

Full Length Research

Bench-Marking, Sustainability and Governance Aspects of Smart Cities

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By benchmarking one can set standards of quality and attributes to compare smart cities with each other based on various constructs and factors. In recent years, there have been many approaches to benchmark smart cities. Existing standards mainly focus on urban sustainability and resilience, which demonstrate that smart city efforts are, or will be placed mainly on these directions. The smart city concept is a powerful approach for moving cities towards sustainability in an increasingly urbanised world. Through the application of a sustainable and integrated development approach, current sustainability limitations of the smart city concept can be mitigated, leading cities to develop towards sustainability in a more efficient and effective manner. For good governance city managers are confronted with the challenge of balancing three overriding concerns: achieving a high quality of life for all citizens, maintaining economic competitiveness and protecting the natural environment. In order to deliver on these challenges, advance technologies, including ICTs, will have to be employed not only to increase the intelligence of socioeconomic systems but also to establish incentive structures promoting the creation of sustainable public value towards emerging smart cities. The real smart city will have to learn how to reconcile individual and collective needs, in other words to channel individual aspirations towards the creation of value for society at large through the attainment of economic, social and environmental objectives. In this paper, we will discuss some of the important dimensions of sustainability, benchmarking of laid down standards and governance aspects of the Smart cities.

Key words: Benchmarking, Sustainability, Governance, Smart Cities

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OBJECTIVE AND METHODOLOGY

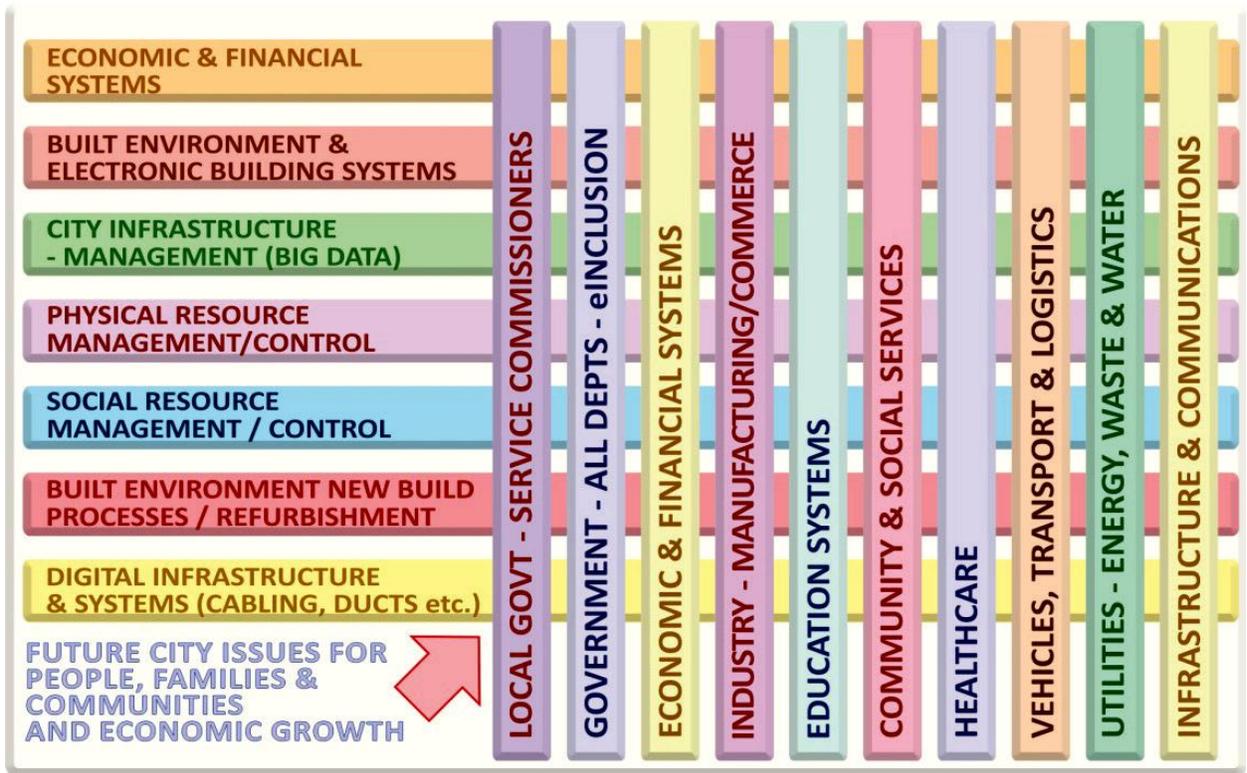
The broad objective of the study is to study the standard research and investigation techniques and methodology of benchmarking the identified smart cities in accordance with set out predetermined and well defined parameters to be able to rank them against the global standards. Similarly an attempt has also been made to assess the sustainability and governance quality of identified smart cities against well defined parameters to add value to the standard benchmarking standards. Case studies have

