecosystem Management Service
		Green Lung Management Service
		Tree Management Service
		Intelligent Bicycle Use Service
	Energy Efficiency Service	Remote Read Energy Service
		Real-time Electricity Use Management Service
		Multifunctional Streetlight Service
	New & Renewable Energy Service	Solar Photovoltaic Service
		Solar Heating Service
		Geothermal/Wastewater Heat Recovery Service
		Wind Power Generation Service
Crime and Disaster Prevention	Rescue/Emergency Medical Service	Emergency Notification Service
		Emergency Rescue Service
	Individual Relief Service	Public Transit Use Safety Service
		Home Crime/Disaster Prevention Service
	Public Safety	Public Place Safety Monitoring Service
		Mobile Security Information Service
		School Zone Service
		Criminal Tracking Service

Appendix 1 (*continued*)

11 Categories	70 Specific categories	228 u-Services
Crime and Disaster Prevention	Institution Security	Unmanned Security Service
	Fire Control	u-Fire Detecting Service
		Firefighting Supporting Service
		Mobile Firefighting Equipment Checking Service
	Natural Disaster Management	Flooding Information Service
		Snow-removing Management Service
		Earthquake Information Service
		Typhoon Information Service
		Tsunami Information Service
	Accident Management	Public Facilities Poison Gas Information Service
		Ground Condition Management Service
		Deteriorated Building State Management Service
	Disaster Management	Disaster Integrated Management Service
Facility Management	Street Furniture Management	Traffic Facilities Maintenance Service
		Street Facilities Maintenance Service
		Bridge Safety Management Service
		Tunnel Safety Management Service
	Building Maintenance	Building Maintenance Service
	River Facilities Maintenance	River Facilities Maintenance Service
	Appurtenant Facilities Management	Retaining Wall Safety Management Service
		Steep Slope Land Management Service
	Underground Facilities Management	Utility Tunnel Management Service
		Water Supply Facilities Management Service
		Sewerage Management Service
	Data Management/Supply	Geospatial Imagery Information Service
		Urban Geographical Information Service based GIS
		Drawing Cooperation Management Service
Education	u-Kindergarten Service	Kindergarten Information Service
		Real time Nursery Monitoring Service
	u-Campus Service	Campus Information Service
		Locker Management Service
		Student Smart Card Service
		u-Infirmary
		u-School Bus Service
		u-Dormitory Service
	u-Classroom Service	u-Classroom Service
	Remote Education Service	Online Education Service
		Cyber School Service
	u-Library Service	Library Information Service
		Electronic Library Service
		u-Book Storage Service
		u-Reading Room Service
		u-Bookmobile Service
	Learning Support	Learning Support Service for the Disabled
Culture, Tour, Sport	Cultural Facilities Management	Heritage Preservation Management Service
		Cultural Assets Management Service
	Cultural Space Experience	u-Gallery Service
		u-Experience Room Service
		u-Convention Service
	Cultural Info Service	Cultural Information Service
	u-Tour Information	u-Tour Service
		City Tour Bus Information Service
		Tourist spots Real Time Video Service
		u-Visitor's Book Service
		Tour Information Service
	u-Park	Park Information Service
		Park Facilities Use Service
	u-Playground	u-Playground Service
	u-Resort	u-Resort Service
	u-Sport	u-Daily Sports Service
		u-Golf Service
		u-Ski Service
Distribution	Product Background Tracking Service	u-Factory
		u-Animal Pen
		u-Farm
		u-Fish Farm
	u-Distribution Center	Storage Management Service
		Intelligent Inventory Management Service
		Intelligent Picking/Packing Service
	u-Transport	Freight Vehicle Management Service
		Optimal Transportation Routing Service
		Cargo Custom Service
		Freight Tracking Service
	u-Delivery	Unmanned Post/Parcel Service
	Distribution Tracking Check	Agriculture, Fisheries, Livestock Background Tracking Service
		Product Background Tracking Service

Appendix 1(continued)

11 Categories	70 Specific categories	228 u-Services
Distribution	u-Store	Wholesale and Retail sales Stock/Release Management Service
		Intelligent Shop Management Service
	u-Shopping	Personalized Shopping Information Service
		Electronic Payment Service
		u-Commerce Service
		u-Customer Management Service
Work and Employment	Employment Information Service	Personal Employment Support Service
		Enterprise Recruitment Support Service
		Employment Information Service
		Labor Market Support Service
		u-License Card Service
	u-Work Service	Remote Conference Service
		Remote Cooperation Service
		u-Office Area Service
		u-Work Center Service
		Enterprise Integrated Card Service
		u-Print Pole Service
		u-Office Lease Service
	Industry Support	Business Start-up Support Service
		Local Industry Support Service
		Local Business Cooperation Support Service
	Industry Safety Supervision	High Risk Work Remote Support Service
		High Risk Workplace Safety Supervision Service
Miscellaneous	Home Management Service	Home Automation Service
		Video Telephone Service
	Outside Linkage Service	Elevator Call Service
		Car Park Linkage Service
		Home Entertainment Service
	Housing Complex Management Service	Housing Complex Management Service
		Housing Complex Security Service
		Housing Complex Community Support Service
		Integrated Resident Card Service
	u-Artifact Service	Building Exterior Digital Illumination Service
		Media Board Service
		Entertainment Bench Service
		Music Fountain Service
		Digital Stepping Stone Service
		Digital Facilities Landscape Service
	u-Theme Street Service	High Tech Street Experience Service
		Specialized Industry Street Service

