Co-owned resources: Intellectual property and data in smart cities

Keywords: Co-ownership, co-owned resources, intellectual property, data, smart cities, service dominant logic, business models

Abstract

Purpose: Smart city projects are projects of urban innovation that have gained popularity in the past years, due to the increasing challenges faced in urban environments. They typically operate in consortia of actors that lead to the co-creation of jointly owned intellectual property and data. While intellectual property and data are significant for economic development, there are very limited studies on their co-ownership regimes.

Design/Methodology/Approach: This study is qualitative. In total 62 in-depth semi-structured interviews were carried out, with predominantly senior members of organisations actively involved in smart city projects. Thematic analysis was used to analyse the data.

Findings: There are three models of co-ownership of intellectual property and data: contractual joint ownership, undetermined or not-yet-determined ownership and open ownership. Each ownership model impacts differently the value-in-use. The relationships between actors in the consortia affect the way in which they co-create intellectual property and data.

Originality/value: This study demonstrates how projects that operate in new models of innovation-led consortia produce new types of resources that are not simply co-created, but co-owned. Co-owned resources have different value-in-use for each one of the different actors, independently of the fact that they jointly own them. This is influenced by the type of ownership model and predisposition of the actors to initially share resources and be flexible. Co-owned resources may generate future value propositions, act as interconnected operant resources and lead to the creation of new business models.

Introduction

The world is facing unprecedented levels of urbanization (Dirks and Keeling, 2009). Consequently, cities will face challenges related to growth, performance, competitiveness and residents' livelihood (McKinsey & Company, 2013). In order to respond to such challenges, cities around the world have embarked on programmes and projects of urban innovation, frequently referred to as smart city programmes. These programmes aim to make traditional urban services more efficient, via the use of digital and telecommunication technologies, in order to benefit their citizens and residing businesses (European Commission, 2019). Urban innovation appears to be currently enabled by a variety of technologies, typically provided by global industrial partners.

The global smart city market is expected to exceed one trillion dollars by 2020 and 2.5 trillion by 2025 (PWC, 2019), with significant funding from institutions – the European

Commission (EC) alone has assigned a budget of nearly one billion euros for smart cities in between 2014 and 2020 (European Commission, 2013)- and investments in R&D and implementation from institutions such as the United Nations (UN), the EC, the European Investment Bank (EIB) and the World Bank, central governments, industrial partners and universities. The actors in such projects work predominantly collaboratively in consortia to deliver innovative urban services to citizens. These projects frequently lead to the creation of intellectual capital, such as urban architecture, organizational resources, collective competences, behaviours and habits, intellectual property, community qualities, common value and others (Dameri et al., 2014). While there is some research on intellectual capital, there are very limited studies on the Intellectual Property (IP) and data involved in and developed from, the process of innovation on urban services. This paper directly responds to Lusch's et al (2010a) call to consider how and whether intellectual property should be protected when customers (in this case citizens) and suppliers are involved in the innovation process. Intellectual property is considered a powerhouse for innovation and economic growth, as it is one of the most significant policy factors that drive economic success (International Chamber of Commerce, 2011). However, different intellectual property regimes have different effect on economic growth (Gould and Gruben, 1996). Accordingly, data-driven technologies are expected to add over £60 billion per year to the UK economy by 2020 (CEBR, 2016). Data and data-driven innovation are considered key to respond to the most significant urban challenges, but they are largely underexploited (HM Treasury, 2018).

Stimulated by these points, this research studies how smart city actors that work in consortia co-create and realise value from intellectual property and data and how the type of consortia affects this, through the lens of the Service Dominant Logic (SDL). SDL is considered particularly valuable in studying service innovations due to its broad nomology and overarching perspective, guided by its foundational premises, which complement other theoretical approaches to innovation (Ordanini and Parasuraman, 2011)**.** Furthermore, it provides a novel perspective on the outdated innovation literature largely rooted to technological product inventions, which is based on a goods-dominant logic paradigm (Michel et al., 2008)**.** This is because viewing innovation through SDL allows for the emphasis to shift from the created goods or services themselves, to the actual processes of developing service (Edvardsson and Tronvoll, 2013).

The paper will first introduce smart city projects, the resource exchanging smart city actors and technology as a resource. Subsequently, it will discuss how service innovation is facilitated through collaboration and how intellectual property and data are created through collaborative consortia between smart city actors. The following section will describe the methodology, followed by the findings, discussion and theoretical and managerial implications.

Literature Review

GENERAL PART ON SDL DELETED as suggested

Smart city projects

Smart cities have been introduced as a solution to the unprecedented levels of urbanisation that the world is currently facing (Dirks and Keeling, 2009). They have been characterised as ecosystems that use information technologies to optimise infrastructure and citizen services, increase the quality of life and foster innovative business models. Currently numerous cities worldwide are rapidly transforming into these artificial ecosystems of interconnected, interdependent organisms that can act in an intelligently coordinated manner (Yovanof and Hazapis, 2009). These cities 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 organisational interaction (Greer et al., 2016). The “smart ecosystem” of a city may provide multiple advanced, user-centric and user co-created services to its citizens (Yovanof and Hazapis, 2009).

Smart cities can be viewed as cities performing well on six characteristics: environment, economy, mobility, people, living and governance (Giffinger and Pichler-Milanović, 2007). They derive from knowledge-intensive creative strategies that have as a long term goal the improvement of the socio-economic, ecological, logistic and competitive performance of cities and rely on a mixture of human, infrastructural, social and entrepreneurial capital (Kourtit and Nijkamp, 2012). These investments in human, infrastructural (transport and Information and Communication Technology (ICT)) and social capital aim to promote sustainable economic growth and a good quality of life, via participatory governance and by intelligently managing natural resources (Caragliu et al., 2011). These goals appear utopic, as typically the smart city projects currently deployed typically focus on infusing different types of technologies in combination with large scale data or machine learning to everyday city operations, in order to improve the quality of urban services. Such projects use communications and sensor capabilities embroidered into the infrastructure of the city in order to optimize electrical, transportation-related and other logistical everyday services, with the goal of improving quality of life (Chen, 2010). These technologies may act as a resource that provides an interaction space between citizens, authorities, businesses and other actors, to become actively engaged in the design and planning processes.

Resource-exchanging smart city actors

The current, albeit limited, literature suggests that ~~operant and operand~~ resources are combined by the smart city societal actors in order to achieve a common result, a smarter city. These resources can be classified as operand and operant (Constantin and Lusch, (1994), where operand resources require an action to be performed upon them (for example goods and money) and are generally considered as ‘hard’ or tangible resources, while operant are acting on other resources (for example knowledge and skills) and can be considered as ‘soft’ or intangible or cultural resources and include the competences, capabilities, and dynamic capabilities of the actors. Operant resources are likely to be dynamic and infinite while operand ones are frequently static and finite (Vargo and Lusch, 2004).

From an SDL perspective, operant resources appear to have a primacy over operand due to their capability to generate strategic benefit (Vargo and Lusch, 2004) and sustained competitive advantage through attributes such as value, rareness, imitateability, and substitutability (Arnould, 2008). Nevertheless, value creation is mediated by operand resources (Akaka et al., 2015) and the importance of natural or national resources, or the need for tangible goods is not decreased (Lusch and Vargo, 2006). How valuable a resource is can be evaluated based on shared institutions or social structures that influence the interpretation of experience and actions among actors (Vargo and Lusch, 2011).

In smart cities, operant and operand resources are being used in an intelligent and coordinated manner to develop integrated, habitable and sustainable urban centres (Barrionuevo et al., 2012). These are integrated by smart actors in diverse configurations. Configuration of resources can be defined as a set of resources available for an intended actor (Edvardsson et al, 2013). The complexity that characterises urban systems in combination to the multiplicity related to the amount of diverse stakeholders who have formed dependencies and interdependencies that deeply affect the urban environment (CISCO, 2012), leads to a very high amount of various configurations of resources. To better understand these, they can be presented in a simplified manner per actor group.

The three main organisational and institutional actors in smart cities are universities, industries and governments (Cocchia and Dameri, 2016), a synergy commonly referred to as the triple helix model (Leydesdorff and Deakin, 2013) of smart city actors, which evolved into a quadruple helix by acknowledging civil society as one of the key actors. This advanced model considers the quadruple helix 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 et al., 2012).

