Exploring the use of the service ecosystem framework to examine how smart city actors co-create value

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1. Introduction: The research problem and its context

The world is facing unprecedented levels of urbanization (Dirks & Keeling, 2009). Half of the world population resides in cities, while ten per cent (10%) lives in only 30 metropolis (Dobbs et al., 2011). In 2008, 75% of the European population lived in urban areas, while this percentage is expected to rise to 80% by 2020 (United Nations, 2011). Even though cities occupy less than 2% of the earth's land, urban inhabitants consume more than 75% of the natural resources available worldwide (Marceau, 2008). Moreover, the urban population is expected to double from 2.6 billion in 2010 to 5.2 billion in 2050 (United Nations, 2011). Cities are already facing numerous challenges that are bound to increase due to rapid urbanization.

As a result, cities are expected to experience challenges related to growth, performance, competitiveness and residents' livelihood (McKinsey & Company, 2013). Deterioration of well being functionalities related to challenging waste management, scarce resources, air pollution and traffic congestion, cause human health concerns. These in addition to aging public infrastructure, are some of the main problems generated by rapid urbanization (Washburn et al., 2009). Other issues are of social and organizational nature, such as multiple stakeholders, increased interdependence levels, competing values and social and political complexity (Yovanof & Hazapis, 2009). Nam and Pardo (2011b) identify these problems as wicked and tangled. In order to address these, the smart city concept has emerged to offer some possible solutions. As wicked and tangled problems are social, political and organizational, smart city innovation strategies must focus on management, policy and technology (Nam & Pardo, 2011b).

Few studies address the organizational and managerial issues of smart city (Chourabi et al., 2012), as literature most frequently focuses on the technological part (Letaifa, 2015). Technology is a means to achieve smart city and not necessarily the most critical factor (Paquet, 2001). This goes to the heart as to what ‘smart cities’ means as a concept. Nam and Pardo (2011a, pg 186) state “the adoption of technology is not an end, but a more vital thing is the smart use of the technology adopted”. Technology and resources must be used in an intelligent and coordinated manner in order to transform urban centres to integrated, habitable and sustainable environments (Barrionuevo, Berrone, & Ricart, 2012). The way in which smart cities operate by offering a balanced centricity between technology, institutions and citizens, can be described as a holistic urban system or an ecosystem, which supports value co-creation amongst all city stakeholders (Letaifa, 2015). Smart cities result from these dense innovation ecosystems that include wide-ranging social interactions and educated labour. The “smart ecosystem” of a city may provide multiple advanced, user-centric and user co-created services to its citizens (Yovanof & Hazapis, 2009). This ecosystem generates value through the use and re-use of information (Komninos, 2008). The mechanisms through which value is created as well as the ways is which value is managed in smart cities, has received little attention in the smart city literature, along with other managerial and organizational aspects.

By recognizing the research gap in the literature related to the management of smart cities and principally the lack of studies on smart city management for the realization of value, this research proposes the use of the Service Dominant Logic (S-DL) and more particularly the service ecosystems framework, in order to study the value co-creation mechanisms of smart city organizations. This novel approach may allow researchers to identify how the smart city ecosystem co-creates value through actor interaction and resource integration, thus contributing to the optimization and efficient management of cities and their resources. The first section of this paper presents a comprehensive review of the context of this study through addressing smart city development and the vision of the main actors of smart city, and providing an introduction to S-DL and the service ecosystem framework. The next section elaborates on the application of the service ecosystem framework on smart cities, while the final section discusses the theoretical implications of this application.

