Smart Cities and their Business Models: a comparison

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Keywords: Smart city, Business Model, e-government, value proposal

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ABSTRACT

Smart cities have attracted the international scientific and business attention and a niche market is being evolved, which engages almost all the business sectors. In their attempt to empower and promote urban competitive advantages, local governments have approached the smart city context and they target habitants, visitors and investments. However, engaging the smart city context is not free-of-charge and corresponding investments are extensive and of high risk without the appropriate management. Moreover, investing in the smart city domain does not secure corresponding mission success and both governments and vendors require more effective instruments. This paper performs an investigation on the smart city business models and is a work in progress. Modeling can illustrate where corresponding profit comes from and how it flows, while a significant business model portfolio is eligible for smart city stakeholders.

1. INTRODUCTION

The smart city domain emerges rapidly and engages almost all the business sectors. During Ovum's 2014 smart city event (http://smarttofuture.com), participants recognized that smart city niche market is estimated to reach the amount of $3 trillion by 2025 and exceed the size of all traditional business sectors. This estimation was grounded earlier by Simon Giles (2012) from Accenture too, who located the source of this money on embedded operational efficiency, as well as on new entrepreneurship. Moreover, CISCO (2014) predicts that the amount of €38.9 billion will be spent on smart cities in 2016 alone.

However, today, the smart city market race is led by public investments. In their analysis on 34 smart cities Anthopoulos and Fitsilis (2014 (a)) found out that 23 of them are or can be considered State-Owned-Enterprises (SOEs), which are founded in an attempt to manage the outcomes of public smart city projects. Later (Anthopoulos and Fitsilis, 2014 (b)) they extended their study on European Smart Cities and telecommunications vendors' analyses and they concluded that from the about 100 investigated cases, only 2 are led by private companies (Malaga (Spain), New Songdo (South Korea)), while less than 10 are the outcome of public private partnerships (PPP) (i.e., Amsterdam and Blacksburg Electronic Village etc.). These findings show that enterprises are still quite reluctant to invest on the smart city sector and they seek to secure their entrance with standardization and business models.

To this end, various smart city standards are under development by governments and standardization institutes. Recently, United States (U.S.) National Institute of Standards and Technologies (NIST) suggested the standardization of Internet-of-Things (IoT) solutions during the Global City Teams Challenge workshop (2014); United Nations (UN) International Telecommunications Unit (ITU) is under the development of smart city standards for sustainable development; British Standards Institute (BSI) has proposed various smart city standards (i.e., PAS180 (BSI, 2014)); while International Standards Organizations (ISO) has proposed smart city standards for sustainable development of communities (i.e., ISO/TC 268 ('Sustainable development in communities') (ISO, 2014)); and European Committee of Standardization (CEN, 2014) develops corresponding standards to address innovative urban transformation. All these efforts try to recognize urban performance indicators, risks, costs and benefits. Although, standardization lowers smart city uncertainties, it does not provide information about the source of smart city market's money and other potential values.

This paper addresses the above last observation and tries to answer the following research question: "*what smart city business models exist and are followed by major smart city cases?*" This research question is not only important to be answered due to the above observation, but due to the continuous transformation of smart city approaches (Anthopoulos and Fitsilis, 2014(a)). Moreover, the answer to this question will be useful to justify who must undertake a smart city initiative; why such an initiative must be implemented

(value proposal); and how a smart city can sustain in economic terms (costs against earnings). From the answer of this question both the smart city industry and local governments will be benefit, since they will all realize the roadmap for a smart city success, from the requirements (key-resources); to the value that the smart city must deliver to its customers; and to the relationship management processes that must be run over a smart city.

A business model analyzes the sources and processes that contribute to organization's value. Although smart cities concern innovative solutions within the urban space and corresponding innovation business models are expected to appear or have already appeared, this research question is extremely important to be answered since it aims to investigate how traditional business models have been applied in smart cities or what types of innovation business models have been developed. In this context, the hypothesis of this paper suggests:

Hypothesis 1. Smart Cities follow various business models, which can be grouped in existing classes.

