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Exploratory Research on the Success Factors and Challenges of Smart City Projects

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As urbanization and its consequences become the issue of modern cities, the concept of Smart City comes as the solution. Though a lot of researches on the topic is 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. The **citizen's engagement** and **governance** are identified as the two key success factors of Smart City Projects along with ICT and other factors as enablers.

The research has 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.; and 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.

The 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, Success Factors and Challenges, Sustainable Urban Development, Citizens Engagement, Role of ICT

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Ⅰ. Introduction

"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 all CO_2 emissions. Growing needs of cities and its citizens urge governments to underatke 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, that 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]. 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.

1.1 Methodology and Reason of Choice

Case study is chosen as a research methodology for this thesis. Robert Yin's work [Yin, 2002] and Izak Bensbasat Case Research Strategy [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 constitutes 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, 2002]. 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.

Ⅱ. 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. There is a need to define Smart City in a more "gerenal" 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."

2.2 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 was

launched as a virtual public domain [van den Besselaar and 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). Other researchers at the Brookhaven National Laboratory made public the ideas of Effecient 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 have 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. 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 an 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].

2.3 Present: Intelligent City; Knowledge City; Smart City

Nowadays the concept of Smart City is more common though it is quite similar to U-City. The difference of former is in the Degree of Intelligence. Smart city is considered as a Post Ubiquitous city. 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. 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].

2.4 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 develop to the soft as well as warm techniques [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 below.

<Table 1> Working Definitions of a Smart City

Practitioners's view
A city "combining ICT and Web 2.0 technology with organizational, design and planning efforts to dematerialize, speed up bureaucratic processes and help to identify new, innovative solutions to city management complexity, in order to improve sustainability and livability" [Toppeta, 2010].
Scholars View
"A city is «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" [Hall, 2000].
City's view
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].

There are mechanisms and approaches to define the term, such as: six-axes approach by European City Project; three-dimensions mechanism by Korean University Industrial Technical Force; Smart Operation Model by ICT from Climate Group, etc.

2.5 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]

2.5.1 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> 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:

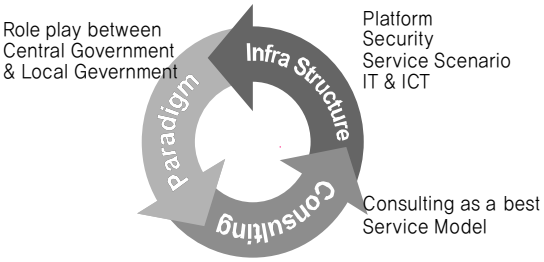
<Table 2> Six axes Approach by European City Project

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

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.

2.5.2 Three dimensions Mechanism by Korean University Industrial Technical Force

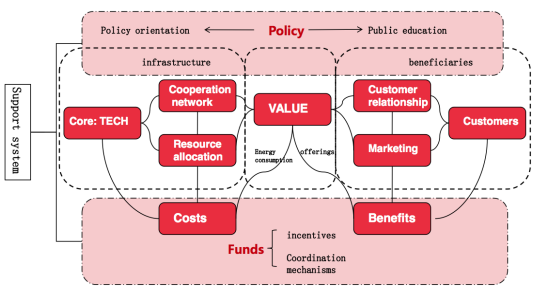
Another mechanism to describe a Smart city is Three Dimension Mechanism, developed by UNITEF, Korean University Industrial Technical Force. It is not a secret that Korea is at the top of leading countries in IT sector and it also leads the development of smart city concepts with it government and corporate 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.



<Figure 1> Three Dimension Mechanism to Define a Smart City

2.5.3 Smart Operation Model by ICT from Climate Group

Climate Group suggests another Smart City Operation model. As presented on the picture below (See <Figure 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> 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, 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.

Ⅲ. Analysis of Smart City Projects

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 rapidly changing statistics on this question. That's why none of the statistics about Smart Cities, presented in the media, would guarantee its accuracy and fair representativeness. By using the most recent data on Smart Cities and emerging projects from major research institutes, 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 have 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.

Let's first consider the ranking, developed by Boyd Cohen, who is a climate strategist and the CEO of CO_2 IMPACT. He leveraged about a dozen global and regional rankings of smart-city components in order to develop a global ranking of smart cities (see <Table 3> below).

Cohen referred to the rankings of the following research organizations and institutions;

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

<Table 3> Global Ranking of Smart Cities by B. Cohen

	CITY	Region	Innovation Ranking	Green City Ranking*	Quality of Life	Digital City Ranking
1	Vienna	EURP	5	4th in Europe	1	8
2	Toronto	NA	10	9th in North America	17	10
3	Paris	EURP	3	10th in Europe (RC: 6)	30	11
4	New York	NA	4	3rd in North America (RC: 8)	47	4
5	London	EURP	11	11th in Europe (RC: 9)	38	13
6	Tokyo	ASIA	22	Above Average in Asia (RC: 10)	46	15
7	Berlin	EURP	14	8th in Europe	17	32
8	Copenhagen	EURP	9	1st in Europe (RC: 1)	9	39
9	Hong Kong	ASIA	15	Above Average in Asia	70	3
10	Barcelona	EURP	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.

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. (see <Table 4>)
5) The IDC rankings of smart cities in Spain (indicated as IDC in the <Table 3>)
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, Smart Cities Council.
8) IBM' "Smarter Cities Challenge" (competitive grant program to award $50 million worth of technology and services to 100 municipalities

Rankings, offered by Digital Community for the cities in the U.S. choose the top digital cities, leading in open data, transparency efforts and innovation in deploying mobile applications to citizens while conforming to fiscal standards. In the <Table 4> top ten cities within the category of 75,000 to 124,999 population are presented, 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.

<Table 4> 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 2 thinknow used in B. Cohen's work, is another way of ranking, which is considered as the most comprehensive city ranking and scoring. The process of scoring is explained below.

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 from 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 [Tothinknow, 2013] 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

<Table 5> Innovation Cities Global Index 2012~2013 from 2 thinknow

#	Rank	City	Country	Region	Sub Region	Class	Score Index
1	3	Vienna	Austria	EUROPE	EURP	1 nexus	57
2	5	Paris	France	EUROPE	EURP	1 nexus	56
3	9	Amsterdam	Holland	EUROPE	EURP	1 nexus	55
4	24	Manchester	UK	EUROPE	EURP	1 nexus	52
5	30	Singapore	Singapore	ASIA	ASIA	1 nexus	51
6	34	Dubai	UAE	MIDDLE EAST	MID-EAST	1 nexus	50
7	36	Helsinki	Finland	EUROPE	EURP	2 HUB	49
8	38	Oslo	Norway	EUROPE	EURP	2 HUB	49
9	56	Barcelona	Spain	EUROPE	EURP	2 HUB	48
10	123	Boulder, Colorado	USA	S. AMERICA	USA	2 HUB	45
11	N/A	Malaga	Spain	EUROPE	EURP	3 NODE	40

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 trends;
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. From the <Table 5> above we can see that 11 out of 13 cases, presented in this paper later, are included into 3 first categories (NEXUS, HUB and NODE) of Innovative Cities Global Index.

Being guided by rakings from different institutions and researches we then choose the cases randomly, taking into account the frequency of their appearance in the ranking lists, as follows:

1) We choose 11 cases from 2 thinknow Innovation Cities Global Index as these cities are most frequently appear in the ranking lists of the relevat research institutes across different regions. Among them Vienna, Paris and Barcelona are also appear in B. Cohen's Global City Rankings.
2) Other cases, also appearing frequently in the media, though somewhat less clear and simetimes contradicting in assessment by ranking institutions, are cases, like Kochi, Amsterdam, and Malta, as they appear in Smart Cities Readiness Guide by Smart Cities Council [Berst, 2013]. While Amsterdam appears under the ranking 9th in the Innovation Cities Global Index from tothinknow, Malta case is reviewed in Smart Cities Council Readiness Guide by 2 thinknow.

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 (see <Table 3>), while Innovation Cities Global Index ranks them

number 3, number 5 and number 56 respectively (<Table 5>. 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 75,000 to 124,999 population category and positioned at number 8 (see <Table 4>).