2. Smart City development

Although the value of the smart city market is estimated to reach hundred of billion dollars by 2020 (Zanella, Bui, Castellani, Vangelista, & Zorzi, 2014), there is still a lack of consensus regarding the definition of smart cities (Ponting, 2013). A literature review performed by Albino, Berardi, and Dangelico (2015) has revealed over 23 used definitions, while Toli and Murtagh (in preparation) identified 31 definitions. Smart cities can be viewed as cities performing well on six characteristics: environment, economy, mobility, people, living and governance (Giffinger & Pichler-Milanović, 2007). They derive from knowledge-intensive creative strategies that have as a goal the improvement of the socio-economic, ecological, logistic and competitive performance of cities and rely on a mixture of human, physical, social and entrepreneurial capital (Kourtit & Nijkamp, 2012). These investments in human, infrastructure (transport and ICT) and social infrastructure promote sustainable economic growth and a good quality of life, via participatory governance and by intelligently managing natural resources (Caragliu, Del Bo, & Nijkamp, 2011). Nam and Pardo (2011b) describe the smart city as a local entity that encourages economic development by holistically employing information technologies and real-time analysis. Komninos (2011) defines them as territories with high learning and innovation capacity, which are embedded in the creativity of the city inhabitants, their institutions of knowledge creation and their digital infrastructure, for the management of communication and knowledge. Nam and Pardo (2011b), support the idea that the smart city feeds information into its physical infrastructure in order to improve accessibility and mobility, efficiencies, preserve energy, improve air and water quality, identify and rapidly resolve problems, quickly recover from disasters, collect data to facilitate decision making, use resources effectively and enable data sharing between entities and domains to empower collaboration. They identify three dimensions of the smart city: technology, people and institutions. Technology efficiently supports the infrastructure through providing mediated services. People provide human infrastructure and facilitate the collective decision-making. Institutions play a pro-active role in people's development.

2.1 The vision of the smart city main actors

Numerous authors identify three main organizational and institutional actors in smart city: universities, industries and governments (Cocchia & Dameri, 2016). This has inspired the triple helix model (Etzkowitz & Leydesdorff, 1995, Etzkowitz & Zhou, 2006, Leydesdorff & Deakin, 2013) of smart city actors, which evolved into a quadruple helix by acknowledging civil society is one of the key actors (Parsons, 1963). This advanced model considers the four helices to operate in a complex urban environment, where the interrelations between universities, industries and the government are formed by civic society and social capital (Lombardi, Giordano, Farouh, & Yousef, 2012). Universities analyse and define the fundamental aspects of the smart city concept and develop intellectual capital (Leydesdorff & Deakin, 2013). Industry translates the academic outcomes into products and services. Its fundamental target is to create knowledge value, while in the meantime it also produces public wealth for citizens. Finally, governments, both in a national and a local scale, are both players and coordinators of the initiatives. They need to play a fundamental role in defining standards and issuing rules. The coordination between the different scales of government (national, regional, city level etc.) is considered essential for a city to function in an innovative way (Nam & Pardo, 2011b). At the same time, the government also monitors and evaluates the value and benefits created by the organizations. The involvement of civic society along with social and capital endowments, form the relationship between university, industry and government (Lombardi et al., 2012). Cocchia and Dameri's (2016) research on each actor's vision of smart city reveals that on the surface the actors appear to share the same vision of a new way to understand future cities (Lombardi et al., 2012). This is the vision of a city economically and environmentally sustainable and socially inclusive (Zygiaris, 2013), while at the same time improving the quality of life of its inhabitants (Chourabi et al., 2012). Nevertheless, in depth analysis shows that each actor has diverse targets that directly influence their vision, and that smart city initiatives are not always as citizen focused as they appear to be (Cocchia & Dameri, 2016).

3. The service ecosystem framework

The service ecosystem framework is part of the Service-Dominant Logic (S-DL), which suggests that all economic activity is best perceived in terms of service-for-service exchange instead of the traditional goods-for-goods or goods-for-money exchange (Vargo & Lusch, 2017). Lusch & Vargo (2014, pg. 24) define a service ecosystem as “a relatively self-contained, self adjusting system of resource-integrating entities that are connected by shared institutional logics and mutual value creation through service exchange”. The S-DL framework is based on five axioms (Vargo & Lusch, 2016). Firstly, service is the fundamental basis of exchange. It is the utilization of resources to benefit another actor. The second axiom suggests that the consumer or user is always a co-creator of value. Value is co-created through individual and organizational interaction. According to the third axiom, all social and economic actors are resource integrators. Value is co-created by economic and social actors through resource integration in an almost infinite number of probable combinations. The fourth axiom supports that value is always uniquely and phenomenologically determined by the beneficiary. Each entity experiences and determines value in a unique way. Finally, according to the fifth axiom the co-creation of value is accommodated through actor generated institutions and institutional arrangements.

