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Exploratory research on success factors and challenges of Smart City Projects

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(Abstract)

Exploratory research on success factors and challenges of Smart City Projects

As urbanization and its consequences become the issue of modern cities, the concept of Smart City comes as the solution. Though a lot of research on the topic has been done, still no clear definition is given for both: Smart City itself and the factors of a successful Smart City. While most of the literature centers the role of ICT it is not a sufficient condition for a city to become Smart; the role of intellectual capital is underestimated. Using a collection of Smart City definitions across the time and providing concrete cases, this research seeks to bridge definition gaps and creates a tool for understanding Smart Cities. Drawing on the findings of several case studies, this research derives several explanatory factors.

As the research proceeds with 3 general parts each has a certain purpose as follows:

1. To bridge definition gaps of the "Smart City" by defining the term "Smart City", based on existing concepts and characteristic mechanisms across times.
2. To develop an analytical tool for Smart City success factors through Explanatory Variables
3. To identify major challenges and barriers of Smart City Projects implementations and to provide recommendations and solutions, based on existing governmental initiatives and pilot projects.

Considering the results of the Multidimensional Smart City Values Analysis the research derives that Citizens Engagement and Governance of the city is important. Based on this, we derive some strategic implications about the successful implementation of a Smart City Project.

Implication 1.

The most important variable that determines the success of a Smart City Project is not the level of ICT development or smart technologies equipment of the concrete city, but the level of Citizens Engagement (CE). While Governance (G) and Infra and ICT (II) come as another 2 primary factors and also have a direct effect on the success of the Smart City, they follow

Citizens Engagement (CE) by their importance. Governance has been and always will be based on citizens' participation. The citizen's perspective is important because it is ultimately people, who will live and work in a smart city. If the features and amenities of the city don't speak to the ways people want to live their lives, all the 'smart' in the world will be of little practical value.

Implication 2.

Infra and ICT (II) is the enabler of the Smart City success. Though analysts, planners, IT companies and other experts tend to define a smart city in terms of its infrastructure: high-speed broadband, wireless and Wi-Fi connectivity, the cloud, sensor networks and the like all of these are important enablers of a smart city, supporting a range of flexible, intelligent services such as smart metering, enhanced traffic management and emergency response systems. "Smartness" of the city can be literately put as equal to the "happiness" of its citizens [Campbell, 2012]. Thus, the level of ICT development nowadays can only be seen as an enabler. ICT technologies allow for greater involvement of individuals in the design, production and delivery of services, thus empowering citizens, making smarter and greener decisions in daily life, making governments and city administrations more transparent, responsive, accountable and trustworthy, involving businesses and citizens in a continuous dialogue [Foley, 2013]. Citizens should define life in megacities together with governments, and with the support from ICT solutions and technology. ICT is an enabler to become a 'Smart City' as these technologies certainly foster the efficient use of resource and collaboration/integration within citizens. On the other side, ICT is not a sufficient condition. For a City to become a 'Smart City' it needs full engagement of its government and its citizens. They need to be aware of the importance of the environmental, social and economic challenges and tackle them. ICT is necessary condition to effectively overcome these challenges, but it is not sufficient by itself.

The major contribution of this paper is identification of key variables of a successful Smart City Projects through case study. Using a collection of Smart City definitions across time and analyzing 13 cases this research emphasizes the role of citizens and their engagement as the first main factor along with governance as the secondary main factor for Smart City Project success. Different to the way other researches define traditional ICT as the primary factor for the success

of Smart City Projects this research shows that in practice technologies can be seen as an enabler of Smart City development driven by citizens. Challenges and barriers are categorized in order to provide Smart Cities' stakeholders with implicational tools and managerial approaches to sustainable urban development, based on existing governmental and corporate initiatives.

Thus, this thesis research contributes to the knowledge of smart cities and ICT integration for urbanization issues solution. By applying the findings of this research at the managerial level stakeholders may benefit by getting higher efficiency of the Smart City Projects and by utilizing knowledge and values of a Smart City Projects in a prioritized way.

Keywords: Smart City Projects, Sustainability, Citizens Engagement, Governance, role of ICT

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Dedicated to everybody, who needs this…

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Chapter 1 Introduction

1.1 Relevance and Objectives of the Research

“Our cities are fast transforming into artificial ecosystems of interconnected, interdependent intelligent digital organisms.” William J. Mitchell, MetropolisMag

In an era where telecommunications and social networking dominate the social and cultural character of the population, reality shows that they can influence where a person decides to settle. Bringing a revolutionary concept of sustainable development, quality of life and innovative use of media, the "Smart City" concept now appears to be the wave of the future urban planning. With the majority of people migrating to urban communities management of public transport, infrastructure and development of a sustainable economy becomes more complex. According to statistics more than 50% of the world population (3,5 bln) now is living in the cities and by the year 2050 the percentage will raise to 70%. Though cities occupy only 2% of the Global Land Area they consume 75% of all energy and produce 80% of al CO2 emissions. Growing needs of cities and its citizens urge governments to undertake new «smarter» path to utilize current and potential resources more effectively and efficiently. Not only cities are the main consumer of energy, they are also the main driving power, producing 50% of the world GDP (cities with the population over 750 thousands) and adding up to 10-15 trillion dollars to global GDP production. Governments now have to implement sustainable development models, based on renewable energy and technologies, which change the structure of the industry and perceptions of major players. Consequently, cities and citizens, as major stakeholders in this transformation, will face new challenges with the progress of urban communities. They will have to adapt accordingly for successful implementation of “Sustainable Development” and “Smart City” concept.

As ABI Research predicted that while $8.1 billion was spent on smart city technologies in 2010, by 2016 that number is likely to reach $39.5 billion [Schelmetic, 2011]-1. As of today, there are 102 smart city projects worldwide, says ABI, with Europe leading the way at 38 cities, North America at 35, Asia Pacific at 21, the Middle East and Africa at six, and Latin America with two. This research will review 13 Smart City Projects, which are represented widely in the media and ranked by major data institutions and agencies. From these cases essential variables, which are already recognized as the comprising factors of the success of Smart City Projects, while new variables, which have not yet received the recognition, will be discovered as well.

The objectives of this research are as follows:

1. To bridge definition gaps of the “Smart City “by defining the term “Smart City”, based on existing concepts and characteristic mechanisms across times.
2. To develop an analytical tool for Smart City success factors through Explanatory Variables
3. To identify major challenges and barriers of Smart City Projects implementations and to provide recommendations and solutions, based on existing governmental initiatives and pilot projects.

1.2 Methodology

Case study is chosen as a research methodology for this thesis. Robert Yin’s work [Yin, 2002] and Izak Bensbasat Case Research Strategy in studies of Information systems [Bensbaat, 1987] are used as guiding principles for case study research. As Benbasat noted the goals of the researcher and the nature of the research topic influence the selection of a strategy. Here provided are 3 reasons why case study research method is a viable option for information systems research:

1. The researcher can study information systems in a natural setting, learn about the state of the art, and generate theories from practice.
2. The case method allows the researcher to answer "how” and "why” questions, that is, to understand the nature and complexity of the processes taking place. Questions such as, "How

does a manager effectively introduce new information technologies?" are critical ones for researchers to pursue.

3. A case approach is an appropriate way to research an area in which few previous studies have been carried out. With the rapid pace of change in the information systems field, many new topics emerge each year for which valuable insights can be gained through the use of case research.

In this case above-mentioned methodology is particularly appropriate for certain types of problems, including those in which research and theory are at their early, formative stages [Bensbaat, 1987]. Smart cities constitute a multidisciplinary field of research and development and despite various approaches from different sources this field is still rather young and characterized by constant technological change and innovation. Also, researchers usually learn by studying the innovations put in place by practitioners, rather than by providing the initial wisdom for these novel ideas.

Case Research strategy is well suited to capturing the knowledge of practitioners and developing theories from it.

Finally, this method allows to point out main factors of Smart City projects and to make generalizations to all stakeholders of Smart City Projects.

Multiple-case study research is desirable, when the intent of the research is description, theory building, or theory testing. These three correspond to Bonoma's design, prediction, and disconfirmation stages, respectively [Bonoma, 1985]. Multiple-case designs also allow for cross-case analysis and the extension of theory. Multiple cases yield more general research results, which can be later used for stakeholders' implications.

Multiple data collection methods are typically employed in case research studies. Ideally, evidence from two or more sources will converge to support the research findings. Yin identifies several sources of evidence that work well in case research [Yin, 1994]. In this paper two major methods are used:

1. Documentation: written materials, ranging from memoranda to newspaper clippings to formal reports.

2. Direct observations: absorbing and noting details, actions, or subtleties of the field environment [Webb and Campbell, 1966]. Also physical artifacts such as devices, outputs, tools, etc. are used for these purposes.

1.3 Expected Results and Contribution

The research is expected to contribute into the matter of understanding Smart Cities in two ways:

1) by developing an analytical tool for Smart City success factors, which can be used for researches and empirical testing in future studies.

2) by providing Smart Cities' stakeholders with implications and managerial approaches for sustainable urban development, based on the categorization of challenges and barriers to Smart City Projects Development.

There is a need to define Smart City in a "general" sense, since numerous researches and articles define it in its own way and still no clear definition of the Smart City is given. Using a collection of Smart City definitions across the time and providing some definition mechanisms and concrete cases, this research seeks to bridge definition gaps and give a general idea of the Smart City.

While most of the literature centers the role of ICT it is not a sufficient condition for a city to become Smart. This study shows that the role of intellectual capital has been underestimated. Drawing on the findings of several case studies, this paper derives explanatory factors, among which citizens engagement and governance are becoming the key factors with ICT and other factors as enablers.

Analyzing the challenges of Smart Cities the research provides recommendations and solutions for Smart City stakeholders, based on the results of case studies. Challenges and barriers are categorized to create a basis for taking concrete actions, when developing Smart Cities Projects and offering solutions through existing governmental and corporate initiatives in the form of Pilot Projects and Business Models Innovation.

Chapter 2 Theoretical Background

2. 1. Smart City: Concept and Definition

Despite the fact that numerous articles and researches have attempted to define the smart city it is still fuzzy, as there is no uniform concept and different approaches are used for this purpose. Some papers discuss it as a general case study, while others deal with specific parts, such as: smart grid, smart meters, Intelligent Transportation System (ITS), smart home, smart water, smart medical care, smart food and other. There is a need to define Smart City in a more "general" sense. To do this it is desirable to look into the history of the smart city definition starting from its "Theoretical Past" till the "Economic Future".

2.1.1 Past: ICT-Driven City; Efficient City; Cyber City; Digital City; U-City

The history of smart cities begins in 1994, Netherlands, when the term «Digital City» (DDS) was launched as a virtual public domain [P. van den Besselaar and D. Beckers, 2005]. That was the period which saw enormous growth in the Internet and increasing use of public media. Many researches began to pay attention to information and communication technologies (ICT), including Dr. Bill Mitchel from MIT (ICT-driven cities). Other researchers at the Brookhaven National Laboratory made public the ideas of the next Big thing – Efficient Cities. By late 1999, when the commercial Internet came in its full use such terms as «Ubiquitous Computing», «U-city», «Cyber city» were presented, and finally in 2000 the idea of «Smart City» came into use.
It is worth to note the case of Korea in the development of the term U-City. The term U-City is used here since 1998 after accepting the concept of ubiquitous computing, a post-desktop model of human-computer interaction created by Mark Weiser, the chief technologist of the Xerox Palo Alto Research Center. There has been a lot of research in this field since 2002. As a result, many local governments in Korea have applied this concept to various development projects since 2005 based on a practical approach to it. A ubiquitous city or U-city is a concept

of integration of ubiquitous computing within an urban environment. It can be described as a merge of information systems and social systems, where virtually every device and service is linked to information network through wireless networking and RFID tags and sensors [Lee, 2013]. Anthony Townsend, a research director at the Institute for the Future in Palo Alto, and a former Fulbright scholar in Seoul views U-city as an exclusively Korean idea [O'connel, 2005].

2.1.2 Present: Intelligent City; Knowledge City; Smart City;

Nowadays the concept of Smart City is most widely used, though it is quite similar to U-City concept. The difference of former is in the Degree of Intelligence. Smart city is considered as a Post Ubiquitous city. U-City is a city with artificial intelligence, made possible by information technology attached to various basic amenities. Newly introduced Smart City is a development from U-City after the introduction of smart phones, or similar telecommunication concept, which allows connection of individuals to the city like human neural network. Smart Cities assumes people involvement and inter-communication, without emphasis on the location of citizens. The significance of two assets - social and environmental capital - distinguish smart cities from their more technology-laden counterparts, drawing a clear line between them and what goes under the name of either digital or intelligent cities. Thus, Smart City depends not only on the endowment of hard infrastructure ("physical capital"), but also, and increasingly so, on the availability and quality of knowledge communication and social infrastructure ("intellectual capital and social capital") [Caragliu, 2009].

The concept of smart city is not fixed and its ever-changing and adaptable nature makes even more complex the achievement of its operative stage. Another interpretation of a Smart City is about the City that uses a smart system, characterized by the interaction between infrastructure, capital, behaviors and cultures, achieved through their integration. Few of us understand where this generational disruptive technology came from and where it may go. The only one thing to be sure about is that the information of communication technology (ICT) covers all areas on smart cities such as government facilities, buildings, traffic, electricity, health, water, and transport.

2.1.3. Future: MESH City; Sense, Soft and "Warm" Technology City.

More modern way of calling SMART cities is MESH cities [Komninos, 2001]. MESH stands for: M=Mobile (mobile devices and the networks that support them provide the bottom-up, real-time information, conduit to supply feedback about a city, its users, and its systems), E=Efficient (about sustainability achieved through effective use, monitoring and management of energy, traffic, etc), S=Subtle (invisible and non-intrusive systems, easy-to-use modern city systems for citizens), H=Heuristics (heuristics-based continuous improvement, which makes the system self-reflexing, adaptive self-forming and citizen-focused).