In an attempt to answer the above question and to justify this hypothesis, this paper follows two research methods: literature review and findings from case studies. First, literature findings are explored regarding business modeling, their classification and patterns. Then existing smart city business models are demonstrated according to literature findings (Alcatel-Lucent, 2012; Turban, 2002) and the outcomes of interviews from case studies. All the identified smart city business models are assigned to patterns presented by (Osterwalder and Pigneur, 2010).

The remaining of this paper is organized as follows: in the background section 2, a brief theoretical analysis of business models and smart city business models is performed. Then, in section 3, results from literature findings and case studies are presented and this paper's research questions is discussed according to the extracted outcomes. Finally, in section 4 some conclusions and some future thoughts are given.

2. BACKGROUND

Defining the smart city is not an easy process and there are too many definitions in literature that make this term quite ambiguous. Various scholars (i.e., Giffinger et al., 2007; Komninos, 2002; Janssen and Kuk, 2011; Churabi et al., 2012; Anthopoulos et al., 2014) define this term with means of integrating Information and Communications Technologies (ICT) with the urban space and provide the city with solutions that enhance local intelligence and more specifically city's dimensions (people, economy, governance, mobility, living and environment). The classification of alternative smart city approaches (Anthopoulos and Fitsilis, 2014) illustrated the evolution patterns and the most attractive smart city forms:

- Web or Virtual Cities that offer local information, online chatting and meeting rooms, and city augmented reality navigation via the Web.
- Knowledge Bases are public databases with crowd sourcing options accessible via the Internet and via text-TV.
- Broadband City/Broadband Metropolis describe fiber optic backbones were installed in the urban area, which enable the interconnection of households and of local enterprises to ultra-high speed networks.
- Mobile/Ambient Cities are metropolitan wireless broadband networks accessible across the city or in some neighbors.
- The smart city approach offers broadband and media infrastructures for business development.
- The Digital City describes a "mesh" metropolitan environment that interconnects virtual and physical spaces and offers various types of e-services that deal with local challenges.

- The Ubiquitous City concerns a next generation urban space that includes an integrated set of ubiquitous services. This approach is accompanied with the construction of new urban spaces where the pervasive computing will be included from the scratch in buildings.
- Finally, the Eco City capitalizes the ICT for sustainable growth and for environmental protection.

Smart city evolution passed through various phases: starting from (a) the Australian cases of Brisbane and Blacksbourg -where the ICT supported the social participation and the social cohesion-; to (b) an urban space attracting business opportunities; to (c) ubiquitous technologies installed across the city; and to (d) solutions that support urban sustainability in terms of resource, waste and energy management and environmental protection. This evolution path justifies the definition provided in Ovum 2014 event by the director of Cities Alliance, Mr. William Cobbett, who described the smart city as the city that "utilizes information collected from across the city in order to predict its own future".

Many vendors address the smart city context and lead the development of corresponding solutions, which enhance sustainability, efficiency, safety and other urban challenges: IBM (2012); Alcatel-Lucent (2011); Schneider (2014); Hitachi (2013); Huawei (2014); Siemens (2014); Oracle (2014); Microsoft (2014); Fujitsu (Hisatsugu, 2014); SAP (2014), CISCO (2014) etc. These vendors develop either end-to-end solutions that can be installed across the city and integrate individual solutions in clusters (i.e., for urban data management) or solutions of smaller-scale that deal with a particular challenge (i.e., smart grids).