3.1 The service ecosystem levels

Service ecosystems operate at the micro (individual), the meso (intermediary) and the macro (institutionalized) level, which concur with essential value co-creation processes (Chandler & Vargo, 2011). In the micro-level, actors articulate the interactions needed to facilitate their interdependence (Akaka, Vargo, & Schau, 2015). They combine resources and penetrate into the wider service ecosystem (Gummesson & Mele, 2010). Service exchange in the micro level is direct between actors (Chandler & Vargo, 2011). The meso-level accommodates all the ordinary structures and activities between firms, customers and institutions. This is where the indirect service-for-service exchange occurs (Chandler & Vargo, 2011), relationships are reinforced and value is created through resource-integrating and service exchange processes, along with the establishment of institutional arrangements, such as rules and norms (Akaka et al., 2015). The macro-level is the domain of wider societal structures and activities, where enduring institutions and rules on community formulation at micro and meso level are assembled (Lusch & Vargo, 2014). The process of exchange in this level is characterized by synergies of direct and indirect service-for-service exchanges, occurring concurrently (Chandler & Vargo, 2011).

4. The application of the service ecosystem framework on smart cities

Certain similarities emerge between the theoretical framework of smart city development and the service ecosystem framework. Cities worldwide are rapidly transforming into artificial ecosystems of interconnected, interdependent organisms that can act in an intelligently coordinated manner (Yovanof & Hazapis, 2009). Public and private sector societal actors work together to achieve a common goal. In other words, they operate as an ecosystem in order to accomplish their objectives through value co-creation (Letaifa, 2015), just like a service ecosystem where value is co-created through individual and organizational interaction (axiom two of S-DL) (Greer, Lusch, & Vargo, 2016).

Smart cities are considered territories of high innovation and learning capacity. Innovation is one of the key dimensions of the smart city and can be technological, organizational or policy based (Nam & Pardo, 2011a). In order to transform urban environments into smart cities, innovation in planning, management and operations is essential (Naphade, Banavar, Harrison, Paraszczak, & Morris, 2011). S-DL argues that all types of innovation involve some kind of service exchange and that the combination and integration of resources determine the boundaries of innovation. This is because innovation stems from integrating resources in unique and novel ways (Greer et al., 2016). By utilizing technology in an intelligent and coordinated manner (Barrionuevo et al., 2012), the smart city ecosystem can provide these innovative solutions in the form of advanced, user dominant and user co-created services to its citizens (Yovanof & Hazapis, 2009). The user centricity and adaption of smart cities (Marsa-Maestre, Lopez-Carmona, Velasco, & Navarro, 2008) is coherent with the first axiom of the service dominant logic where resources are utilized for the benefit of another entity (beneficiary).

By observing the value co-creation processes (figure 1) using the service dominant logic, it is noted that the similarities between the theoretical framework of smart city development and the service ecosystem framework open up fruitful avenues for analysis. In this way it may support analysis of the extent and effectiveness of value co-creation and thus the appropriateness of the mechanisms established for co-creation in future work. The following sections will study the process of value co-creation in smart city ecosystems through exploring the way in which resources are integrated by smart city actors, the institutions and institutional arrangements that coordinate these integrations, and finally the levels of interactions between the actors.

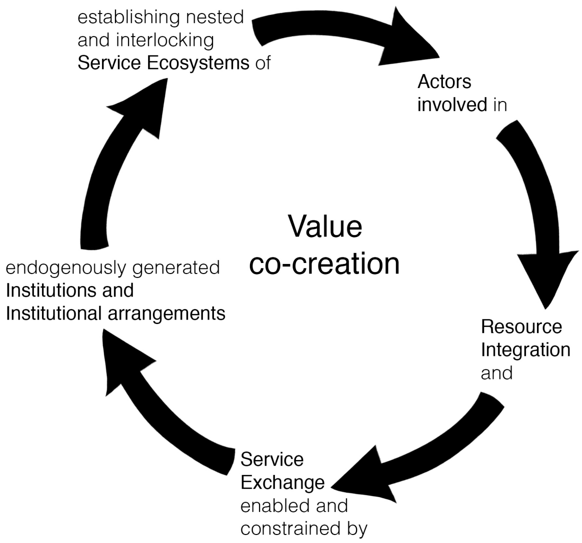


Figure 1. Representation of the narrative and process of S-DL. Adapted from: (Vargo & Lusch, 2016)

4.1. The process of value co-creation

Through the development of the S-DL framework over the years, the narrative of value co-creation has gradually evolved. The most recent narrative of this framework suggests that value is co-created through “resource-integrating, reciprocal-service providing actors” (Vargo & Lusch, 2016, pg. 7), that co-create value via aggregated meaningful experiences in nested and imbricated service ecosystems, governed through institutions and institutional arrangements, which have been endogenously –deriving from the inside of the ecosystem- generated. The main components of these processes are presented in figure 1.