Thus, to keep representativeness ballance we chose cases with different band scores (Nexus, Hub, Node), different categories (population category) and methods (individual researcher B. Cohen versus Research Institutions)

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 analysis is done. This relates to 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 in this paper and data from other existing researches and media sources. That's why it is important to cover full set of variables responsible for Smart City Project success, which certain research institutes ranking lists are missing out.

While SmartCity Council ranking shows only positive side of Amsterdam City (such as ICT and Governance) we will show later in this paper, that Amsterdam lacks some crucial essence to be called Smart City, as the project couldn't satisfy the needs of citizens, failed to get the feedback and cooperation from the stakeholders, what ultimately led to its "death" [van den Besselaar and Beckers, 2005].

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 is necessary to provide comprehensive assessment of the cases taking into account all recently available data from the media and researches.

3.2 Reason of Choice for Variables

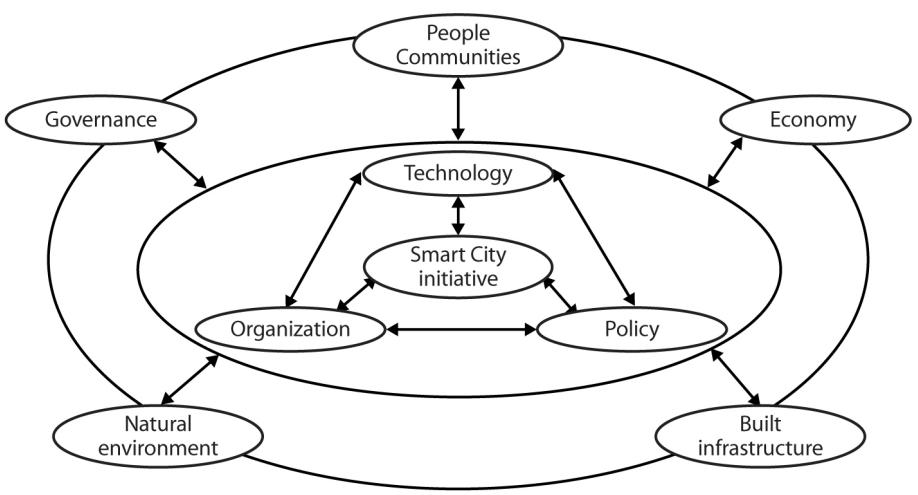
Just as the definition of the term "Smart City" is not yet fixed among researchers there are no standards, rules or fixed sets of variables to define Smart City Project's success. The plenteousness of Smart City Projects, named successful in the media and existing researches will not guarantee the fact, that all essential factors were included, while determining Smart City success. It is explained by the variety of variables, explaining different cases and the "novelty nature" of such variable considering the rapidly changing statistics and trends on Smart City Projects. The variables set can not be fixed in time as more values will be added for Smart City definition as time goes by. Rather it should be logically flexible, leaving the space for new factors to be included. With the above-mentioned in mind this paper will not only take into account existing factors, from available

sources, 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) Smart City Initiatives Framework (see <Figure 3>).
2) The Smart Cities Wheel, B. Cohen (see <Figure 4>).
3) Research by A. Caragliu, Del Bo, and P. Nijkamp [Caragliu, Del Bo, and Nijkamp, 2009].
4) Six-Axes Approach by European City Council (<Table 2>) as well can be used as an example of variables generation.

3.2.1 Smart city Initiatives Framework

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.



<Figure 3> Smart City Initiatives Framework

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.

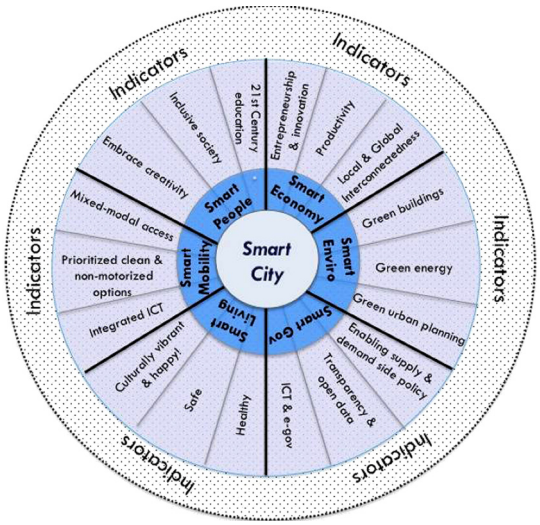
As authors suggest, technology may be considered as a meta-factor in smart city initiatives, since it could heavily influence each of the other seven factors. Due to the fact that many smart city initiatives are intensively using technology, it could be seen as a factor that in some way influences all 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.

3.2.2 The Smart Cities Wheel, by B. Cohen

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

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 [Cohen, 2012, ubmfuturecities.com].



<Figure 4> The Smart Cities Wheel by B. Cohen

3.2.3 Research by Andrea Caragliu and Peter Nijkamp "Smart Cities in Europe"

However all the variables systems mentioned above do not highlight 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 leart 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 also 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, [Caragliu, Del Bo, and Nijkamp, 2009]. 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 comprehensive and inclusive. Based on the Six-axes approach (<Table 2>), Smart City Initiatives Framework (<Figure 3>), The Smart Cities Wheel, by B. Cohen (<Figure 4>) and other mechanisms and factors to define Smart City, we derive 7 factors to define Smart City Project success. As mentioned before some factors will be combined to form new ones, while others will remain the same. Thus, we will be able to include the factors, which yet has not been covered in previous researches. Each factor will be valued a Strong (S), Medium (M) or Weak (W), depending on the level of the certain value in each Smart City case.

3.3 Variables Generation and Analysis

While an exact definition has yet to be formed, a smart city provides high quality of life to its citizens with the following seven drivers acting as forces of innovation. These seven drivers are used as an explanatory variables further in research to define the success or failure of the certain Smart City Project. 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 there is a more detailed analysis of all 7 factors.

3.3.1 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.

3.3.2 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.

3.3.3 Economy

Level of Economy, which includes the level of business development, holistic and synergetic planning of the City Initiatives. Giffinger also suggests innovation, entrepreneurship, pro-

ductivity, 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].

3.3.4 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].

3.3.5 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.

3.3.6 Infrastructure (Basic, Built, Mobile) and ICT

Infrastructure has several meanings, depending on the term of context used in. In this research we refer to the complex of basic, built and mobile infrastructure (hard infra) as well as the innovative environment in a city, with the infrastructure of supporting technologies, communication and service delivery among

government, businesses, and citizens (soft infra). We will review each component in details below.

(1) 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.

(2) Built Infrastructure

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

(3) 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.

(4) 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].

3.3.7 Civic Engagement

This variable can be called "secret ingridient" that turns the idea of a smart city into reality. In a nutshell, we're talking about people-elected officials, city planners, policymakers, citizens, business leaders, financiers and public-private partnerships [Berst, 2013]. In general, this dimension relates to the abilities, behavior, and experience of citizens in ICT applications and services of the city. 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. This encompasses the outreach, inclusion and cooperation cities need to get the best results from technology investments. Experience has proven that for smart cities to work, citizens must be considered and consulted from day one and at every step along the way. Fortunately, social media and web portals make citizen engagement far easier today.

3.4 Analysis of Smart City Case Studies

After we defined explanatory variables it is time to see how each variable is presented in a certain Smart City case and what's the influence of variables on the case's outcome.

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 "essence" of a smart city. First 4 cases are characterized in <Table 6>.