been employed as methodology of this piece of study in an illustrative and exemplary manner.

The Role of Standards for Smart Cities

The City Systems

The output of Cities depends on a comprehensive infrastructure to deliver physical and social resources,



Graphic by Telemetry Associates Limited

Figure 1: Some Elements of the Future Smart City

Source: <http://www.bsigroup.com/LocalFiles/en-GB/smart-cities/resources/The-Role-of-Standards-in-Smart-Cities-Issue-2-August-2014.pdf>.

without which both the effectiveness of the City as an economic unit and its economic performance will be impaired. For example, the ease with which people communicate, travel and meet plays a key part in the City’s ability to foster a thriving business community, creating requirements for development of the transport and communications infrastructure and services. The physical and social resource systems can be thought of as delivery channels, enabled by supporting information flows. Figure 1 shows some of the sources of information and data that are derived from infrastructure and systems (horizontal bars) and the service delivery channels (vertical bars) that depend on the information and data.

At present service delivery through the vertical channels tend to operate in isolation from each other - they are “silos” of information, activity, and governance. However, there are many areas where information gathered through the City’s infrastructure for one service is relevant to another service. Digital infrastructure provides a medium for delivery of digital services and taking information from citizens, offering the potential of increased service integration within and between delivery channels, enabling ‘smarter’ Cities – delivering improved services to citizens and businesses, and making much

more efficient use of physical and social resources. For example, tele-health delivered through applications in the Healthcare delivery channel may rely on data about a patient’s daily activities generated from sensors in the home and on information from social resource management systems – integration of information across different key inputs.

Standards Implications for a Smart City

The findings of the gap analysis in the standards strategy are that there are plenty of standards covering interoperability within the context of particular service delivery systems, but there is a lack of overall interoperability framework standards that work across systems. BSI held an Interoperability scoping workshop on 1st March 2013 which identified the following potential standardization topics:

- o Providing a General Guide to cover infrastructure and data use in cities.
- o Defining the requirement at the Framework Level for an Interoperability Ecosystem.

- o Creating a data concept model to give a common understanding of information in the Smart City.
- o Setting out a Code of Practice for Open Data covering definition and access.
- o Defining the technical specifications for a Digital Consumer Unit.

BSI has set up an interoperability committee to help scope and develop an interoperability standardization roadmap. An immediate need that was identified in the standards strategy was the lack of common terminology around the area of smart cities. BSI is therefore developing a new publicly available specification to establish a shared understanding of smart cities terms and definitions. This will help to build a strong foundation for future standardization and good practices. The main aims of the standard are:

- o Improve communication and understanding of the smart cities field by enabling developers, designers, manufacturers and clients to use a common language when talking about smart cities.
- o Reduce the likelihood of confusion between parties in the supply chain and add clarity in cases of legal dispute.
- o Create industry awareness of common smart city concepts through a rigorous, independent consensus-building process involving a wide group of UK stakeholders.

There are already established standards for information security management and data protection. The BS ISO 27000 series of standards embrace best practice in information security. It includes ISO/IEC 27001 which is a specification for an *information security management system* (ISMS) which aims to ensure that information security management is established and maintained through continual improvement. For Smart Cities to function effectively vast quantities of data need to be captured, stored, transferred and destroyed on a timely basis. If such data is defined as personal information, then the organization responsible for collecting it (whether directly or via an outsourced partner) is obliged to comply with the *UK Data Protection Act*. This stipulates that fair processing and retention take place and appropriate security, transfer and destruction be carried out. In 2009, BSI published BS 10012 which helps organizations establish and maintain a best practice personal information management system so that they can better comply with this legislation. The newly-published ISO/IEC 29100 approaches privacy risk management issues from a framework-level perspective. Such initiatives require an ongoing and close collaboration between standards makers and policy

makers, of increasing importance in the context of the new EU Privacy Directive and the growing use of identity management technologies (such as biometrics). Existing standards can also be applied to improve the resilience of Smart Cities.