4.2. Integration of smart city resources

Value co-creation stems from the integration of resources by economic and social actors (axiom three). Smart cities utilize a synthesis of resources from their societal actors in order to innovate in the knowledge economy and society (Dameri, 2017). Numerous resources can be identified in the smart city literature as seen in table 1. These can be tangible or intangible. Tangible resources include technologies (Barrionuevo et al., 2012), such as information and communication technologies (ICT) (EIP-SCC, 2013) and web 2.0 technology (Toppeta, 2010), as well as sensors and automated systems; a city's hard infrastructure (Caragliu et al., 2011) including roads, bridges, railroads and others; and data and information which are typically infused in the city's infrastructure (Nam & Pardo, 2011a) in order to facilitate the provision of services. Additionally they include financial and environmental capital (EIP-SCC, 2013) such as energy and raw materials. Intangible resources include human capital (Caragliu et al., 2011) such as a skilled labour force (Kourtit & Nijkamp, 2012), social capital (Caragliu et al., 2011) such as culture and societal values and entrepreneurial capital force (Kourtit & Nijkamp, 2012), which comprises of leadership, knowledge and education among others. In the service dominant logic, resources such as knowledge, skills and competencies are characterized as operant, because they have the ability to act on other resources to create value, while resources such as raw materials, infrastructure, goods and money –thus resources of a tangible nature- are characterized as operand because they can be acted upon in order to create value (Akaka et al., 2015). Operant resources are regarded as the fundamental resources of economic and social exchange (Chandler & Vargo, 2011). The value and importance of each of these resources is determined by the social structures that dictate the actions and interplay between actors (Vargo & Lusch, 2011).

Resource	**Including**
Tangible Resources	
Information	Data
Technologies	Information and Communications Technology (ICT) Web 2.0 Technology Sensors Automated systems
City infrastructure	Physical infrastructure Services
Financial Capital	
Environmental Capital	Energy Raw materials
Intangible Resources	
Human capital	Skilled labour force
Social Capital	Culture

	Societal Values
Entrepreneurial Capital	Leadership Knowledge Education

Table 1. Tangible and intangible smart city resources. Created by the authors.

4.3. Resource integrating smart city actors

Operant and operand resources are combined by the smart city societal actors- namely university, industry, government and civic society- in order to achieve a common result, a smarter city. Universities and research centres, as entities, were the first actors to study and experiment with pilots and models of smart city. They use urban data sourced from citizens as well as planning authorities, in order to analyse and develop models and theories (Cocchia & Dameri, 2016). Additionally, they can create and experiment on innovative technologies applied on urban environments, explore the relation between their cost and benefit and may provide industry with knowledge and technological solutions (Etzkowitz, 2008).

Industry actors make value propositions through the transformation of user data driven research and academic output into products and services (Cocchia & Dameri, 2016) as they create exploratory alliances in order to benefit from sharing resources (Möller, Rajala, & Svahn, 2005). Firms frequently enter in such alliances with various public actors such as universities and research centres, as well as with different city-scaled governmental players, with the scope of augmenting the probabilities of developing new technologies and services (Sandulli, Ferraris, & Bresciani, 2017).

The government is both a regulator of the industry and an active player (Cocchia & Dameri, 2016). Governments, in the city level, have the role of planning and implementing the smart city vision. They are coordinating, organizing and regulating the other actors part of their ecosystem (European Parliament, 2014). Additionally, governments are responsible for addressing emergent topics that stem from technological advancements, such as cyber security and privacy issues (Ebrahim & Irani, 2005), as it is challenging for them to innovate without normative stimulus (Eger & Maggipinto, 2009).

The final actor of the quadruple helix is the smart city user who through personal devices and other equipment (Harrison et al., 2010) provides invaluable data that co-create value through information use and re use (Komninos, 2008). Citizen data is collected by using sensors, kiosks, meters, smart phones and smart appliances, as well as through implanted medical devices and is analysed with various software (Harrison et al., 2010). Without such resources the smart city ecosystem cannot function. The participation of citizens in the ecosystem, goes far beyond providing data, as they are the human engine of a city and have a behavioural influence to its historical as well as cultural heritage (Zygiaris, 2013), thus additionally influencing the norms under which co-creation of value occurs. Citizen engagement in smart city initiatives is essential in the design and planning process (Batty et al., 2012) and in the ‘co-production’ of goods and services (Paskaleva, 2011).