As mentioned before, 13 cases, which has been chosen as the most representative, will be reviewed in this paper in order to carry out a comprehensive assessment of Smart Cities' Successful Factors. As the assessment proceeds we can keep some factors, while excluding others, which are not directly explaining the out-

<Table 6> Characteristics of Failure Projects

V	Amsterdam	Malta	Kochi (India)	Colorado
HC	Medium. Innovative pilots for data and mobility, but lots of setbacks: failure to deliver right info about railways/ buses/in the right time. [Houthuijzen, 2013]	Weak. Bad transportation sevices [timesofmalta.com, 2011] Malfunction of meters [Barry, 2013] Malta is trailing behind many other EU countries with its pension system [Taberner, 2013]	Strong. Increasing living standards and human development indices. More attention is given to legal system. Empowerment of women projects (Women-operated auto taxis [KochiCity Forum, 2013] Emphasis on open society welcoming outsiders to attract highly educated specialists and experienced workers, as well as Foreign Investments.	Strong. People encouraged innovation and the industry's move into the digital age via "smart grid" [Helms, 2013] automated meters have already been widely deployed by many utilities)
SC	Weak. Ineffective citizens education system, non responsive to citizens' complaints Users' complains about declining service of DDS	Strong. Communities and companies are involved into education process. Emphasis on the question of education: how to bring universities into Smart City Malta).	Weak. People are not ready to face changes, brought by ICT and Internet of Things. Protests of citizens regarding SmartCity initiatives, which lead to inconveniences in citizens' lives	Weak. Non-awareness of the project benefits and utilization causing by lack of communication with the citizens [Helms, 2013]. Lack of communication with customers [King, 2010].
E	Weak. Shortcomings in legitimacy, poor planning, high developing costs, impossibility to manage the system	Weak. No agreed time on goals achievement, no investments attracted as planned, detour of the goal paths and contradiction of the initial goal, no promised jobs created [maltastar.com, 2012]	Medium. Influence of Global crisis, but Economy is rising due to special economic zones, boosting FDI and overall infra, attractive IT sector, growth of residential, commercial and retail sector.	Weak. Lack of planning and short seeing of the upcoming scales and costs. The market hasn't matured for the project
G	Weak. Starting as a grassroot initiative DDS couldn't get support from government, became a non-profit organization, and eventually transformed into a private company. Its vulnerability in a competitive market led to its demise.	Weak. Incompetence, non-ability to make up plans, costs overrun [maltastar.com, 2011] Government overpromised and undelivered. [maltastar.com, 2012] Weak internal control, failure to meet obligations regarding Smart City [timesofmalta.com, 2011], [timesofmalta.com, 2012]	Weak. Delay of government approval for city status and construction plan. Disputes inside the government over the smart city project as an anti-national project [Neelakandan, 2011]. No tentative date fixed for launching work. All inhabitants on the 136 acres moved out KOCHI: The global economic meltdown, technical hassles, procedural delays and a host of other factors are holding up the implementation of the proposed SmartCity Kochi [The Hindu and Kerala, 2011]	Weak. Lack of planning, bad management, no clear goal, inability to look into the demand side of the project, cost over runs [Helms, 2013]

V	Amsterdam	Malta	Kochi (India)	Colorado
ES	Strong. (Amsterdam Climate Plan, 16 pilots) [Karen, 2012]	Strong. Sustainability, environment protection act, voluntary sustainable development initiatives by businesses [timesofmalta.com, 2012].	Weak. Acute water scarcity adds to the environmental issues, though government is continuously developing projects on water supplement nd treatment.[Praveen, 2013]	Strong. Initially responsive approach to the sustainability: open parks, nature conservatio projects, expanding capabilities of its Climate Action Plan [ibm.com, 2013]
II	Strong. Initially enabled with all the optic (soft) and hard infra. Plenty of pilot projects based on mobile and open data	Medium. Malfunction of smart meters due to mismanagement of the administration [Barry, 2013]	Strong. Leading infra and logistic facilities trong ICT (3 main IT parks built as the Hub and Spoke model; Unmatched bandwidth. Two submarine cables. Teledensity is twice the national average. Incubator for startups (more than 120 companies)[KochiSmartCity, 2012]	Strong. Several green high-tech organizations, transforming general homes into highly effective and sustainable (smart meters, solar panels). Full integration of the latest software technology into built infra [ibm, smartercities challenge, 2011]
CE	Weak. Lack of ownership by users, declining participation and commitment. Citizens were. more consumers than owners of the DDS. Lack of active collaboration among many individuals and organizations, without a hierarchy	Weak. No freedom of expression. Opposition of Maltese citizens re Smart City as it can hurt the ancient Maltese culture. Concerns re adequacy of road infrastructure leading to the SmartCity area [Borg, 2011]	Weak. Expected employment opportunities are not delivered. Citizens oppositions regarding culvert raising were not met. After the construction of Metro Rail, it is impossible to raise it, people suffer every monsoon [Helms, 2013]	Weak. Misleading info to the customer. The devices were too simplistic, and demand was not as great as Xcel anticipated. Many homes didn't meet Xcel's installation criteria [Helms, 2013]

come. The assessment will show us the reason of a certain outcome (Success or Failure), when specific values are cultivated or left without proper attention.

Case #1: Kochi Smart City project

SmartCity Kochi is an IT Special Economic Zone under construction in India. Smart City (Kochi) Infrastructure Pvt. Ltd. is a joint venture company formed to develop the Kochi Smart City project. Government of Kerala (16% share), TECOM Investments (84% share), a subsidiary of Dubai Holding are the main investors of the company. Located in the coastal area of Kerala, India, Kochi was aimed to be one of the largest IT parks of India This project envisions minimum 8.8 million sq. ft. of built up space out of which at least 6.21 million sq. ft. will be specifically for IT/ITES/allied services. 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. But, for a project originally conceived in 2005 and for which the foundation

stone was laid in November 2007, SmartCity Kochi has never really managed to keep up with deadlines for a variety of reasons [Smart City Kochi Observations, 2012]. The progress of the project was delayed by political reasons and disputes over government approval for city status and construction plan [IANS, 2010]. There were few issues in getting a single SEZ status as the land is separated by a waterbody. The main concern was that it would deny local population access to the traditional sources of water. The protesters said that the acquisition of Masjid-Bund Road would deprive them of a shortcut to the Edachira junction and demanded to make the road the natural boundary [The Hindu, Kerala, 2007]. Even though Ministry of Commerce have granted a single SEZ status for entire 246 acres of land in December 2011, what was important to avail the benefits of a multi-purpose SEZ the construction is put on hold. The global economic meltdown, technical hassles, procedural delays and a host of other factors are another reasons, holding up the implementation of the proposed SmartCity Kochi [The Hindu, Kerala, 2011].

Environmental Sustainability factor is weak. Even though government continuously develops projects on water supplement and treatment due to acute water scarcity there are still many issues to settle before sustainability level will be improved [Praveen, 2013]. From this case we can see the importance of Governance factor for the development of Smart City Projects, which leaves much to be desired for Smart City Kochi. Though **Human Capital** level is strong here due to residential hospitality, retail and recreational facilities, business support services and raising education level of younger citizens, **Social Capital** is assessed as weak due to the "gap" between people and the Internet of Everything. The prospect of living in a smart city where everything can be accessed with the use of a mobile device and an Internet connection is promising, but may still be a dream for some people. It can be a challenge to convince a farmer, whose main source of income is planting and harvesting crops, that he would be better off living in a house controlled by a smartphone app. Yes, the farmer may be intrigued, but when the glitz of the tech world fades, the farmer will be left with the question: "What am I supposed to do for my daily needs?" In addition, as long as the government doesn't answer people's concerns and claims regarding issues with infrastructure and other construction works, which are hindering people's lives it would be hard to get the feedback and support from the citizens, who's needs should be addressed first. That's why **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 a technology park under development in Kalkara, Malta. It is being developed into a major new center of excellence for knowledge-based companies The plan is to transform the Ricasoli Industrial Estate into a state-of-state-of-the-art information technology and media city on the models of Dubai Internet City and Dubai Media City. The project was un-

veiled on 10 September 2007 by the Prime Minister of Malta, Lawrence Gonzi. The project, which costs at least € 275 million and covers an area of 360,000 square meters, is to be fully completed in 2021, although the first offices opened in 2010 [malta.smartcity.ae, 2010]. 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 the promised jobs still need to materialize. Despite guarantees that 5,600 jobs would be created within a short time, there was never any agreed timeframe for the creation of jobs. Politicians' comments are that this is the long-term project which should not be measured on the creation of jobs, but on the extent of the development [Berst, 2013]. Poor governmental planning delays the progress of the Project. (i.e. removing the sewage pump to make way for the project, etc.) [timesofmalta.com, 2012].