A Standard Framework for Smart Cities

To ensure Smart City technology fulfils its potential, a range of standards are needed to address issues faced at different levels, from the decision-making at the city level to the interoperability of particular devices. Principles-based standards can provide guidance to help the City Authority define its targets. Performance standards can help the City Authority procure the infrastructure and services that will help achieve these targets. And interoperability standards can ensure that the data captured in the City's infrastructure and systems is suitable for use in a range of service delivery channels. Figure 2, adopted from the Smart Cities Research brief Standards for classifying services and related information, shows the current standards hierarchy with associated standardization work.

Importance of City-rankings

Dealing with the importance of rankings from the point of view of regional science, one has to take a deeper look at the background: As a consequence of strong economic and technological changes over the last decade's cities and regions are facing growing competition for high ranked economic activities (Begg, 1999). On the urban level, cities aim at improving their competitiveness and their position in the European or national urban system. Since the European integration process has diminished differences in economic, social and environmental standards, cities have converged in their basic conditions for competition, which is increasingly scaled down from the national level to the level of cities and regions (Storper, 1995). This trend enhances the importance of specific local characteristics, which provide comparative advantages competing for increasingly footloose and mobile global enterprises, investors, tourists and capital (Parkinson et al. 2003; Giffinger et al. 2003, 2007). Facing this development, urban competitiveness and corresponding strategic approaches with specific goals and modified instruments have become important efforts of urban politics (Tosics, 2003). The comparison of cities within rankings can support investors in their choice of location on the one hand, but it can also be an important guide for future city development on the other. As rankings reveal particular strengths and weaknesses of the cities, policy makers are enabled set specific actions to work on certain problems and to implement measures

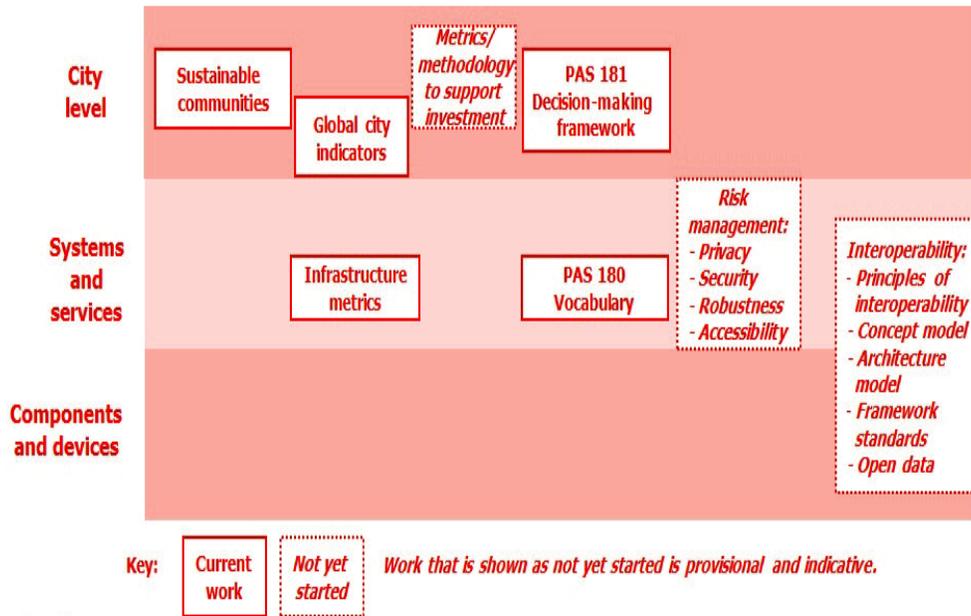


Figure 2: Hierarchy of Standards

Source:http://www.smartcities.info/files/Smart_Cities_Research_Brief_Standards_or_classifying_services_and_related_information_1.pdf.