By studying the way in which the smart city actors operate interdependently by co-creating value through reciprocally exchanging tangible (operand) and intangible (operant) resources, the emergence of a service ecosystem can be observed. The smart city actors appear to be linked through common dynamic processes, referred to as service provision (Vargo & Lusch, 2017), which define them along with the resource integration activities possible through service exchange, such as the exchange of data, innovation and the common use of a technology or expertise. According to the S-DL narrative these resource-integrating, reciprocal-service providing actors, co-create value through service exchange enabled and constrained by endogenously created institutions and institutional arrangements (Vargo & Lusch, 2016)

4.4. Institutions and institutional arrangements

The co-creation of value is regulated and organized through institutions and institutional arrangements generated by the service ecosystem actors, according to the fifth axiom of S-DL (Vargo & Lusch, 2016). Institutions are defined as humanly conceived rules, norms and beliefs that permit or constrict action and provide meaning and expectation to social life (Scott, 2014), while the institutional arrangements are high-order congregations of interdependent institutions, commonly referred to as institutional logics (Vargo & Lusch, 2017). The role of institutions and institutional arrangements is one of a mechanism of facilitation of resource integration and service exchange procedures (Vargo & Lusch, 2016).

The institutions and institutional arrangements under which the smart city ecosystem actors interact between each other, are partially dependant on the urban environment under which they operate. This is because smart city actors operate on variant urban environments, as a result, they may abide by a number of different rules, norms and beliefs thus under different institutions and institutional arrangements. These arrangements are continually reiterated through recursive relationships between resource integrating actors (Vargo & Akaka, 2012). The British Department for Business, Innovation and Skills (BIS, 2013) has identified six aspects guiding smart city approaches. The first aspect regards the facilitation of citizen access to information through a secure digital infrastructure that has adopted an open access approach to re-usable public data. The second supports that smart city approaches should recognize that the delivery of services will become better by becoming citizen centric, as citizens are the active users of smart city services (United Nation, 2012) and part of the ecosystem. In order to do so the rest of the smart city actors should prioritize citizen's needs and further enable information sharing instead of operating in multiple service silos. Data collection and sharing may enable better decisions (Nam & Pardo, 2011a). The third aspect is based on enabling an intelligent physical infrastructure, based on smart systems or the internet of things (IoT), that will facilitate service delivery and inform decisions. The fourth principle regards receptiveness to the experimentation on new approaches and innovative business models that may potentially alter the way in which business is conducted. The fifth aspect guiding smart city approaches is related to transparency regarding the outcomes and performance of the city. Actors expect a high degree of transparency and access to various information and policies (Kuk & Janssen, 2011). The final aspect suggests that leadership needs to have a clear and consistent vision of smart city and how this will affect its citizens as well as how change will be delivered.

Summarizing, the institutional arrangements under which smart city actors may operate, are the following: providing citizen facilitation to information access through digital infrastructure, focus on citizen centric services, enabling of intelligent physical infrastructure, receptiveness to learn and experiment, encouraging transparency of outcomes and performance and ensuring a clear and consistent leadership vision.

4.5. Levels of interactions

The use of the service dominant logic allows researchers to study how smart city actors operate between each other and as a whole. By studying the interactions between smart city actors in the micro, meso and macro level, the value co-creation mechanism of the smart city ecosystem, can be studied.

At the micro level service exchange occurs between two individual actors, thus the interaction is framed in dyads (Chandler & Vargo, 2011). Each of the smart city actors (a) is distinctively and uniquely connected to another actor (b) via a service-for-service exchange (s). For example civic society provides university with data while the university provides technology in return (dyad A), thus both civic society and the university are active participants in this exchange. In another example the university provides innovative models to industry while the industry provides technological solutions, funds or other kind of resources to the university (dyad B). A graphic representation of the dyadic interactions, explained in section 4.3, can be found in figure 2. In this level every actor engaging in exchange is coordinated by a set of institutions (Williamson, 2000). How successful the dyad interaction will be often depends on the accordance between the institutions of actor (a) and (b), as similar actor institutions suggests that the interaction is likely to be more successful

(Akaka, Vargo, & Lusch, 2013). The micro level interactions are nested in a broader meso level context (Chandler & Vargo, 2011).