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 and Dameri, 2016).

Industry actors make value propositions through the transformation of user-data-driven research and academic output into products and services (Cocchia and Dameri, 2016) as they create exploratory alliances in order to benefit from sharing resources (Möller et al., 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 aim of augmenting the probabilities of developing new technologies and services (Sandulli et al., 2017).

The government is both a regulator of the industry and an active player (Cocchia and Dameri, 2016). Government at the city level has the role of planning and implementing the smart city vision. They coordinate, organize and regulate the other actors part of their ecosystem (European Parliament, 2014).

The final actor of the quadruple helix is the smart city user who, frequently, 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 are usually collected by using sensors, kiosks, meters, smart phones and smart appliances w and are 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 on 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 are linked through common dynamic processes, referred to as service provision (Vargo and Lusch, 2017).

Technology as a resource in smart cities

Smart cities work by infusing information into their physical infrastructure to enhance citizens' convenience, mobility, air and water quality, advance efficiency, conserve energy, and rapidly identify and fix issues, manage disasters, make informed decisions, use the city resources efficiently and enable cooperation between entities (Nam and Pardo, 2011).

Technology is considered an enabler of smart cities (Paquet, 2001) and its necessity to deploy smart city projects can be observed by the vast amount of literature on the development of technological solutions. This is, additionally, particularly evident from its central role in smart city definitions. Technological solutions can be either already developed and tested before being applied to the smart city programme/project or can be newly formed solutions that utilize the project as a testbed, thus transforming it in a pilot. Such projects frequently involve the collection of data through IoT platforms by governmental and industrial actors as well as citizens, that are sometimes made open (Ahlgren et al., 2016). Open data are data practically and legally available for utilization and republication by any party (Lindman et al., 2013). As a result, at the end of the pilot, new intellectual property as well as new data are created. Intellectual Property (IP) is defined by the World Intellectual Property Organization (2019, p. 218) as "creations of the mind: inventions, literary and artistic works, and symbols, names, images and designs used in commerce" and can be divided in two parts: industrial property and copyright. Industrial property includes patents, utility models, trademarks, industrial designs and geographical indications of source, while copyright includes amongst others literary and artistic works and architectural designs. Essentially, IP is "something unique that you physically create" (GOV.UK, 2019) and encompasses different types of protection which depend on the nature of the property. While some types of protection are attributed automatically, for others formal procedures need to be followed.

While there is some literature on intellectual capital (Dameri and Ricciardi, 2015) there is very limited research on intellectual property in smart cities. This appears to be related to the difficulty of identifying ways to accurately measure intellectual property.

Forming collaborations to achieve service innovation

The intellectual property and data involved in the creation of urban services is the result of elaborate urban innovation projects, that typically involve a multitude of actors that co-create value through collaborations. As indicated above, technology plays a major role in this process. Technology in service innovation has a dual role, as both an operant resource, acting upon other resources to enabling value creation and as an operand resource, having the role of a facilitator (Lusch and Nambisan, 2015).

Studying innovation from an SDL perspective, the focus of its definition shifts from "production of innovative products to resource integration and enhanced value propositions" (Michel et al. 2008, p. 65). Service innovation occurs through advancing existing or creating new processes and/or resources, that result in new or further developed value propositions (Skålén et al., 2014).

SDL 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). Service innovation is frequently connected to new

ways driven by actors to integrate resources and capture value within service systems (Edvardsson et al., 2011). In other words, SDL conceptualises that value co-creation is formed through innovative resource integrations (Vargo and Lusch, 2008).
Nam and Lee (2010) identify two dimensions of creating value: the degree of co-creation and the degree of networked collaboration. Drawing from Payne et al. (2008), they suggest that the process of value co-creation will likely form the innovation in service and consequently the process of interaction is particularly significant. The second dimension suggests that service innovation is provoked by collaboration between multiple actors and resources in order to co-create value. Essentially, these actors integrate their resources to co-create value (Vargo and Lusch, 2017) that will lead to service innovation.
But why are these collaborations essential? Managers are aware that no single firm obtains sufficient knowledge and human resources to create innovations that can compete in the global market (Lusch et al., 2010b). Consequently, they form alliances or collaborations. Early literature on the attempt to create technological innovation describes how firms created alliances in order to deliver breakthrough technological developments, with varying -mostly negative- degrees of success (Cummings, 1991). Cummings (1991) argues that in order for such alliances to be fruitful, the partnering actors must commit to the transfer of skills, knowledge and tools, in order to receive long-term economic gains from this interaction. In recent years, firms still suffer from insufficient internal technological resources and capabilities, which render them incapable to develop complex technological projects (Cesaroni and Duque, 2013). For this reason, recently multinational firms that develop technologies related to urban innovation, such as IBM, CISCO and Siemens have entered into alliances and collaboration networks with other actors (SMEs, governments and universities), in order to obtain capabilities to develop such technological projects. Nevertheless, in these types of alliances, ambiguities on intellectual property ownership frequently make managers reconsider about taking part in R&D collaborations and if not clarified, may be the source of intense debates (Cummings, 1991) as intellectual property is critical to the long-term interests of the organizations.
As discussed above, collaboration is critical to the delivery of smart city projects (Cocchia and Dameri, 2016), particularly in exploratory work involving innovation (Ferraris et al., 2017). Through the process of innovation new enhanced value propositions occur (Michel et al., 2008). The value-in-use of these value propositions though, can be threatened by ambiguities on intellectual property and data ownership (Cummings, 1991). Consequently, this study addresses the gap in the existing literature related to the ownership of intellectual property and data co-created through formal actor collaborations in smart city projects, through the lens of the service dominant logic.

Methodology

Data collection

This study is qualitative due to the complex nature of the collaborations that result into the creation of IP and data, as well as the relative novelty of the implementation of smart city projects. In-depth anonymous interviews were chosen. This is due to the nature of these projects. This type of projects involve a large number of different kind of actors coming from all actor groups, that do not only have similar but additionally competing interests. This is particularly applicable to projects where there are multiple commercial actors that offer similar services. Additionally, the majority of the projects involve commercially sensitive information related to technology, knowledge and data. This information is challenging to obtain without conducting in-depth interviews with participants. Obtaining vivid, accurate and inclusive accounts based on the personal experiences of the selected participants (Burgess, 2003) and creating an environment of trust, was imperative to comprehend the enabling factors and challenges encountered in the process of co-creating IP and data. Semi-structured interviews based on topic guides were used to permit for a higher degree of flexibility and personal interaction (Jones, 1985).

The topic guide included questions on both the organisation and the projects. The main subjects of the topic guide can be found in table 1 and focused on the mission and business model of the organisation and the variety of projects the organisation is involved in, as well as more detailed questions on the projects themselves such as the funding structure, the processes and development of the project, the internal and external relationships between actors, the ownership of the resources deployed, the role of the user and the biggest challenges and enablers. Semi-structured interviews allowed for a higher degree of understanding of the interviewees' perceptions and opinions on complex and delicate issues (Barriball and While, 1994), such as the relationships with other project partners, current and future challenges as well as confidential contracts on intellectual property and use of proprietary technology. A preliminary pilot study was conducted to test how comprehensive the questions were after which slight changes were made to the topic guide. The interviews were recorded and transcribed verbatim.

Organisation	**Government**	**University**	**Civic society**
Organisation-based questions			
Main aim and scope	Main aim and scope	Main aim and scope	Main aim and scope
Business model	Sources of funding	Sources of funding	Sources of funding
Main clients/users	Structure and coordination	Structure	Coordination
	Main users		
General project questions			
General description of the project			
Aim, scope and end user			
Funding structure			
Collaborators involved			
Processes of intellectual property development			
Ownership of resources			
Organisation specific project-based questions			
Main collaborators			
Types and level of interactions with all project collaborators	Types and level of interactions with all project collaborators and other governmental agencies	Types and level of interactions with all project collaborators	Types and level of interactions with all project collaborators
Types and level of interactions with external project partners			
Resources exchanged within the project			
Involvement of clients and/or users in the processes of IP co-creation	Involvement of citizens and/or users in the processes of IP co-creation	Involvement of users in the processes of IP co-creation	Involvement of citizens in the processes of IP co-creation
Ownership and future use of IP			
Biggest enablers and challenges in the project			
Biggest enablers and challenges in the interactions			
Biggest enablers and challenges in the IP co-creation process			

Table 1: Interview topic guides divided by actor group.