However, despite this documented vendors' interest on smart city, most corresponding investments are performed with public initiatives. Anthopoulos and Fitsilis (2014(a); 2014(b)) demonstrated that most of the examined smart cities (34 and 100 accordingly) concern public projects, where vendors were paid with public money to develop and install their solutions. Only two cases (New Songdo and Malaga) are private investments, while about 10 concern PPPs, where project risk is shared among both public and private organizations. These findings question this reluctance of the private sector to place direct investments on smart cities. CISCO (Falconer and Mitchell, 2012) identified city complexities (multiple parties, stakeholders, and processes) and different interests as the barriers in implementing smart city solutions. Another potential reason for this reluctance is described by Simon Giles (2012), who claimed that the value of the smart city market is still under development and corresponding business models too.

2.1 Business Modeling

Business model concerns quite a recent concept and although it is broadly discussed, a common definition is missing (Morris et al., 2006). A business model describes the rationale of how an organization creates, delivers, and captures value (economic, social, cultural, or other forms of value) (Turban, 2002). One of the most widely accepted definitions come from Timmers (1998), according which a business model concerns "an architecture of the products, services and information flows […]". This definition recognizes actors, roles, potential business value and the source of revenue. A business model framework or "canvas" (Osterwalder and Pigneur, 2010) contains four components and places in the center the value proposition (Fig.-1) (Bucherer and Uckelmann, 2011):

- The *Infrastructure* component describes the *key partners* in value proposition, which perform *key activities* and *require key resources* to implement the value proposition.
- *The value proposition* specifies what is actually delivered to the customer
- The *customer* component includes the *customer segments* addressed by the company, such as related *channels* and *customer relationships*.
- The *financial* component comprises the costs as well as the revenues.

Although there could be various value propositions, business models can be classified in five patterns according to (Osterwalder and Pigneur, 2010):

- *Unbundling business models*, which can be utilized by firms that perform all the three fundamentally different types of businesses: customer relationship; product innovation; and infrastructure businesses (i.e., private banking).
- *The long tail business model* according which a firm tries to sell less for more. This model can be addressed by the offering of a large range of niche products, each of which sells relatively infrequently (i.e., LEGO).
- *Multi-sided platforms*, which bring together two or more distinct but interdependent groups of customers (i.e., game console production vendors).
- *Free* business model continuously benefit at least one substantial customer segment from a free-of-charge offer (i.e., cell phone operators).

Open business model can be used by companies to create and capture value by systematically collaborating with outside partners (i.e., Procter and Gamble).

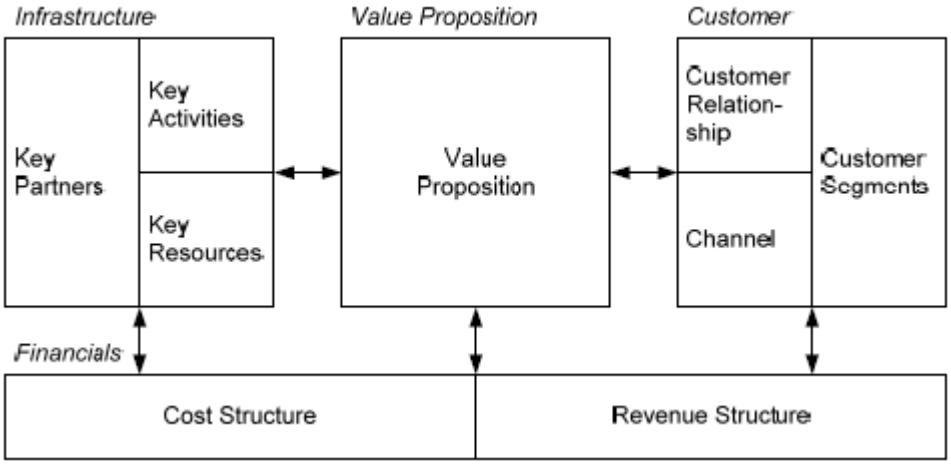

Fig. -1: Business Model Framework (Bucherer and Uckelmann, 2011)

Business model innovation concerns the development of novel business models, which whole way of firms doing business (Bucherer and Uckelmann, 2011). Business model innovation is utilized by companies that adapt and innovate in every dimension (product or service, process, marketing, organization) as a means to stay competitive in times of change. Amazon for instance, transformed the entire book trading model and incorporated online shopping, automated distribution and collaborative filtering.