The project is now also being hit by the euro crisis. The Parliament actually said that Malta had spent € 13 million on the project in 2011, without much of foreign investments, which it would hope to attract. The perception of the companies that do not have a base in Europe yet, that Malta's membership of the Eurozone is a problem. The problem may not necessarily be Malta itself, but how the uncertainty with the single currency will affect the main markets these companies would aim to penetrate, not to mention the potential losses from exchange rate fluctuations [timesofmalta.com, 2012]. 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. As per <Table 6>, we can see the values of each factor, such as Infrastructure and ICT, Economy, and Civic Engagement. All these factors are weak, except for the first one. Another strong factor for this case is **Social Capital**, since there is a trend to bring differnet stakeholders into education system. **Human Capital** is at the Medium level, due the fact that the majority of the citizens are wealthy and life expectancy is raising, but these two are balanced out by lacks of welfare system and poor transportation system. Thus, SmartCity Malta cannot be called a successful Smart City Project.

Case #3: Boulder, Colorado SmartGridCity

The Smart Grid City project in Boulder Colorado, 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. As Paul Mauldin comments: "the Project hasn't even died and the inquest has already begun." And it's no wonder. The Xcel project has missed its completion date and costs have already overrun by 300 percent to 44.5 million dollars. That's a good-sized "pilot" project for a city with a population of around 100,000. Now the Colorado Public Utilities Commission is determining who will pay for the overruns-ratepayers or Xcel shareholders [Mauldin, 2010]. Even Xcel itself admits that the communication with the customers was poor. As Randy Huston, Xcel Energy's Director of IT Infrastructure and Smart Grid, admitted: "Everything we've done in Boulder Smart Grid City Project was in the interest of the customer, we've just really failed at explaining that." Because Boulder's smart grid was one of the first in the country, some of the technologies it used, such as fiber optic communication technology, turned out to be less than ideal. The new two-way communication technology, installing smart meters for less than a quarter of the population and other features almost doubled the project's cost within a year after it began. 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].

Finally, the city perceives that the utility is charging too much and not being responsive to their needs as a consumer and starts down the path to municipalize. Boulder residents failed to see any benefits, at least to judge by the comments residents leave in public forums. For instance, here is a Mr. Milburnski: "I live in Smart Grid City, and I have a Smart Meter, and the problem isn't that Xcel failed to communicate with me, it's that the system is really, really dumb-so dumb as to be virtually useless. Case in point, the closest I can get to Real Time energy consumption data is with a 15 minute delay. Over optical fiber! EBay can give me millisecond response to something I'm bidding on halfway around the world and it takes Xcel 15 minutes to give me something I could have gotten from my dumb meter by walking outside and looking at it. Give me a blinking break" [Skinner, 2013].

There are two important lessons from the Xcel experience. First, Xcel failed to demonstrate real benefits from their smart grid investments. Numerous utilities were represented as well as smart appliance manufacturers and representative of the US EPA. Although the vision of a consumer-enabled smart grid was clearly articulated, it became apparent that the regulated utilities were not incentivized to move forward with a smart grid business model. The utilities were happy to install smart meters, because those could be rate based. But the applications for the smart grid were nowhere to be found. Second, the Boulder experience high-

lights the importance of a level of consumer engagement that may not be possible in the regulated utility business model. Several times during the Boulder City Council meeting, the proponents of municipalization pointed to the qualitative benefit of building an electric system that is responsive to the renewable energy priorities of the community. "If we take over the utility, the concept behind SmartGridCity – of consumer information, consumer choice, and consumer communication – would be a huge part of what we would do," said Sarah Huntley, a City of Boulder communications manager. "It's one of our fundamental reasons why we want to get involved: to let people know enough about their energy use and be empowered to make choices about how to reduce use." However, the solution to these must in part be driven by changes in regulatory policy.

From this case **Social Capital** factor 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. For more details refer to <Table 6>.

Case #4: Amsterdam Digital City, (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. **Human Capital** factor is medium because of satisfactory income and welfare system, abundance of pilot research projects to educate citizens and innovative pilots for data and mobility (with lots of setbacks, however, such as failure to deliver right info about railways and buses in the right time, other information regarding government services, etc. [Houthuijzen, 2013]). **Social Capital** level is weak though, since the education system was nonresponsive to citizens' needs and complaints. Also there users complained about declining service of DDS.

Economy factor is weak due shortcomings in legitimacy, poor planning, high developing costs, impossibility to manage the system.

Governance factor is weak as well: starting as a grass-root initiative DDS couldn't get support from government, then became a non-profit organization, and eventually transformed into a private company. Its vulnerability in a competitive market led to its demise. Its vulnerability in a competitive market led to its demise.

Environmental Sustainability is strong as Amsterdam City has a Climate Plan and relative 16 pilots [Karen, 2012]. **Infra and ICT** factor is also strong as the Project was initially enabled with all the optic (soft) and hard infra, with a plenty of pilot projects based on mobile and open data. Finally, **Citizens Engagement** factor is weak, because of the lack of ownership by users, declining participation and commitment. Citizens were more consumers than owners of the DDS. Lack of active collaboration among many individuals and organizations, without a hierarchy all added to a poor involvement of the citizens into the Project's development. Amsterdam certainly has other share challenges: the more rural area north of the City, where the majority of new windmills are supposed to go, is opposed to new turbines; enormous amounts of energy is needed to keep the City, which is some 2 meters below sea level, from flooding; electricity pricing now rewards heavier users; the Netherland's population density and limited land area make it particularly vulnerable to food security; and social agitation and concerns with immigration sprout-up every now and then. However, every city is facing a growing array of challenges and threats and no city, no matter how wealthy, or how well managed, can afford to be complacent [Hoornweg, 2011].

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

Case #5: Singapore

Even in a part of the world known for its brisk growth, Singapore stands out as a beacon of economic vitality. An island nation with one of the world's highest per capita incomes, Singapore is committed to keeping the country a magnet for foreign investment. With nearly five million people sharing an island smaller than New York City, Singapore faces a continuing challenge in managing the impact of its high population density, especially traffic congestion. Its record has been stellar. As a result of heavy investment in its public transportation infrastructure - including the deployment of the world's first congestion charging system - Singapore has created one of the most modern, affordable and heavily used public transport networks in the world, with nearly three million people riding the bus and 1,600,000 people riding the train on any given day [IBM case study, 2009]. Singapore's highly developed economy relies on good governmental policies, a highly skilled workforce, high productivity and cutting edge technology. For decades, Singapore has been tackling the growing pains of a booming Asian city. Fearful that it will become overrun with vehicles, the government has damped demand by making them frightfully expensive. The price of a BMW 320i sedan, for example, is around $140,000, more than three times its average U.S.

sticker price, in part because a buyer has to pay about $55,000 for a "certificate of entitlement." To lessen its dependence on water piped in from neighbor Malaysia, the city-state has made its gutters, drains and rivulets a vast basin to catch rainfall. To curb runaway real estate prices, the government recently slapped higher taxes on speculators who try to flip properties and placed limits on loan amounts for second homes. These kinds of policies would be denounced as anti-growth or intrusive in other developed countries, like the U.S. But in Singapore, they represent part of an almost scientific approach to growth. In 2012, Singapore's economy grew 14.5%. Direct foreign investment increased 123%, to $37.4 billion [Chowdhury, 2011]. Singapore 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 paying bills, shopping, booking concert tickets, reserving places at restaurants, accessing videos and libraries, browsing through world's leading museums and art galleries, communicating with friends and family, studying for higher degrees and even doing high level research and development could all be done at unprecedented levels of comfort and efficiency [Arun, 1999]. Moreover, while Singapore has one of the highest home ownership rates in the world (90% of the Singaporean population owns their own home or apartment) the politicians are doing their best to keep vehicle ownership rates as low as possible with the auction system just to obtain the rights to purchase a car and all other measures, mentioned above. 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, mentioned above, such as local water management system to reduce dependence on water from outside programs and to reduce traffic and CO_2 emissions, reinforce **Environmental Sustainability** factor. **Infra and ICT** factor is strong as technology is cheap, simple and easy to use, literally, in every area from mundane daily tasks to scientific researches. Besides, technology is effectively used to communicate with citizens (transportation technology to help people navigate the public transportation system and the city bureaucracy, and widely used by people of younger and older ages. 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 **Economy, Governance** and **Civic Engagement**, making Singapore Smart City a true success.