Participants

In total 62 in-depth, qualitative interviews with mostly senior members of organisations actively involved in smart city projects, were carried out. The participants of this study were selected through purposive sampling. They should be members (preferably senior) of an organisation or institution actively involved in at least one (but typically more) official smart city project, for a significant period of time. To ensure this, they were selected according to their involvement in signature projects or programmes that fit the following criteria:

- They must be formal projects with established funding streams and defined contracts;
- Their main objective must be or directly related to urban innovation and the smart city agenda;
- They can be ongoing, in expansion phase, operation phase or concluded, but should have already officially launched for at least six months before the interview. Completed projects and projects close to completion were preferred;
- They are based on at least one UK city. EU projects that do not have a city in the UK as a main partner, were excluded;

These projects are usually funded by Horizon 2020 funds (H2020), EU Research and Innovation programmes or public innovation funds by different UK governmental departments. The majority of the participants, 50 of the 62 interviewees, were senior members of their organisation or institution, while the rest (12) were mid-level members, directly involved in the projects. These provided complementary valuable information and clarifications on the operation side. The interviewees covered a broad spectrum of actor groups involved in smart city projects:

- 22 from various levels of the government of which 14 from local government;
- 17 from industry of which 14 from for profit companies;
- 13 from universities of which three were university led consortia;
- 8 from hybrids between governmental and industry organisations (governmental organisations with commercial portfolios or publicly funded private companies)
- 2 representing the interests of civic society.

The salient characteristics of all interviewees can be found in Table 2.

Type of actor **Industry**	**Position**	**Sector**
For profit	CEO and founder of software provider and consultancy	ICT and citizen engagement
For profit	CEO and founder of software provider	Citizen engagement
For profit	CEO and founder of ICT provider	ICT
For profit	CEO and founder	Planning consultancy and citizen engagement
For profit	CEO and founder	ICT and citizen engagement
For profit	CEO and founder	ICT
For profit	COO and founder of technology provider	Transport
For profit	Head of infrastructure in consultancy	Infrastructure
For profit	Head of smart cities related department	ICT and infrastructure
For profit	Head of smart cities related department	Construction and infrastructure
For profit	Founder and Director	Across sectors
For profit	Head of smart cities related department	Digitalization

For profit	Business advisor	Across sectors
For profit	Strategy manager	Transport
For profit - Industrial Alliance	Business advisor	ICT
Non profit	Senior programme manager	Across sectors
Charity	Senior project manager	Energy
Hybrid Gov-Industry		
For profit	Programme manager	Energy
For profit	Head of transport	Transport
For profit	Innovation manager	Health
Non profit	Director	Digitalisation
Non profit	Director	Digitalisation
Non profit	Senior specialist	Transport
Non profit	Technology lead	ICT
Non profit	Consultant	Transport
Civic society		
Charity	Programme manager	Community engagement
Citizen group	Coordinator	Community engagement
Government		
Local Government	Smart cities strategy	Across sectors
Local Government	Smart cities strategy	Across sectors
Local Government	Head of smart city related programmes	Across sectors
Local Government	Innovation lead	Across sectors
Local Government	Innovation lead	Innovation
Local Government	Department lead in council	ICT
Local Government	Department lead in council	Transport
Local Government	Project leader in council-led programme	ICT
Local Government	Project manager in council-led programme	Energy
Local Government	Project manager in council-led programme	Transport
Local Government	Economic advisor	Across sectors
Local Government	Innovation manager	Innovation
Local Government	Project manager in council project	Infrastructure and digitalisation
Local Government	Project manager in council programmes	ICT
Regional Government	Senior project manager in council-led programme	Energy
Regional Government	Strategy lead	Digitalisation
Government Department	Head of programme	Digitalisation
Government Department	Head of centre	Transport
Gov. funded institution	Project manager in regional programme	Across sectors
Gov. funded institution	Team leader	Infrastructure
Gov. funding body	Innovation lead	Across sectors
Foreign Government	Programme manager	Across sectors
University		
University led consortium	Project leader and Professor	Across sectors
University led consortium	Partnership manager	Across sectors
University led consortium	Funding advisor	Across sectors
Governmental Centre within university	Director	Education and consultancy
Institute within university	Director and Professor	Education and consultancy
Institute within university	Head of research	ICT and digital
Institute within university	Senior researcher	Energy
Institute within university	Senior project officer	ICT and digital
Department	Professor	Education and public engagement
Department	Professor	Across sectors
Department	Deputy Director	Across sectors
Department	Research associate	ICT
Multi university programme	Fellow	Across sectors

Table 2: Characteristics of all interviewees.

Data analysis

The interviews were recorded, transcribed and pseudonymized. The data collected were analysed in two stages (Figure 1). In the first stage all interactions involving IP and data between the various actors were identified from the transcripts and mapped individually according to the type of organisation and the programme/project's characteristics. More specifically:

For organisations:

- Type of actor (industrial, hybrid, governmental, academic, civic society)
- Business model (for profit, non profit, charity)
- Size of company
- Variety of services offered

For projects:

- Type (pilot, alpha/beta, demonstrator, scale-up, ordinary service etc)
- Focus (across sectors, infrastructure, transport, energy, digitalisation, planning, health, education, citizen engagement etc)
- Level of technology used
- Models of ownership of resources

This categorisation allowed for a better understanding of the interactions between actors, what factors may fact them and the extend to which the above elements have an effect on the process of creating and utilising the co-owned resources.

In the second stage, thematic analysis was used in order to identify, analyse and describe patterns, or themes, within the data collected (Braun and Clarke, 2006). Themes were identified both at the manifest level, where directly observable information are used, and at a latent level, where underlying phenomena were examined (Boyatzis, 1998). More specifically, the thematic analysis focused on identifying key factors that affect the way and the processes in which co-owned resources are being developed, the most significant enablers and challenges in their management and co-use, and factors that may hinder their future use either from the organisation or from external actors. This allowed to form a comprehensive view of the co-ownership models, how they are shaped and the elements that influence their development and use. These themes were analysed in combination with the data resulting from the first stage to further understand the influence of specific actor and project characteristics to processes related to the co-ownership of resources. This allowed potential underlying patterns to emerge and institutional drivers that shape these interactions to be identified.

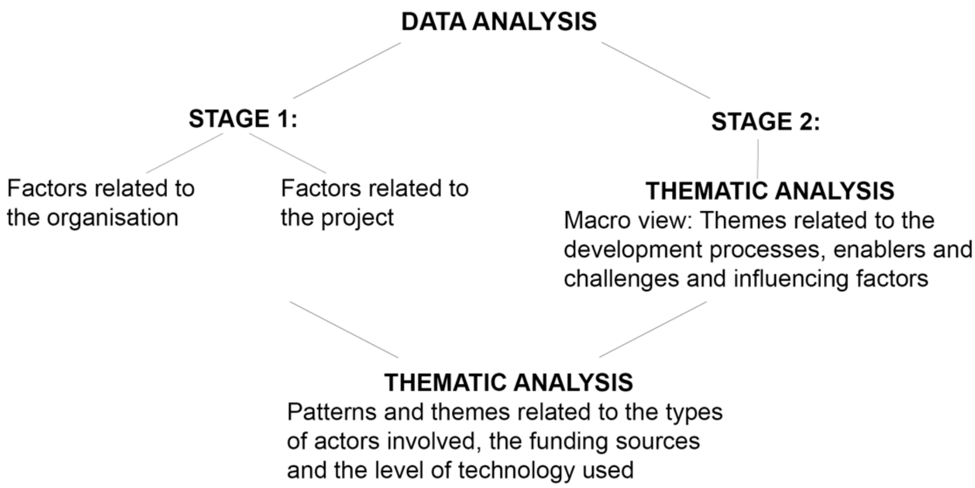

Figure 1: Process of data analysis.