References

Ancarani, Alessandro (2005). Towards quality e-service in the public sector: The evolution of web sites in the local public service sector. *Managing Service Quality*, 15(1), 6–23.

Batty, M., Axhausen, K. W., Giannotti, F., Pozdnoukhov, A., Bazzani, A., Wachowicz, M., et al. (2012). Smart cities of the future. *The European Physical Journal Special Topics*, 214(1), 481–518.

Bell, M. L. (1981). A matrix approach to the classification of marketing goods and services. In J. H. Donnelly, & W. R. Geroge (Eds.), *Marketing of services*. Chicago, IL: American Marketing Association.

Bowen, John (1990). Development of a taxonomy of services to gain strategic marketing insights. *Journal of the Academy of Marketing Science*, 18(1), 43–49.

Caragliu, Andrea, Del Bo, Chiara, & Nijkamp, Peter (2011). Smart cities in Europe. *Journal of Urban Technology*, 18(2), 65–82.

Chase, Richard B. (1978). Where does the customer fit in a service organization design. *Harvard Business Review*, 56(6), 137–142.

Cook, D. P., Goh, C. H., & Chung, C. H. (1999). Service typologies: A state of the art survey. *Production and Operations Management*, 8(3), 318–338.

Cunningham, Lawrence F., Young, Clifford E., & Lee, Moonkyu (2005). Customer perceptions of service dimensions: American and Asian perspectives. *The Service Industries Journal*, 25(1), 43–59.

Dilworth, J. B. (1983). *Production and operations management* (2nd ed.). New York, NY: Random House.

ETRI (2010). *u-Service for the u-Korea.* : The Ministry of Public Administration and Security National Information Society Agency.

Giffinger, Rudolf, Fertner, C., Kramar, H., Kalasek, R., Pichler-Milanovic, N., & Meijers, E. (2007). *Smart cities: Ranking of European medium-sized cities.* : Centre of Regional Science (SRF), Vienna University of Technology.

Gil-Castineira, F., Costa-Montenegro, E., Gonzalez-Castano, F. J., Lopez-Bravo, C., Ojala, T., & Bose, R. (2011). Experiences inside the ubiquitous Oulu smart city. *Computer*, 44(6), 48–55.

Glückler, Johannes, & Hammer, Ingmar (2010). A pragmatic service typology: Capturing the distinctive dynamics of services in time and space. *The Service Industries Journal*, 31(6), 941–957.

Greisinger, Tim (Producer). (2009). Let's Build a Smarter Planet: Smarter Cities. [Presentation] Retrieved from http://www.itu.int/ITU-D/asp/CMS/Events/2012/RDF/IBM_ppt.pdf.

Haywood-Farmer, J. (1988). A conceptual model of service quality. *International Journal of Operations and Production Management*, 8(6), 19–29.

Hill, T. P. (1977). On goods and services. *Review of Income and Wealth*, 23(4), 315–338.

Hollands, R. G. (2008). Will the real smart city please stand up? Intelligent, progressive, or entrepreneurial? *City*, 12(3), 303–320.

Holt, Douglas B. (1995). How consumers consume: A typology of consumption practices. *Journal of Consumer Research*, 22(1), 1–16.

Jeong, Keong Seok, Moon, Tae Heon, & Heo, Sun Young (2009). A study on u-city service classification and the service framework for the standardization of u-city service. [A study on u-city service classification and the service framework for the standardization of u-city service]. *Journal of the Korea Planners Association*, 44(3), 231–246.

Judd, R. C. (1964). The case for redefining services. *Journal of Marketing*, 28(1), 58–59.

Karmarkar, Uday S., & Pitbladdo, Richard (1995). Service markets and competition. *Journal of Operations Management*, 12(3–4), 397–411.

Kellogg, Deborah L., & Chase, Richard B. (1995). Constructing an empirically derived measure for customer contact. *Management Science*, 41(11), 1734–1749.

Kellogg, Deborah L., & Nie, Winter (1995). A framework for strategic service management. *Journal of Operations Management*, 13(4), 323–337.

Ki, H., Yang, D., Byun, W., We, S., Jung, M., & Sim, Y. (2009). *The development architecture and prototype of the u-city integration platform.*

Kotler, P., & Armstrong, G. (1994). *Principles of marketing* (6th ed.). Englewood Cliffs, NJ: Prentice-Hall.