Case #6: Vienna

Smart City Vienna is a long-term initiative by the city of Vienna to improve the design, development and perception of the federal capital. Smart City Vienna looks at a cross-section of the city, covering all areas of life, work and leisure activities in equal measure, and includes everything from infrastructure, energy and mobility to all aspects of urban development. Smart City Vienna has set itself the task of consistently and continuously modernizing the city in order to reduce energy con-

sumption and emissions significantly without having to forego any aspects of consumption or mobility. Smart City Vienna stands for the "intelligent city," intelligent and innovative solutions, responsible and sustainable use of resources [SmartCity Wien, 2013]. 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. 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). Ranking is based on recognized criteria and takes into account all relevant existing surveys [smartcity. wien.at, 2012]. 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. One of them is Siemens, launching Aspern Smart City (a district in northeast of Vienna) a living lab, that tests designs and systems for intelligent cities of the future. "Intelligent traffic solutions, green buildings, water management, and smart grid infrastructure are just a few of the technologies helping to steer today's urbanization toward sustainability," says Siemens, all of which will be incorporated in this development. The goal is to use resources as efficiently as possible by connecting building systems with intelligent power grids and information and communication technologies that interact. The district, which covers 595 acres on a former airfield, will have apartments and offices, and a business, science, research, and training center. Half the area will be reserved for public areas - plazas, parks, and recreation areas. The dense, walkable community sits on the shores of a lake and has easy connections to public transportation. Step by step, between now and 2030, the district will evolve into a city with 20,000 residents and 20,000 additional jobs. This project represents an opportunity to develop a long-term integrated concept for an energy-optimized city district using appropriate technologies, products, and solutions in a real-world infrastructure. The goal is to make the whole system 'smarter,' says Siemens. Decentralized renewable energy with energy storage will supply Aspern's electrical needs. IT solutions will detect faults in the system, recognize inefficient consumption patterns, and identify potential opportunities for savings [Medina, 2013]. The perfect infrastructure, forward-looking mobility and "smart" offerings for citizens are also what make the city on the Danube so attractive and Smart.

International organizations and companies need a smart infrastructure. Reachability and an efficient transport infrastructure are important key factors in this. Numerous international organizations and global companies have chosen Vienna as a city for their headquarters. The most prominent example is probably the UN, which has made Vienna one of its four official seats and is represented here by a total of 15 organizations, including UNIDO (industrial development), IAEO (atomic energy commission)

and UNHCR (refugee commission). The city's transport infrastructure has become increasingly efficient in recent years as a result of a series of special measures. Vienna's public transport network is considered to be one of the best in the world, after the modernization its fleet of buses by deploying increasing numbers of electric vehicles. Investments in rail transportation are planned in line with the city's future-oriented transport policy, allowing the constant growth in passenger numbers to be managed properly in the future. "Zero emissions buses," City bike network and Carsharing initiatives are all a greater alternatives as a further element of personal mobility [vienna.info, 2014].

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** factors, **Governance, Environmental Sustainability** are all together add to the success of implementation Vienna Smart City Project.

Case #7: Dubai

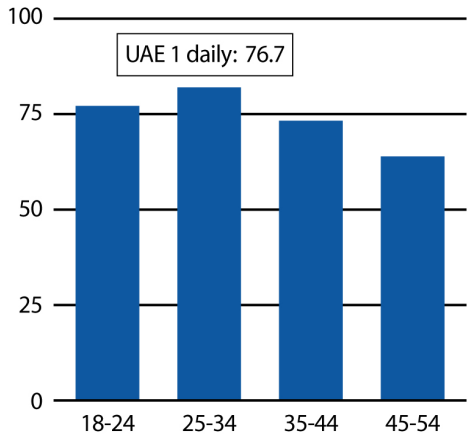
Dubai Internet City is one of the largest Information and Communications Technology (ICT) business parks in the Middle East and North Africa region. As a knowledge-oriented business model, DIC was the pioneer behind the creation of the business park concept in the region and today, hosts well over 15,000 knowledge workers. The ICT business park hosts a dynamic international community of about 700 IT companies which include Fortune 500 brands as well as a number of growing enterprises, entrepreneurships and ventures: Microsoft, Dell, Intel, IBM, Canon, General Electric and Cisco just to name a few, with GDP of 6.7 trln dollars. Dubai has its position set to be a city of "now" and enjoys wealth of praise for its advanced ICT infrastructure. Dubai is the most liked urban city for the Middle East as well as all of Asia, in terms of where people move to pursue better quality of life and career opportunities. E-government has already been a great success for the Dubai government, and taking it in consideration, the government has embarked bigger initiative of e-services to transform Dubai into a "smart city." In 2014 his Highness Sheikh Mohammed bin Rashid Al Maktoum, Vice-President and Prime Minister of the UAE and Ruler of Dubai, launched a strategy to transform Dubai into a 'Smart City,' linking the emirate's government services and the public through the use of smart devices accessed freely using high-speed wireless internet connections. Smart City's main aim is to provide better connections and increase cooperation between the emirate and its residents. It promotes the use of government facilities using the largest possible number of smart applications. Through the project, high-speed wireless internet connections will be provided in public locations. Smart sensors will be installed throughout the city to provide live information and services with the aim of providing all

residents and visitors with a better quality of life. Because of the available infrastructure for connectivity, every smartphone user will be able to access up-to-the-minute information on weather, traffic, entertainment, tourism, flights, dining, emergency services and much more, any time, anywhere. Businessmen and investors can also take advantage of the open access to smart services delivered by ports, customs and bourses. The strategy features six key pillars and 100 initiatives on transport, communications, infrastructure, electricity, economic services, urban planning. Under the strategy, 1,000 government services will go smart in the next three years [Wam, 2014].

Onwards, the "smartness" of Dubai City is assessed across several factors to define clearly where Dubai stands now.

Dubai is all about **Smart Environment**. Recent statistics from the Telecommunication Regularity Authority (TRA) of UAE highlights general growth of overall telecom users due to strong ICT infrastructure in place. As per the statistics of July 2013, there were 14,930,471 active mobile subscriptions with 180.3 mobile subscriptions per 100 inhabitants, while the number of fixed lines accounted up to 2,053,797 with 24.8 fixed lines per 100 inhabitants. The numbers indicate the high penetration rate of Telecom ICT usage by the inhabitants of UAE. Due to high end infrastructure of ICT in place, the rate of communication is quite high. This shows that a smart environment is already in place to transform Dubai into a smart city and people are actively using ICT to participate in the life and development of the Smart City. Since it is the citizens of a city who decide the success of a smart city transformation, as they are the end users who are going to consume the services, it is very important to understand the overall behavior of citizens when it comes to consumption of e-services. Usage of e-services should become a daily norm for citizens in order for the government to offer smart services. According to "Internet World Stats," the UAE has 5,859,118 Internet users as of June 12, 2013, 70.9percent of the population of the country has access to internet either through web or mobile devices. Such a high percentage of users makes Dubai a city, which has a huge potential for implementing smart city-related initiatives and projects. Since technology drives the very core of a smart city, the usage of smart mobiles cannot be taken out of the overall transformation equation. According to "Our Mobile Planet" Website, some interesting statistics are available to further understand the overall behavior of Dubai's citizens. Smart phone penetration rate is 56% with a frequency Mobile Internet Usage via Apps being 75% daily. If we categorize usage of Smart Apps by location the usage is distributed as follows: At Home-94%, At Work-76%, On the go-73%, Café of Coffee shop-72%, Public Transport-56%. Age is also an important element of internet e-service usage either through web or smart phones, and it gives an indication of overall behavior of citizens. The following statistics from "Our Mobile Planet" portray the potential success for Dubai as a smart city (See <Figure 5>).