2.2 The Smart City Context

Before proceeding to the identification of existing smart city business models, it is important for the smart city components to be mentioned. Almost all well managed and large-scale smart cities follow the multi-tier architecture (Anthopoulos and Fitsilis, 2014(b)) in their attempt to integrate the physical with the ICT environment. However, another interesting approach appears to be adopted by smart cities and concerns the Internet-of-Things (IoT), meaning that many smart cities could utilize data from sensors, buildings and users-as-sensors with their applications, without necessarily install networks from scratch or other large-scale infrastructure. (Fig-2) illustrates such a multi-tier architecture, where the IoT could be part of the infrastructure layer. This architecture demonstrates smart city components:

- Facilities (broadband networks, smart buildings, IoT) (*infrastructure layer)*
- Services (various types of e-services provided by smart city stakeholders) (*service layer*)

- Data (produced or collected during service execution or day-to-day activities) (*information layer)*
- Users (service providers and service consumers) (*user layers: servants and end-users*)
- Environment (natural environment and city resources such as, roads, bridges, water etc.)

These components deal with smart city dimensions (Giffinger et al., 2007). Potential business models could refer to any or all the smart city components. For instance, smart city vendors develop and deploy facilities; operators earn from facility utilization or service provision; service providers earn from their service delivery etc. To this end, various contemporary business models can be deployed in a smart city. On the other hand, the IoT offers great potential for innovation business models, since it interconnects product stream with information stream (Bucherer and Uckelmann, 2011). Corresponding business models capitalize the seventh information laws, regarding its share-ability; perish-ability; value increment with accuracy, combination and use; more does not mean better; and non depletability. These IoT characteristics and information laws indicate the information value, which concerns *delivery of right information, in the right granularity, at the appropriate condition, in time, anywhere at an appropriate price*. This risen value has introduced several corresponding innovation business models such as (Bucherer and Uckelmann, 2011):

- *Product-as-a-Service (PaaS)*, which utilizes the IoT to enable means of performance measuring and billing.
- *Information Service Providers*, which utilizes existing data-centers to store and deploy IoT information. This business model comes close to contemporary service provision models.
- *End-user involvement*, where users do not only contribute to personalized goods' production processes but to their entire life-cycles.
- *Right-time Business Analysis and Decision making*, with which the IoT is utilized for its real-time access and analysis provision opportunities across supply-chains or product lifecycles.