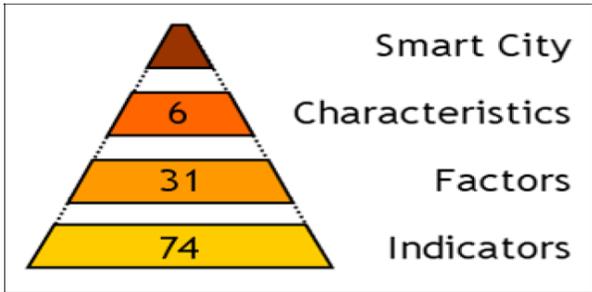
for sustainable development when considering the results of a high quality ranking or benchmarking. In addition to that, positive results in a widely published and approved city-ranking can also be used as a central part of a city's marketing strategy: a top-rank in a highly reputed city-ranking definitely helps to improve the international image of a city. Thus, city-rankings have become an important empirical base for disclosing comparative advantages and sharpening specific profiles and consequently for defining goals and strategies for future development.

Ranking Approach

As the Smart Cities ranking approach focuses on the specific situation of medium sized cities in Europe, the basic objectives of this ranking approach are defined as:

- (1) Transparent ranking of a selected group of cities
- (2) Elaboration and illustration of specific characteristics and profiles of every city
- (3) The encouraging of benchmarking between selected cities
- (4) Detection of strengths and weaknesses for strategic discussion and policy advice.

In order to implement this approach we defined 'smart city' – based on round table discussion and literature research - as follows: "A Smart City is a city well performing in 6 characteristics, built on the 'smart' combination of endowments and activities of self-decisive, independent and aware citizens." (<http://www.smart-cities.eu/model.html>; found on 18th of June, 2008). However, the term 'smart city' is not used in a holistic way but in most examples one emphasizes specific characteristics of different fields of urban development and even the awareness and participation of a city's inhabitants regarding special issues of urban development. Accordingly, 'smart' implies the implicit or explicit ambition/intention to improve its performance regarding urban development in the specific characteristics. According to literature and a round-table-discussion, six 'smart' characteristics had been identified which are likely to be relevant: economy, people, governance, mobility, environment and living. Figure 3 shows these 6 distinctive characteristics that are regarded as the relevant group characterizing a smart city. They are broken down into 33 relevant factors which reflect the most important aspects of every smart characteristic. Finally, every factor of a smart characteristic is defined empirically through a group of corresponding indicators. In total, 74 indicators had been



Source:http://www.smartcities.eu/download/smart_cities_final_report.pdf

Figure 3: Description of Smart City

SMART ECONOMY (Competitiveness)	SMART PEOPLE (Social and Human Capital)
<ul style="list-style-type: none"> ▪ Innovative spirit ▪ Entrepreneurship ▪ Economic image & trademarks ▪ Productivity ▪ Flexibility of labour market ▪ International embeddedness ▪ <i>Ability to transform</i> 	<ul style="list-style-type: none"> ▪ Level of qualification ▪ Affinity to life long learning ▪ Social and ethnic plurality ▪ Flexibility ▪ Creativity ▪ Cosmopolitanism/Open-mindedness ▪ Participation in public life
SMART GOVERNANCE (Participation)	SMART MOBILITY (Transport and ICT)
<ul style="list-style-type: none"> ▪ Participation in decision-making ▪ Public and social services ▪ Transparent governance ▪ <i>Political strategies & perspectives</i> 	<ul style="list-style-type: none"> ▪ Local accessibility ▪ (Inter-)national accessibility ▪ Availability of ICT-infrastructure ▪ Sustainable, innovative and safe transport systems
SMART ENVIRONMENT (Natural resources)	SMART LIVING (Quality of life)
<ul style="list-style-type: none"> ▪ Attractivity of natural conditions ▪ Pollution ▪ Environmental protection ▪ Sustainable resource management 	<ul style="list-style-type: none"> ▪ Cultural facilities ▪ Health conditions ▪ Individual safety ▪ Housing quality ▪ Education facilities ▪ Touristic attractivity ▪ Social cohesion

Source: Smart cities – Ranking of European medium-sized cities: http://www.smart-cities.eu/download/smart_cities_final_report.pdf

Figure 4: List of Characteristics and Factors

defined and used for operationalising the relevant factors. As the list of factors results from the definition in an idealistic way, two of the factors could not be defined empirically because of the lack of data. Thus, only 31 factors remained in the ranking procedure.