Findings

The 62 actors interviewed as part of this research were part of 51 distinct urban innovation projects that respond to the smart city agenda. From these, 33 programmes operated in consortia. These have a variety of goals, typologies and funding streams. Most of these actors have participated in multiple of the projects studied and collaborated between each other in diverse combinations, as they are part of the same service ecosystem. This appears to be typical in this type of organisations as one common characteristic shared by the majority of the projects is that they operate in formal consortia. From these formal consortia, there appear to be two main outcomes in terms of co-created intellectual property and data. Either the intellectual property and data belong to a single partner (single ownership) or the IP and data are jointly owned. This study focuses on studying solely the co-produced and jointly owned intellectual property and data. From these it appears that through pilot and test-bed projects the actors of the consortia co-create joint intellectual property and data that works in three ways:

- Contractual joint ownership
- Undetermined (or not yet determined) ownership
- Open ownership

The findings suggest that contractual joint ownership models are typically found in projects that come from technology heavy consortia, while undetermined and open ownership models are found in projects where the consortium is focusing more on collaboration and knowledge exchange rather than developing new technology per se (Figure 2). The following sections will initially describe each of these ownership models and how they operate and consequently will present enabling factors and challenges that affect the process of intellectual property and data co-creation.

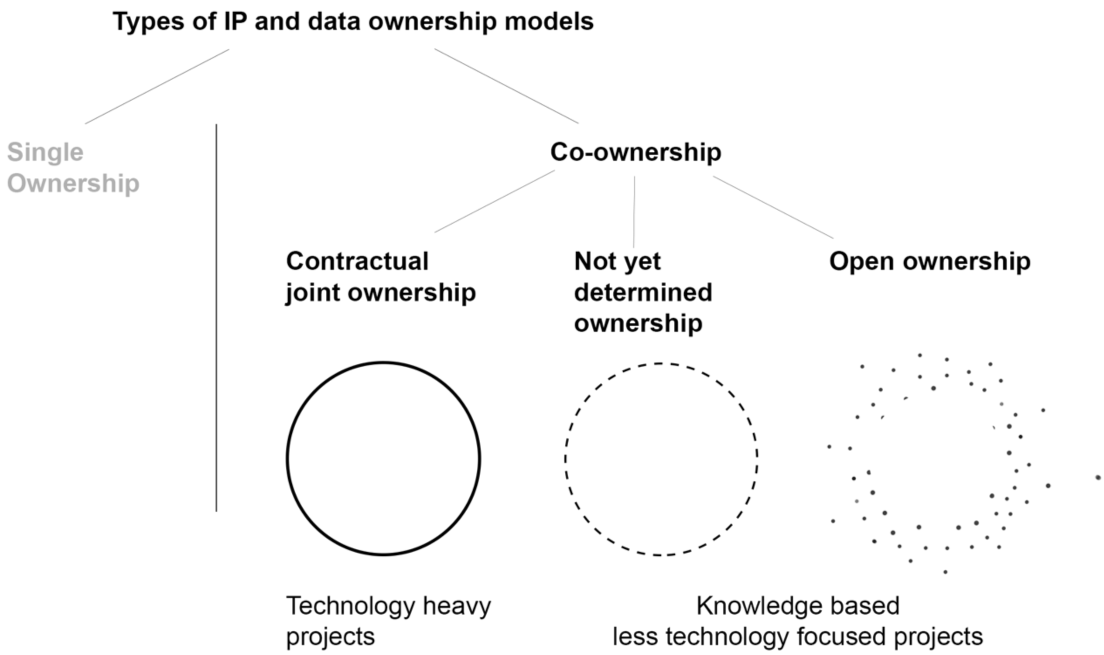

Figure 2: Overview of the main intellectual property and data ownership models.

Contractual joint ownership

In technology and funding intense pilots and testbeds (such as those focusing on infrastructure connectivity), the consortia operate under strict contracts that prescribe the type of relationships between the partners, what will be offered and who owns every single element produced. The interviewees reported that in such contracts it is imperative to be part of the consortium from the start. Distinctively, a senior consultant in such a consortium stated that “you can't come to join the consortium midway through because of who owns things”. At the end of the project, no open material including the resulting IP is expected to be created. In another technology intense project that includes multiple industrial partners, the IP and data jointly generated has been already used by all partners, under contracts determined from the start of the project. A senior manager in a similar project described the agreement within their consortia as “if you created IP during the project, then the project owns the IP but you're able to exploit that”, as indeed appeared to have been done by most of the project partners. In two of the projects, it was not only the output that was strictly prescribed in the contracts, but the resources spent by the actors as well. Throughout the projects, some actors asked for re-negotiations of the contracts according to their new contributions, while in other cases some industrial actors declined to participate in re-negotiations or to commit more resources, especially human.

A challenge frequently encountered in technology intensive consortia is the unwillingness between the industrial actors to share intellectual property or even communicate with potential competitors. A key member of such a project, reported “I've had a number of instances where one commercial partner has told me they will not join an activity because a specific other commercial partner will be in the room and they will not sit in the same room as them.” This unwillingness is particularly present in projects that produce intellectual property of joint ownership. A professor vividly explained that when trying to collaborate with multinational industrial actors “their legal team couldn’t quite handle that model. They were just in stasis; therefore, they didn't come on board.” Another interviewee who was part of a large consortium explained that frequently these “challenges of being responsive and dynamic in smart cities come from very reasonable ethical, legal, financial considerations that need to be made. Often more complex processes exist certainly within local government and with the large corporates”. Consequently, the rigidity of the joint ownership agreements in technology and industry consortia undoubtedly severely impaired the open sharing or dissemination of the intellectual property and data generated.

Undetermined ownership

In less technology heavy and more open collaboration-based pilot projects, the actors had less rigid structures and were seen as being more willing to share resources such as learnings, expertise and data between each other. They were interested more in investing in the process of co-creation of value and less in just developing technological solutions. This may be related to the fact that industrial partners wanted to create long term relationships with the councils and other public actors, as they will be their future clients. As one of the interviewees coming from a major industrial partner in many projects stated, it’s about “working hand in glove with public sector partners to refine it [the technology]. It is not just about the technology itself, it is actually how you deploy it and work with other partners.” In such projects, the implementation of the joint ownership of the data and intellectual property created was sometimes more obscure due to the difficulty in determining knowledge-based intellectual property or intellectual property of softer nature. As a member of such a consortia observed regarding the agreements on potential commercialization and use of jointly owned IP “again, the provision was made to make it as lightweight as possible to do”. Interestingly, neither the IP nor the data resulting from this project have been used since the conclusion of the project in 2016. Most of the actors have not kept relationships between each other and no further intellectual property related discussion occurred after the end of the project. In another project, two of the actors had a significant fallout that led to the termination of both formal and informal discussions between them. At the conclusion of the project and since no other discussions occurred, the industrial actor kept the urban sourced data and utilized a small part of them, while the governmental partner has not utilised them, or tried to access them, since project conclusion. In at least three other projects, the jointly created and owned intellectual property has been used only to produce some industry reports or academic papers, but not in any further projects. In these less rigid agreements, the potential fluidity of ownership in some projects led to stagnant situations where it was simply not used.

Open ownership

A number of projects have as a goal to provide open data but few aim to provide open intellectual property. These are only encouraged by publicly or university led consortia. A key university interviewee explained that they wanted to “build an environment that people could experiment with their own data and other data”, to foster understanding. But the benefit of opening the data goes beyond citizen understanding to actively make an impact on public services. One of the leading partners in such projects suggested that “the assumption that we have is that if we open or at least make everything public sector license we’ll be able to increase the capabilities of the public sector, which will then allow them to digitize, to at least the level of the private sector, and create quite a significant market for new ways of doing things". This is particularly important for organisations representing the public's interests as "there's a big disparity between the private sector and the public sector in terms of digital transformation." Again, the "openness", even in public entities, is limited to protect commercially -or other-sensitive information, with no interviewee providing an exact explanation of what these include. Moreover, there were practical challenges that prevented some projects from making all data available. As explained by a university professor leading one of the projects "the default approach is that everything was open, but you then have the practical issues are actually making this open". These practical issues have to do with aspects such as maintenance of data platforms or access platforms, quality and updating the data and the need for human resources to facilitate the process of sharing. One university actor observed that data storage was not the issue but "it's being able to get insights from it. It's the analytical side of it that people really struggle with". Indicating that simply making some data open may not in itself be enough.