Kuk, George, & Janssen, Marijn (2011). The business models and information architectures of smart cities. *Journal of Urban Technology*, 18(2), 39–52.

Layne, Karen, & Lee, Jungwoo (2001). Developing fully functional e-government: A four stage model. *Government Information Quarterly*, 18(2), 122–136.

Lee, Jungwoo (2010). 10 year retrospect on stage models of e-government: A qualitative meta-synthesis. *Government Information Quarterly*, 27(3), 220–230.

Lee, Jungwoo, Baik, Songhoon, & Lee, Choonhwa (2011). Building an integrated service management platform for ubiquitous cities. *Computer*, 44(6), 56–63.

Lee, Jungwoo, Kim, Hahyun, & Lee, Minjung (2012). Qualitative validation of a u-city services typology using expert heuristic. *Journal of the Korea Society of IT Services*, 12(3), 325–340.

Licata, J. W., & Mowen, J. C. (1997a). A qualitative and quantitative analysis of consumer categorization of services. *Research in Consumer Behavior*, 8, 247–269.

Licata, Jane W., & Mowen, John C. (1997b). A qualitative and quantitative analysis of consumer categorization of services. *Research in Consumer Behavior*, 8, 247–270.

Linders, Dennis (2012). From e-government to we-government: Defining a typology for citizen coproduction in the age of social media. *Government Information Quarterly, 29*(4), 446–454.

Lovelock, Christopher H., & Yip, Geroge S. (1996). Developing global strategies for service businesses. *California Management Review, 38*(2), 64–86.

Michel, Hélène (2005). e-Administration, e-government, e-governance and the learning city: A typology of citizenship management using ICTs. *The Electronic Journal of e-Government, 3*(4), 213–218.

Mills, Peter K., & Margulies, Newton (1980). Toward a core typology of service organizations. *Academy of Management Review, 5*(2), 255–266.

Ng, Sandy, Russell-Bennett, Rebekah, & Dagger, Tracey (2007). A typology of mass services: The role of service delivery and consumption purpose in classifying service experiences. *Journal of Services Marketing, 21*(7), 471–480.

Olorunniwo, F., & Hsu, K. (2006). A typology analysis of service quality, customer satisfaction and behavioral intentions in mass services. *Managing Service Quality, 16*(2), 106–123.

Paswan, Audhesh, D'Souza, Derrick, & Zolfagharian, Mohammad Ali (2009). Toward a contextually anchored service innovation typology. *Decision Sciences, 40*(3), 513–540.

Quitzau, Anders (Producer). (2010). IBM's vision & Strategy for a Smarter Planet. [Presentations] Retrieved from https://blog.itu.dk/MEGV-E2011/files/2011/12/smarter-planet-duusaq.pdf.

Rust, Roland T., & Metters, Richard (1996). Mathematical models of service. *European Journal of Operational Research, 91*(3), 427–439.

Schein, E. H. (1992). The role of the CEO in the management of change: The case of information technology. In T. A. Kochan, & M. Useem (Eds.), *Transforming organizations* (pp. 325–345). Oxford: Oxford University Press.

Schmenner, R. W. (2004). Service businesses and productivity. *Decision Sciences, 35*(3), 333–347.

Shin, Jin Dong, Lee, Jae Won, Lee, Sang Hun, & Kim, Hyong Bok (2009). A study on using u-service to strengthen urban competitiveness. *Journal of Geographic Information System Association of Korea, 17*(4), 417–430.

Shostack, G. Lynn (1977). Breaking free from product marketing. *Journal of Marketing, 41*(2), 73–80.

Shostack, G. Lynn (1987). Service positioning through structural change. *Journal of Marketing, 51*(1), 34–43.

Silpakit, P., & Fisk, R. P. (1985). Participatizing the service encounter: A theoretical framework. In B.T.M. (Eds.), *Services marketing in a changing environment.* Chicago, IL: American Marketing Association.

Silvestro, Rhian, Fitzgerald, Lin, Johnston, Robert, & Voss, Christopher (1992). Towards a classification of service processes. *International Journal of Service Industry Management, 3*(3), 14.

Thomas, D. R. E. (1978). Strategy is different in service business. *Harvard Business Review, 56*(4), 158–165.

United Nations (2012). *United Nations e-Government Survey 2012, 160.*

Walravens, N., & Ballon, P. (2011, 20–21 June). The city as a platform: Exploring the potential role(s) of the city in mobile service provision through a mobile service platform typology. *Paper presented at the Mobile Business (ICMB), 2011 Tenth International Conference on.*

Wemmerlöv, Urban (1990). A taxonomy for service processes and its implications for system design. *International Journal of Service Industry Management, 1*(3), 21.

Zuboff, Shoshana (1988). *In the age of the smart machine: The future of work and power.* New York: Basic Books.

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