

## PRESENTING THE SMART CITY BUSINESS MODEL: QUALITATIVE AND QUANTITATIVE INDICATORS FOR ENERGY SERVICES

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### ABSTRACT

*This article introduces a theoretical framework for the analysis of business models that involve public actors and city governments in particular, in the value network. It starts from an established business model framework and expands it to include an additional set of indicators required to successfully perform a qualitative and quantitative analysis of the business models of new services offered by cities. It then applies this framework to several divergent cases from the energy services sector in which city governments are involved as part of their efforts in becoming “smarter cities”. Hence, in order to understand the existing challenges and to recommend some effective solutions for smart cities facing business models and necessary indices in the field of energy, it is necessary to study and examine business models in smart cities with the approach of qualitative and quantitative indices in the field of energy, especially in the industries related to electricity. The present study was aimed to identify and present business models for smart cities together with emphasizing qualitative and quantitative indices in the field of energy in order to realized the importance of the present subject through studies and to take steps to determine necessary indices. The pattern of the present study was theoretical-basic and an analytic-descriptive method with past views was used to explain it. Moreover, library and attributive resources were employed in order to collect data.*

### INTRODUCTION

Today, countries have an increasing tendency towards smartening of cities. In addition, business have been faced with a challenging and changing environment in smart cities which have forced them to compete in order to achieve ongoing improvement and innovation. On the other hand, this has coincided with the globalization of energy, especially electricity, and the necessity to make presence in global markets. These difficulties mainly pertain to the business models of these new services, combined with the fast moving pace of the ICT and electrical industry and slow reaction time of city administrations to changes in these sectors. In this quickly evolving context, city governments need to rethink the ways in which they interact with large Power distribution companies (DSOs) in offering services to their citizens as well as how they communicate with those citizens. New sets of indicators, based in both qualitative and quantitative research can provide helpful guidelines in achieving this[1].

These questions link up to the ever-evolving concept of Smart Cities. We will see that although this notion remains

vague, it has a great deal of potential in framing some particular challenges cities face today and provides new ways of thinking about potential future issues. As DSOs generally form a large part of the operationalisation of the Smart City concept, we will take a closer look at how electrical industry can be an important tool in reaching “Smart City goals” policy makers set out, as long as careful and systematic thought, facilitated by structured approaches using qualitative and quantitative indicators, goes into the development of the business models for these new “smart” services. Developing, rethinking or making a strategy explicit can allow cities to adapt more quickly to the changes and challenges in the field referenced above. This article takes electrical industry services as a case to explore new ways of thinking about business models in a public context and proposes a new set of qualitative and quantitative indicators and theoretical framework to tackle pressing questions in this area[3]. Finally, since energy sector and electric power distribution companies in particular are infrastructures needed for business models in smart cities, with qualitative and quantitative developments happening in this field in the recent years, as well as the great extent of activities in electricity distribution, we need the most up-to-date and newest optimal models for business in our smart cities. Therefore, this research intends to examine the status, logic and model of business available in smart cities based on the features of business models in order to offer a model on the basis of the results obtained from the examination. Based on this, energy and distribute energy companys can survive in such a fast paced and competitive world and prepare themselves for future changes.

### Smart City

Even though the term is relatively young, the operationalisation of what a Smart City is, can vary dramatically depending on the approach. Several attempts have been made at formulating a definition of the Smart City, taking different perspectives. In an effort to be holistic, several areas a city should focus on in making itself “smarter” have been identified, such as competitiveness, social and human capital, participation, transport and ICT, natural resources and quality of life [2,3]. This was not only the case in sectors that are directly related to ICT or telecommunications, but also in various other sectors and industry branches beyond it e.g. health, culture, media, mobility, energy, government, policy etc[4]. In spite of the many attempts at definitions, the Smart City concept remains elusive [5]. However, it is an indication of the increasing need to develop new ways of looking at the city of the future and to think about structured approaches to provide answers for the diverse and complex questions companies, citizens and governments face there.

Rather than attempting a holistic and general definition of what a Smart City is we prefer to clarify our perspective on the concept in the follow in section. Generally, a smart city is a city which seeks to enhance citizens' life quality and to provide sustainable development using modern technology and IT. For a city to be entitled "smart", it must have certain dimensions and characteristics. Since "smart city" is a novel concept in today's world, different sources consider different dimensions for it. However, all of them pay special attention to the following two main goals: life quality enhancement and sustainable economic growth. Over the last few years, the concept of "smart city" has been put forward in different countries. On the other hand, numerous challenges have turned the concept of smart cities into a serious must; by 2013, over 140 cities in the world have started smartening plans, most of which are in North America, Europe, and East Asia[1]. What has made these cities start to implement this novel concept? The factors are as follows:

**Increase in Urbanization:** statistics show that the population of the world increasingly tends to live in cities. Currently, over 50 percent of the world's population lives in cities. Also was 39 percent in 1970 and it is predicted that it will reach 70 per cent in 2050.