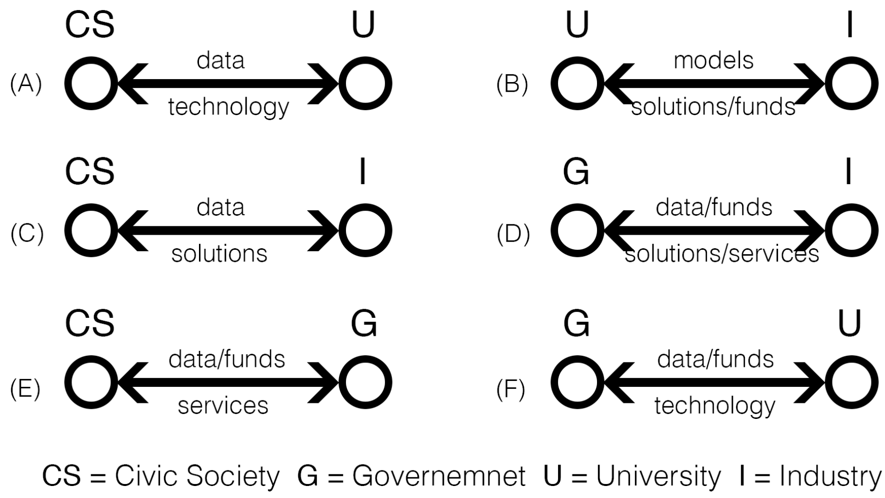


Figure 2. Dyadic interactions between smart city actors. Created by the authors based on Chandler and Vargo (2011).

At the meso level there is an indirect service-for-service exchange, as one actor (a) serves another (c) through a third actor (b). In this level the interaction is studied in triads. For example civic society indirectly serves the industry through directly providing data to the university and the industry indirectly serves the civic society by providing technological solutions or funds to the university (triad AB) as seen in figure 3. Here the two actors, civic society and industry directly serve one another by serving the same actor (the university). In relation to the micro level, this level includes additional actors and operates under a unique set of institutions (Akaka et al., 2013).

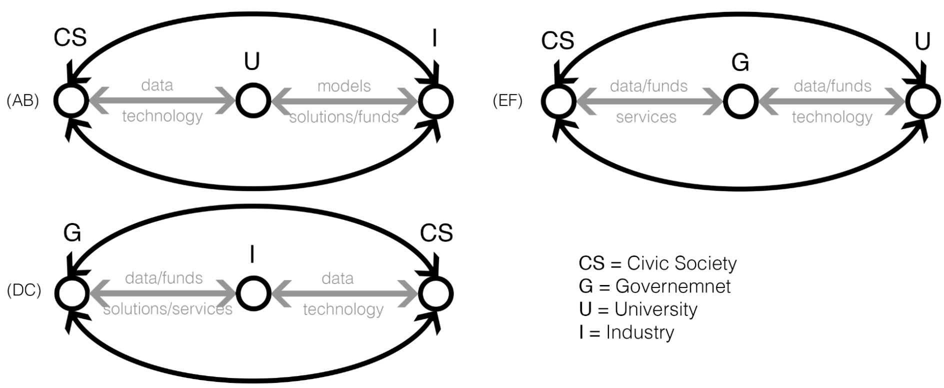
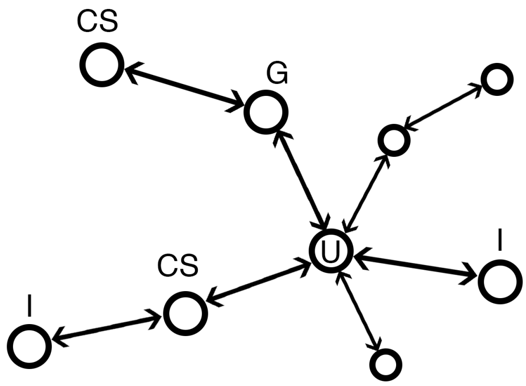


Figure 3. Triadic interactions between smart city actors. Created by the authors based on Chandler and Vargo (2011).