A public sector interviewee that focuses on open data reported that "I think I was probably a bit naive to start off with thinking, when you see all the blogs and stuff, and it's like data is the new oil, and dah, dah, dah. Yes, I get that, but I think there's still some way to go, to be honest with you. I don't think we've got to the point. I think once we've got a lot more IoT sensors, and vast amounts of data being collected, things might change." This indicates that even though there are some processes for open data collection in place, they are still limited, thus impacting the quality of the data created. The low quality, related to insufficient collection techniques such as the number of available sensors, has been pinpointed by a number of interviewees, part of all actor groups.

Dissemination and Open IP

While the quality of open data might be a challenge, an even bigger challenge appears to be how to disseminate open intellectual property. Having university actors actively involved in the project and not just in a research capacity appeared to facilitate the dissemination of the results and knowledge based open IP resulting from the projects. Nevertheless, issues arose as according to a professor "academics are quite territorial. If you're wanting to try and do a collaborative project, one of the big challenges that you have is actually pulling together disparate partners". Additionally, the interviewees observed that some actors appeared to be reluctant to share important soft findings from the projects (sometimes referred to as knowledge based intellectual property), even if they were obligated to do so by the funding body, in order to not affect relationships between the project partners. This is an additional practical limitation to making IP and data open. Consequently, the relationships between the actors within a project appear to significantly affect the value co-creation process.

Enablers and challenges in the co-creation of IP and data

As indicated above, a significant impact factor on the process of value co-creation appears to be the way in which collaboration occurs with public institutions. The COO of one SME highlighted the importance and benefits offered by an open and collaborative council, explaining that "since we started working with them, the level of engagement, trust, support, just off the scale." This is in comparison with an opposite experience with another council where the process of collaboration in a known and otherwise successful project in terms of deliverables, was described as unproductive

and difficult as" in every step of the way with [council name], they threw another barrier up, another barrier up, another hurdle, another barrier". The long-term success of a project within a publicly funded consortium is reported to "all been enabled by a client that has been willing to see innovation, willing to support it, willing to talk to us about the eventual business case". The client referred to here is a local council.
But why is the collaboration with public actors so pivotal? In the value co-creation process, councils and other local government actors offer to consortia access to their physical city assets (such as street furniture, lamp posts, bollards etc). The willingness of the councils to 'exploit' their assets by offering access to them, coupled with the innovative culture in some councils, act as enablers of value co-creation in consortia and formal collaborations. The role of councils as enablers goes beyond offering access to their assets to bidding for funds that help them bring economic development and prosperity to their city and region. The head of innovation of one council explained that "we've always wanted to support the ecosystems in [city name]. We wanted to support the smaller companies in [city name], the people with new ideas that were growing, to develop in [city name], to solve problems that are in the region and hopefully turn into new, bigger, and exciting companies." All interviewees in similar positions in councils agreed with this view and support the view that these types of programmes have helped local SMEs grow. SMEs appear to be utilizing such collaborations for the past years, in order to develop, test or scale up their services, in other words to create, refine or prove commercially exploitable intellectual property.

Discussion

It is evident from the findings that smart city actors form project-specific formal consortia in order to integrate their resources and co-create value. The type of the project appears to be a determining factor on the type of ownership agreement. Technology intense projects seem to have more rigid contracts in place, while open-collaboration projects, that are less technology intense, have less rigid contracts of undetermined -or open- ownership.
These smart city actors are part of a service ecosystem, which appears to be moderately configurated, with actors moving between projects. This can be observed by the overlap of the actors in a number of projects. The smart city service ecosystem appears to be driven by its will to innovate and create new value propositions. the strength and quality of the relationships between the partners within the consortia, especially between the councils (or other governmental agencies) and the industrial actors serve as both enablers and challenges to achieve this.
As service innovation is embedded in social structures and within specific social systems (Edvardsson and Tronvoll, 2013), smart city actors adopt specific social positions that enable them to co-create intellectual properties. Councils typically appear to act as catalysts for the consortia to be formed and funding to be obtained. This is because the councils hold access to operand resources, such as physical assets and citizen data without which the industrial actors cannot innovate. On top of that they hold access to operant resources in the form of soft capital, specifically skills and knowledge. They also have the ability to set limits in the use of their resources, thus delineating the possible value propositions. They typically enter in these types of consortia to boost the economic development of their city, rather than create exploitable intellectual properties, as well as collect data that will help them in decision making processes.

As innovation is a process of rearrangement of the institutional structure prevalent in the service ecosystem, conflicts and tensions can arise (Koskela-Huotari et al., 2016). These tensions affect the value co-creation process and have led to industrial partners falling out, feeling mistreated or disenabled from participating in the consortium. Moreover, following the conclusion of the project, conflicts between the public, private and university partners have led to ambiguity and uncertainty about the use of the joint IP that has been co-created. Certain actors were not willing to enter into discussions with each other, thus resulting in situations that hinder the value-in-use of the urban service co-created by the consortia. In short, in collaboration-based projects with softer outputs, after experiencing conflicts, the actors frequently did not engage in conversations to clearly determine IP and data ownership, which had a negative effect in the value-in-use of the service.

Similar outcomes were observed in open ownership models. Certain intellectual properties and data were not created for commercialization purposes, but to be made open. The findings demonstrate how public actors and universities are making efforts to create open data which speaks to the literature suggesting that open data create innovation possibilities for both public and private actors (Zuiderwijk et al., 2014). However, the findings did not demonstrate how or if these open IP and data are ever used. The challenges on quality and technical issues discussed above have an impact on value-in-use to the extent that relatively little value may realised. As Chan (2013) suggests, there is no affirmation that the results of such projects actually lead to purposeful or beneficial collaboration. Thus, while adopting an open ownership model in theory appears beneficial, in practise, it might hinder the realisation of co-created value-in-use.

In contrast, in technology heavy consortia, where financial investment was also much higher, the quality of the relationships between the partners had much more limited effect on the value output and the future use of the co-created IPs and data. This is because the initial IP agreements were particularly rigid and clearly indicated how the joint IP could or could not be used by each of the actors and what resources were expected to be offered by the partnering actors. As beneficial as this rigidity appears for potential future use of the intellectual properties and data, the actors indicated that this had negative effects on the process of innovation. The process of innovating is becoming more open, necessitating change in the way industrial actors manage it, which is evident by the increasing prominence of the need for use of external knowledge resources (Chesbrough, 2004). In these types of projects, the inflexibility shown by specific industrial actors to share resources beyond what has been contractually established, appears to hinder the consortium's ability to co-create value. Furthermore, as indicated in the findings, some industrial actors, typically multinational firms, refused to participate in the consortia at all, out of "fear of sharing". Innovation in smart cities is a process that involves high numbers and different categories of actors (Angelidou, 2015), thus the unwillingness of many industrial actors to share resources, such as their existing intellectual properties, with other actors may in the mid to long term lead to loss of value for them. The paradigm of open innovation indicates that industrial actors should use resources both external and internal to the firm, in order to advance their technology, or use external channels to generate additional value (Chesbrough, 2004). While this has been established by the literature for quite some time, some key players in the sector have yet to accept the argument and rise to its challenges.

The "fear of sharing" demonstrated by some industrial actors appears to be contrary to the institutions and institutional arrangements typically present in smart city consortia. Smart cities are considered territories of high innovation and learning capacity. In order to transform urban environments into smart cities, innovation in planning, management and operations is considered essential (Naphade et al., 2011). As mentioned above, the findings demonstrate that in pilot and testbed smart city projects, in order for the actors to gain indispensable resources to innovate, they need to co-create value in consortia. In order to be able to work between each other, they need to abide by the endogenously generated institutional arrangements of the service ecosystem that govern the resource exchange and value co-creation (Vargo and Lusch, 2016). The findings suggest visible disruptions in the co-creation processes, due to distance between the institutional arrangements under which certain actors operate and those governing the smart city service ecosystem. The ecosystem appears to work on beliefs and narratives based on the advancement of urban services and in some cases in the improvement of citizens' urban experiences. The complexity of the interactions required to achieve these goals calls for open collaboration models where flows of information are exchanged beyond what is strictly prescribed in contracts. In other words, in order to be able to collaborate, these organisations presuppose a cultural willingness to share information among their partners (Fawcett et al., 2011), without which the project will not produce any IP or data. This is in line with Mele's (2009) view that emphasizes the socio-cultural nature of resource integration and the significance of the expectations, needs and capabilities of the actors in the value co-creation process.