The remarkable trend of usage through different ages shows the acceptability of citizens for making e-services as the means of doing different business and retail transactions.



<Figure 5> Dubai Citizens' E-service Usage by age

Smart Governance. Last but not the least, a strong and efficient governance should be in place to oversee the transformation and delivery of a smart city's services. Dubai would have the largest open global laboratory for creative people and specialized companies to try all that is new in science and immediately apply it. Dubai Government applies strategic plan to all dimensions of the Smart City, including business development, transportation, energy, education and other services. The strategic plan is based on three basic ideas: communication, integration and cooperation. These ideas will enhance communication between the residents of the city and its institutions and facilities through easy access and information sharing of data about the city among themselves to keep them informed about government entities, schools, hospitals, roads and transport, sensor systems, buildings, energy and others. This can be achieved through various governmental programs, including "My window to Dubai" program. The plan also includes development of smart and personal boards containing all information and data about the city of Dubai in one place to make it easy for individuals to communicate with various institutions and facilities in Dubai. Dubai Electronic board will be allocated to decision makers, which includes all the data and information that they may require to ensure that their decisions serve the public interest.

As part of the Dubai Smart strategy, Roads and Transport Authority (RTA) implements a comprehensive plan to ensure access to provide the smartest transportation system in the world through development of traffic systems, transportation, and creation of a "unified control center" for all means of transportation and traffic, as well as providing more than 200 services, using smartphones at the end of 2015, in addition to RTA's current services. With regard to the energy sector, Dubai Electricity and Water Authority (Dewa) intends to launch a number of initiatives including the development of "smart electrical grid" to encourage owners of houses and buildings in Dubai to use solar energy and sell the surplus to the government through the network itself, as well as "smart meters" that contribute to rationalizing the consumption of electricity and water, where the Authority aims to achieve more of well-being and comfort for clients with confirmation on sustainability approach, to make Dubai the smartest in the field of the environment globally. As part of the announced plan, the "Dubai Design District" will be transformed into the smartest spot in the world where companies can provide smart solutions tailored to meet the needs of customers and facilitate transactions such as licenses, visas, customs and other government services. Department of Economic Development (DED) in Dubai intends to provide a package of solutions and applications

that serve the retail trade in Dubai and its transformation into a "smart business," by which to achieve control and monitor trends for buyers with emphasis on reducing the carbon footprint and paperwork, an affirmation of the Department's undying keenness to achieve sustainable development and enhance business competitiveness according to the highest standards in place in line with the objectives of "Smart Dubai" initiative. Dubai Municipality (DM) is working on the transformation of 450 e-services into smart services. It is also working on the implementation of smart parks and beaches projects that provide specific information on weather conditions, sea, temperatures and safety guidelines, as well as the launch of "I-Dubai," which provides information relating to the services of the municipality as well as the "Smart Address" and other initiatives and services the Dubai Municipality intends to transform into Smart models over the next two years. The Dubai Police plan for 2014 includes implementation of a number of smart phone services that aim to reduce the burden on members of the public and ensure that none of them need to visit the police stations except in cases that requires personal presence [Wam, 2014].

To resume the assessment of the current case we should notice, that Smart City is about the future of the public services; it's about greater efficiency, community leadership, mobile working, and continuous improvement through innovation; it is about improving democratic processes and transforming the ways that public services are delivered. While Dubai excelled in providing its citizens with a quality e-governnce and ICT sevices (therefore **Infra and ICT** factor is strong), it still has challenges while enhancing democracy level (gender equality issues) and keeping the balance between information privacy of its citizens and its usage. Currently, Dubai is just in the initial phases of setting up this building blocks for a smart city transformation, thus **Human Capital** factor is at the medium level. Another challenges relates to **Environmental Sustainability**, which is also at the medium level, due to water shortage, urbanization issues and still low focus on sustainability [dubaiinternetcity.com, 2013]. But as the government launches social programs to improve sustainability and gender equality these factors are expected to raise. **Social Capital** is strong with all the e-services and more than 15000 knowledge workers, providing for the Smart Environment of Dubai City as mentioned above.

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 with all kind of government strategies making **Governance** factor is exemplary strong for this case. Strong emphasis is made on a public participation in enhancing services efficiency. Orientation on communication with citizens enables Dubai Smart City to engage its citizens at the highest possible rate, thus **Civic Engagement** factor is strong. Therefore, Dubai Internet City is another successful case.

Case #8: Smartcity Malaga Project

According to the IDC Smart Cities Index Ranking [idc.com, 2013], Málaga is currently the "smartest" city in Spain. Málaga achieved the number 1 position due to its high scores

in the smartness dimensions, despite its relatively low final score for enabling forces (people, economy, ICT). Málaga scored very well in two of the smartness dimensions, namely smart energy and environment, and smart services. Its success in smart energy and environment comes as no surprise, as it is a pioneer in becoming an eco-efficient city through its Smart City Málaga project [www.smartcitymalaga.es]. The Smart City Málaga project's ultimate goal is to demonstrate that with the development of the technologies it is possible to achieve 20% energy savings. The city of Málaga was selected by Endesa for the project because of its excellent electrical infrastructure, its universities and businesses and strong support from the local government. The budget is partly financed by the ERDF with backing from the Spanish Junta de Andalucía, the Ministry of Science, and the Centre for the Development of Industrial Technology (CDTI). The project covers the Playa de la Misericordia area of Málaga, and will benefit 300 industrial customers, 900 service providers, and 12,000 households over four years [Gallotti *et al.*, 2011]. 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. ENDESA's ultimate goal to make a 20% energy saving is expected to be achieved by adopting the following measures: providing optimal integration of renewable energies into the power grid; bringing generators closer to consumers by establishing new models of distributed energy resources management; using batteries to store the energy generated, so that some of the energy can be used later for climate control of buildings, public lighting, and electric transport; leveraging new smart meters, advanced communication systems, and real-time control to transform electric distribution network operations, enabling new energy management and improving quality of service. 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. Concerning smart services, Málaga scored high on the security and emergency services offered to its citizens, and on the strong availability of e-education. Based on the Smart Cities Index in Spain [idc.com, 2013] we conclude, that **Human** and **Social Capital** factors are strong thanks to 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 as Malaga smart City is the Europe's largest eco-efficient city initiative, comprising 11 companies. **Infra and ICT** factor is strong as well, 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. **Governance and Economy** factors are strong as Smart City Malaga has the support from the local govern-

ment as well as universities, businesses and research institutions. 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

The "City of Light" is making headway towards being a Smart City. Being called a "Resilient city," by B. Cohen in his "Global Ranking of Top 10 Resilient Cities," Paris is transitioning towards a low-carbon economy while also preparing to avert the worst of climate change [Cohen, 2011]. Paris is among the few global cities that are members of C40 and the World Mayors Council on Climate Change, and are signatories to the Mexico City Pact, which includes a voluntary commitment to mitigate and adapt to climate change. Paris scored highest on Cohen's ranking of rail transit use/capita and was among the leaders in his 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.

Regarding Innovations measures and Smart Strategies Paris has rolled out an extensive innovation program featuring more than 100 research tests across its territory. In 2013 Paris has chosen to support Inria and CITRIS to conduct their research Paris Smart City. In handling social, democratic, environmental, economic and cultural issues, the City of Paris recognizes the value of talking to and exchanging experiences and expertise with other cities. Thus, it participates in the Inria and CITRIS research along with San-Francisco City, so as to enable exchange of smart ideas and innovation strategies. As a result, Paris enjoys rich and constructive exchanges and partnerships with cities in areas such as transport, innovation, the environment, urban planning and culture. In addition to developing strong partnerships at the local level, Paris is committed to sharing its values of liberty, solidarity and the respect for identities [Rodriguez, 2013].

Doing a more detailed assessment, 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. These initiatives speak for strong **Environmental Sustainability** factor. Because of good health care system and variety of social media solutions **Human** and **Social Capital** levels are high. **Governance** factor is strong, thanks to smart business model, based on intelligent communication between vehicles, rental stations and customers, as well as government's support of research projects and smart city surveys. Above all, Paris has a strong **Infra and ICT** and **Civic Engagement** factors. Technologies are continuing to be developed through an extensive innovation program, oriented on app development and crowdsourcing initiatives. 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, therefore Smart City Paris is a successful case.