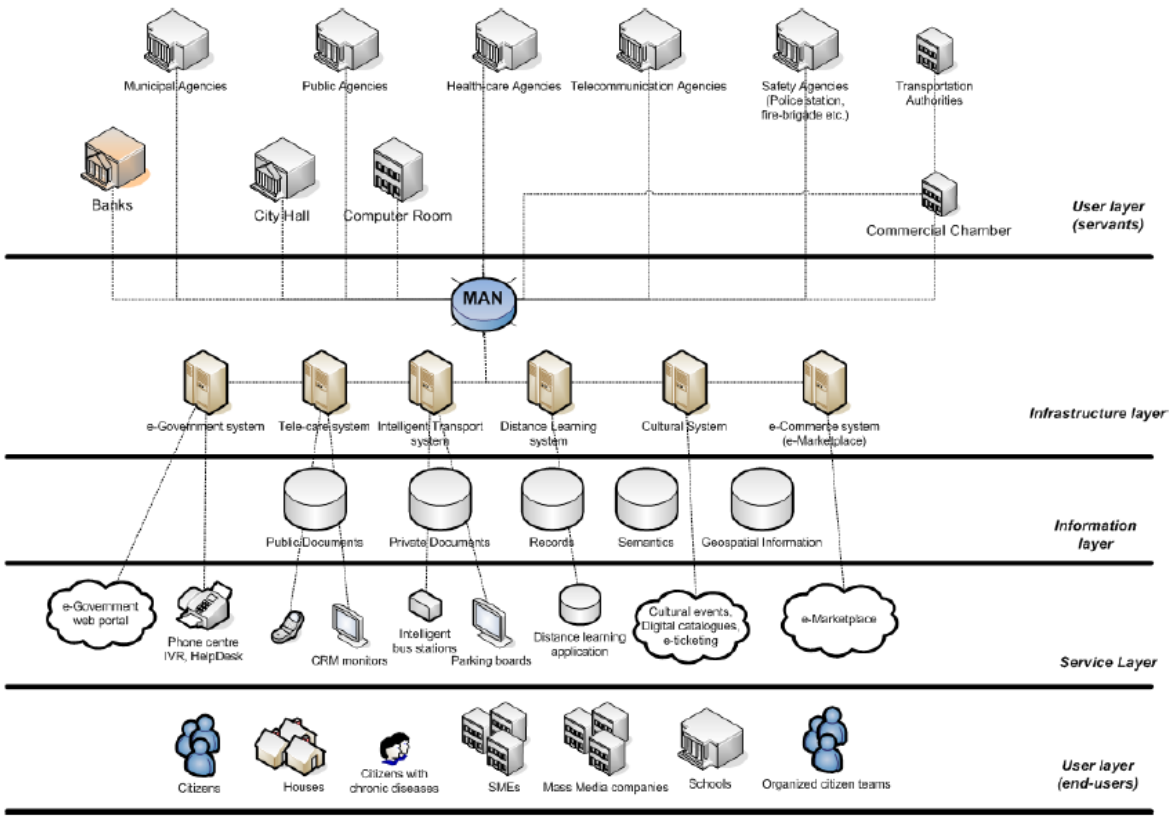

Fig.-2: a multi-tier smart city architecture (Anthopoulos and Vakali, 2012)

3. DOMAIN STUDY: EXISTING SMART CITY BUSINESS MODELS

This section attempts to identify existing smart city business models, except from the contemporary ones. To this end, authors use literature findings and compare them with finding from case studies of major international smart cities, which were analyzed with visits and discussions with their representatives. This identification did not "a priori" considered any particular value proposer, such as the city, a service provider, a network owner etc. Smart city stakeholders are too many and exceed city stakeholders: local and central governments; utility providers; ICT companies; Non-Governmental-Organizations (NGOs); international organizations; chambers and industry organizations; academia; companies; and citizens. Thus, each stakeholder (or in groups) could develop value proposals for local customers. As such each smart city service or product can be concerned that it follows or should follow a contemporary or innovative business model.

3.1 Literature Findings

Janssen and Kuk (2011) considered public sector's value proposals to and they identified corresponding web-based business models. Their rationale concerned the interrelation of government strategy with smart city information architecture as a means to meet their customers' expectations.

- *Full service provider (FSP)* business model, according which organizations provide full services (collaborating with various segments or other organizations) to directly or via allies owning customer relationships.
- *Content provider*, in terms of information offering.
- *Direct-to-customer*, according which the city offers information and/or services to its customers (citizens and enterprises).
- *Value-net-integrators*, which means information collection from various organizations, processing and delivery.
- *Infrastructure service provider*, in terms of infrastructure rental or Hardware-as-a-Service.
- *Market* creation, meaning matching demand and supply in various sectors (i.e., volunteer network structuring for cases that demand volunteers).
- *Collaboration,* in terms of tools provision for civic-engagement, decision making, crowd-sourcing etc.
- *Virtual communities,* where groups of common interests are structured and share content.