In the future, ICT is going to be developed into the soft as well as warm techniques. Artificial Intelligence technique will be upgraded to act like a human being with emotions. [Shin, 2012]. Future of today's Smart Cities can be referred to as Sense, Soft and Warm Technology City. Lee and Hancock categorize the definitions of Smart City by subjective view on them [Lee and Hancock, 2012]. Three definitive categories are presented in the Table 2.1 below
As per these practical and academic views definitions of a Smart City are different and there is no one «fit-to-all» meaning of a Smart City. Based on the variety of different conceptual definitions of a smart city presented above, this paper proposes a comprehensive set of factors that are essential to understanding smart city projects.

Table 2.1 Working Definitions of a Smart City

View Type	Definition
Practitioner View	a) The use of Smart Computing technologies to make the critical infrastructure components and services of a city —which include city administration, education, healthcare, public safety, real estate, transportation, and utilities — more intelligent, interconnected, and efficient."[Forrester, 2011]. b) "A smart city is based on intelligent exchanges of information that flow between its many different subsystems. This flow of information is analyzed and translated into citizen and commercial services. The city will act on this information flow to make its wider ecosystem more resource-efficient and sustainable. The information exchange is based on a smart governance operating framework designed for cities sustainable." [Gartner, 2011] c) "Smart city" [refers to] a local entity — a district, city, region or small country — which takes a holistic approach to employ[ing] information technologies with real-time analysis that encourages sustainable economic development." [IDC, 2011] d) A city "combining ICT and Web 2.0 technology with other organizational, design and planning efforts to dematerialize and speed up bureaucratic processes and help to identify new, innovative solutions to city management complexity, in order to improve sustainability and livability." [Toppeta, 2010].
Scholar View	a) "Smart City is referred as the safe, secure environmentally green, and efficient urban center of the future with advanced infrastructures such as sensors, electronics and networks to stimulate sustainable economic growth & a high quality of life" [Hall, 2000] b) "A city can be defined as «smart» when investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance"[Caragliu, 2009]. c) "A city well performing in a forward-looking way in economy, people, governance, mobility, environment & living, built on the smart combination of endowments and activities of self-decisive independent and aware citizens" [Giffinger and Gudrum, 2010] d) A city "connecting the physical infrastructure, the IT infrastructure, the social infrastructure, and the

	business infrastructure to leverage the collective intelligence of the city" [Harrison, C., et al].
City View	a) Smart City as a high-tech intensive and advanced city that connects people, information and city elements using new technologies in order to create sustainable greener city, competitive and innovative commerce and an increase life quality with a straightforward administration and maintenance system of city" [Barcelona City Hall, 2011]. b) "Amsterdam Smart City uses innovative technology and the willingness to change behavior related to energy consumption in order to tackle climate goals. Amsterdam Smart City is an universal approach for design and development of a sustainable, economically viable program that will reduce the city's carbon footprint" [Amsterdam Smart City, 2009]. c) A city that monitors and integrates conditions of all of its critical infrastructures, including roads, bridges, tunnels, rails, subways, airports, seaports, communications, water, power, even major buildings, can better optimize its resources, plan its preventive maintenance activities, and monitor security aspects while maximizing services to its citizens. [Hall, 2000]. d) A city striving to make itself "smarter" (more efficient, sustainable, equitable, and livable)

Though the ICT was at the heart of the Digital City in the early years, the smartest cities are now discovering how to use technology and redesign internal operational procedures to deliver more efficient and effective services to their Customers [Foley, 2013]. Whatever changes a municipality must make, customer-centricity – the true essence of 'smart' – comes down to people. Technology is a means to an end, but a clever new e-service will all but fail if people don't like it or won't use it. Municipal employees, whether they are inconspicuous administrators or face citizens every day in a neighborhood office, must understand: their work must always focus on servicing customers. Customers, meanwhile, must be ready to engage with their city authorities and work in partnership to make ever e-service deliver on its promises. Customers are certainly at the heart of today's smart city. In some places there may even be an app to prove it.

Thus, Urban performance currently depends not only on the city's endowment of hard infrastructure ('physical capital'), but also, and increasingly so, on the availability and quality of knowledge communication and social infrastructure ('intellectual capital and social capital'). The

latter form of capital is decisive for urban competitiveness. It is against this background that the concept of the smart city has been introduced as a strategic device to encompass modern urban production factors in a common framework and to highlight the growing importance of Information and Communication Technologies (ICTs), social and environmental capital in profiling the competitiveness of cities. [Caragliu, 2009]. The significance of these two assets - social and environmental capital - itself goes a long way to distinguish smart cities from their more technology-laden counterparts, drawing a clear line between them and what goes under the name of either digital or intelligent cities.

With the above-mentioned in mind, the Smart City can be defined as the next stage in the process of urbanization and Digital City Development, where the focus is still on the role of ICT infrastructure, however such factors as Human and Social Capital, Civic Engagement, Customer Centricity and Governance, Environmental Interest are becoming important and indispensable drivers for the Smart City success. Growing importance of each factor, named above, with the Citizens Engagement and Governance seen as premium ones, will be discussed later in this research and proved with the results of the analysis of Smart City case studies.

2.2. Mechanisms and approaches to define Smart City Projects.

The singular definitions, mentioned above, are not the only way to explain Smart City. Taking into consideration the fuzzy nature of the Smart City definition it is better to summarize the characteristics of a smart city, using the most common characteristic mechanisms, which show the main values a smart city project. Several mechanisms, existing in the scientific researches are to be described in this research:

1) Six–axes approach, suggested by European Cities Project [Giffinger, 2007]
2) Three dimensions mechanism by Korean University Industrial Technical Force [Shin, 2012]
3) Smart Operation Model by ICT, Climate Group [Webb, 2011]

2.2.1 The Six-axes approach, suggested by European City Project

The smart city model presented by European Cities Project defines a Smart City as a city well performing in 6 main characteristics, built on the 'smart' combination of endowments and activities of self-decisive, independent and aware citizens.

Table 2.2.1.1 Six-axes approach to characterize a Smart City, by European Cities Project

SMART ECONOMY (Competitiveness) □ Innovative spirit □ Entrepreneurship □ Economic image &trademarks □ Productivity □ Flexibility of labor market □ Embedded Internationally □ Ability to transform	SMART PEOPLE (Social and Human Capital) □ Level of qualification □ Affinity to life long learning □ Social and ethnic plurality □ Flexibility □ Creativity □Cosmopolitanism/Open-mindedness □ Participation in public life	SMART GOVERNANCE (Participation) □Participation in decision-making □ Public and social services □ Transparent governance □ Political strategies & Perspectives
SMART MOBILITY (Transport and ICT) □ Local accessibility (Inter-)national accessibility □Availability of ICT infra □Sustainable, innovative and safe transport systems	SMART ENVIRONMENT (Natural resources) □ Attractiveness of natural conditions □ Pollution □ Environmental protection □ Sustainable resource Management	SMART LIVING (Quality of life) □ Cultural facilities □ Health conditions □ Individual safety □ Housing quality □ Education facilities □ Touristic attractiveness □ Social cohesion

Table above presents the concept of Smart Cities as a complex of components from

environmental to social perspective. The ability to integrate these components with the help of innovative technologies will therefore ensure project success. In summary, a Smart city remains:

1) a city, where citizens and services providers have an access to enhanced information flow.

2) such city maximizes the utilization of its key resources by leveraging data gathered through widespread embedded sensors and controls, real time data analytics and ubiquitous communications.

3) a city, which combines disparate data sets to offer productivity insights and enhancement to its citizens and service providers.

4) a city, which maximizes the economies of scope and scale across its multiple infrastructure layers through a common service delivery platform, or Urban Operating System ("Urban OS").

5) a city, which uses innovative technology and innovation to strive to go beyond economic targets, to deliver sustainable, quality of life improvements for its citizens, its industry and the local environment.

2.2.2. Three dimensions mechanism by Korean University Industrial Technical Force

Another mechanism to describe a Smart city is Three Dimension Mechanism, developed by UNITEF, Korean University Industrial Technical Force.

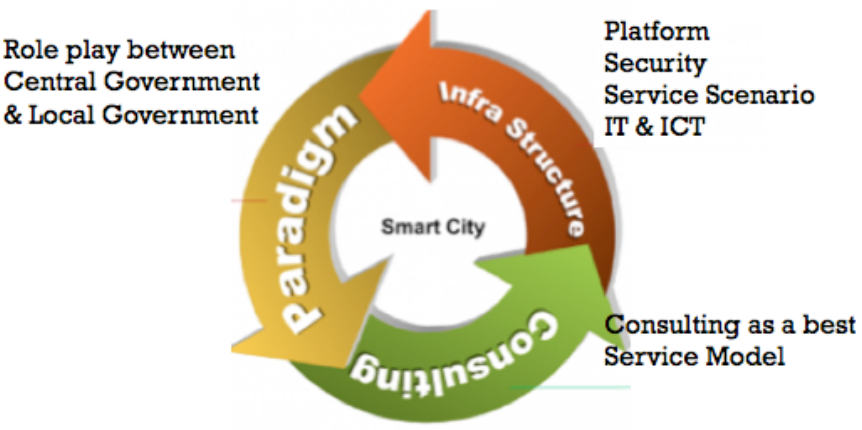

Figure 2.2.2.1 Three Dimension Mechanism to define a Smart City

It is not a secret that Korea is at the top of leading countries in IT sector and it also leads the development of smart city concepts with it government and corporate agencies. According to the UNITEF the first and most important issue is the infrastructure of the smart city such as platform, security, and service scenario. The second issue is the paradigm of smart city such as role-play between Central Government and Local Government. The third issue is the consulting in order to have the best service model according to many types of organs, and business.

2.2.3. Smart Operation Model by ICT from Climate Group

Climate Group suggests another Smart City Operation model. As presented on the picture below (Fig 2.2), it is a complex system of values with the TECH as the core. This model emphasizes Policy and Funds as two pillars of harmonic functioning and support system for the Smart City Project. Public education, incentives, coordination mechanisms serve as tools for effective operation and values generation of the Smart City Project.

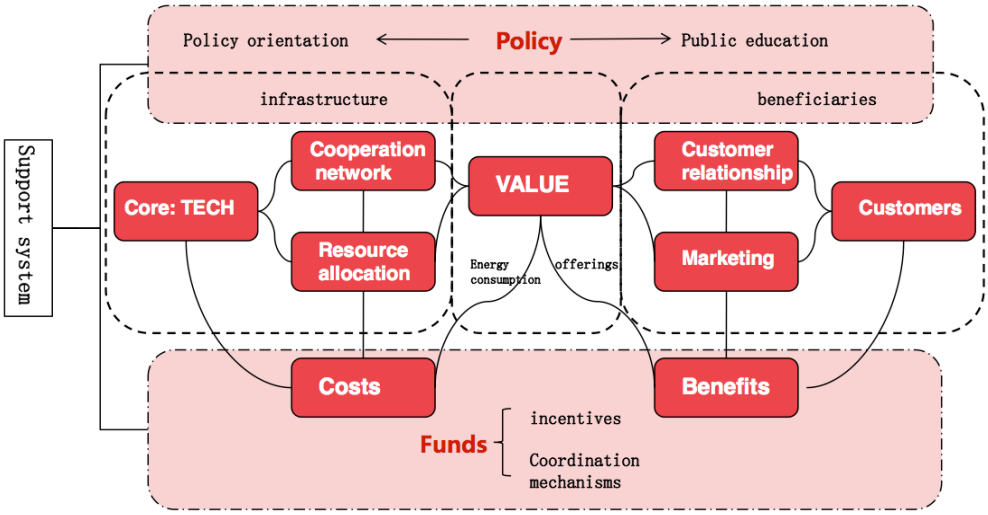

Figure 2.2.3.1 Smart Operation Model by ICT, Climate Group

The models, mentioned above, are only a few operational models to define Smart City Projects, and all they put different factors as a core for the success of the Smart City Project. If we take a more detailed look on the core of Smart city Projects, as stated by different organizations, we

could find even more definitions. The European Union sees it as an urban growth in a Smart Sense for its metropolitan city-regions [Del Bo, 2008].

At a mesoregional level, we observe renewed attention for the role of soft communication infrastructure in determining economic performance [Paskaleva, 2009]. However, the availability and quality of the ICT infrastructure is not the only definition of a smart or intelligent city. Other definitions stress the role of human capital and education and learning in urban development. It has been shown, for example, that the most rapid urban growth rates have been achieved in cities where a high share of educated labor force is available [Komninos, 2009].

Despite their abundance and difference all these concepts in their separateness cannot provide a full complex of values and a complete definition, based on a full complex of values, derived from concrete examples and cases of real Smart City Projects. Using already existing concepts and approaches and analyzing 13 cases of Smart City Projects, this paper will attempt to derive full complex of variables including those, which are not yet covered in the academic literature, to define the term «Smart City». By analyzing cases this paper will define the main factors of a Smart City's success. These factors, brought together, will comprise an essential tool for understanding smart cities initiatives and advancing the vision of characterizing smart city design initiatives, implementing shared services and navigating their emerging trends and challenges. This tool will also make the concept of a Smart City Project more applicable and will help to understand how each factor works for each case, and what actions are to be undertaken from a managerial perspective.

Chapter 3 Analysis of Smart Cities Through Examination of Case Studies

3.1. Reason of choice for Case Studies

Before introducing cases and variables, used in this research it is worth mentioning, that though a lot of data about existing Smart Cities is given, some cities still may not be taken into account due to the emerging and rapidly changing statistics on this question. That's why none of the statistics about Smart Cities, presented by relevant organizations and researches, provides full and accurate numbers and facts. By using the most recent data from major research institutes on Smart Cities and the information on emerging projects and latest trends, lately mentioned in the media, this research will attempt to provide more accuracy by distributing representativeness of cases used for analysis, so as to include the most renowned and highly covered ones in recent researches, and those, which are not yet received attention of ranking institutes, but are increasingly referred to as the ones, deserving consideration.

There are many rankings relevant to Smart Cities. This paper uses rankings, developed by researchers and research institutes. Boyd Cohen is a climate strategist and the CEO of CO2 IMPACT, leveraged about a dozen global and regional rankings of smart-city components in order to develop a global ranking of smart cities He took into account rankings, developed by the following organizations and compiled a table of Smart City Ranking (Refer to table 3.1.1)

1) Innovation Cities ranking by 2thinknow (to get a fair comparison of the level of innovation in top global cities)

2) Rankings of the quality of life of cities and infrastructure levels (Mercer survey: 2012 Quality of living worldwide city rankings)

3) Siemens regional rankings of green cities

4) The digital city rankings of Digital Community for cities in the U.S. (Tablc 3.1.2)

5) The IDC rankings of smart cities in Spain (indicated as IDC in the Table 3.1.1)

6) The digital governance in municipalities worldwide study to compare cities on their innovative use of ICT.