Case #10: Barcelona

Barcelona was recently ranked number 2 smart city in Spain, according to IDC Smart Cities Index Ranking [idc.com, 2013]. In relation to Málaga, Barcelona scores less high in the smartness dimensions, but compensated with a much better starting position (the enabling forces). From the outset, Barcelona benefitted from high adoption of ICT and mobile solutions. This makes **Infra and ICT factor** strong for this case. In the smartness dimensions, Barcelona excels in smart mobility. Barcelona is a leader in Spain in terms of revolutionizing its transport sector, and has been designated the hub of innovation for electric vehicles. Spain's transport sector is responsible for 37.9% of final consumption of energy and accounts for more than a quarter of total CO_2 emissions. Spain is actively facilitating the acquisition of low-emission vehicles, for instance by offering subsidies (of up to €7,000 per vehicle) for plug-in hybrid or pure electric plug-in vehicles. Barcelona's LIVE project (Logística per a la Implementació del Vehicle Elèctric (http://w41.bcn.cat/) has made it the innovation hub for electric vehicles. LIVE is a public-private platform, which aims to support and promote the development of electric mobility in the city and metropolitan area of Barcelona. The development partners in the project are Barcelona City Council (Environment, Mobility, and Economic Promotion), the Government of Catalonia (Catalan Energy Institute), ENDESA, and Seat. Other partners and collaborators include IDAE (the Institute for the Diversification and Saving of Energy, Ministry of Industry), UPC, IREC, Leitat, STA (Technical Automotive Society), Barcelona Digital, TMB, BSM, Regesa, Tabasa, Saba-Abertis, Catmoto, Nissan/Renault, Toyota, Siemens, Volt-Tour, Avele/Avere, Altran, Quimera, Idiada, RACC, Circutor, and Initzia. LIVE has 234 current charging points, with additional points planned for the near future. On its Web site, supported by Google Maps, LIVE shows all the current, future, and temporarily unavailable charging points. In some cases, there is more than one charging point (socket) in each charging station. LIVE's charging points map can also be accessed remotely via Apple's iPhone and Google's Android. LIVE's Electric Vehicle Card is the ID card for electric vehicle users in the city of Barcelona, enabling users to carry out electric charges in any point in the city. For now, the charging service is free, but the charging card has limited credit. When the credit runs out, users will have to add more credit to the card. With the LIVE electric vehicle card, users can access a myriad of other benefits besides free charging, such as: up to 75% of vehicle registration tax; free parking in any regulated area of the city, according to regulated criteria, for Barcelona residents; new public car parking lots with 3% of spaces reserved for electric vehicles and facilities ready for the future inclusion of points in the rest of the spaces. The municipality of Barcelona is also evaluating other incentives to further promote the uptake of electric vehicles in the area, including: fewer tolls and a reduction in the level of tolls; promotions with the Generalitat (FGC) and RENFE to encourage the use of public transport; preferential access to restricted areas (low emission areas) and overnight services; permission to use bus and carpool lanes [Gallotti, 2011]. 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. These initiatives address the environmental issues and get high scores on **Environmental Sustainability** factor, which is strong for Barcelona Smart City. **Governance** factor is also strong for its adaptation planning, identifying key stakeholders and metrics associated with ensuring successful adaptation. Barcelona Government sets the Smart city model around the three pillars: 1. Ubiquitous infrastructures; 2. Information from sensors, open data, and citizens; 3. Human capital, actors, communities [Battle, 2011]. Government fulfills 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, which are at the medium level. Though there is a strong ubiquitous infra for citizens usage, such as free municipal wi-fi mesh network and public transport, people lack the skills to effectively utilize all smart solutions, which are currently offered. Also there is a demand for VC funding for innovation and low global connectivity. But despite these challenges Barcelona shows strong level of **Social Capital**, 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 in creating, sending and sharing personal contents through mobile networks and 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 was ranked number 36 in Innovation Cities Global Index 2012~2013 from 2 thinknow as a HUB 2 with a score of 49 (see <Table 5>). The HUB category means the dominance or influence on key economic and social innovation segments, based on global trends. Helsinki Smartcity's strategy focus area includes three areas of development: 1. City Development; Openness and communality; Availability of digital services; 2. Information Technology; IT-efficiency and know-how; 3. Offices and enterprises; Productivity and influence [Poikola *et al.*, 2012].

Several Projects of Helsinki Smart City are dedicated to public-sector data, which is open and available to every stakeholder. For example, Forum Virium Helsinki's Smart City Project Area is involved in the development of digital urban services, that make travelling and living in the city easier. The services are used with mobile devices and they are an integral part of their urban environment. This Project area focuses especially on ubiquitous technology-technologies that are thoroughly integrated into everyday objects and activities. These services involve real-time traffic information for citizens, among others. Another area within the Smart City Projects is opening of public data. With open access to public data, new and more versatile services are created by individuals and companies.

Helsinki Region Infoshare project aims to distribute information concerning the Helsinki area in an efficient, straightforward way to all interested parties. The project is progressing at a fast pace towards making public-sector data open and available to all. The data that is set for public release in the Helsinki Region Infoshare project relates to, for instance, living conditions, economics, employment and exercise. Open regional data on the web can be exploited freely and without charge. The data is offered for the use of municipal administrations, universities, higher education institutions, research institutes and citizens alike [www.opencities.net, 2014]. Helsinki creates new clusters for smart city strategy and mobile living labs. 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. Apps4 Finland competition-Helsinki Public Transport Visualized Apps4 Finland 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. All these initiatives serve to involve citizens into the process of Smart City development while enhancing the level of living and communication.

Strong **Human** and **Social Capital** factors are 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. As well as various campaigns to make citizens aware of initiatives by Helsinki's Smart City Project [www.opencities.net, 2014]. High level of Social Capital is also 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.

Governance factor is strong as Finnish government uses Living Labs to stimulate innovation

and 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** factor is 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 Infra and 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, 2014]. All in all, 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. And the latter provides for increased participation, which enables the city to draw on the knowledge and creativity of its citizens to address problems and realize its opportunities.

Case #12: Oulu

Oulu is the sixth largest City in Finland, the largest City in Northern Finland and the largest urban concentration in Northern Scandinavia with its 188,000 inhabitants, including 5000 foreigners representing 116 different nationalities. The City's residents are its most important asset. The drive towards the future and to create and innovate is likely because of the youngest population in this region of Finland and in Europe with an average age of 34.5 years. Oulu has also highest regional R&D spending per capita in Finland. Northern Finland region has the third highest R&D intensity of all EU regions (6.58% ad per Eurostat 2012). Especially the city is known for its ICT sector; there are 14,000 ICT jobs in region. City has also good business infrastructure and very innovation and R&D friendly central administration. City of Oulu has an internationally recognized tradition as an innovation center. Especially city's track record in the field of ICT can be regarded as a great success. Secret behind this development is in seamless collaboration in between all the central players related to innovation. This includes PPPP-Private-Public-People-Partnership. All parts of innovation support are in place, stretching all the way from basic infrastructure and services, to world-class research and support for businesses. Environmental Sustainability level is strong with a plenty of R&D activities on wellness, biotech and environmental technology. Oulu research group is currently developing the pan OULU WSN infrastructure to automatically meter energy consumption in homes and for environmental monitoring using low-power sensors [Gil-Castineira *et al.*, 2011]. Oulu's innovation engine is like the DNA in the body, being part of each cell (Bell, Robert *et al.*, 2012). It is based on the long tradition of co-operation between education and research institutes, companies, public sector as well as enthusiastic and innovative individuals. That's why the term Public-Private-People-Partnership is more likely when talking about Oulu Smart City, instead

of Public-Private-Partnership, as an approach to cooperation activities, which is strategy driven and innovation oriented. Collaboration projects are developed and executed based on a real need, which means fast and easy deployment of the results. Oulu is called the City of innovation with the strategy, oriented on Technology Ubiquitous Oulu. The "PATIO" (test user community tool) empowers ordinary people to experiment new services. **Human** and **Social Capital** factors are strong for Oulu case and 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 and laboratories, offer technological know-how as well as facilities for technology testing and for the evaluation of user experience enrichment and level of engagement.