Table 1: web-based business models applied by cities and their interrelations

id	Web-based business model	Business model pattern
1.	*Full service provider (FSP)*	*Unbundling*
2.	*Content provider*	*Direct service provision*[1]
3.	*Direct-to-customer*	*Direct service provision*[1]
4.	*Value-net-integrators*	*Open*
5.	*Infrastructure service provider*	*Unbundling*
6.	*Market*	*Open*
7.	*Collaboration*	*Open*
8.	*Virtual communities*	*Open*

[1]*Direct service provision does not concern a pattern*

All the above business models concern city's proposed value. Table 1 illustrates how the above web-based business models match the previously mentioned patterns. These outcomes demonstrate that open pattern appears most in web-based models, while unbundling instances exist too. Contemporary business models exist even in web-based cases and the city operates as a direct content and service provider to its habitants and enterprises.

On the other hand, Anthopoulos and Fitsilis (2014 (a); 2014 (b)) reported various smart city business models. Although business models are not supposed to be observed in public organization cases (i.e., Masdar, Gdansk etc.), even in these forms smart city is utilized by the city to attract visitors, habitants and investments. Moreover, some of the investigated cases concern novel business models, such as the South Korean "city-in-a-box", which is replicated in other Asian cases; the Dubai/Malta/Kochi Smart City captures value from the private investments of the located companies at the business parks; and Taipei eco-city concerns a sustainable growth business model. These studies assigned representatives from two contemporary business model classes:

1. *E-Service* business model (Turban, 2002) (Table 2).
2. *Openness of the Commercial Enterprise and ICT network ownership* (Alcatel-Lucent, 2012) business model (Table 3).

Table 2. E-Service business models

id	Service Group	e-Services / products	e-Commerce Business Model(s)	Cases	Business model pattern
9.	**SGroup1** *Web City*	City guides, urban virtualization	1. Social Networks	America-On-Line (AOL) Cities Kyoto, Japan Bristol, U.K.	*Free*
10.	**SGroup2** *Knowledge Base*	E-Government, e-Democracy, e-learning	1. Membership 2. Social Networks 3. Affiliate marketing	Copenhagen Base Craigmillar Community Information Service, Scotland	*Open*
11.	**SGroup3** *Broadband City & Mobile City*	Broadband communications services	1.Value chain integration	Seoul, S. Korea Beijing, China Helsinki Geneva-MAN, Switzerland Antwerp, Belgium	*Unbundling*
12.	SGroup5 *Smart City*	e-Business Intelligent Transportation, e-parking	1.Affiliate marketing 2.Value chain integration 3.Membership	Taipei, Taiwan Tianjin, China Barcelona, Spain Brisbane, Australia Malta Dubai	*Unbundling*
13.	**SGroup4** *Digital City*	E-health and tele-care services, e-security	1.Value chain integration 2.Social networks 3.Direct online marketing 4.Digital malls 5.Information agents 6.Affiliate marketing 7.Tendering 8.Reverse auctioning 9.Group purchasing 10. Customization	Hull, U.K. Cape Town, South Africa Trikala, Greece Tampere, Finland Knowledge Based Cities, Portugal Austin, U.S.A. Blacksburg Electronic Village, U.S.A.	*Unbundling*
14.	**SGroup6** *Ubiquitous City*	Ubiquitous services, communications services	1.Value chain integration	New Sondgo, S. Korea Dongtan, S. Korea Osaka, Japan Manhattan Harbour, Kentucky, U.S.A. Masdar, United Arab Emirates Helsinki Arabianranta, Finland	*Unbundling*
15.	**SGroup7** *Eco City*	Eco-services, smart grids, waste/recycle management	1.Customization 2.Social networks	Dongtan S. Korea Tianjin (Singapore), Austin, U.S.A. Amsterdam Copenhagen Taipei, Taiwan	*Unbundling*

Tables 2 and 3 have been extended from their previous versions and business model patterns have been assigned. In (Table 2) each service group was considered to be offered by an individual provider (or groups of stakeholders). The assignment of a pattern in (Table 3) considered the network to be the key-resource for value proposition. To this end, network owner delivers value to individuals and enterprises. An important outcome of this assignment process concerns the appointment of business model patterns to cases where network-relative business models were not applicable.