At the macro level the exchange of services creates a complex network, as actor synergies are comprised by both direct and indirect service-for-service exchanges. The various triads apply their resources for the beneficiary of a specific context (Chandler & Vargo, 2011). In this case, considering the university as the beneficiary, the civic society provides information to the government, which provides them in the form of data to the university in a triadic indirect interaction, while the industry provides funds directly to the university in a dyadic interaction (figure 4). This is merely a sample of the number of interactions this ecosystem contains.



CS = Civic Society G = Governemnet U = University I = Industry

Figure 3. Smart city actors interactions on the macro level, with university as the beneficiary. Created by the authors based on Chandler and Vargo (2011).

As actors navigate through interactions and become influenced by various institutions and service exchanges, they may assume different roles in the ecosystem thus their micro, meso and macro level context is bound to continuously change (Edvardsson, Tronvoll, & Gruber, 2011).

5. Theoretical implications

The use of the S-DL to study smart cities as service ecosystems provides a framework to researchers that opens up fruitful avenues for analysis of the value co-creation and resource integration mechanisms in smart city ecosystems. Certain considerations arise that stem from the global aspect of smart cities, the multidisciplinarity of sectors involved and the increasing popularity of “big data” and IoT. These considerations will be explored in this section.

The first consideration regards the global aspect of smart city ecosystems, as the industrial and university actors involved in such ecosystems often cross the urban scale boundaries that constrain both the government and citizens. Industrial actors predominantly, but not always, create global solutions that can be applied to more than one smart city around the globe. Some of the most known players are IBM, Cisco, Telefonica, Siemens, Bosch and others. Furthermore, a large percentage of the smart city research and literature produced from universities is non-context specific and can be adapted locally to a specific context after certain considerations are made. The internationality of these actors increase the complexity of the ecosystem, as global contexts appear to be more complex than domestic ones due to the increased embeddedness of microlevel interactions within meso and macro institutions that cross geographical boundaries (Akaka et al., 2013).

Other considerations arise from the multidisciplinarity of sectors involved in smart city organizations, as different sectors might operate under different institutions and institutional arrangements. The smart city industry involves players from a variety of sectors such as IT, construction, healthcare, energy, environmental studies and others. Akaka et al. (2013) support that the likelihood of a successful interaction between two actors that abide by a different set of institutions, may be reduced and may lead to conflicts. Conflict between service ecosystem actors may frequently occur due to the multiplicity of networks in which different actors belong, and the different value creating function they assume in each network (Akaka & Chandler, 2011).

Moreover, the increasing popularity of “big data” and IoT, particularly relevant to smart cities, posses questions related to the change of actor dynamics. “Big data” is a term commonly used by media to characterize large or complex data sets and are predominantly associated with the data storage and data analytics (Ward & Barker, 2013). Large-scale data and IoT are rapidly gaining momentum due to their analytical advantages (Mehmood et al., 2017). Vargo and Lusch (2017) argue that the new era of “big data” appears to be well aligned with the S-DL, as data analytics enable a new typology of organizations that adapt to the dynamics of the system (Zeng & Lusch, 2013). The analysis of large-scale data will allow sensors and devices to capture and record smart citizens’ behaviours (Mehmood et al., 2017).

This will affect the position of the actors in the ecosystem as the dynamics of citizen data input methods will change. Additionally, it provokes questions related to the further loss of direct interaction between the other actors and the civic society. Since the collection and analysis of large-scale data may eliminate the element of direct interaction between the actors, there is a loss of opportunity for customer engagement and the opportunity to influence the customer’s flows and outcomes (Grönroos, 2011). In this case the smart city customers are the citizens of each urban environment (United Nation, 2012). In addition to loss of opportunity the use of data about past behaviour to predict future behaviour, hence types of future interaction, may lead to value co-destruction, meaning to the decline in at least one of the system’s well-being, through direct or indirect interaction (Plé & Chumpitaz Cáceres, 2010), due to the inaccurate predictions that may occur through the use of historic data. Consequently, it is not the data per se that may co-create or co-destruct value but the way in which data is analysed. Different ways of analysis may result in the prioritization of different types of interactions, which will have intended and unintended consequences for the ecosystem.