From the user community's point of view-both citizens and business-city appears as a smart space providing rich interaction between the physical, virtual and social spaces. This means that citizens can enjoy about innovative service solutions, such as innovative schools, and also contribute to the development of new services. One way to serve citizens is to develop communal ubiquitous technology to embed information technology into the urban environment in an invisible manner, enabling the production of better services for citizens. A 'ubiquitous city' has been envisioned as an urban environment in which solutions and devices using embedded information technology merge physical, virtual, and social spaces into one seamless entity. The primary task of ubiquitous technology is to facilitate the lives of citizens.

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 with the policy instruments such as pre-commercial procurement contribute to pushing innovation and 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 explains strong **Infra and ICT** factor, which in turn enhances another essential factor of the City's success – **Civic Engagement**. Wireless network opened it up to ubiquitous-computing researchers, offering oppor-

tunities 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.

City of Oulu is a forerunner Smart City due to the strong **Governance** factor. It has been able to use this competitive advantage to develop new innovations, businesses and services for the benefit of the whole society. Oulu's citizens have been playing a central role in the development work. Innovative approach and capability to react fast to the changes are securing Oulu's role in the top of the global technology cities also in the future [Rantakokko, 2013]. This speaks for strong **Civic Engagement** factors and adds to the success of Oulu Smart City.

Case #13: Manchester

Manchester is ranked number 24 by Innovation Cities Global Index 2012~2013 from 2 thinknow with a total index of 52 and NEXUS 1 category (see <Table 5>), making the city a critical Nexus for multiple economic and social innovation segments. Manchester is 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. Greater Manchester is working to take advantage in development on the use of data, such as mobile phone data, vehicle systems, satellite data and camera data. There is an approach to bring all of this data together to create an oversight of the city. This would allow to see where people flows might have an impact on the transport system, resulting in creating more efficient and reliable routes and giving selective priority to buses on certain routes [Taylor, 2013]. Strong **Human Capital** factor is reasoned by good welfare programs and recognition of people as assets by valuing work differently, promoting reciprocity, building social networks, etc. 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' and a test bed for new future Internet services [Manchester City Council, 2013], what speaks for a strong **Economy** factor. Government also 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. **Environmental Sustainability** factor is strong, as the city harnesses the latest technology for the goal of becoming the greenest city in the UK. 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 help to achieve the main goal of such initiatives. In general, Manchester has an advanced infrastructure of open access fiber to premises. It supports creation of co-ownership approaches, with its Digital City Test-Bed and Living Lab Corridor Digitization Project, which are expected to unite 500 businesses and over 1,000 residents over next two years. These inputs into strong **Infra and ICT factor. Strong 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 ownvviews about how city challenges can be tackled via social media. This last case is a success.

3.5 Comparative Analysis of the Variables

After making a thorough analysis of all 13 cases we will carry out a comparative analysis in order to see how these factors influence the final outcome of the Smart City status. Based on the comparative analysis we will conclude which value propositions are most important for the Smart City. We would be able to see that Smart City initiatives do not position Information and Communications Technology (ICT) as a key value of smart city [smartercities.nrdc.org].

As we've already generated 7 variables (see paragraph 3.3), now we need to decide which variables can be considered as input variables, i.e. those, which directly influence the outcome of the Smart City Case. The rest of them will be output variables, i.e. those which do not influence the outcome of the case, rather they are influenced by the outcome of the case. Thus, 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 cases. 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 7> we can explain why a certain Smart City Project is more or less successful. Each factor (variable) in the table is given a value of S (Strong), M (Medium) and W (Weak), and each case is identified as S (Success) or F (Failure). In the <Table 7> we see that all 4 cases, identified as failure, have weak Civic Engagement (CE) and Governance (G) factor, while the remaining successful cases all have strong values for these factors (except for Barcelona's case, where Civic Engagement

(CE) factor is Medium. Such clear values of CE and G factors enable us to conclude that Civic Engagement (CE) and Governance (G) are the main variables, along with II (Infra and ICT) factor, which is also a main variable by default, considering the role of Internet techonologies for Smart Cities, mentioned in all above-mentioned researches and definitions of a Smart City. However, this variable (II) is not as clear, when explaning the outcome of a failure cases, what proves that Infra and ICT (II) can not be seen as the sole and primary factor for the development of Smart City Projects. While for Colorado (Boulder), Kochi and Amsterdam Infra and ICT (II) factor was strong, these cities, however, failed to get the support of citizens due to either poor communication or ignorance of their needs and complaints, thus not been able to engage them into the process of Smart City development, such as data sharing, innovative ideas generation and implementation, what was the basis for successful application of all the "smart solutions," offered by a Smart City Project.

<Table 7> Comparative Analysis of Smart City Factors

Case		HC	SC	E	G	ES*	II	CE
1 Amsterdam	F	M	M	W	W	S	S	W
2 Kochi	F	S	W	M	W	W	S	W
3 Malta	F	M	S	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.

We define Human Capital (HC), Social Capital (SC) and Economy (E) as 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 successful cases. All 3 factors in successful Smart City Project are strong, except for Barcelona case (Medium). The remaining environmental variables also explain the output directly or through each other.

According to the results of comparatie analysis, presented in the <Table 7> we conclude that two factors: Governance (G) and Civic Engagement (CE) can be called primary for the success of Smart City Projects, since they both were valued "Strong" for successful factors and "Weak" for failure cases. 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 view, 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 combination also influence the success of the Project. However, even when these factors are strong in certain cases, if the primary Civic Engagement (CE) and Governance (G) factors are weak, the Project will not be successful, as in cases of Kochi, Colorado (Boulder) and Malta, where Human Capital or Social Capital factors are strong.

So, what are the guiding principles for the creation of successful smart cities? Which factor is more essential among Infrastructure and ICT, Innovation, Governance and Economy, 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. The results of the comparative analysis of variables shows that in all 4 failure cases Governance and Civic Engagement factors were weak, while for all 9 remaining successful cases these factors were strong, inlcluding Human and Social Capital values.

Also, Infra and ICT (II) can not stand as a sole explanatory factor for the Smart City development as we can see in 4 failure cases, where Infra and ICT (II) valued strong, except for Malta case (medium). 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 Smart City Initiatives Framework, mentioned in paragraph 3.2. (<Figure 3>), such factors, as Economy and Governance, Built Infra and Natural Environment are set equally important with People and Communities.Based on the analysis of 13 cases, this research shows the priority of Civic Engagement (CE) and Governance (G) factors, along with Infra and ICT factor (II) as enabler.

Unlike Smart City Inititives Framework, which assesses technology as a meta-factor for Smart City's success (as the most influential over the rest of other seven factors) this research 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 and secondary 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.

Ⅳ. Implications and Conclusion

Considering the case analysis results, 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 folow **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 not a sufficient condition 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 literatelly 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 a necessary condition to effectively overcome these challenges, but it is not sufficient by itself.

Ⅴ. Contributions and Limitations

The major contribution of this paper is identifying key variables of a successful Smart City Projects through case study. Using a collection of Smart City definitions across time and providing concrete examples (13 cases) this paper seeks to bridge the definition gap and emphasizes the role of Citizens' Engagement and Governance

level in the development of Smart City Projects. Different from the way other researches assess traditional ICT as the primary factor for the success of Smart City this research revealed Citizens and their Engagement as the first main factor along with Governance as the secondary main factor for Smart City Project success, assuming, that in practice, technologies can be seen as an enabler of Smart City development driven by the User or Citizen. The comparative analysis of 13 cases, carried out in this research, serves as a practical tool for Smart City stakeholders, while generating strategies and managerial approaches to sustainable urban development, based on existing governmental and corporate initiatives and precedents. However, this research shows some limitations. First limitation is that the number of cases selected can not 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 paper only reviews cases which are broadly mentioned in the media. Though only a few cases were covered in this paper, the factors derived from the paper can be extrapolated for the remaining Smart City projects. 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.

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