Besides, the following rankings were used in this paper as well:

7) Rankings and data by Alcatel Lucent, Climate Group, Arup.

8) IBM' "Smarter Cities Challenge" (competitive grant program to award $50 million worth of technology and services to 100 municipalities around the world.

Rankings, offered by Digital Government and National League of Cities choose the top digital cities, leading in open data, transparency efforts and innovation in deploying mobile applications to citizens while conforming to fiscal standards (Refer to table 3.1.2)

Table 3.1.1 Global Ranking of Smart Cities by B. Cohen

Rank	CITY	Region	Innovation Ranking	Green City Ranking*	Quality of Life	Digital City Ranking**
1	Vienna	EUROPE	5	4th in Europe	1	8
2	Toronto	NA	10	9th in North America	17	10
3	Paris	EUROPE	3	10th in Europe (RC: 6)	30	11
4	New York	NA	4	3rd in North America (RC: 8)	47	4
5	London	EUROPE	11	11th in Europe (RC: 9)	38	13
6	Tokyo	ASIA	22	Above Average in Asia (RC: 10)	46	15
7	Berlin	EUROPE	14	8th in Europe	17	32
8	Copenhagen	EUROPE	9	1st in Europe (RC: 1)	9	39
9	Hong Kong	ASIA	15	Above Average in Asia	70	3
10	Barcelona	EUROPE	19	NR in Siemens (RC: 3)	40	NR in DCR (IDC: 2)
10	Boston	NA	1	6th in North America	36	NR in DCR (DC: 8)
10	Sydney	ASIA	20	N/A Siemens (RC: Runnerup)	11	33
				*RC-Resilient Cities Ranking		
**NR means not rated in Digital Governance Survey/(IDC and DC rankings used instead						

The 13th Annual Digital Cities Survey had the following top 10 Priorities:

1. Open Government/ Transparency/ Open Data
2. Mobility / Mobile Applications
3. Budget and Cost Control
4. Hire and Retain Competent IT Personnel
5. Broadband and Connectivity and Portal/ E-government
6. Cyber Security
7. Shared Services
8. Cloud Computing
9. Disaster Recovery/ Continuity of Operations
10. Virtualization: Server, Desktop/ Client, Storage, Applications.

On the figure below top ten cities within the category of 75 000 to 124999 population is presented.

Table 3.1.2 The 13th Annual Digital Cities Survey

75,000-124,999 population category	
1st	City of Avondale, Ariz.
2nd	City of West Palm Beach, Fla.
3rd	City of Roseville, Calif.
4th	City of Westminster, Colo.
5th	City of Lowel, Mass.
5th	City of Davenport, Iowa
5th	City of Richardson, Texas
6th	City of Lynchburg, Va.
7th	City of Independence, Mo.
8th	City of Arvada, Colo.
8th	**City of Boulder, Colo**
9th	City of Roanoka, Va.
10th	City of Pueblo, Colo.

Innovation Cities Global Index 2012-2013 from 2thinknow is another way of ranking, seen as the most comprehensive city ranking and scoring.

Table 3.1.3 Innovation Cities Global Index 2012-2013 from 2thinknow

#	Rank	City	Country	Region	Sub Region	Classification	Index Score
1	3	Vienna	Austria	EUROPE	EUROPE	1 NEXUS	57
2	5	Paris	France	EUROPE	EUROPE	1 NEXUS	56
3	9	Amsterdam	Netherlands	EUROPE	EUROPE	1 NEXUS	55
4	24	Manchester	United Kingdom	EUROPE	EUROPE	1 NEXUS	52
5	30	Singapore	Singapore	ASIA	ASIA	1 NEXUS	51
6	34	Dubai	United Arab Emirates	EMERGING	MID-EAST	1 NEXUS	50
7	36	Helsinki	Finland	EUROPE	EUROPE	2 HUB	49
8	38	Oslo	Norway	EUROPE	EUROPE	2 HUB	49
9	56	Barcelona	Spain	EUROPE	EUROPE	2 HUB	48
10	123	Boulder, Colorado	United States	AMERICAS	USA	2 HUB	45
11	no rank	Malaga	Spain	EUROPE	EUROPE	3 NODE	40

Each city was selected from 1,540 cities based on basic factors of health, wealth, population, geography as well as potential relative to peers. The final 450 cities had data extracted the city benchmarking data program on 162 indicators, and this was reduced to 445 published cities. Each of the benchmarking data was scored by analysts, using best available qualitative analysis and quantitative statistics. Underlying data was then balanced against current global trends, by analysts to form a simplified 3 factor score for Cultural Assets, Human Infrastructure and Networked Markets. For city classification, these scores were competitively graded into 5 bands (Nexus, Hub, Node, Influencer, Upstart) based on how broad based (multiple indicators) the city

performance was. As per Innovation Cities Global Rankings all cities are graded into award categories based on their band score. In descending order of importance to the innovation economy:

1) NEXUS: Critical nexus for multiple economic and social innovation segments;

2) HUB: Dominance or influence on key economic and social innovation segments, based on global rends;

3) NODE: Broad performance across many innovation segments, with key imbalances;

4) INFLUENCER: Competitive in some segments, potential or imbalanced;

5) UPSTART: Potential steps towards relative future performance in a few innovation segments.

Being guided by several rakings from different institutions and researches we then choose the cases randomly as follows:

1) We choose Vienna, Paris and Barcelona cases from B. Cohen's Global City Rankings' Table

2) We choose Singapore, Dubai, Oslo, Helsinki, Boulder, Malaga and Manchester from Innovation Cities Global Index 2012-2013, classified across different regions.

3) We choose Amsterdam, Kochi and Malta cases as they appear in Alcatel Lucent's World Smart City Report.

4) Smart Cities Council Readiness Guide by 2thinknow devotes a case to Malta ("Malta– Why not a smart city", p. 4 of Chapter 2). Amsterdam also appears under rank 9 in their Innovative Cities rankings.

We can see the difference in rankings, given by different institutions and researches. Thus Cohen ranks Vienna, Paris and Barcelona as number 1, number 3 and number 10 (Table 3.1.1, while Innovation Cities Global Index ranks them number 3, number 5 and number 56 respectively (Table 3.1.3). Singapore goes at the ranking # 30 (Mid-East Region, Nexus 1, index score 50), Dubai, goes few positions below at the rank # 34 (Mid-East Region, Nexus 1, index score 50), Helsinki is ranked #36 (Europe, 2 HUB, index score 49), Oslo ranked # 38, Europe, 2 HUB, index score 49). Then goes Manchester at rank # 106 (USA, 2 HUB, index score 46), Boulder at rank 123 (USA, 2 HUB, index score 45) and Malaga, which is not ranked but goes under NODE 3, with index score 40.

As mentioned above, Boulder has been ranked by Digital Cities Survey in 75000 to 124999

population category and positioned at number 8 (Table 3.1.2).

Thus, taking into account different categories, offered by these ranking we chose cases with different band scores to spread the representativeness of the cases (Nexus, Hub, Node) as well as different categories (population category) and methods (individual researcher B. Cohen)

However, we should note that assessments and rankings of the above-mentioned organizations (Smart City Council, Digital Cities Survey, etc.) serve only for initial choice of cases and can not guarantee the status of the concrete case as a success or failure, before a more detailed case after analysis is done, since only some certain variables and specific factors are taken into consideration and others maybe missing, while above rankings were developed.

There are some specific cases, like Amsterdam, Malta, Boulder, which though have being ranked highly by major assessing institutions, yet not finally recognized as successful, given the results of case analysis and data from existing researches and media. With the analysis of other information from different sources (The life and death of Amsterdam Digital City) we will show Amsterdam lacks some crucial essence to be called Smart City. While SmartCity Council ranking shows only positive side of it due to its ICT and Governance, but as per the DDS case (Life and Death of Digital Amsterdam City) the project couldn't satisfy the needs of citizens, didn't get feedback and cooperation from the stakeholders, what ultimately lead to its failure.

The same can be said about Malta and Kochi cases, which have contradicting assessments by different researchers. That's why further detailed analysis of cases in necessary to provide full and deep assessment of the cases taking into account all available date from the media and researches.

3.2. Reason of choice for variables

Just as was said about Smart City's definition before there are no standard or fixed set of variables responsible for Smart City Project success. Though we can refer to some existing researchers and data from publicly available sources, or to the data, provided by governments of some cities it will not guarantee inclusion of all essential factors to determine Smart City

success, because variables may vary for different cases and new variables may appear, taking into account rapidly changing statistics and trends of Smart City Projects.

Thus, the paper will not only take into account existing factors, from available source but also develop new factors by either combining several existing factors into one or coming up with new factors, not yet covered in previous researches. For this purpose different sources of variables are to be used, such as

1) The Integrated Framework of Smart City Initiatives is used (Figure 3.2.1.1).
2) The Smart Cities Wheel, by B.Cohen (Figure 3.2.1.2)
3) Research by Andrea Caragliu, Chiara Del Bo, and Peter Nijkamp. "Smart Cities in Europe", Journal of Urban Technology_, Vol. 18, No. 2, April 2011, p. 65–82.
4) Six-Axes Approach by European City Council (Table 2.2.1.1) as well can be used as an example of variables generation.

1) Smart city Initiatives Framework

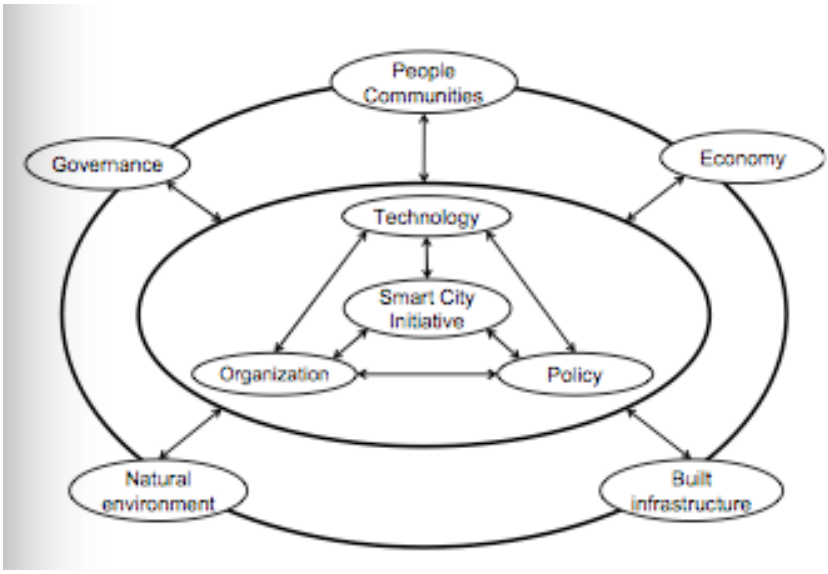

Figure 3.2.1.1 Smart City Initiatives Framework [Hafedh et al., 2012]

Based on the exploration of a wide and extensive array of literature from various disciplinary areas authors identify eight critical factors of smart city initiatives: management and organization, technology, governance, policy context, people and communities, economy, built infrastructure, and natural environment. These factors form the basis of an integrative framework that can be used to examine how local governments are envisioning smart city initiatives. The framework suggests directions and agendas for smart city research and outlines practical implications for government professionals. The framework addresses several internal and external factors that affect design, implementation, and use of smart cities initiatives. The goal is not to produce a set of components to rank smart cities, but to create a framework that can be used to characterize how to envision a smart city and design initiatives, which advance this vision by implementing shared services, and navigating their emerging challenges. The eight clusters of factors include (1) management and organization, (2) technology, (3) governance, (4) policy, (5) people and communities, (6) the economy, (7) built infrastructure, and (8) the natural environment.

Though this integrative framework suggests ICT as key drivers of smart city initiatives, authors note that despite proclaimed advantages and benefits of ICTs use in cities, their impact is still unclear. Indeed, they can improve the quality of life for citizens, but they can also increase inequalities and promote a digital divide. Thus, city managers should consider certain factors when implementing ICT with regard to resource availability, capacity, institutional willingness and also with regards to inequality, digital divide and changing culture and habits.

Authors suggest each of the factors as important to be considered in assessing the extent of smart city and when examining smart city initiatives. The factors provide a basis for comparing how cities are envisioning their smart initiatives, implementing shared services, and the related challenges. This set of factors is also presented as a tool to support understanding of the relative success of different smart city initiatives implemented in different contexts and for different purposes. Similarly, this framework could help to disentangle the actual impact on types of variables (organizational, technical, contextual) on the success of smart city initiatives.

In their work authors see all factors having a two-way impact in smart city initiatives (each likely to be influenced by and is influencing other factors), at different times and in different

contexts, some are more influential than others. In order to reflect the differentiated levels of impact, the factors in our proposed framework are represented in two different levels of influence. Outer factors (governance, people and communities, natural environment, infrastructure, and economy) are in some way filtered or influenced more than influential inner factors (technology, management, and policy) before affecting the success of smart city initiatives. This counts for both direct and indirect effects of the outer factors.

As authors suggest, technology may be considered as a meta-factor in smart city initiatives, since it could heavily influence each of the other seven factors. Due to the fact that many smart city initiatives are intensively using technology, it could be seen as a factor that in some way influences all other success factors in this framework (Hafedh et al., 2012). However, later in this research ICT will be given a different role as an enabler.

2) The Smart Cities Wheel, by B. Cohen

Let's now turn to another variables system, used by B.Cohen: "Smart Cities Wheel".