Finally, the diffusion of large-scale data analysis and IoT lead to a global issue that is becoming more relevant day by day, the issue of cyber security. How can citizens and other smart city actors ensure that they do not, involuntarily, become direct or indirect resource providers in fraudulent or malign activities? According to Hewlett Packard (2014) 70% of the most popular devices that utilize IoT technologies, faced vulnerabilities in terms of password security, encryption and general lack of granular user access permissions. The number of devices at risk is expected to augment significantly, since IoT devices are estimated to include 26 billion units by 2020 (Middleton, Kjeldsen, & Tully, 2013). Such a potential breach of security means the involvement of actors in value co-creation to which they have not consented to participate. The participation of citizens in involuntary value co-creation is yet another proposition of potential value co-destruction.

6. Implications of service ecosystems framework in Smart City

Adopting the service ecosystems framework in smart cities provides researchers with a telescoping lens that enables the study of inter-organizational service exchange. This point of view allows managers and leaders to comprehend the reciprocal relationship of the smart city ecosystem actors (Greer et al., 2016). Understanding the nature of organizational relationships through service exchange, allows managers, as well as researchers, to study how the interactions of smart city actors create value. Additionally, the service perspective allows leaders to identify which relationships they should create in order to efficiently promote value creation and management (Vargo, Akaka, & Vaughan, 2017). Finally, service ecosystems view innovation, an essential dimension of smart cities, as the outcome of knowledge and resource integration rather than the sole combination of operand and operant resources (Greer et al., 2016). This allows innovation in smart cities to be studied from a resource integration point of view. The latter is vital, as smart cities are composed by numerous resources that vary in nature, from human to infrastructural and technological.

The study of resource integration in smart cities through the S-DL can provide invaluable insights into how the use of resources can be optimized. This will lead to a more efficient management of cities, thus to managerial and organizational urban innovation, which may lead to the improvement of quality of life and well being for citizens. Finally, the use of S-DL to study smart cities provides researchers with a framework to examine the institutions and institutional arrangements in the smart city ecosystems. As mentioned above, shared institutions in an ecosystem are crucial to the co-creation of value.

7. Conclusions

The concept of the smart city was born as a response to the challenges brought by the rapid urbanization of the past decades. Despite the recent popularity of the term there is still a lack of consensus regarding the definition of smart cities. Literature suggests that smart city initiatives are heterogeneous and unfocused. While on the surface all smart city actors appear to share the same vision, their outlook and interests are not harmoniously aligned. Actors are more interested in striving for their own benefits than the common goals. Additionally, the findings demonstrate that citizens, do not appear as the core of smart city efforts. Moreover, while there is vast literature on smart city, it mostly focuses on the technological aspect and does not adequately address the organizational and managerial aspects of smart city development. This research provides a framework through which smart cities can be studied as service ecosystems, through the service-dominant logic.

Service ecosystem framework considers all business as service business and is based on five axioms according to which service is the basis of exchange and value is co-created by economic and societal actors through resource integration. When studying smart cities through the lens of the service-dominant logic researchers can study the mechanisms through which the smart city ecosystem co-creates value through actor interaction and resource integration.

Smart cities have been described by numerous authors in the literature as ecosystems, due to the way in which they operate. Smart city actors function in an interconnected way by fuelling one another with resources in order to create innovative solutions. These resources can be physical or knowledge and data based. By applying the theoretical insights of S-DL, it can be observed that actors operate as resource integrators that co-create value through exchange. Smart cities are heavily based on innovation, which is considered essential for the transformation of traditional urban environments to smart ones. S-DL supports that innovation fundamentally involves some type of service exchange, thus the metamorphosis of a city implicates the use of services. Finally, as in service ecosystems resources are exchanged in order to benefit the customer, smart city actors combine their assets to produce user centric services. The use of the S-DL to analyse smart cities offers the opportunity to study how actors of the smart city ecosystem, co-create value through organizational relationships and service exchange and may provide insights to managers on the type of interrelationships in which they should invest. It offers a novel approach to study the interactions and resource integration occurring between the ecosystem actors, as well as study co-destruction of value through involuntary resource integration. The study of value propositions in smart cities can have further implications, as optimized value management can improve the smart city services that citizens receive, and eventually lead to the enhancement of the urban life quality.

Further research on smart city as service ecosystems through the use of the service-dominant logic, is essential in order to identify and in depth analyse the value co-creating mechanisms of smart city initiatives. Additionally, research on the interaction between smart city actors guided by different institutions and institutional arrangements may benefit the identification of value management practises. Finally, research on cyber security and the effects of involuntary value co-creation is essential due to the increase of such threats.

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