To give an example: ‘Smart people’ as characteristic is

defined through the 7 factors mentioned above in Figure 4; for instance, the factor ‘affinity to lifelong learning’ is then operationalized through the indicators ‘Book loans per resident’, ‘Participation in life-long-learning in %’ and ‘Participation in language courses’.

Ranking of Smart Global Cities

Global City and Choice

As a demonstration of the development benchmarking, a research study was conducted by the Institute of Information Sciences Shanghai Academy of Social Sciences November, 2014, PRC (<http://www.globalcityinfo.org/upload/files/1414917913864.pdf>), by selecting the largest development city as the research subjects in the world, select the following subjects that have benchmarking from comprehensive assessment in the regional and world city network. Europe: London, Paris, Moscow, Berlin. America: New York, Chicago, Los Angeles, Toronto, Buenos Aires, Rio de Janeiro. Asia: Beijing, Shanghai, Seoul, Tokyo, Singapore, Hong Kong, Dubai, Mumbai. Oceania: Sydney. Africa: Cairo and other 20 cities.

Smart City and Construction

The so-called smart capital in this report corresponds to the world's urban smart construction, which covers the current "smart city" construction, but also expresses the subject of urban development as a long-term development vision, including wisdom innovation based on IT can create smart community, smart home, intelligent transportation, smart logistics, smart medicine, smart banking, smart grid, smart government, smart schools, smart agriculture, smart environment and smart construction that has a direct role in boosting the national economy and social development, and sustainable development of new industries, new service models, new formats and innovative technologies. Smart capital aims to reflecting the development levels in those areas. The research study takes the multi- element into account, mainly focuses on the following three aspects: The first is the infrastructure of building smart cities. Wisdom of infrastructure are the passages that can make city information content run unobstructed; the indicator mainly considers the readiness of city information and the intensive level of urban IT information infrastructure, etc. The second is the forefront development of city smart economy, the important content industry, text, images, video, games and other cultural content production and service organization is a form of an urban industrial for a city that involved in a large area, even global information division. The third is the wisdom of the city to build the wisdom of governance, social governance, and the application of modern technology capabilities and the clarity of administrative processes, which represents the level of urban public services.

Infrastructure

In the task of building smart city, the most important thing

is reasonable infrastructure and effective application of questions. In fact, both in developed and developing countries, cities also face enormous pressure of infrastructure, are committed to providing a more efficient transport system, more reliable low-carbon energy, more secure water networks and more social infrastructure scalability to successfully smooth transition to urbanization. Synthesizing different international organizations' studies on the ICT infrastructure and urban development opportunities, through comparing and analyzing, we choose three most important and representative indicators in city-construction basic support: first is the foundation of the network space, on information and communication infrastructure and basic technology applications; second is the foundation of physical space, mainly select smart transportation as assessment objects (in the physical space, city infrastructure includes water, electric, coal and city building except transportation, but from our selection, smart construction development has the strongest potential to improve the functionality of the urban transport in the near future). Third is IT market opportunities for expanding frontier of innovation capability, that is, global urban construction innovation can be regarded as an indicator in the basic performance of digital economy. Thus, the basic indicators of assessing the smart urban construction are: the level of Internet access, the quality of broadband networks, intelligent transportation systems, and the foundation of the digital economy.

Key Indicators

Internet Access

Internet access level refers to the number of Internet users to calculate the percentage of the total number. The higher of this ratio indicates that the degree of their dependence on the Internet will be higher, the cooperation among different organizations and people are closer and broader. In order to have higher utilization, make economy and society more dynamic and inspire more innovation, people only to fully flow information together.