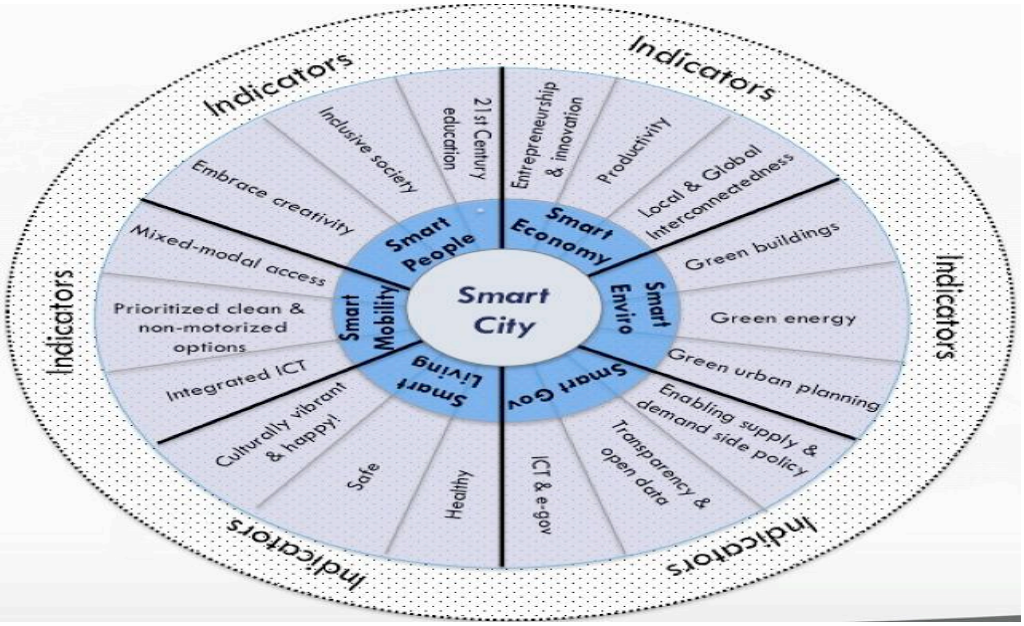

Figure 3.2.1.2 The Smart Cities Wheel by B. Cohen

This model has been inspired by the work of many others, including the Center of Regional Science at Vienna University of Technology, Siemens' work with the Green City Index, and Buenos Aires' "Modelo Territorial" among others). Boyd used blended data from publicly available sources, with this primary data provided by some of the eligible cities in an effort to enhance the accuracy of the 2013 rankings. Therefore the results include data from: the Innovation Cities Index, Brookings Metro Monitor for the Smart Economy measurement; Corporate Knights, Siemens and the Green Building Councils for Smart Environment; Digital Governance Rankings from Rutgers and open databases counted from municipal open data sites for Smart Governance; ranking data from Mercer and Monocle for Smart Living; modal share data from various sources and bike sharing data from Bike-Sharing World Map for Smart Mobility; and Citi Hot Spots and GINI inequality index data for assessing Smart People.

3) Research by Andrea Caragliu and Peter Nijkamp "Smart Cities in Europe".

However all the variables systems mentioned above do not stress the role of citizens engagement, which is used in some alternative approaches to smart city projects definition.
An alternative approach by Andrea Caragliu gives profound attention to the role of social and relational capital in urban development. Here, a smart city will be a city whose community has learned to learn, adapt and innovate. This can include a strong focus on the aim to achieve the social inclusion of various urban residents in public services (e.g. Southampton's smart card) and emphasis on citizen participation in co-design. Sustainability is seen here as a major strategic component of smart cities. The move towards social sustainability can be seen in the integration of e-participation techniques such as online consultation and deliberation over proposed service changes to support the participation of users as citizens in the democratisation of decisions taken about future levels of provision. (Andrea Caragliu and Peter Nijkamp, 2011)
Thus the system of variables derived in this research after case analysis, takes into account all aspects of traditional definitions and alternative approaches to make it more complex and inclusive. Thus, 7 factors of Smart City Success are given as initial input factors, with one factor eliminated later.

3.3 Analysis of Smart City Case Studies

Before analyzing concrete examples of Smart City Projects a brief look at the current global state-of-the-art city construction trends shows that smart-cities are being built in consideration of each nation's unique characteristics [Glaeser and Berry, 2006]. Different cities have different legacies driven by their historic economic and political development, geographical form, energy mix, demographic structure etc. Even cities with similar legacies will differ as their political administrations have differing political priorities. Each Smart City has characteristics and objectives specific to its situation. For example, Copenhagen has the ambition to become carbon neutral by 2025 and to create a world-class hub for clean technology. In Japan Smart Cities are discussed in the context of environmental issues, so Green City concept is stressed there. This is something that will be prioritized to a greater or lesser extent and will therefore define the nature of the smart city strategy. In a city like Madrid the emphasis may be on water conservation and therefore the smart solutions will see a bias towards water conservation. In other European countries the issue is discussed mainly from the standpoint of the society to be established through Smart Cities. Singapore, due to its density of population, is an incubator for creative innovation. People are playing the main role in the success of building the Smart Singapore City. Dubai is introducing the state-of-the-art technology into the concept of urban development under the theme "digital city" or "wireless city". Dubai Internet City will be reviewed later in this research as one of the 13 Smart City Projects.

Thus, as Simon Giles states it, Cities are constantly trading off priorities and addressing legacy challenges; as such, they will define their smart city agenda in necessarily differing terms. Again, as been mentioned above, the concept of smart cities goes far beyond the technological progress and pass, first of all by the citizens and how the city managers will make citizens theirs priority. Obviously, good governance of the city is undoubtedly another key factor of success for a city to become "Smart". In this case, good governance as an aspect of a smart administration often referred to the usage of new channels of communication for the citizens.
Let's now analyze Smart City Projects one by one in order to find out the true essence of a

smart city. While choosing the cases several indicators and rankings of major data institutions and agencies were used. Among them are Innovation Cities Global Index 2012-2013 from 2thinknow, measuring each city potential as an innovation economy at the current time. World's largest city classification and global ranking with 445 benchmark cities were used along with rankings, developed by Siemens Institution, IDC, and other organizations.

This research will cover 13 cases, which are most representative and most renowned from the ones that can be found in the media and scientific researches. The cases also seem appropriate for variables generation in order to define the reason of a certain outcome, when some of the values are cultivated or left without proper attention.

Case#1 Kochi Smart City project

Located in the coastal area of Kerala, India, Kochi was aimed to be one of the largest IT parks of India. It is ideal setting for companies serving Europe, Middle East and America. The city is easily accessible through a modern and efficient international airport, and possesses state-of-the-art transshipment and logistic facilities. The project was proposed in 2004 as a significant boost to the state's IT industry through creation of about 90 000 skilled paid jobs. However, the project is already delayed for several political reasons (delay of government approval for city status and construction plan). From this case, Governance is derived and valued as weak. Human Capital level is strong here due to high education level of citizens, abundance of R&D centers, openness of the people to foreign trends and experience. Social Capital is also strong, due to business support services, residential hospitality, retail and recreational facilities. However, despite these two factors are strong, Civic Engagement level is weak, as some of the citizens view the project as anti-national due to the intention of the government to shift ownership of the present Info park project to Dubai Internet City. These collapsing interests of stakeholders and delays in planning show that it is too early to call Kochi Smart City Project a success [Praveen, 2012].

Case#2 Malta

SmartCity Malta is being developed into a major new center of excellence for knowledge-based companies. It is expected to make a significant contribution to Malta's economy, by opening up

new development avenues, specifically in the IT and IT-enabled services sectors. SmartCity Malta has the most advanced and reliable ICT and power infrastructure in Malta. Though Malta SmartCity Project is considered to be Tecom's first successful overseas project after the failure of the SmartCity Kochi project it couldn't meet the goal to create the expected 2800 number of jobs due to the poor governmental planning (i.e. removing the sewage pump to make way for the project) [Times of Malta, 2011]. In addition, Malta is trailing behind other EU countries with its pension system [Taberner, 2013]. While the retirement age keeps raising as well as the life expectancy government's reforms are still not enough to curb future costs. Despite possession of good Infra, Technology and Mobile Services Malta's Government couldn't support comfortable transport and other services for its citizens. Neither it allowed freedom of expression nor creation of promised IT jobs, what caused lack of trust and cooperation of citizens with the government and other stakeholders. This in turn influenced Civic Engagement factor, which is at the very low level. Besides, the economy is still recovering from European Economic Crisis. From this case we can derive such factors as Infrastructure and ICT, Economy, and Civic Engagement. All these factors are weak, except for the first one. Human and Social Capital factors are at the medium level as the fact of the majority of the citizens are wealthy and life expectancy is raising it is balanced out by lacking welfare system and poor transportation system. Thus, SmartCity Malta cannot be called a successful Smart City Project.

Case#3 Boulder, Colorado SmartGridCity by Xcel

The goal of this pilot, carried out by Xcel Energy, was to create a fully-functioning smart city powered by an energy-efficient, self-monitoring smart grid, and, to determine which energy-management tools customers prefer, and which technologies are the most effective at improving power delivery [King, 2010]. The initial vision of this Project was to sell the technology to the customer, providing the fully electronic houses by adding solar energy. But, due to poor communication with customers and cost overruns promised services were not delivered. Customers' concerns over the privacy implications of Smart Grid proposals and technology were never addressed and the public was required to pay for something that offered little or no benefit while incurring significant risks and costs [Helms, 2013]. Vague goals, bad planning and poor management from the outset didn't allow for proper cooperation and trust-built relations

with the customer. Values of Smart Grid were not communicated to the public and no feedback was addressed, making this case barely another "Research Project, whose cost got out of hand" [Berst, 2010]. Social Capital variable is defined as weak since Smart Grid Program didn't meet the goal to bring stakeholders together, neither did it provide all in-home benefits as anticipated. Moreover stakeholders and the market were not mature to accept the kind of the project and the missteps of its pioneering character were not given credit for the courage to try. Regulators, ratepayers and other stakeholders didn't trust the success of the project and citizens only assessed it as a giant "stop" sign. No surprise that such approach from the social perspective wouldn't input into the success of the project, but even could "kill" innovation. Though Human Capital factor is strong, thanks to high level of education and welfare of citizens, Civic Engagement is weak and the Project is criticized to be a failure.

Case#4 Amsterdam Digital City, "De Digitale Stad" (DDS)

The term Digital City was invented in 1993 in Amsterdam. DDS is the abbreviation of De Digitale Stad, Dutch for The Digital City [van den Besselaar and Beckers, 2005]. The DDS was a virtual public domain, invented in 1993 in Amsterdam DDS was the organization that maintained it. DDS initially was a success, but in the end, failed to become a sustainable local information and communication infrastructure. The history of the DDS started as an 'experimental project' able to obtain government subsidies for a while, but as it transformed into a self-supporting non-profit organization, and finally into a commercial company, its goals changed accordingly: from an experiment in creating a public domain in cyberspace it emerged into organization, focused on profits from Internet projects that could be used to keep the Digital City alive. Finally, profitability became its main goal, and this resulted in closing down the Digital City, because it was considered solely from the point of view of cost. As a commercial company the DDS image became merely a trademark, not receiving any support from citizens, thus it failed to engage a customer as the major stakeholder. Also, despite satisfactory income and welfare system, abundance of pilot research projects to educate citizens, the education system was non0responsive to citizens' needs and complaints. While data and mobility services were provided, there were setbacks and failures to deliver the right information in the right time regarding transportation, government services, etc. This explains why Human and Social Capital

factors are not at strong, but at medium level. From the economic perspective there were shortcomings in the legitimacy. Governance factor is weak, since no support from the government was given to the DDS Project. Only two factors: Environmental Sustainability and ICT could be called "strong", thanks to several Projects and 16 pilots on Climate issues, directed to reduction of CO2, while strong ICT sector is explained by equipment of the City by the latest "hard" and "soft" infrastructure, open data and mobile technology from the very beginning of IT development. To resume, due to inability to involve citizens and make them interested in the DDS Project after its privatization, the Project has failed to nurture the essential values of a successful Smart City Project, among which is Civic Engagement.

So far unsuccessful cases were reviewed and analyzed. Below more successful cases, including an Iconic Singapore Smart City will be mentioned.

Case #5. Singapore

Singapore is a highly developed country, which relies on good economic policies by the government, a highly skilled workforce, high productivity and cutting edge technology. It has several critical values to be a successful Smart City, but PEOPLE are the greatest value along all others. It is due to the scarcity of any resources apart from geographic location. People became the main driving force of the country development. Efficient and comfortable way of doing daily tasks, special housing program by the government, allowing for 90% population to own their own homes, smart financial policies to attract foreign investments and high level of research initiatives to propel "smart researches" even more all together works as the input into strong level of Human and Social Capital. Also, sustainability programs, such as local water management system to reduce dependence on water from outside and limited vehicle ownership program to reduce traffic and CO2 emissions, reinforce Environmental Sustainability factor. All these initiatives are directed to enhance the "livability" of the city and to turn the challenges into opportunities. Literally all factors are strong here, including Human & Social Capital, Economy, Governance and Civic Engagement levels, making Singapore Smart City a true success.

Case#6 Vienna

According to the complex ranking, drawn up by American climate strategist Boyd Cohen,

Vienna is considered to be Europe's number one Smart City for Quality of Life and at the top in other areas, such as in innovation, technology and sustainability. Ranking is based on recognized criteria and takes into account all relevant existing surveys [smartcity.wien.at, 2012]. Vienna is the only city that ranked in the top 10 in every category: innovation city (5), regional green city (4), quality of life (1) and digital governance (8). Vienna is establishing bold smart-city targets and tracking the progress to reach them, with programs like the Smart Energy Vision 2050, Roadmap 2020, and Action Plan 2012-2015. Different interests groups are actively involved in urban planning processes what enhances the involvement of people and emphasizes the importance of customer centricity [Cohen, 2011]. Knowledge platform, consisting of companies, government and research institutes is created for smart city project implementation. Government was able to build strong partnerships between the city, the research sector and the industrial sector by business models creation, evaluating and benchmarking innovative solutions and technologies. Smart City Vienna understands urban life primarily as a social, and only secondary as a technical and logistic problem, involve people into City's activities and raising their awareness for smart city issues and the need for change. Information, communication and active participation are the main principles to increase Civic Engagement. Accordingly, strong Human and Social Capital levels, Governance, Environmental Sustainability and Civic Engagement factors are all together add to the success of implementation Vienna Smart City Project.