Theoretical Implications

Using smart cities as a paradigm to study how value can be co-created in complex innovation-dependent service ecosystems, allows for a deeper understanding on how actors that operate under new innovative business models create new value propositions. The findings of this study suggest that these types of ecosystems produce new types of resources that are not simply co-created, but potentially co-owned. While it is widely known that resource integration into value propositions can occur between both multiple actors and a network of actors (Ballantyne et al., 2011), what happens with the resulting co-owned resources has been given little to no attention. The findings suggest that there are three types of co-ownership of resources: contractual joint ownership, undetermined or not-yet-determined ownership and open ownership. As indicated in the discussion each ownership model can have a significant effect on the value-in-use of the service.

Development of future value propositions

The fourth axiom of SDL indicates that value is always determined by the beneficiary (Vargo and Lusch, 2016), but in this case who is the beneficiary? While in traditional SDL literature, the beneficiary is the firm receiving the service or the customer (Vargo and Lusch 2008), in this study the beneficiary cannot be intuitively determined. In order to answer this question, instead of perceiving interaction as integration of resources between two actors (Vargo and Lusch, 2008), it can be perceived as interaction between the consortia and each of its members. Simplistically, the actor offering the value proposition is the consortium, while the beneficiary is each of the members of the consortium. Thus, the co-owned resource has different value-in-use for each one of the different actors, independently of the fact that they jointly own it.

For contractual joint ownership models, the value-in-use appears to be straightforward: value is determined by the beneficiary as indicated above. When the ownership of a resource is undetermined or not yet determined, the value-in-use cannot be currently evaluated as the beneficiary is still unknown. Consequently, it depends on future promises of value (Ballantyne and Varey, 2006) thus on future value propositions rather than the current outcomes of the consortium. These future value propositions, amongst others, stem from:

- The potential for investment in future relationships with actors, such as the creation of a new partnership or introduction to new clients/collaborators
- the potential to enter in new markets, existing or not yet existing
- the development of operant knowledge-based resources, that may offer a sustainable competitive advantage to the organisation
- the co-ownership of operand resources, such as data and/or intellectual property that may be integrated with newly developed/acquired resources.

Consequently, in this model the interactions between actors may acquire an additional value in the mid or long-term, thus making the future value-in-use more challenging to determine. The same applies to the open ownership model, where the value-in-use depends on whether actors will act upon the resources in the future. As per above, in this model future value can be co-created through the resource integration of the co-owned open resources with other resources. However, in the case of open ownership models, the actors that will utilize these resources will, for a significant part, be unknown (or 'not yet determined) and not part of the current service ecosystem. In short, both current and future actors -external to the service ecosystem- have the possibility to use these co-owned resources to create value in the future. Since this is unknown, in line with the increasing research on the potentials of sharing economy and open data, the future value propositions created might result in negative value-in-use for some of the current actors. Consequently, the level of openness of the co-owned resources may offer to the actors within the ecosystem, both significant possibilities for future value creation and at the same time may impact negatively their prospective value-in-use.
Future research should focus on understanding the complex value co-creation mechanisms under undetermined ownership and open ownership models and provide conceptual as well as managerial clarity on how to prevent loss of value.

Creation of sustainable competitive advantage through co-owned resources

Additionally, theoretical implications emerge related to the types of co-owned resources. These can be found in figure 3. Operand resources, which require action to be performed upon them (Constantin and Lusch, 1994), are more intuitive to attribute ownership to, or divide with other actors. Consequently, their future value-in-use can be determined or assessed by the actor. In this way it is also more evident, understandable and clear to the actors, why they need to invest in their development. On the other hand, for operant resources which act upon other resources, such as knowledge and capabilities, it is very challenging to determine how a co-ownership model can work. Drawing from the resource-based view, as the interactions within the consortia become more multidimensional and more interconnected, co-owned resources transform into interconnected operant resources which are more difficult for competitor actors, external to the consortia, to acquire or develop (Madhavaram and

Hunt, 2008). This may become a source of competitive advantage for the actors (Barney, 1991).

This is particularly applicable to consortia that integrate resources with the goal of technological innovation (Cummings, 1991), where no single firm possesses sufficient knowledge and human resources create innovations in services that can compete in the global market (Lusch et al., 2010b). In this sense, even though operand resources might appear as a more sensible investment for the consortium actors to invest in the first place, the interconnected operant resources yield more opportunities for the creation of a sustainable competitive advantage in the long term. This is especially applicable in innovative business environments, such as the one in the context of the paper, where traditional business models have not been established yet and these industrial partners are still in the process of developing sustainable business models and future value propositions. Consequently, it is determined that co-owned resources, regardless of their ownership model, have the possibility to create sustainable competitive advantage for the actors that possess them and potentially lead to the creation of new business models through future value propositions.

Further research on co-ownership models of operant resources is imperative to determine how co-owned resources may positively -or even potentially negatively- affect the future value-in-use of the participating actors. Additionally, future research on the impact of interconnected operant co-created resources on future value propositions and the new business models, is imperative.

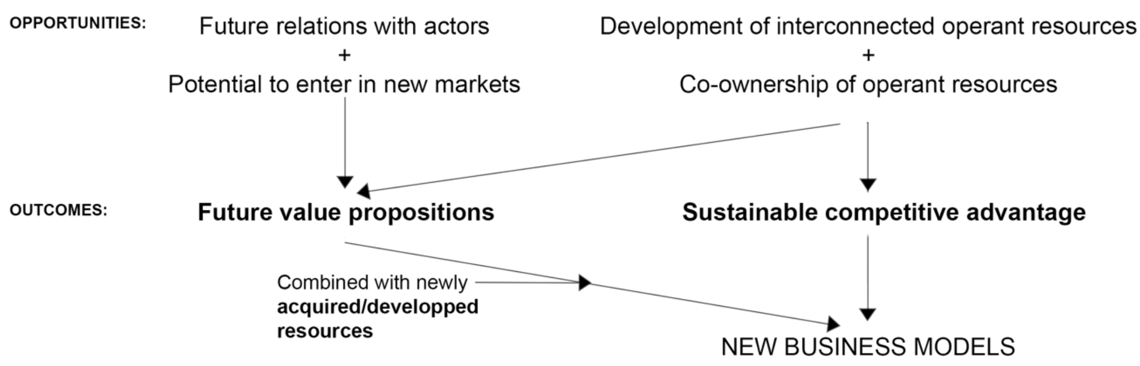

Figure 3: Potential outcomes for future value co-creation.

Managerial Implications

While each of the three models of ownership proposed above have positive and negative aspects, they all have a common trait: if the actors that adopt them do not take into account the demanding nature of innovation in collaborations or do not abide by the institutions on predisposition to share governing the ecosystem, the value co-creation process will be hindered and the value-in-use of the resulting service with be negatively affected. Throughout this value co-creation process there are three main aspects that emerge as crucial in the projects within the smart city ecosystem. These stem from both the findings on the current practises followed in the projects and the theoretical implications of such findings.

Future value-propositions for actors

Firstly, the potential for co-creation of value-in-use for the actors within the project consortium does not necessarily lie within the project itself, but in the future value propositions that might result not only from the collaboration and the co-creation process, but from the potential future use of the co-owned resources as well. As discussed above, this is particularly applicable to undetermined and open models of ownership. In order to benefit from this, industrial partners should be willing to provide access to the organisation's resources, mainly existing technological intellectual property and datasets and invest human capital, thus not allowing the culture of "fear of sharing" to affect their ability to create future value propositions. Accordingly, public actors and universities and particularly councils need to provide access to the resources they uniquely possess, such as access to urban data and physical infrastructure.

Development of new business models

The provision and access to resources is directly related to the second aspect, on the creation of a sustainable competitive advantage. This can be created through the interconnected operant resources that result from the resource integration process between the different actors within the consortium. As discussed above, this competitive advantage may lead to potential new business models. This is particularly relevant to the field of smart cities, where the majority of the SMEs involved in these projects are still in the process of shaping their business model, while multinational companies are in the phase of investing in R&D.
In order to achieve the creation of new propositions, both industrial and public actors need to be predisposed to offer abundant capable operant resources essential for the development of the projects, mainly human skills and knowledge. This is particularly applicable to industrial actors that offer knowledge-based services such as consultants. This again leads to the final crucial aspect related to flexibility in the managerial and operational part of the consortium.