Table 2 values show that the unbundling pattern appears most in the examined cases and more specifically in all cases where key-resources exist and utilized by the smart city: broadband, smart, digital, ubiquitous and eco-cities. This is a reasonable outcome, since all these city forms require different types of facilities for their service provision (networks, grids, sensors, etc.). Even in case that these facilities are rent for service provision, the unbundling pattern still exists. Things changes when the IoT is utilized as the key-resource, which results to the corresponding IoT business models. However, cities in the above examined cases have not capitalized the IoT yet, which is left an open space for start-ups and other vendors to develop their customers' value.

Table 3. Openness of the Commercial Enterprise and ICT network ownership business model assignment

id	Business Model	Cases	Business model pattern
16.	Open (Public Network)	Bristol, U.K. Amsterdam Cape Town, South Africa Helsinki Antwerp, Belgium	*Open*
17.	Private (Independent Private Developer)	Malta Dubai New Songdo Taipei, Taiwan Tianjin, China Dongtan, S. Korea Osaka, Japan Austin, U.S.A.. Manhattan Harbour, Kentucky, U.S.A. Masdar, United Arab Emirates	*Unbundling*
18.	Exclusive (Selected Provider)	Seoul, S. Korea Beijing, China Helsinki Arabianranta, Finland Blacksburg Electronic Village, Australia	*Unbundling*
19.	Managed (Appointed Provider)	Geneva-MAN, Switzerland Trikala, Greece Barcelona, Spain Brisbane, Australia Tampere, Finland Hull, U.K. Knowledge Based Cities, Portugal	*Unbundling*
20.	Not Applicable	America-On-Line (AOL) Cities	*Information Service Provider* [1]
21.	Not Applicable	Kyoto, Japan	*Information Service Provider*[1]
22.	Not Applicable	Copenhagen Base	*Open*
23.	Not Applicable	Craigmillar Community	*Open*
24.	Not Applicable	Information Service, Scotland	*Open*

[1]*Direct service provision does not concern a pattern*

3.2 Case Studies

Except from the above literature findings, some case studies were explored with physical visits and interviews with the corresponding supervisors (Table 4). Case studies were selected according their appearance in literature and international coverage, while this study is still in progress. The outcomes are of extreme interest, since smart city headmasters that have been interviewed consider the smart city from different lens, while most have not considered the importance of applying a business model on their case due to the fact that they concern public projects. Interviews' analysis is beyond the purposes of this paper and only the extracted proposed values are presented, which have been assigned to business models and corresponding patterns. Proposed customer values are different among the examined representative cases.

Table 4: Outcomes from visits and interviews by smart city experts

id	Case	Date of examination	Proposed Value	Business Model	Pattern
25.	Tampere	25/4/ 2012	Create business opportunities	Open network with expert free-lancers	Open
26.	Trikala	10/10/2014	Smart city know how to other cities	Direct sale	Unbundling
27.	Geneva	30/8/2013	Develop high speed networks and smart grids for energy management	Open access network (rent to operator)	Open
28.	Zurich	2/9/2013	Develop high speed networks and smart grids for energy management	Open access network (rent to operator)	Open
29.	Australian cases (Brisbane, Queensland, Melbourne)	20/7/2013	Develop new ideas for the urban space	Full service provider	N/A
30.	New Songdo, Seoul	16/02/2014	City as a product	Full service provider	Unbundling
31.	London	29/4/2014	Climate change management	Full service provider	Unbundling
32.	Smart Vienna	5/4/2014	Develop standards for smart city solutions	Value-net-integrators	Open
33.	New York City	3/10/2014	Develop cloud services and open data	Information service provider	Unbundling
34.	World Bank	29/09/2014	Develop cloud services and open data in developing countries' cities	Information service provider	Unbundling
35.	UN ITU	9/10/2014	Standardize smart sustainable city infrastructure	Open access network (rent to operator)	Open
36.	UN Habitat	2/9/2014	Engage mayors internationally to preserve climate change and establish urban resilience.	N/A	N/A