Case#7 Dubai

Dubai Internet City is one of the largest Information and Communications Technology (ICT) business parks in the Middle East and North Africa region. As a knowledge-oriented business model, DIC was the pioneer of business park concept. Today it hosts 15000 knowledge workers. It is a strategic base for over 700 IT companies (Cisco, Microsoft, HP, IBM, Siemens, Oracle), covering 2 bln people with GDP$ 6.7 trln. While the Human Capital factor is medium here (gender equality issues) as well as Environmental Sustainability (water shortage, urbanization versus low focus on sustainability) government launches social programs to improve sustainability and gender equality [dubaiinternetcity.com, 2013]. Economy level is strong here due to the knowledge economy ecosystem, oriented to support business development,

specifically for ICR companies. The e-government model is stressed as the basis of government functioning. Strong emphasis is made on a public participation in enhancing services efficiency. Therefore, Dubai Internet City is another successful example.

Case# 8 Smartcity Malaga Project

ENDESA' Smartcity Málaga Project is Europe's largest eco-efficient city initiative.

ENDESA is the name of the organization, initiating Smartcity Malaga Project. It offers state-of-the-art technologies in smart metering, communications and systems, network automation, generation, storage and smart recharging infrastructure for e-vehicles. Using its latest technologies the government of Malaga achieved many goals, including, but not limited to: raised customer awareness and change of habits by consulting their consumption, rates and the environmental impact online; involvement all agents in the electricity system, from generation to consumption. Both: Human and Social Capital levels are strong (wealth and welfare system, latest technologies to reduce power intake in households, inclusion of business and science sector to contribute into universities, national and regional research centers. All kinds of government support cervices are offered, including initiatives to encourage the use of EV (Electric Vehicles), recharging stations. Environmental Sustainability is strong (Europe's largest eco-efficient city initiative, comprising 11 companies) as well as ICT sector, thanks to the blend of major IT Giants, including IBM, which make the infrastructure most reliable on the market, resulting in the best availability-to-cost ration. IT also ensures data security and safe access to the various components of the system. Above all, Civic Engagement is at the heart of the Project's success and end-user buy-in throughout the process is at the center of efforts to make the Smartcity Malaga a success.

Case# 9 Paris

As is typical of sustainability-related rankings, the "City of light" fares well making its headway towards being a resilient city. Resilient cities, those that are working to transition towards a low-carbon economy while also preparing to avert the worst of climate change, are gaining interest and attention from policy makers, city councils and others worldwide [Cohen, 2011].

Paris is highly rated in several categories including innovation (3), green cities in Europe (10),

and digital governance (11). Paris was already on the world map for its highly successful bike sharing program, Velib, and recently similar model for small EVs, called Autolib, was launched by the mayor. Paris scored highest on Boyd's ranking of rail transit use/capita and was among the leaders in the study on adaptation due to both its "adjustment to climate change" plan as well as being one of the only cities in the study to have tangible adaptation projects underway such as having recently completed planting 100,000 trees and 20,000 square meters of rooftop gardens. These initiatives speak for strong Environmental Sustainability factor. Because of good health care system and variety of social media solutions Human and Social Capital level is high. Governance factor is strong, thanks to smart business model, based on intelligent communication between vehicles, rental stations and customers. Government supports multiple research teams from CITRIS and INRIA to focus on environmental and social challenges. Above all, Paris has a strong ICT and Civic Engagement factors. Technologies are continuing to be developed through an extensive innovation program featuring more than 100 research tests across its territory. Government has a very "participatory" character. The involvement of citizens enables governance to gain greater acceptance and tackle new issues in order to reach the most satisfactory decisions.

Case# 10 Barcelona

Barcelona was recently ranked the number two smart city in Spain in the IDC report, and for the good reason. While Barcelona currently has a low percentage of renewables, it is a global leader and innovator with respect to the introduction of solar thermal ordinance, which requires all new and renovated buildings in the city to incorporate solar thermal energy, usually in the form of solar water heating. It recently launched the LIVE EV project to promote the adoption of EVs and charging infrastructure, and the city also recently announced a major partnership to develop a living lab for smart-city innovation [IRBC Conference, 2011]. All this addresses the environmental issues and gets high scores on Environmental Sustainability factor. Barcelona government also scored high for its adaptation planning, identifying key stakeholders and metrics associated with ensuring successful adaptation. Smart city model of Barcelona is set around the three pillars:

1. Ubiquitous infrastructures;

2.Information from sensors, open data, and citizens;
3.Human capital, actors, communities [Battle, 2011].

Government fulfill the Smart city Strategy through the initiatives, like: Smart Districts, Living Lab initiatives, Infrastructure building, Open data (sensors, open standard and city platform) and all kinds of new services for citizens, bringing all stakeholders together and contributing into effective cooperation. But there are some challenges, regarding the demand for Human Capital and skills; Demand for VC funding for innovation; Low global connectivity. But despite these challenges Barcelona shows strong level of Social Capital, ICT, Environmental Sustainability, Governance and Civic Engagement. The latter factor is reinforced by different initiatives, such as Web 2.0 project, based on mobile phones, and allowing people feel more involved in the city life, by taking an active part and creating, sending and sharing personal contents through mobile networks. Other apps and initiatives, like Real time location based information over the city generated by citizens' reporting problems or incidents. Governance factor is strong. Electro-Mobility-Implementation Plan and Public-Private Partnership (PPP) along with other initiatives of the government are undertaken for impulse, coordination, monitoring and communication of the electro-mobility in Barcelona. There is an Urban Lab Model for better services for the City, citizens and Companies, as well as "test and pilot base" of new products and services with urban impact to Barcelona as the learning city.

Government also succeeded in satisfying the "Big Society" of the City through create of Digital Inclusion Partnerships in housing, health, education, voluntary and community sector, social entrepreneurs, digital and creative businesses, arts and cultural industries. They bring together various strata, like the grass roots, geeks, and entrepreneurial talent. Bringing this case to conclusion, except for Human Capital and Economy factors, which are at the medium level, Barcelona shows high level of all primary factors for the success of its Smart City Project.

Case#11 Helsinki

Helsinki creates new clusters for smart city strategy and mobile living labs. A mobile cluster is emerging in Helsinki. This strengthens motivation, incentives, innovation, and enables

externalities. The mobile applications cluster is sustaining Helsinki ‘s Smart City strategy. There are several examples of empowering citizens in order to make Helsinki a Smart City. The city government uses competitions for Open Data apps as strategy for cluster development. Open interfaces are an important step in the development of the City’s systems. Certain examples of such open data tools include:

1. Tell-on-the-Map (Commentary tool, enabling a dialogue between citizens and city).
2. Apps4Finland competition – Helsinki Public Transport Visualized Apps4Finland makes data available related to environment and spatial information, thus using city data as idea incubators.
3. Service Map: open information channel about offices and services. High level of Human and Social Capital is explained by high quality of living (Helsinki offers its residents many alternatives of housing to suit different lifestyles and life situations, development of digital urban services that make travelling and living in the city easier, technologies that are thoroughly integrated into everyday objects and activities, such as real-time traffic information for citizens) [Schaffers, 2012]. Biennial events are held to promote and improve social, cultural and economic life. Campaigns to make citizens aware of initiatives by Helsinki’s Smart City Project [City of Helsinki]. High level of Social Capital is supported by strategies for creating visualizations that can enable citizens make use of and benefit from open data, and define the components necessary to grow a sustainable, repeatable platform, process and ecosystem to leverage the principles of open data, turning data into information, information into action, and action into change.

Strong public-sector data open and available to all by Helsinki Region Infoshare Project is one of the many Government initiatives [IBM Challenge Report]. Open regional data on the web can be exploited freely and without charge. Finnish government uses Living Labs to stimulate innovation, delivery of citizen-centric services. By implementing Demand and User-driven Innovation Policy and by utilizing data from the municipal organizations in Helsinki Region it addresses the needs of customers and all stakeholders regarding City Management and other relevant procedures.

Strong Environmental Sustainability factors are achieved through development of energy

efficient datacenters by Helsingin Energia Helsinki Smart City, improving the sensors' energy efficiency. Datacenters represent a big step in resolving energy production models in the cities'and in the development of local, decentralized energy production as well. High level of ICT is another characteristic of Helsinki Smart City. The reason to it is an abundance of telecom companies, including NOKIA, providing mobile-based services and apps The Helsinki Decisions website publishes minutes and other decision-related information from the city. [Helsinki Region Infoshare]. Finally, high level of Civic Engagement complements the success of Helsinki Smart City. It is based on the openness of the government, which in turn, leads to greater awareness, greater awareness will lead to increased participation and increased participation will enable the city to draw on the knowledge and creativity of its citizens to address problems and realize its opportunities.

Case#12 Oulu

Oulu also can be called the City of innovation. The Smart City strategy is oriented on Technology Ubiquitous Oulu, with the policy and strategies as the main drivers for this strategy. For example the "PATIO" (test user community tool) empowers ordinary people to experiment new services. Human and Social Capital factors are supported with world-class research and business education, such as Living Labs. Living labs act as generators of ideas and innovative solutions through open innovation, and as "arenas" bringing together different actors from both the demand and supply side in the relevant value networks. Research and technology communities such as research institutes/laboratories offer technological know-how as well as facilities for technology testing and for the evaluation of user experience enrichment and level of engagement.

Government tries to adapt policy instruments to create business. Test user community tool empowers ordinary people to experiment new services. Citizens and businesses have an immediate interest in shaping their living and working environment. Representing the demand side, they increasingly organize themselves in grassroots citizen interest groups or professional communities. Local governments set challenges and implement policies for development and orchestrate the planning and decision process. Policy instruments such as pre-commercial

procurement contribute to pushing innovation. The use of new communication channels for the citizens, e.g.: “e- governance” or “e-democracy”. Another “bright side” of the city is its economic development. City is in the list of the seven best new global cities for startups. In 2012 Oulu was awarded for being the most intelligent community in Europe, and was ranked at the Top 7 globally.

Innovation and ICT centers expanded from the city all over the country. Oulu Technology Park (Technopolis Plc.) is the first technology park in Nordic countries, founded in 1982 to provide premises to ICT companies and act as an incubator. Oulu has been in forefront in development of an open source virtual world platform called realXtend that lets anyone create 3D environments and applications. This speaks for strong ICT sector as well, which in tern enhances another essential factor of the City’s success – Civic Engagement. Wireless network opened it up to ubiquitous-computing researchers, offering opportunities to enhance and facilitate communication between citizens and the government [Ubiquitous Oulu Smart City, 2011]. All parts of the innovation support are in place, ranging all the way from the basic infrastructure and services, to the world-class research and support for businesses. And the citizens play the main role for the innovation.

Case#13 Manchester

Manchester is also seen as a successful example of the Smart City Initiative, using digital strategies and smart environments for urban renewal. Since mid-1980s the City Council embarked on city regeneration, driving economic change through technology and emphasizing the neighborhood focused action, creative city, and innovation. In 1990s Manchester telematics Partnership was born. Currently, e-services are actively used to address inequalities and digital democracy. Balance of top-down and bottom-up actions is achieved. Digital Strategy 2008 was reviewed in 2011 with respect to EU Digital Agenda and consulting with local stakeholders. The main objectives of such strategy are Digital inclusion, generation of skills and tackling the divides; Digital industries, new employment, cluster of digital and creative businesses; Digital innovation: working with the future Internet research community to support Manchester as Smart City.

Strong Human Capital factor case is reasoned by good welfare programs and recognition of people as assets by valuing work differently, promoting reciprocity, building social networks, etc. Innovative Economic Model, providing for integration of all silos into one: Digital Inclusion+Living Labs+Open Access+Coowner.

Strong Social capital and Governance factors are relied upon Government initiatives and vision for the city region by 2020. Smart Innovation and People project (Smart-IP) brings together Manchester City Council, researchers from the University of Manchester on future internet services and the community reporters. This attracts new investment and jobs from high-tech companies as the city becomes a 'Living Lab' test bed for new future Internet services [Manchester-to-lead-smart-city-project, 2010]. Government initiates flagship projects toward Smart City, including a regeneration challenge of East Manchester; Eastserve; Corridor Living lab NGA project and the next generation open access fiber optic network. All these initiatives put people at the heart of the agenda and the neighborhood regeneration as the starting point. Also, digital collaborations through Living Labs and an inclusive and sustainable approach to digital development helps to achieve the main goal of such initiatives. In general, Manchester has an advanced infrastructure of open access fiber to premises; support creation of co-ownership approaches.

Continuing with the rest of factors, Manchester has a strong ICT sector with its Digital City Test-Bed and Living Lab Corridor Digitization Project, which are expected to unite 500 businesses, 1000 residents over next two years. Civic Engagement is achieved through user driven open innovation, sustaining user engagement. Residents of the city are encouraged to carry the devices to monitor the environment and feed back real time information through wireless connections while they are walking, cycling or using public transport. People are also encouraged to provide their own views about how city challenges can be tackled via social media. This last case is a success.

After making a thorough analysis of all 13 cases and reviewing Smart City values, offered by various Corporates (Alcatel-Lucent Market and Consumer Insight team; European cities portal,

IBM Citizenship Program) we can come up with several values or variables which are considered to be important for Smart City Development But is it possible to say for sure which factor is the essential? Is it Infrastructure, ICT and Innovation, Governance and Economy, or Human and Social Capital? Well, besides such core factors as ICT, Open Data, which were previously considered the central part of the Smart City Model this analysis discovered that Human and Social Capital, Governance and most of all, Civic Engagement factors can not be ignored. These factors are indispensable for the success of the Smart City Project.
After Analysis of Smart City cases and variables generation we will conclude which value propositions are most important for the Smart City. We would able to see that Smart City initiatives do not position Information and Communications Technology (ICT) as key to the value of smart city [smartercities.nrdc.org]. While for Amsterdam ICT & Infrastructure value were strong, this city however, failed to get the support of citizens and engage them into data sharing what was a basis of its successful development initially.

The following section will summarize the variables that have been generated after the analysis of the case studies and define which one are to be decided as input variables and which one should be removed from the list of input variables.