Broadband Quality

The role of broadband for economic development is becoming increasingly important, becomes a new engine of economic growth. Internet access is only from the surface and the amount of the level of information, however, broadband reflects the quality of Internet. High-speed networks can provide a better platform for the economic development of the Internet improvement,

Table 1. Assessment Result

City	Infrastructure				Ranking
	Internet Access	Broadband Quality	Intelligent Transportation System	Infrastructure of Digital System	
London	3	2	1	9	1
Seoul	2	1	6	8	2
HongKong	6	3	6	4	3
Singapore	1	15	3	4	4
Toronto	5	12	1	7	5
New York	8	7	10	1	6
Chicago	8	13	6	3	7
Berlin	14	4	3	11	8
Sydney	4	11	11	6	9
Paris	15	5	3	12	10
Tokyo	13	6	6	10	11
Los Angeles	8	10	16	2	12
Buenos Aires	18	9	12	16	13
Dubai	7	20	15	13	14
Moscow	16	8	13	20	15
Shanghai	11	16	13	17	16
Beijing	11	16	16	17	17
Mumbai	17	14	19	19	18
Rio de Janeiro	19	19	18	15	19
Cairo	20	18	20	14	20

Source: Ranking of Smart Global Cities:
<http://www.globalcityinfo.org/upload/files/1414917913864.pdf>

which represents a new stage of the development of Internet. This demand is born accompanied by big data, networking and cloud computing.

Intelligent Transportation System

The public transport system reflects the reliability and security of the public transport network. The more trip modes that the city provides for people, the higher quality of system operation, such as, metro, bus, taxi, light rail, electric car, railway commuter and free bike. It reflects more seamless links between different travel modes, reflects the wisdom of the city traffic, and the comprehensive index at this stage can also be seen as intelligent transportation evaluation of the city.

Foundation of Digital Economy

Composite Index mainly reflects the corporate's effective application of ICT and the degree of its dependence on digitization. It includes a proportional percentage of businesses using computers, the use of electronic means for commercial transactions, as well as investment in three areas in terms of ICT. This, in fact, is appropriately presented in the shape of Assessment Results in a tabular and comprehensive form; as presented below in Table1 for the computed Ranking of Smart Global Cities.

In the ICT ranking, as shown above in Assessment Results: Table 1, smart infrastructure of both New York and Sydney entered the first echelon instead of Singapore and Toronto. In addition, Seoul showed

prominent in this aspect and to be No.1. In the second echelon, the ranking of ICT is similar to the total ranking. Moscow and its better ICT construction has entered the first echelon, however, Buenos Aires fell into the third echelon. In the third echelon, Shanghai, Beijing, Dubai and Buenos Aires have the same total marks, but the Internet access of Dubai shows obviously better, the broadband quality of Buenos Aires is better. From the single item, Singapore shows prominent in Internet access, ranking first, but its broadband quality shows relatively weaker, this drags its ranking. The broadband quality Berlin ranks the fourth. The United States by virtue of its advantages in the application of ICT in economic, its three cities advance ranking. Beijing and Shanghai are relatively better performance of Internet access level indicators, ranking only 11th.

Smart Economy

Smart city aims to establishing a virtual image of the real city through the smart system, using Internet of things, cloud computing, ubiquitous network, intelligent network and other technical patterns, finishing the adjustment of city transportation, energy, medical treatment, the redundancy and incoherence of governance. In a word, the Internet provides a medium, application provides a platform, and content is the focus, while the culture is still the core. Wisdom provides unprecedented communication channels for the development of cultural content, forming a dense fusion between smart city and culture creative city. Many big cities sum up culture, sports, travel, civilization and digital application from the dimension of culture. Index interpretation of cultural creativity and digital application is the interpretation of core dimension of smart city.

Key Indicators

City Innovation Ability

The city innovation ability investigates the innovational ability of all kinds of technological fields including IT. This index derives from 2014 city innovation index published by thin-know, which contains the necessary innovational environment for cultural factors, human resources factors, and market factors, reflects the most important factor in smart economy to some extent.

Software Development Force

Software development capability index takes into account the ability of a city on producing the cultural production and the level of factor market development in the new

media. This index is from *The World's Most Competitive Cities 2013 published by IBM*. The composite dimension observes the core sectors of digital content industry---several key indicators in software development force industry, mainly includes business environment, law environment, market condition, talents reserve, degree of specialization, smart infrastructure and connectivity and surroundings.