Managerial and operational considerations

Flexibility in operations and the established contractual agreements appears to be the key in this case. This is because the existence of rigid contractual joint ownership models cannot ensure value co-creation, due to the potential lack of communication or lack of disposition to share resources between the other actors in the consortia. At the same time undetermined or not yet determined ownership models negatively affect the value-in-use resulting from the project, as the intellectual property and data frequently go unused due to ambiguity on ownership, thus hindering the potential for the creation of future value propositions. Interestingly, similar results appear to be yielded with open models as well, where the intellectual property and data is so open that no one from the project partners within the consortia considers using it for commercial purposes. In these cases, typically academics use the intellectual property for dissemination, while in others, companies -particularly SMEs-, external to the ecosystem might use the open intellectual property to inform their services.
In order to avoid this, all project actors need to establish intellectual property and data contracts at the start of the project, with a clear understanding that innovation is an ongoing process and additional resources might be required in later stages. Managers from the industry need to discuss from early stages dissemination of knowledge related to intellectual property and communicate clearly their needs and future goals.

Additionally, they need to be flexible to reiterate the contract according to recent developments and changes, in order to avoid problems in the project due to rigidity. From the other side, managers from the public sector need to demonstrate understanding of the needs and interests of the industry and be accessible and supportive especially to SMEs. Finally, it can be observed that the lack of use of the open data resulting from the project might be related to the low quality of some of the outputs, especially the ones coming from projects with no continuous stream of funds. Nevertheless, the creation of open IP and data is certainly a step towards building valuable databases and creating familiarity of citizens and businesses with how they can use these.

ASPECT	Contractual joint ownership	Undetermined ownership	Open ownership
Degree of flexibility	Low	High	High
Possibility to evaluate current value-in-use	High	Moderate	Low
Potential for creation of not yet determined future value propositions	Low	High	High
Potential for the development of resources that can lead to new business models	High	High	High
Potential for future value-in-use	Moderate	High	High

Table 3: Aspects according to the ownership model.

Future research should focus on better comprehending how co-owned resources can enhance future value propositions for both industrial and public actors and how they can trigger the creation of new sustainable business models. Additionally, future research should addresss how open intellectual property and data can be more effectively transformed in order to be more usable, as well as how intellectual property agreements can be modified to allow for the degree of flexibility essential to all service innovation projects.

References

Ahlgren, B., Hidell, M. and Ngai, E.C.H. (2016), “Internet of Things for Smart Cities: Interoperability and Open Data”, *IEEE Internet Computing*, IEEE, Vol. 20 No. 6, pp. 52–56.

Akaka, M., Vargo, S. and Schau, H.J. (2015), “The context of experience”, *Journal of Service Management*, Vol. 26 No. 2, pp. 206–223.

Angelidou, M. (2015), “Smart cities: A conjuncture of four forces”, *Cities*, Elsevier Ltd, Vol. 47, pp. 95–106.

Arnould, E. (2008), “Service-dominant logic and resource theory”, *Journal of the Academy of Marketing Science*, No. 36, pp. 21–24.

Ballantyne, D., Frow, P., Varey, R.J. and Payne, A. (2011), “Value propositions as communication practice: Taking a wider view”, *Industrial Marketing Management*, Elsevier, Vol. 40 No. 2, pp. 202–210.

Ballantyne, D. and Varey, R.J. (2006), “Creating value-in-use through marketing interaction: the exchange logic of relating, communicating and knowing”, *Marketing Theory*, Sage Publications Sage CA: Thousand Oaks, CA, Vol. 6 No. 3, pp. 335–348.

Barney, J. (1991), “Firm Resources and Sustained Competitive Advantage”, *Journal of Management*, Sage PublicationsSage CA: Thousand Oaks, CA, Vol. 17 No. 1, pp. 99–120.
Barriball, L.K. and While, A. (1994), “Collecting Data using a semi-structured interview: a discussion paper”, *Journal of Advanced Nursing*, Wiley Online Library, Vol. 19 No. 2, pp. 328–335.
Barrionuevo, J.M., Berrone, P. and Ricart, J.E. (2012), “Smart cities, sustainable progress”, *IESE Insight*, Vol. 14, pp. 50–57.
Batty, M., Axhausen, K.W., Giannotti, F., Pozdnoukhov, A., Bazzani, A., Wachowicz, M., Ouzounis, G., et al. (2012), “Smart cities of the future”, *The European Physical Journal Special Topics*, Vol. 214 No. 1, pp. 481–518.
Boyatzis, R.E. (1998), *Transforming Qualitative Information: Thematic Analysis and Code Development*, Sage Publications.
Braun, V. and Clarke, V. (2006), “Using thematic analysis in psychology”, *Qualitative Research in Psychology*, Taylor & Francis, Vol. 3 No. 2, pp. 77–101.
Burgess, R.G. (2003), *Field Research: A Sourcebook and Field Manual*, Routledge, London, New York.
Caragliu, A., Del Bo, C. and Nijkamp, P. (2011), “Smart cities in Europe”, *Journal of Urban Technology*, Vol. 18 No. 2, pp. 65–82.
CEBR. (2016), *The Value of Big Data Andthe Internet of Things Tothe UK Economy*.
Cesaroni, F. and Duque, L.C. (2013), “Open Innovation and Service Dominant Logic: Application of Foundational Premises to Innovative Firms”, *Harvard Deusto Business Research*, Vol. 2 No. 1, pp. 17–34.
Chan, C.M.L. (2013), “From open data to open innovation strategies: Creating e-services using open government data”, *2013 46th Hawaii International Conference on System Sciences*, IEEE, pp. 1890–1899.
Chen, T. (2010), “Smart grids, smart cities need better networks [Editor’s Note]”, *IEEE Network*, Vol. 24 No. 2, pp. 2–3.
Chesbrough, H. (2004), “Managing open innovation”, *Research Technology Management*, Vol. 47 No. 1, pp. 23–26.
CISCO. (2012), *Smart City Framework: A Systematic Process for Enabling Smart+Connected Communities*, edited by Falconer, G. and Mitchell, S., available at: https://www.cisco.com/c/dam/en_us/about/ac79/docs/ps/motm/Smart-City-Framework.pdf.
Cocchia, A. and Dameri, R.P. (2016), “Exploring Smart City Vision by University, Industry and Government”, *Blurring the Boundaries Through Digital Innovation*, Springer, pp. 259–270.
Constantin, J.. and Lusch, R.. (1994), *Understanding Resource Management*, The Planning Forum: Irwin Professional Pub, Oxford, OH.
Cummings, T. (1991), “Innovation through alliances: Archimedes’ hall of mirrors”, *European Management Journal*, Vol. 9 No. 3, pp. 284–287.
Dameri, R.P. and Ricciardi, F. (2015), “Smart city intellectual capital: an emerging view of territorial systems innovation management”, *Journal of Intellectual Capital*, Vol. 16 No. 4, pp. 860–887.
Dameri, R.P., Ricciardi, F. and D’Auria, B. (2014), “Knowledge and intellectual capital in smart city”, *European Conference on Knowledge Management, Kidmore End*, Vol. 1, pp. 250–257.
Dirks, S. and Keeling, M. (2009), “A vision of smarter cities: How cities can lead the way into a prosperous and sustainable future”, *IBM Institute for Business Value*,