3.4. Variables Generation and Analysis

The results of the case studies are used to generate 7 factors (explanatory variables). The factors are as follows:
1.Human Capital (which refers to level of capital, education, awareness, wealth and welfare of the people);
2.Social Capital (which is basically a level of cooperation and trust within and to the socium and to all stakeholders, including corporations, government, etc.);
3. Level of Economy (which is a mixture of business approaches, holistic and synergetic planning of the city initiatives, flexibility of the labor market and the like);

4. Governance (which includes good management with open data and other innovative forms of governance, like e-governance);
5.Environmental Sustainability (which is based on green technologies, an "doing-more-with-less" principle);
6. Infrastructure (basic, built, mobile) and ICT;
7. Civic Engagement (which emphasizes customer centricity and gives citizens' major role to play in the development of the Smart City Project. Below is a more detailed analysis of all 7 factors.

1.Human Capital

Human capital is a mixed factor and includes the level of capital, education, awareness, wealth and welfare of the people. Several cities nowadays have started transformational projects and initiatives called "smart city initiatives" to better serve citizens and to improve their quality of life [Giffinger, 2007]. That's why Human Capital along with the Social Capital, following below, is now receiving more attention from the City Management as the shift has been made from the "hard" ICT core toward its "soft" and "social" end.

2. Social Capital

While Social Capital also refers to people and citizens just as the first factor here the priority of consideration is given to the level of cooperation, partnership and trust among all stakeholders (corporations, customers, government, etc.) and communication within the socium [Hafedh, et al., 2012]. Addressing this two factors in general, and the topic of people and communities in particular as a part of smart cities is critical, and traditionally has been neglected on the expense of understanding more technological and policy aspects of smart cities. Projects of smart cities have an impact on the quality of life of citizens and aim to foster more informed, educated, and participatory citizens. Additionally, smart cities initiatives allow members of the city to participate in the governance and management of the city and become active users. If they are key players they may have the opportunity to engage with the initiative to the extent that they can influence the effort to be a success or a failure. It is critical also to refer to members of the city not only as individuals, but also as communities and groups and their respective wants and

needs within cities. People and communities is a component that requires smart cities initiatives to be sensitive in balancing the needs of various communities.

3. Economy

Level of Economy, which includes the level of business development, holistic and synergetic planning of the City Initiatives. Giffinger also suggests innovation, entrepreneurship, productivity, flexibility of the labor market as well as the integration in the national and global market as the compounds of Economy factor for the Smart City. It is crucial for a Smart City to create a beneficial environment to get such economic outcomes as business and job creation, workforce development, and productivity improvement [Giffinger, 2007]. Studies by IBM institute for Business Value also identify Business as one of the core systems of smarter cities, comprising city services system [Dirks and Keeling, 2009]. Capacities for smart business systems include ICT use by firms, new smart business processes, and smart technology sectors. The smart city initiatives are designed to develop information technology capacities and establish an agenda for change by industry actions and business development [Cairney and Speak, 2000].

4. Governance

Governance factor is comprised of management, open data and other innovative approaches to data management, like e-governance. As of now, "smart government" is defined as an administration, which integrates information, communication and operational technologies, optimizes planning, management and operations across multiple domains, process areas and jurisdictions and generates sustainable public value. Smart governance is described as an important characteristic of a smart city that is based on citizen participation [Giffinger, 2007] and private/public partnerships [Odendaal, 2003]. Several cities have felt an increased need for better governance to manage their projects and initiatives [Griffith, 2001]. According to Johnston and Hanssen, smart governance depends on the implementation of a smart governance infrastructure that should be accountable, responsive and transparent [Mooij, 2003]. This infrastructure helps allow collaboration, data exchange, service integration and communication [Odendaal, 2003].

5. Environmental Sustainability

Environmental Sustainability is based on green technologies, an "doing-more-with-less" principle. Smart city initiatives are forward-looking on the environmental front [Giffinger et al., 2007]. Core to the concept of a smart city is the use of technology to increase sustainability and to better manage natural resources. Of a particular interest is the protection of natural resources and the related infrastructure [Hall, 2000], such as waterways and sewers and green spaces such as parks. Together these factors have an impact on the sustainability and livability of a city, but in our case, Environmental Sustainability will be not influential (input) factor, but an influenced (output) factor. So even though it was taken into consideration when examining smart city initiatives, it will be removed from the comparative analysis.

6. Infrastructure (Basic, Built, Mobile) and ICT

Infrastructure has several meanings, depending on the term of context used in.

Basic Infrastructure

In terms of utility and facility functional operations, the infrastructure represents the underground and aboveground cables and pipes networks, supported with all related assets. The primary concept of establishing the digital infrastructure networks is to distribute a sufficient number of sensors that meet the needed level of assets connectivity and control. The network utilizes a variety of communication links, including optical fiber, microwave, packet radio, satellite, and acoustic, resulting in diversity of throughput, latency, and intermittence throughout the network.

Built Infrastructure

It encompasses every object, comprising the "Hard Core" of the City: Buildings, Transportation, Energy and Power Systems.

Mobile Infrastructure

It is a complex of all mobile devices, which enables people to access Internet and information

from their personal mobile phones, tablets, etc.

ICT Infrastructure

ICT infrastructure, just as basic infrastructure, includes wireless infrastructure, but in a more complex way (fiber optic channels, Wi-Fi networks, wireless hotspots, kiosks, etc.) [Al-Hader and Rodzi, 2009]. It encompasses intelligent systems and integrated communication infrastructure, such as Smart grids, which are seen as a major opportunity to merge power and ICT industries and technologies. Thus, the implementation of an ICT infrastructure is fundamental to a smart city's development and depends on some factors related to its availability and performance. Indeed, smart object networks play a crucial role in making smart cities a reality. However, despite proclaimed advantages and benefits of ICTs use in cities, their impact is still unclear. They can improve the quality of life for citizens, but they can also increase inequalities and promote a digital divide. Thus, city managers should consider certain factors when implementing ICT with regard to resource availability, capacity, institutional willingness and to inequality, digital divide, changing culture and habits [Jasseur, 2010].

7. Civic Engagement

Civic Engagement underlines all above-mentioned factors, as citizens are the main actors, playing the central role in the development of a Smart City. Citizens are engaged in the Smart City development process in a million ways as providers or consumers of information and data, generators of ideas and initiatives through crowdsourcing and SNS, they are also called prosumers as their role of consumers and producers became mixed in the recent economy trends.

3.2.1 Comparative Analysis of the Variables

We choose 6 out of 7 variables in the table as input variables: 1.Human Capital (HC); 2.Social Capital (SC). 3.Economy; 4.Governance (G); 5. Infra and ICT (II) and 6. Civic Engagement (CE). We removed the Environment Sustainability (ES) variable as it can not be an input variable in our case. It can be an output variable though, meaning that the condition of environmental sustainability might depend on overall success of the Smart City Project, but not

necessarily receiving a direct effect from it. However, it can be influenced by the quality of main success factors, since, if there is no strong governance, citizens' involvement and support of green initiatives the sustainability of the City might be under threat. By the look at the table below (Table 3.2.1.1) we can explain why a certain Smart City Project is more or less successful. Civic Engagement (CE), Governance (G) and II (Infrastructure) are the main variables and the remaining: Human Capital (HC), Social Capital (SC) and Economy (E) are peripheral variables (they are somewhat less clear, but still input variables). The 6 variables individually or in groups influence the success of the Smart City Project. The main 3 variables are clear enough to show the direct effect on the success or failure of Smart City Project. The remaining environmental variables also explain the output directly or through each other.

According to the table we conclude that two factors: Governance (G) and Civic Engagement (CE) can be called primary for the success of Smart City Projects.

Table 3.4.1 Variables of the Smart City Projects' Success

Case	HC	SC	E	G	ES*	II	CE
1 Amsterdam F	M	M	M	W	S	S	W
2 Kochi F	S	S	M	W	M	S	W
3 Malta F	M	W	W	W	S	M	W
4 Colorado F	S	W	W	W	S	S	W
5 Singapore S	S	S	S	S	S	S	S
6 Vienna S	S	S	S	S	S	S	S
7 Dubai S	M	S	S	S	M	S	S
8 Malaga S	S	S	S	S	S	S	S
9 Paris S	S	S	S	S	S	S	S
10 Barcelona S	M	S	M	S	S	S	M
11 Helsinki S	S	S	S	S	S	S	S
12 Oulu S	S	S	S	S	S	S	S
13 Manchester S	S	S	S	S	S	S	S
* Removed variable							

Also Infrastructure and ICT (II) follows as the next primary factor behind the first two. Though the first two factors are both clear and could be judged as equal they are not equally important.

To decide it we need to look deeper into the definition of "Governance" variable itself. As Giffinger defines: "Smart Governance is an administration that integrates information, communication and operational technologies; optimizes planning, management and operations across multiple domains, process areas and jurisdictions; and generates sustainable public value. It is an important characteristic of a smart city that is based on citizen participation" [Giffinger, et al, 2007].

It means, that Citizen Participation or Customer Engagement (CE) is the basis of a strong Government factor. Smart Governance is defined not only by Smart People, but by their Engagement and readiness to share knowledge, information through crowdsourcing or any other forms. In this case Civic Engagement (CE) and Governance (G) become the first and secondary primary factors, while Infrastructure and ICT is an enabler factor and goes third by its importance.

As for the environmental (peripheral) factors Human Capital (HC) and Social Capital (SC) individually or in a combination also influence the success of the Project. However, even though both factors are strong, if the primary Civic Engagement (CE) and Governance (G) factors are weak, the Project will not be successful, as in case of Kochi.

So, what are the guiding principles for the creation of successful smart cities? As Clara Gaymard, CEO of General Electric France states it: "is important that we don't focus entirely on the technology, but on outcomes and consumer and citizen engagement" [Berthon, 2011]. There is a need for ownership by consumers and users of the new solutions that are being developed as well as public leadership to incentivize private sector involvement and collaboration between sectors on standards for processes and technologies.

When comparing the results of our analysis with the Integrated Framework below (Figure 3.2.1.1), such factors, as Economy and Governance, Built Infra and Natural Environment are set equally important with People and Communities. This research based on the analysis of 13 cases shows the priority of Civic Engagement (CE) along with Governance (G) and ICT (II) as

enabler.

Different to the way Integrated Framework assesses Technology as a meta-factor in smart city initiatives (as the most influential on each of the other seven factors) this thesis analysis shows Civic Engagement (CE), Governance (G) and ICT (II) as a complex of 3 main factors, influencing the final status of the Smart City Project by its order. However, the table of variables, generated after case analysis, cannot be seen as all-inclusive assessing tool for benchmarking and definition of the major components of Smart City Projects. It serves as an implicational tool for stakeholders to better understand the meaning of a Smart City and to locate and apply main values, components of the City in the right direction to achieve better efficiency and desirable outcomes. More on this will be mentioned in the Limitations section of this thesis research.

Chapter 4 Challenges of Smart City Projects and Recommendations.

4.1. Challenges of Smart City Projects Implementation

When analyzing variables, defining the success of Smart City Projects, we came up with various barriers and challenges. These challenges are ranged from economical and technological to social and regulatory, which are typical for any other project. But some specific challenges, considering the innovative and complex character of Smart City Projects should be named here as well. To classify them the following 5 groups were created:

1. Complexity Challenges
2. Economical Challenges
3. Technological Challenges
4. Social Challenges
5. Governance and Coordination Challenges

Below each group will be given a detailed explanation and analysis.

1. Complexity of Smart City system

Smart Cities are not a new technology concept by itself, rather denote the intelligent combination of currently established systems. So this combination increases the complexity exponentially regarding involvement of cities as actors in the value network, with all the agencies and domains they entail, and the potentially large differences between cities themselves. Also this complexity entails a range of other challenges as follows: a) Integration and convergence issues; b) Differences in administrative and technological maturity; c) Standardization; d) Open Data; e) Privacy and security issues.

a) Integration and convergence issues

In the context of this ever-increasing complexity and platformization, integration and convergence issues become relevant and interoperability between systems will be exceedingly important.

Even as cities tackle issues that cut across segments of society - for example, transportation policies that affect economic development - their operations are organized and their data is collected separately. Cities tend to focus their technology investments on optimizing a single infrastructure layer like energy management, transport or water supply, for instance by implementing a smart traffic management system to reduce congestion or a smart energy grid to reduce loss from the network. However, tackling infrastructure in isolated silos keeps cities from achieving the resource efficiency potential that ICT can offer. A truly smart city would use technology to integrate across infrastructure silos, enabling the city to operate as a single system. This will involve such tasks, as bridging silos in information and operations. Integration of separate infra levels into one for an effective synergetic system is then the main point to overcome such challenges.

Thus, convergence issues must be considered in order to exchange information from person to person, from people to machines, from machines to people, or from machines to machines. Smart Cities need to be able to integrate themselves into national, regional and international infrastructures, e.g., to share location data about businesses or development land, or to establish the marital status of citizens. The development of data and service standards, ensuring application interoperability and data exchange are key to this. Institutional and organizational processes need to be developed, to facilitate the shared development and deployment of e-government applications across cities. Smart Cities will integrate wireless technologies and operators, making provision seamless and transparent. Many cities already have fragmented, partial coverage of wireless networks: the next step will be to find ways to help these public and private networks to converge or integrate into city-wide networks, which will require both technical developments and regulatory changes.

The work of Smartcitieschallenge.org initiative in cities like St. Louis, Providence and Ho Chi

Minh City has revealed that changes in technology, data analytics and other tools can help cities bridge those gaps and enhance collaboration across departments [smartercitieschallenge.org]-68. Such changing element is cloud computing, for example, which is the trend of platformization. Such element is helping the private sector to reduce cost, increase efficiency, and work smarter. From a business perspective, cloud computing is a key concept to enable a global ecosystem, where organizations are able to be more competitive. The sharable and the on-demand nature of cloud computing are compelling for today's highly distributed yet collaborative-driven workforce.

b) Differences in administrative and technological maturity.