**Changes in age pyramids:** based on the estimations done from the UN's social and economic affairs, 16 percent of the world's 9 billion population (i.e. 1.5 billion people) will be at the age of 65 or over in 2050. This seems to be significant in comparison with current status (400 million people). It can be said that one of the most useful functions of smart cities is to help elderlies and the disabled do their daily assignments.

**Environmental Concerns:** currently, 30 billion tons of carbon coming from burning fossil fuels enters the atmosphere every year. Based on the analyses carried out by the international agency of energy, if a solution is not found for this situation, the amount of carbon in the atmosphere will be doubled.

**Polarization of Economic Growth:** predictions indicated that 600 of top cities in the world will have 60 percent of GDP between the years 2010 and 2025. In addition, they will have the population of about 2 billion. Therefore, big and crowded cities in each country will act as competitive advantages of that country.

According to the definition presented by the EU, a smart city refers to a city which has the following six features:

**1) Smart Transportation.** The key to smart transportation lies in smart transportation systems (ITS); this is a known concept in the world's transportation systems. In order to realize smart transportation, it is necessary to use certain new technologies and equipment in fleet. These technologies include: Global Positioning System (GPS), Dedicated Short-Range Communications (DSRC), wireless internet network, mobile phones, radio waves, road cameras, and positioning equipment, all of which are needed in electricity distribution companies in order to

offer favorable and accessible services.

**2) Smart Environment.** A smart environment is one in which we can use new technologies to maintain environmental resources. Generally, in order to evaluate the quality of the environment in the world, they measure certain indices. The most important indices are: pollutants (such as carbon dioxide), energy (level of consumption and intensity of consumption), buildings (energy consumption in each building), transportation (non-auto transportation level), etc. In fact, one of the purposes of smart cities is to improve environmental indices through managing energy consumption.

**3) Smart Economy.** many countries have provided certain plans in order to develop their economy and to move towards a smart economy. In this regard, we can refer to Wellington city (i.e. capital of New Zealand). In order to achieve such goals, administrators of Wellington are intending to turn their city into the communications center of the country, leading to opportunities for economic investments; with a careful look at this, the role of electricity distribution companies is undeniable.

**4) Smart Citizens.** The key elements of such a dimension of smart cities are training, creativity, and public cooperation in city affairs. Using technologies for virtual training and integrating training centers, many losses in education systems have been made up for. Moreover, electricity distribution companies play a considerable role in the success of these processes.

**5) Smart Lifestyle.** Security, health, rich culture, as well as tourism development are parts of smart life. Enhancement of health care services, using IT which needs proper and safe electricity distribution companies, can improve the level of social health.

**6) Smart Government.** IT in a smart city helps the government to act better in terms of delivering service. In addition, with the publication of information connected to functions, they can help to develop a transparent government; without electricity distribution companies giving proper services, its success will be out of the question[2].

It is important to remember that these six dimensions do not have separate structures, and in many cases, advances in one dimension demand advances in another. Furthermore, holistic approaches must not be forgotten when it comes to achieving goals. For the purposes of this article we will take a closer look at DSOs in the city as an example of a sector that is likely to be a significant part of the Smart City.

### **Business Model**

Today, business models are the key to success. Therefore, having a managerial approach for strong businesses is essential in cities. Business management together with necessary patterns provides an integrated and systematic method for design, implementation, and management of business processes in cities.

Considering the fact that business management systems provide an opportunity for smart processes in cities, all solutions lead to a business system which is the core of urban systems working to enhance performance[6]. In fact, the modeling of businesses is a tool that helps cities reach competitive advantages, and enhancement of business performance and process can be a systematic representative planned by business analysis model [7]. In scholars' viewpoint, Business models have been defined emphasizing different faces. Ayer and Follack [8] found the model to be a description of business system for values. According to Ostrwalder and Pignior business model is a description of a value that a company offers to one or more customers. It is a plan that a company and its employees uses in order to produce, market, and deliver value and communicational capitals, leading to positive and consistent incomes [9]. In the following, according to Ostrwalder (2005), we come across questions as the bases of a business model in the field of smart cities:

- 1) Services: What business is a smart city active in? What valuable services does it give to the market?
- 2) Customer: Who are targeting customers and how are they being communicated with?
- 3) Managing infrastructures: In smart cities, how should infrastructural activities been done?
- 4) Financial aspects: What is the income model and structure of business in smart cities?
- 5) What features do human resources demand for smart cities possess? [9].

