Understanding Smart City Business Models: A Comparison

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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.

Categories and Subject Descriptors
K.1.1 [**Markets**]: Computing Milieux - *the computer industry*. K.4.3.4 [**Reengineering**]: Computing Milieux – Computers and Society - *Organizational Impacts*

Keywords
Smart city; Business Model; e-government; value proposal

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 [11] from Accenture too, who located the source of this money on embedded operational efficiency, as well as on new entrepreneurship. Moreover, [5] 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 [2; 3], which 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.

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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 [2]. 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 [1; 14] and the outcomes of interviews from case studies. All the identified smart city business models are assigned to patterns presented by [12].

The remainder 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
Various scholars [3; 6; 9] define smart city 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). To this end, many vendors ([1; 5] etc.) lead the development of corresponding solutions, which enhance sustainability, efficiency, safety and other urban challenges.

However, despite this documented vendors' interest on smart city, most corresponding investments are performed with public initiatives. Existing works [2; 3] 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 [8] 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 [7], 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 [11]. A business model describes the rationale of how an organization creates, delivers, and captures value (economic, social, cultural, or other forms of value) [13]. One of the most widely accepted definitions come from [15], 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" [14] contains four components and places in the center the value proposition [4].

Although there could be various value propositions, business models can be classified in five patterns according to [12]:

- 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).

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 [3] 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. 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 utilized in a smart city.

3. DOMAIN STUDY: EXISTING SMART CITY BUSINESS MODELS

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 [10] 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. Web-based business models match the previously mentioned patterns. These outcomes demonstrate that open pattern "conquer" 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, [2; 3] 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 Municipality 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 [14] (Table 1).
2. Openness of the Commercial Enterprise and ICT network ownership [1] business model (Table 2).

In (Table 1) each service group was considered to be offered by an individual provider (or groups of stakeholders). The assignment of a pattern in (Table 2) 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 change when the IoT is utilized as the key-resource, which results to the corresponding

Table 1. E-Service business models

id	e-Commerce Business Model(s)	Cases	Business model pattern
1.	1. Social Networks	America-On-Line (AOL), Kyoto (Japan), Bristol (U.K.)	*Free*
2.	1. Membership 2. Social Networks 3. Affiliate marketing	Copenhagen Base, Craigmillar Community Information Service (Scotland)	*Open*
3.	1. Value chain integration	Seoul, Beijing, Helsinki, Geneva-MAN (Switzerland), Antwerp (Belgium)	*Unbundling*
4.	1. Affiliate marketing 2. Value chain integration 3. Membership	Taipei (Taiwan), Tianjin (China), Barcelona, Brisbane (Australia), Malta, Dubai	*Unbundling*
5.	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*
6.	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*
7.	1. Customization 2. Social networks	Dongtan (S. Korea), Tianjin (China), Austin (U.S.A.), Amsterdam, Copenhagen, Taipei (Taiwan)	*Unbundling*

IoT business models. However, cities in the above examined cases have not capitalized the IoT yet, which leaves an open space for start-ups and other vendors to develop their customers' value.

3.2 Case Studies

Except from the above literature findings, some case studies were explored with trips and interviews with the corresponding supervisors (Table 3). 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 2. Openness of the Commercial Enterprise and ICT network ownership business model assignment

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

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

Table 3: Outcomes from visits and interviews by smart city experts

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

Table 3 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 [7] 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 [13]. To this end, this study demonstrates 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 successfully.

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