When discussing the creation of Smart Cities, one must remember that when trying to facilitate the development of thousands of urban areas across they bring together a wider range of different institutions (emergency services, health, planning, education, economic development, etc.) that are trying to deliver a range of complex and different services to citizens and businesses, within a variety of national, regional, state and local political and administrative structures. These urban areas are at radically different stages of technological, political and administrative development. These differences in administrative and technological maturity will both shape and constrain the ability of individual cities to become smarter. Many cities are keen to articulate their Smartness to the world, and yet few cities have moved beyond the pilot scale to widespread adoption, and those that have are struggling to integrate solutions at platform level. For example, Singapore is leading the way in relation to citywide sensing and control platforms with LIVE Singapore, but it is still in the early stages of maturity.

c) Standardization

Standardization is clearly an important task, affecting all levels of middleware implementation, assuring transparent and reliable interfaces to the middleware, as well as interoperability between products and services across very different domains. Thus, interoperability and standardized ways of communication between systems is an important research subject, crosscutting all Smart City domains. It is noteworthy to mention how Korean Ministry of Land, Transportation and Maritime Affairs derived the "Convergence" problem, which entails "Lack

of standardization" problem. The solution to this problem is to show the people the successful application of "smartness" of the cities in an already developed city that is now accommodating problems, such as transportation, security, and pollution. "Smart city should not start in newly built cities, but from existing and developed ones" [Kim, 2012].

The "u-City World Forum" was held in November 2011 to help set an international standard to pave the way for exports of Smart city and promote Korea's technology abroad [Shin, 2012]. Korea is about ten years ahead in the Smart City industry but the international standardization tends to fall behind such progress. To fulfill the dream of K-City (named after Korean wave Hallyu), which help the country lead the Smart City industry globally the first job of the government is to set the international standards and terminologies. Though it is a long-term plan involving at least seven to eight years Korea's advanced infrastructure and the people's prompt adaptation to new technologies promise to lead the world market of Smart City through its Korean-style software.

d) Open Data

The development of Smart Cities requires a pragmatic approach to technological development and deployment that is based on open standards and interoperability, which is vendor neutral and focused on the needs of cities, citizens, and businesses. So, one particular challenge in the context of Smart Cities relates to open data business models. As services become pervasive and ubiquitous, the matter of opening up databases will become more important.

The development of open data and data sharing is also a requirement for the development of e-government in Smart Cities. Public data needs to be made open and accessible, through the establishment and use of a repository of definitions and taxonomies that makes data consistent throughout the country. This will provide a standardized foundation for developers to use and re-use government content – including address and location service information, data, maps, transport information, timetables, etc. However this requirement for open data creates another challenge:

e) Privacy and security issues

The overall priority must be to establish user confidence in the upcoming technologies, as otherwise users will hesitate to accept the services provided by Smart Cities. Personal data contribute to a better monitoring of the city environment (think to bwired.nl) providing real-time data, but still keeping users/citizens owners of data. To make people willing to contribute, they must be assured in the safety of their personal information.

2. Economical Challenges

Economical challenges can be categorized as follows:

a) Need in infrastructure and Intelligent systems

When it comes to economical challenges, most mentioned problems here are financial, infrastructural. Such question as «How to finance the investment, what return can be expected, In which timeframe?" arise. Many of today's cities are suffering from years of disinvestment in basic infrastructure, and especially technology infrastructure. These gaps, due in part to budgetary pressure but also to the regular turnover of leadership, have kept cities, their leaders and citizens from realizing their full potential, slowing economic development and constraining their ability to make informed, data-driven decisions. As mentioned before in Convergence Issues, Smart city needs to be embedded in the existing infrastructure (transport, smart buildings, energy generation plants, etc.), which might compromise its sustainable development. Significant financial resources are needed to adapt new technologies to existing facilities. However, this consideration of the surroundings and inclusion it in planning will initiate local and regional improvements necessary for the effective operation of Smart Cities. Smarter Cities Challenge engagements all over the world are demonstrating how the right investments in infrastructure can introduce long-term efficiencies and dramatically transform a city's prospects for growth. Austin spent about 20 bln dollars for their "Green initiative project" to attach IMS (metric sensors, controller and data collectors) and spent 3 years to collect all the information. But the result justified the investments and time spent as Austin saved 600MWt of energy in the first 2 months of the project completion.

b) Economic framework, favoring the status quo

Sole focus on economic gains in the short-term and a fear of (higher investment) costs are the issues, caused by delayed visibility of benefits, offered by Smart Cities. Improvements on conventional solutions become increasingly clear only in the medium to long term. Investors need to be aware of all values and benefits Smart City provides (both, tangible and intangible). Here investment subsidies for particular elements (e.g. solar power related equipment) are crucial to encourage active participation in Smart City co-creation.

c) Business model delivery of smart services and finance innovation

As mentioned above, issues like securing a budget for large-scale projects are typical, since Smart City utilizes high-tech computer networks to efficiently manage the city.

In an era of austerity, especially in European and US cities, investment funds are scarce. In order to invest in the new technologies that will make the urban information economy possible, cities will need to take an innovative approach to how they deliver services (operating model), how they charge for them (business model) and how they finance it all (finance model).

3. Technological Challenges.

The main question here is "Which technologies, based on international standards, are available and how to avoid obsolescence?" Ebrahim and Irani presented a set of challenges related to the implementation of ICT: IT infrastructure, security and privacy, and operational cost. Challenges of ICT infrastructure include lack of knowledge regarding interoperability, availability and compatibility of software, systems and applications and security and privacy challenges, such as threats from hackers and intruders, threats from viruses, worms and Trojans, privacy of personal data, high cost of security applications and solutions. Finally, there are Operational Cost Challenges, coming from high cost of IT professionals and consultancies, high cost of IT; cost of installation, operation and maintenance of information systems, training of IT specialists. All these challenges only add to the set of Technological Challenges.

4. Social Challenges

a) Involvement of End-Users

When cities contemplate new ways to deliver basic services, support from citizens is essential

for the success. Citizens who are uninformed or disengaged cannot support, and may actively oppose, even the best policies. The public needs easy, open and continuous access to a wide variety of data and planning information, and people must be brought into a project early so they can participate in designing it. So, the question of "How to motivate and involve end-users, granting the same level of comfort and cost competitive solutions" is crucial for the development of Smart City Initiative.

b) Myopic view of the Smart City value

Many cities adopt a myopic view of value in economic terms. While this may simplify investment decision-making, it lacks the richness and diversity of life in the city. Economic value is only one of many ways for public investments to create value. The challenge is to establish a framework for measuring and expressing value that resonates with citizens and enables politicians to articulate how they are enriching everyday life in many ways.

c) Lacking Clarity of vision

It is not always clear to administrators how smart technologies will resolve the issues faced by the population on a day-to-day basis. The technology descriptions can be quite abstract (cloud computing, data analytics etc.) and can often obscure the true impact of the technology. The challenge is to explain to stakeholders in the city how an average day in their lives will change with the adoption of smart solutions.

d) Awareness of the general public on Smart city.

Even in the most successful cities this challenge is not overcome as the information is asymmetric and public involvement is low. Humanistic approach to a Smart City is necessary. In many cases residents living within the Smart city cannot tangibly feel the Smart city since it was not developed on demand by the residents, but was designed through the perspective of city engineers.

e) Ecological awareness, requiring "re-thinking" of conventional behavior

"Smart thinking" means changes in behavioral attitude and psychological perception of the

people. “Smart Cities thinking” also addresses the new products, services, protocols, and governance layers, enabled by these contemporary ICT, and so the area also addresses organizational and cultural aspects, including the relationship between behavioral change and such approaches. It is crucial to involve citizens who consume energy in order to build up an energy-ecosystem consisting of energy suppliers, energy managers, policy makers and citizens. The major hurdle in this domain is the lack of familiarity of elderly people with such new services and technology, which so far has excluded them from the benefit of a diffuse information and communication network [Webb, 2011]. So, the need to “teach” elderly consumers and change the behavior of younger consumers is obvious.

5. Governance and Coordination Challenges

Increased complexity regarding involvement of cities as actors in the value network, with all the agencies and domains they entail, and the potentially large differences between cities themselves will take a lot of efforts to make the concept of Smart City work smoothly and implement all of the benefits Scholl studied challenges of e-government key projects, and found that stakeholders’ relations is one of the critical factors to determine success or failure of such projects [Mooij, 2003]. Currently, problems are in inadequate political support out of fear of losing influence and resistance from citizens. Holistic integrated planning, dedication of visionary, committed and ambitious key actors (politicians, developers, etc.), formation of win-win coalitions, involvement of citizens and other stakeholders in the decision-making process from start-to-implementation phase, all the benefits, which can be achieved, when the integration of all stakeholders is successfully implemented.

Cities are complex organizations and decisions that involve multiple departments tend to take time and are often at odds with the sales cycles of companies. Procurement cycles for cities can take up to three years from initiation to sale, which can prevent innovative, under-resourced companies from participating in smart city development opportunities. Coordination within the city's operational silos can be challenging; introducing the private sector to that equation compounds the complexity. Though, still little literature on smart cities addresses issues related to governance several cities have already benefited from the emergence of ICTs that improve

their governance. This ICT-based governance is known as smart governance. It widely represents a collection of technologies, people, policies, practices, resources, social norms and information that interact to support city-governing activities. According to Mooij [2003] the presence of leadership is important for good governance. In the same way, Lam emphasized on the presence of a "champion" that collaborate with all stakeholders as an essential factor for good governance [Lam, 2005]. Smart governance has already been described in this research before as an important characteristic of a smart city that is based on citizen participation and private/public partnerships.

4.2 Recommendations for Smart City Development

Previous section identified the variety of challenges to implementation of Smart City Projects. In general all the challenges are widely divided into private and public, just as the recommendations, which follow in this section. While recommendations for both sectors differ across 5 major challenge groups, they have much in common.

The recommendations will be given in the same order and challenge groups: Complexity, Economical, Technological, Social and Governance.

Public Sector Recommendations:

1. Recommendation to overcome Complexity issues includes:

Knowledge sharing opportunities (Government and Citizens); Organic-market oriented (emergence/bottom up) vs. government top-down (control) approach in diversifying smart city services; Direct service implementation versus test-bed/living lab approach, depending upon technology maturity level (approved tech. vs. new tech. for capability building; Realization of citizen-and service-oriented government system with ICT; Standardization and benchmarking projects to realize a safe and sound society from the way of promoting ICT convergence services closed to citizen's personal lives; Standardization of successful projects performance

and encouraging the broad adoption of best practices; Advancing public services through open and creative services; Laying a legal foundation for expanding best practices; Identification of regulatory barriers.

2. Recommendations to overcome Economical challenges

Develop new service models and expand its performance to create public demands for new technologies.

3. Recommendations to overcome Technological challenges

Improvement of public services with advanced ICT; Increase of Smart devices and ICT capacity; Smart City Infra Integration: Network effects and service user adoptions: Multiple Devices Access Versus Smart Phone Access (Infra. Investment).

Network capacity and usage status will play important role in promoting smart cities where higher data bandwidth will be required in order to meet future citizen's demands.

4. Recommendations to overcome Social challenges

Creation of more value; Sustainability services for smart green need citizens to engage it and change their behaviors through robust incentive system which helps sustaining eco-system for smart green services; Innovating advanced civic engagement/participatory services by developing cloud-based, crowd-sourced applications (citizen's input and feedback); Improving single-point entry access & enabling more cost-effective self-service; Empowering user driven innovation through open data platform strategy; Facilitating new service development and providing ability to leverage city data; Increase in government transparency and crowd-sourcing movement; Diversifying and exploring different service domains (utilities, transportation, healthcare, etc.).

5. Recommendations to overcome Governance challenges

Innovation approach to Governance/Smart Governance and contributing into creature of the initial market environment for e-Government are main recommendations to overcome Governance Challenges. Smart City Governance methods need to be updated according to the

enormous potential of smart city projects. And this can only be realized if the program is set up to succeed with the right capabilities in place and sufficient authority to be able to manage a complex ecosystem. With significant innovation in operating models, business models and governance structures changes are also should be done in the use of enterprise structures. Such non-traditional enterprise structures as cooperatives, mutual and social enterprises will be more effective to bridge the gap between public and private. These entities could be supported by the city but kept free from the institutional bureaucracy of government and nurtured as entrepreneurial start-ups. Such an entity could attract funding from multiple sources, and operate as a not-for-profit enterprise, reinvesting any revenue generated through its provision of data services back into its core mission of creating socio-economic and environmental benefits for the city region. Smart city leadership and governance model matters; Centralized/holistic based smart city strategy versus decentralized strategy; Smart city development need a dedicated organization and robust processes, governance principles and performance measurements to leverage services within the city.

Private Sector Recommendations:

Private sector recommendations are given in the same order as the 5 challenges groups above. Specific attention is to be given to Business Model Innovation as a recommendation to overcome economical challenges. Clarification of Smart City Vision and Values will be discussed in details through existing initiatives to tackle social challenges.

1. Recommendations to overcome Complexity challenges

Engagement with government agencies, collaborative partnerships; creating smart city eco-system for innovation and entrepreneurship through different types of private-public partnership (e.g. special purpose company); Integrating planning, development and management processes and principles for smart city initiatives

2. Recommendations to overcome Economical challenges

Pilot Projects, Portals and Business model innovation for a strategic and entrepreneurial

approach to ICT. This recommendation will be discussed in details further in this research.

3. Recommendations to overcome Technological challenges

Investment in ICT and Infrastructure (techno) Adding intelligence technologies (sensors and data analytics) create more value for new service innovation and economic opportunity for start-ups; Converging/integrating smart city infrastructure; Converging ICT with smart urban spaces (streets, buildings, parks, public utilities, homes); Developing more intelligent technologies to support diverse services and smart green services (e.g. smart grid); Developing interoperability of smart city services (service composition thinking) and infrastructure integration (multiple-devices platform, networks and integrated data center).

4. Recommendations to overcome Social challenges

Raising awareness of techno solutions by engaging industry leaders through experience from Pilot Projects for proper scaling up of larger projects; Clarifying the vision of Smart City/Value with the support of metrics

5. Recommendations to overcome Governance challenges

Defining smart city governance: Defining smart city visions and road-mapping a comprehensive smart city strategy for continued leadership (clarify roles and responsibilities).

It is necessary to pay special attention to Business Model Innovation as a recommendation to overcome economical and governance challenges. There is a necessity to cultivate business models innovation to help the public and private sectors generate value from their data sets and to enable the digital economy to flourish. It is important that city leaders take a more integrated approach to city planning that shifts focus away from the physical real estate and re-balances the strategic planning process to focus on the economic, social and digital aspects of city development. The most progressive cities cultivate business model innovation in their cities - helping the public and private sectors generate value from their data sets and putting in place the foundational infrastructure (both hard assets, such as physical data stores, and softer aspects, such as legislation on data privacy issues) to enable the digital economy to flourish. The overall

priority must be to establish user confidence in the upcoming technologies, as otherwise users will hesitate to accept the services provided by Smart Cities. Personal data contribute to a better monitoring of the city environment (think to bwired.nl) providing real-time data, but still keeping users/citizens owners of data. To make people willing to contribute, they must be assured in the safety of their personal information. To innovate such business models it is necessary to expand best practices and initiatives of Government and Major IT and Telecommunication Giants.