In this research, using an optimized basic business model offered by Ostrowalder, we try to express business models of smart cities, with an approach of energy; and we do case study in electricity distribution companies. Indeed, the reason we choose it is the integration of business models, and since it does not have a systematic attitude for designing business models, it is not utilized.

### **Infrastructures required for smart cities:**

Various models have been designed for smart cities. One of these models was introduced by Hitachi. Hitachi has a longstanding history in designing smart cities. This company has pictured the structure of smart cities in four categories:

**National Infrastructures:** this layer includes infrastructures which are beyond the management of a city. In this layer, components such as energy, water, electricity, transportation system, and communications in a national level are of importance. Furthermore, the relevance of these systems in different cities is managed in this layer.

**Urban Infrastructures:** this infrastructure is a collection of small operational units in cities. This layer must be in

harmony with national infrastructures. In this model, the collection of national and urban infrastructures is called public infrastructures including : energy, transportation, water, and communications.

**Service Infrastructure:** this layer includes urban facilities and services such as training, health, finance, and etc. Service infrastructure interacts with urban infrastructures in order to offer various services.

**Urban management infrastructure:** this infrastructure uses IT for coordinating the three layers. The roles of this layer are: information management, operation management, and exploitation of urban facilities. Components such as green transportation systems including electric cars, water and sewage management systems, and smart electricity network lie in this layer. The purposes of this structure includes optimizing and forming balance between supply and demand, reducing wastes, increasing productivity, delivering valuable services with high value-added tax, removing illegal activities, and finally offering smart life components[2].

Considering infrastructures needed for development of smart cities in all levels, the role of energy and especially electricity distribution companies is vital; even if we do not consider a broad view like a smart city, for the following reasons, electricity distribution companies are considered to be an inevitable choice in business models of smart cities in the third millennium. Also development of digital devices which are sensitive to electricity quality:

- a) Considering the fact that the amount of electricity used by such devices, with a five-time growth, will go from 10 percent to 5 percent by 2020.
- b) High growth in energy usage, and a 100-percent increase in electricity consumption in the world, and a 300-percent increase in electricity consumption in the middle east by 2050.
- c) Development of electric and hybrid cars and a 50-percent increase in their numbers in the car basket of the world by 2050.
- d) Necessity of reducing carbon, and entering renewable energies into the world's electricity basket.

### **Qualitative and Quantitative Indices**

According to the above-mentioned procedures, and considering qualitative and quantitative indices, electricity distribution is very necessary in smart cities, because the elements of smart cities have changed greatly and the relationship of its components will be much more complex than now; and with current methods, we cannot manage them.

Generally, considering the elements and infrastructures needed for smart cities, we can summarize the qualitative and quantitative indices of electricity distribution companies as follows: reducing silence time, reducing fatalities in electricity distribution network, increasing electricity quality, using different energy sources such as renewable sources, scattered producers, and etc, number of users, interaction with users, mutual contact with consumers, and selling extra electricity to electricity network, accordance with other urban infrastructures, optimal usage of existing infrastructures in electricity distribution networks, accessibility of networks, managing energy consumption, using smart measurement devices, having employees with technical and expert knowledge needed for smart cities[10,11,12]. Finally, considering the infrastructures required for smart cities and considering Ostrowalder's business model, we can present smart cities' business models with qualitative and quantitative indices of energy as follows:

- 1) Services: reducing silence time, reducing fatalities in electricity distribution network, increasing electricity quality, using different energy sources such as renewable sources, scattered producers, and etc.
- 2) Customer: Number of users, interaction with users, mutual contact with consumers, and selling extra electricity to electricity network.
- 3) Managing infrastructures: accordance with other urban infrastructures, optimal usage of existing infrastructures in electricity distribution networks, accessibility of networks
- 4) Financial aspects: Managing energy consumption, using smart measurement devices
- 5) Human resources: Having employees with technical and expert knowledge needed for smart cities

## CONCLUSION

Electricity distribution companies nowadays are of important pillars for business models in smart cities. On the other hand, this has become more important following the need to participate in global markets and globalization. Currently, business models in smart cities are facing a great challenge in a way that traditional companies with low synergy turn into dynamic companies with high synergy. Finally, we understand from the present study that by applying a business model in smart cities and by considering qualitative and quantitative indices of electricity distribution companies, there will be opportunities to help to move forward in all the six dimensions of smart cities. In addition, the use of smart networks are recommended in this regard, which make it

possible for electricity distribution companies to apply online distance control to network equipment. However, there are lots of things can be mentioned in the field of smart networks. On other words, they can retrieve networks automatically and distribute network load in order to reduce fatalities and optimally use equipment with the help of smart software and by connecting network elements and users. hence, they provide opportunities for realization of the six dimensions of smart cities.

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