Vol. 8.
Edvardsson, bo and Tronvoll, B. (2013), “A new conceptualization of service innovation grounded in S-D logic and service systems”, *International Journal of Quality and Service Sciences*, Vol. 5 No. 1, pp. 19–31.
Edvardsson, B., Tronvoll, B. and Gruber, T. (2011), “Expanding understanding of service exchange and value co-creation: a social construction approach”, *Journal of the Academy of Marketing Science*, Springer US, Vol. 39 No. 2, pp. 327–339.
European Commission. (2013), *Using EU Funding Mechanism for Smart Cities*.
European Commission. (2019), “Smart cities”.
European Parliament. (2014), “Mapping Smart Cities in the EU, Directorate General for InternalPolicies Policy”, edited by Policy, E. and S.
Fawcett, S.E., Wallin, C., Allred, C., Fawcett, A.M. and Magnan, G.M. (2011), “Information technology as an enabler of supply chain collaboration: a dynamic-capabilities perspective”, *Journal of Supply Chain Management*, Wiley Online Library, Vol. 47 No. 1, pp. 38–59.
Ferraris, A., Erhardt, N. and Bresciani, S. (2017), “Ambidextrous work in smart city project alliances: unpacking the role of human resource management systems”, *The International Journal of Human Resource Management*, pp. 1–22.
Giffinger, R. and Pichler-Milanović, N. (2007), *Smart Cities: Ranking of European Medium-Sized Cities*, Centre of Regional Science, Vienna University of Technology.
Gould, D.M. and Gruben, W.C. (1996), “The role of intellectual property rights in economic growth”, *Journal of Development Economics*, Vol. 48 No. 2, pp. 323–350.
GOV.UK. (2019), “Intellectual property and your work”, available at: https://bit.ly/2XX6QtV (accessed 22 October 2019).
Greer, C.R., Lusch, R.F. and Vargo, S.L. (2016), “A service perspective”, *Organizational Dynamics*, Vol. 1 No. 45, pp. 28–38.
Harrison, C., Eckman, B., Hamilton, R., Hartswick, P., Kalagnanam, J., Paraszczak, J. and Williams, P. (2010), “Foundations for smarter cities”, *IBM Journal of Research and Development*, Vol. 54 No. 4, pp. 1–16.
HM Treasury. (2018), *The Economic Value of Data:Discussion Paper*.
International Chamber of Commerce. (2011), *Intellectual Property:Powerhouse for Innovation and Economic Growth*, available at: www.iccwbo.org.
Jones, S. (1985), “The analysis of depth interviews”, *Applied Qualitative Research*, Gower Aldershot, pp. 56–70.
Komninos, N. (2008), *Intelligent Cities and Globalisation of Innovation Networks*, Routledge.
Koskela-Huotari, K., Edvardsson, B., Jonas, J.M., Sörhammar, D. and Witell, L. (2016), “Innovation in service ecosystems-Breaking, making, and maintaining institutionalized rules of resource integration”, *Journal of Business Research*, Elsevier Inc., Vol. 69 No. 8, pp. 2964–2971.
Kourtit, K. and Nijkamp, P. (2012), “Smart cities in the innovation age”, *Innovation: The European Journal of Social Science Research*, Vol. 25 No. 2, pp. 93–95.
Letaifa, S. Ben. (2015), “How to strategize smart cities: Revealing the SMART model”, *Journal of Business Research*, Vol. 68 No. 7, pp. 1414–1419.
Leydesdorff, L. and Deakin, M. (2013), “The triple helix model of smart cities: a neo-evolutionary perspective”, *Smart Cities*, Routledge, pp. 146–161.
Lindman, J., Rossi, M. and Tuunainen, V.K. (2013), “Open data services: Research

agenda”, *2013 46th Hawaii International Conference on System Sciences*, IEEE, pp. 1239–1246.

Lombardi, P., Giordano, S., Farouh, H. and Yousef, W. (2012), “Modelling the smart city performance”, *Innovation: The European Journal of Social Science Research*, Vol. 25 No. 2, pp. 137–149.

Lusch, R.F. and Nambisan, S. (2015), “Service innovation: A service-dominant logic perspective.”, *MIS Quarterly*, Vol. 39 No. 1.

Lusch, R.F. and Vargo, S.L. (2006), *The Service-Dominant Logic of Marketing : Dialog, Debate, and Directions*, M.E. Sharpe.

Lusch, R.F., Vargo, S.L. and Tanniru, M. (2010a), “Service, value networks and learning”, *Journal of the Academy of Marketing Science*, Springer, Vol. 38 No. 1, pp. 19–31.

Lusch, R.F., Vargo, S.L. and Tanniru, M. (2010b), “Service, value networks and learning”, *Journal of the Academy of Marketing Science*, Vol. 38 No. 1, pp. 19–31.

McKinsey & Company. (2013), “How to make a city great.”, available at: http://www.mckinsey.com/insights/urbanization/how_to_make_a_city_great.

Mele, C. (2009), “Value logic in network”, *Sinergie*, Vol. 16, pp. 217–241.

Michel, S., Brown, S.W. and Gallan, A.S. (2008), “An expanded and strategic view of discontinuous innovations: Deploying a service-dominant logic”, *Journal of the Academy of Marketing Science*, Vol. 36 No. 1, pp. 54–66.

Möller, K., Rajala, A. and Svahn, S. (2005), “Strategic business nets—their type and management”, *Journal of Business Research*, Vol. 58 No. 9, pp. 1274–1284.

Nam, K. and Lee, N.H. (2010), “Typology of service innovation from service-dominant logic perspective”, *Journal of Universal Computer Science*, Vol. 16 No. 13, pp. 1761–1775.

Nam, T. and Pardo, T.A. (2011), “Smart city as urban innovation: Focusing on management, policy, and context”, *Proceedings of the 5th International Conference on Theory and Practice of Electronic Governance*, ACM, pp. 185–194.

Naphade, M., Banavar, G., Harrison, C., Paraszczak, J. and Morris, R. (2011), “Smarter cities and their innovation challenges”, *Computer*, Vol. 44 No. 6, pp. 32–39.

Ordanini, A. and Parasuraman, A. (2011), “Service innovation viewed through a service-dominant logic lens: a conceptual framework and empirical analysis”, *Journal of Service Research*, Sage Publications Sage CA: Los Angeles, CA, Vol. 14 No. 1, pp. 3–23.

Paquet, G. (2001), *Smart Communities and the Geo-Governance of Social Learning*, Faculty of Administration, University of Ottawa= Faculté d’administration, Université d’Ottawa.

Paskaleva, K.A. (2011), “The smart city: A nexus for open innovation?”, *Intelligent Buildings International*, Vol. 3 No. 3, pp. 153–171.

Payne, A.F., Storbacka, K. and Frow, P. (2008), “Managing the co-creation of value”, *Journal of the Academy of Marketing Science*, Springer, Vol. 36 No. 1, pp. 83–96.

PWC. (2019), *Creating the Smart Cities of the Future" Executive Summary*.

Sandulli, F.D., Ferraris, A. and Bresciani, S. (2017), “How to select the right public partner in smart city projects”, *R&D Management*, Vol. 47 No. 4, pp. 607–619.

Skålén, P., Gummerus, J., von Koskull, C. and Magnusson, P.R. (2014), “Exploring value propositions and service innovation: a service-dominant logic study”,

Journal of the Academy of Marketing Science, Vol. 43 No. 2, pp. 137–158.
Vargo, S.L. and Lusch, R.F. (2004), “Evolving to a New Dominant Logic for Marketing”, *Journal of Marketing*, American Marketing Association , Vol. 68 No. 1, pp. 1–17.
Vargo, S.L. and Lusch, R.F. (2008), “Service-dominant logic: continuing the evolution”, *Journal of the Academy of Marketing Science*, Springer US, Vol. 36 No. 1, pp. 1–10.
Vargo, S.L. and Lusch, R.F. (2011), “It’s all B2B…and beyond: Toward a systems perspective of the market”, *Industrial Marketing Management*, Elsevier, Vol. 40 No. 2, pp. 181–187.
Vargo, S.L. and Lusch, R.F. (2017), “Service-dominant logic 2025”, *International Journal of Research in Marketing*, Vol. 34 No. 1, pp. 46–67.
WIPO. (2019), *World Intellectual Property Indicators 2019*, *World Intellectual Property Organization*, Vol. 1, Geneva, available at:https://doi.org/10.1016/0172-2190(79)90016-4.
Yovanof, G.S. and Hazapis, G.N. (2009), “An architectural framework and enabling wireless technologies for digital cities & intelligent urban environments”, *Wireless Personal Communications*, Vol. 49 No. 3, pp. 445–463.
Zuiderwijk, A., Helbig, N., Gil-Garcia, J.R. and Janssen, M. (2014), “Special Issue on Innovation through Open Data-A Review of the State-of-the-Art and an Emerging Research Agenda”, *Guest Editors’ Introduction. Journal of Theoretical and Applied Electronic Commerce Research*, Vol. 9 No. 2, pp. 1–2.
Zygiaris, S. (2013), “Smart city reference model: Assisting planners to conceptualize the building of smart city innovation ecosystems”, *Journal of the Knowledge Economy*, Vol. 4 No. 2, pp. 217–231.