Table 4 confirms business models that are followed by smart cities in practice. Open access network for instance appears the most favorite among the other network owners' models. Open Access (PTS, 2009) provides a network business model that separates the physical bearer network from the service network. The infrastructure of an Open Access network is built by an operator. Retail service providers (RSP) directly lease bandwidth on the infrastructure network to provide service packages to end subscribers. In the conventional model, an operator builds and

operates its network and delivers services to end-users. Unlike the conventional model, Open Access builds a layered network over which separate Service Providers deliver their services.

3.3 Discussion

This study showed that the smart city domain has already involved many (26) different business models according to literature findings and the examined cases. Most of these models are grouped in 3 classes (web-based, e-commerce, network ownership), while they all align to three business model patterns (open, free and unbundling). These findings answer this paper's research question, while they validate this paper's grounded hypothesis. The identified and presented business models concern the smart city owner perspective, which means that not all the potential stakeholders' perspectives on proposed values are examined. However, these outcomes do not necessarily create a limitation for this study; since most smart cities are being developed with public initiatives and the involvement of the private sector with individual resources has appeared only in small scale cases, which operate as exemplars. A quite unexpected outcome concerns network's commercialization, where theoretically proposed business models do not appear in practice, where the open access network is mostly preferred.

Important findings have also been extracted regarding the values that the investigated activities propose. Today smart cities appear as the solution to manage urbanism, waste, emissions and resource in cities. However, these values do not clearly appear when the question goes to business model. More specifically, all the examined business models appear to return value to smart city owners, in terms of internal efficiency (web-based models); money (network providers); city attractiveness (e-commerce models); or standardization (value integrators). Finally, although IoT is being discussed extensively and corresponding innovative products and services are being developed, it is still under development in the smart city context and it has not been utilized yet.

These outcomes are of extreme interest to both the smart city industry and the local governments. Today, despite the increasing smart city development, argument appears about the corresponding technology push which is enforced by vendors (Soderstrom et al., 2014). To this end, this study demonstrate how the proposed values will be delivered to smart city stakeholders and the means, which would involve vendors in smart city privatization.

4. CONCLUSIONS

This paper addresses a significant problem in the smart city domain, regarding money and value sources of the smart city market. More specifically, although smart city concerns an accepted fast growing market, it is not clear how this money and corresponding values are proposed and created. This problem importance is great due to the investments' size, as well as due to the observed private sector's reluctance to enter this market without public support. Vendors justify this reluctance with complexity barriers. In this regard, this paper investigated smart city business models from the owner perspective and grounded a research question concerning their number, characteristics and classification.

In an attempt to answer this paper's research question, literature findings regarding smart city business models were collected and discussed. Literature returned three business model types (web-based, network owner and e-commerce), which have been utilized in different manner by various smart city cases. On the other hand, business model patterns were assigned to the extracted smart city business models and successful matching to three patterns was observed (open, free and unbundling). Moreover, this paper

examined real case studies internationally and observed that the adopted business models are quite different to the ones discovered in literature. Another unexpected outcome concerned smart city network's commercialization, where open access model is the preferred one. Finally, findings show that IoT has not been capitalized in smart cities yet and corresponding business models have not been extracted.

Although this paper concerns a work in progress, existing outcomes can be utilized by smart city vendors, while future research aims to shed light on more prestigious smart city cases and discover means with which enterprises can enter smart cities succesfully.

5. ACKNOWLEDGMENTS

This research has been co-financed by the European Union (European Social Fund - ESF) and Greek national funds through the Operational Program "Education and Lifelong Learning" of the National Strategic Reference Framework (NSRF) - Research Funding Program: ARCHIMEDES III. Investing in knowledge society through the European Social Fund.

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