Pilot Project (SIEMENS in Europe, SK Telecom in Korea – case of Songdo and Jeju-do) and projects of other companies working in specific areas of Smart Cities (E-vehicles, Smart Grids, Automated systems, Green and Eco solutions) are good examples of such initiatives to overcome Private Sector Challenges.

4.2.1 Pilot Projects, Portals and Scenarios

One of the first steps in a successful smart city program implementation is the development and communication of Smart City Vision. This vision will concisely articulate the ambition, intention and imperatives of the program. It will depict the type of value, which the city is aiming to create through its smart city investments, whether it be human, environmental, intellectual or financial capital. The vision will depict how the smart city will look and feel - what a day in the life of the average citizen will be like. In the most advanced cases, it will segment the citizen base and articulate how different behavioral segments will experience change (pensioners, family units, children etc.). This common vision will help unite multiple government departments, the public and private sectors and civil society around a common view of the art of the possible. The vision will also be grounded in a detailed suite of metrics that will form a performance framework to aid capital allocation decisions, maintain integrity to the core vision over time and demonstrate the added value of investments. Most importantly, this multifaceted view of value should resonate directly with citizens, enabling politicians to articulate the value of public sector investments in terms that matter. A good example of such "visualization program" is exampled in "Korea IT Times "A look into the Smart City" [Kim,

2012]. To better understand what the future lays ahead in Smart City, there are several scenarios depicting a life of Han Nu-ri (the word also means enjoy in Korean), who will live in Seoul Yongsan International Business Zone in the future. Nu-ri's everyday life illustration will help readers understand what Smart City is all about.

The vision will also be grounded in a detailed suite of metrics that will form a performance framework to aid capital allocation decisions, maintain integrity to the core vision over time and demonstrate the added value of investments.
Another good way of giving the idea of smart solutions and its effects on everyday life of the cities is Pilot Projects, through which the results are seen much faster and the risk of implementation of such projects are reduced thanks to the financing of such pilots by the project initiators [citymart.com/call/llga2013]. LLGA.org is an example of such Pilot Project Initiatives. LLGA web-portal offers smart solutions through pilot projects. LLGA (The Living Labs Global Award) was created in 2009 as an annual program that has brought together 42 global cities and 1,519 providers leading to more than 30 pilots, reaching 285 million citizens world wide through better investment decisions.

In the past three years, 38 global cities have awarded the technologies, services and products that best meet their strategic challenges through LLGA. It works in coordination with UN Global Compact Cities Program, Oracle, Climate Group and others. During the selection process more than 1000 solutions were evaluated and a dialogue with 350 global cities was set, leading to 30 pilots, which are presented in the web site. The advantage of such pilots is in showcasing the full impact and viability of their solutions before cities take major procurement decisions. Success stories such as CitySolver (wireless network technology), show that piloting can accelerate the time to market from an average of 24 months to just 6 months, seamlessly connecting piloting and later roll-out stages.

CitySolver is a solution based on wireless network technology, taking advantage of the proliferation of mobile devices. It is composed of proprietary software (a management platform) and hardware (a sensor for urban environments). CitySolver's visualization platform allows the

clients to get real time traffic information on different routes defined. Information regarding travel times, average speeds, and traffic volume is delivered to users and managers directly. Sensors can be installed on existing urban furniture and do not require street closures or other expensive roadwork.

Another success of LLGA Pilots is Citysmart.com. Citymart.com connects cities and solution providers to improve the lives of citizens around the world. Less than 20% of cities publish their needs, less than 10% know about solutions, available to them and almost 90% of cities do not trust information from providers. On Citymart.com, cities come to discover solutions, submitted by providers around the world. Here Cities also publish Calls for Solutions to inspire their investments and regulation. Above all Citymart.com gives providers the tools to validate their track record, references and impact, what ensure Cities about the credibility of the provided information.

These Pilots' successful stories show that piloting can accelerate the time to market from an average of 24 months to just 6 months, seamlessly connecting piloting and later roll-out stages

4.2.2 Initiatives by Private Companies as examples of Business Model Innovation

All over the world government organizations and major IT giants like IBM, ABM, Sisco, Siemens, SK Telecom, Living PlanIT and others are working with a range of Smart City Projects, among which are ambitious program like Songdo (Korea), Masdar City (Abu Dhabi), PlanIT Valley (Porto, Portugal), requiring considerable amount of planning and coordination of resources among firms. Building such a city at all is a daunting proposition, but the biggest challenge is more conceptual: It is the need to design a system that puts all that technology truly at the service of the inhabitants—and not the other way around [Sassen, 2012].

1. Songdo: Starting from Scratch

The best-known example of a "City from Scratch" (also called instant city) is Songdo

International Business District, an intelligent city near Seoul that's equipped with advanced sensors and monitors from Cisco Systems. The city's multitasking devices are able to open and close, turn on and off, or stop and start everything from the toaster to the videoconference with the boss to the video camera view of a child at play. All of this can be done from both home and office, though the distinction between the two becomes increasingly vague in a fully "sensored" city. Songdo is also about recycling and greening. It is built on reclaimed land and deploys all the latest green technologies.

The idea of a smart city is one thing. Bringing it to fruition is another. A considerable amount of planning and coordination of resources among firms is required to launch ambitious projects such as Songdo, let alone launching a standardized communication infrastructure critical for making a smart city. Networking on a scale of a smart city, or any city for that matter, requires firms with the technological expertise and future vision. A network is not simply a network of pipes in a technologically advanced city. The network carries vital information as well. In the Songdo case, several companies were considered, including LG and Microsoft, before settling on networking giant Cisco. Planned cities like Songdo require heavy integration that can bring internet-connected benefits on top of traditional utilities, with end-user, consumer services billed on top at a modest monthly fee.

2. Jeju Smart Grid

The smart cities concept is not limited to new construction sites like Songdo. It is possible for existing populations to benefit from new technologies such as smart grid, renewable energy sources (wind and solar) and electric car infrastructure. Jeju Island has a number of positive properties, which make it ideal for testing smart grid functions. Of these properties, a relatively small area allows testing a limited population with access to renewable energy resources such as wind and solar. Furthermore, the island's small size makes it suitable for testing electric car infrastructure. As a special self-governing province, Jeju can also set forth legal and institutional framework required for smart electricity service. The following smart grid services have been implemented in Jeju: 1) Smart distribution (automation) over DC power lines; 2) Smart home

energy reduction; 3) Smart metering and infrastructure; 4) Wind power micro-grid; 5) Active demand response for consumer usage; 6) Electric vehicle charging station integration.

Smart grid and smart city initiatives have benefits for citizen comfort, environmental benefits, and long term cost savings. But implementing the ideas behind smart cities and smart grid will take coordination across the public (government) and private sectors (companies). The most important task (as the Multidimensional Analytical Framework already showed) will be Citizens Engagement. In today's world where citizens have become 'prosumers', meaning not only being passive consumers, but also active creators of services, the idea that the city vision should be co-designed by government and citizens is particularly pertinent to the smart city ideology, which holds transparency and inclusivity as central tenets. As the citizens are the primary reason for the existence of city policy, engagement can support cities to define and achieve their goals.

Though we are still in the fledgling years of the smart city transformation, we run the risk of over-hyping the potential and failing to engage politicians and citizens at a human level.

To summarize all the recommendations above, all the challenges can be responded, when separate tasks are harmoniously united into a coordinated broader strategy. Here a clear vision of a Smart City and Engagement of Citizens will play a greater role for success of the Smart City development projects.

Chapter 5 Implications and Conclusions.

5.1 Implications and conclusions

Considering the results of the Multidimensional Smart City Values Analysis shown in Figure 1, we derive that Citizens Engagement and Governance of the city is important. Based on this, we derive some strategic implications about the successful implementation of a Smart City Project.

Implication 1.

The most important variable that determines the success of a Smart City Project is not the level of ICT development or smart technologies equipment of the concrete city, but the level of Citizens Engagement (CE). While Governance (G) and Infra and ICT (II) come as another 2 primary factors and also have a direct effect on the success of the Smart City, they follow Citizens Engagement (CE) by their importance. Governance has been and always will be based on citizens' participation. The citizen's perspective is important because it is ultimately people, who will live and work in a smart city. If the features and amenities of the city don't speak to the ways people want to live their lives, all the 'smart' in the world will be of little practical value.

Implication 2.

Infra and ICT (II) is the enabler of the Smart City success. Though analysts, planners, IT companies and other experts tend to define a smart city in terms of its infrastructure: high-speed broadband, wireless and Wi-Fi connectivity, the cloud, sensor networks and the like all of these are important enablers of a smart city, supporting a range of flexible, intelligent services such as

smart metering, enhanced traffic management and emergency response systems. “Smartness” of the city can be literately put as equal to the “happiness” of its citizens [Campbell, 2012]. Thus, the level of ICT development nowadays can only be seen as an enabler. ICT technologies allow for greater involvement of individuals in the design, production and delivery of services, thus empowering citizens, making smarter and greener decisions in daily life, making governments and city administrations more transparent, responsive, accountable and trustworthy, involving businesses and citizens in a continuous dialogue [Foley, 2013]. Citizens should define life in megacities together with governments, and with the support from ICT solutions and technology. ICT is an enabler to become a ‘Smart City’ as these technologies certainly foster the efficient use of resource and collaboration/integration within citizens. On the other side, ICT is not a sufficient condition. For a City to become a ‘Smart City’ it needs full engagement of its government and its citizens. They need to be aware of the importance of the environmental, social and economic challenges and tackle them. ICT is necessary condition to effectively overcome these challenges, but it is not sufficient by itself.

5.2 Contributions and Limitations

The major contribution of this paper is identification of key variables of a successful Smart City Projects through case study. Using a collection of Smart City definitions across time and analyzing 13 cases this research seeks to bridge the definition gap and creates the analytical tool for understanding the key comprising factors of a successful Smart City Project. The analysis emphasizes the role of citizens and their engagement as the first main factor along with governance as the secondary main factor for Smart City Project success. Different to the way other researches define traditional ICT as the primary factor for the success of Smart City Projects this research shows that in practice technologies can be seen as an enabler of Smart City development driven by citizens. Challenges and barriers are categorized in order to provide Smart Cities’ stakeholders with implicational tools and managerial approaches to sustainable urban development, based on existing governmental and corporate initiatives. However, this

research shows some limitations.

First limitation is that the number of cases selected cannot represent full statistics on Smart City Projects. This condition is hardly observed also due to the rapid development of technologies, smart and green solutions worldwide. Particularly emergent countries are now expanding IT solutions and new Smart Cities are rising just as "mushrooms after the rain". That's why it's impossible to consider all cases and this research only reviews cases, which are widely mentioned in the media and scientific researches. However, though only a few cases were covered in this research factors derived from cases can be extrapolated and applied to other Smart City Projects, as tendencies, discovered by the case analysis, are true for any Smart City in its general meaning.

Second limitation is that cases were not classified by specific categories (like regional, level of maturity, characteristics and objectives), thus implications derived are given in a very general manner without specific recommendations to a certain type of Smart City Projects. All these limitations can be addressed in future researches, which are highly desirable, taking into account constantly changing and evolutional nature of Smart City concept per se.

Finally the results of this research serve as a very general outlook for the existing and future Smart City Projects as it is impossible to cover the abundance and variety of such Projects with the evaluation of IT sector in mind. A lot of work should be done toward factors systematization and standardization in order to increase the accuracy and reliability of the results. The main purpose of this research, however, is in discovery of the new direction and trends of Smart City development toward Soft Sector and Social Capital and importance of Human Factor and Citizens Involvement, downgrading the supremacy of ICT and challenging its status quo.

(한국어 요약)

스마트 시티 프로젝트의 성공 요인 및 도전과제에 대한 탐색적 연구조사

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반면에, ICT자체가 스마트시티 조성의 충분 조건이 될 수 있는 것은 아닙니다. 한 도시가 "스마트" 해지기 위해서는 정부와 시민의 전면적인 참여가 필요합니다.
즉 정부와 시민 모두가 환경적, 사회적, 그리고 경제적 과제들의 중요성을 인식하고 이를 해결하기 위해 함께 노력해야 합니다. ICT 기술은 이 모든 과제를 극복하기 위한 필수 조건이 될 수는 있지만, 그 자체로 충분하지는 않습니다.
최종적으로 본 논문에서는 다양한 사례 연구를 통해 성공적인 스마트 시티 프로젝트의 주요 변수를 식별해내고자 합니다. 시대 흐름에 따른 다양한 스마트 시티 정의 고찰 및 13 개 사례 분석에 의해, 시민참여도를 스마트 시티 프로젝트의 성공을 위한 제1 주요 요인으로, 지배구조를 제2 주요 요인으로 선정하였습니다.
다른 연구들이 스마트 시티 프로젝트 성공의 주요 요인으로 기존의 ICT를

정의하는방식과 달리, 본 연구는 기술이 실질적으로 시민주도 스마트 시티 개발의 원동력으로 파악될 수 있음을 증명합니다. 본 연구는 성공적인 스마트 도시 개발을 위한 도전과제들을 분류하고, 스마트도시 이해관계자들에게 기존의 정부 및 기업의 전략들을 기반으로 '지속 가능 도시 개발'을 위한 실행수단과 경영방법을 제공합니다.

전반적으로,이 논문은 도시화 문제의 해결을 위한 '스마트 도시 및 ICT 통합관련 지식' 형성에 기여하고자 합니다. 경영 관계자들은 본 연구 결과를 적용하여 스마트 시티 프로젝트 추진의 효율 제고 및 스마트 시티 프로젝트 관련 지식들의 우선 순위 선정 등에 활용할 수 있습니다.

Keywords: Smart City Projects, Sustainability, Citizens Engagement, Governance, role of ICT

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