Digital Content Industry

This index is a composite index, which comprehensively reflects the application ability of a city's ICT and relevant talents' quality and cost. This index is from cities of opportunity 2014 published by PWC. The quality index is 70%, the cost index is 30%. The composite index includes the following aspects in the external manifestation of the city: the city restaurants, theaters, concert halls, cinemas quality and diversity; the spirit of the times that the city has, taking into account the factors of cultural, social and economic aspects; network shows the three sub-indices of active city museum comprehensive evaluation.

Interaction between Reality and Virtual

The basic interaction between reality and virtual with ICT constructs a cultural interactive system, from the developmental level of one city, we mainly consider a city's regional radiation and influence in the cultural aspects. This index is from Global Power City Index 2013. This composite dimension mainly includes the following aspects: trendsetter, cultural resources, cultural facilities can be visited, attraction to visitors, cultural interaction.

Smart Governance

Faced with the challenge of information technology and the information society, the world is committed to the development of e-governance policy, which is an important part of the smart city. E-governance is not only the use of information technology to increase the efficiency of government services and the quality of governance. It is associated with the management of the government, involving the relationship between government and society, closely related to the government's basic management system. Making efforts to improve competitiveness and ultimately trying to achieve e-governance by building e-government is not only the inevitable result of the development of information technology and the information society, but also is the inevitable trend of government management.

Key Indicators

Citizen Service

Public service is a composite index, which aims to evaluating the daily services for urban residents, including online service, information service, etc. The index references "2014 E-Government Report" of United Nations on on-line services framework, which is an indicator that is from services and applications based on the city website through sampling calculated. This indicator relates to culture, sports, tourism, online work, employment, child protection, pet care, family life, housing and real estate registration and rental and all aspects of other urban life. This indicator is specialized in urban e-governance. Global City has great difference in providing public services, and there is no standard, uniform service content, which may due to the huge different demands of global cities for urban residents. The similarity of global city is that local governments have mastered the important information resources, has great service ability, but the difference is mainly reflected in the management philosophy. Different management philosophy resulted in the integration of different content, and the great differences in final services.

Business Service

Business services index evaluation to provide the degree of service for business or other commercial activities. This index references "2014 E-Government Report" of the United Nations on G2B service framework. It is evaluated, according to 20 cities sampling sites and service applications, combined with the quantitative indicators of the cities of opportunity 2014 published by PwC. Commercial services have been regarded as the most valued part of e-governance in the global city. Most commercial activities of most global cities have been provided for business lifecycle services. Therefore, in commercial service indicators, competition is fierce among global cities. Based on this, the index includes content from start-up business, business management, finance, labor, tax and other business lifecycle. For business events, the same as public services, global cities have already transited to a new stage that faces service object-oriented, integrated services to provide a package of services lifecycle.

Public Management

Public management evaluation is the participation in public affairs and public administration. This index references "2014 E-Government Report" of United Nations on public information framework. It is evaluated,

according to 20 cities sampling sites and service applications, combined with the British Economist evaluation of some indicators of each urban environment, education, etc., to calculate sampling indicators and quantitative indicators. This index contains all aspects about public affairs services, including education, environment, health, medical, health, safety, transportation and politics. These important aspects in the urban management of public affairs, not only require the government to provide services, but also need to participate in the population. Therefore, this indicator is both indicator of e-government services, but also reflects the extent of e-participation index, also has a large gap between urban areas.

Public Communication

Public social evaluation is the city leadership of social network. This index references "2014 E-Government Report" of United Nations on e-participation framework. According to the public sampling of 20 cities' websites and applications, combined with the ATKearny (2014) global urban indicators in the measurement of political vitality and information exchange, it gets the sampling. Everyone has the right of accessing to government information, and participate in the governance process in the network society. Its tendency must be the leading way to democracy. To achieve leadership of network society, it requires not only comply with the spirit of equality in the network, but also governance structures must be designed and constructed in accordance with public expectations. This indicator considers activity on social media and leadership to analyze network of social governance. Because the world's social media platforms have differences, this indicator mainly measures from the applications of all the cities in social media.

Comprehensive Evaluation and Ranking

Comprehensive Evaluation System

The Assessment Results- Table 2 is the construction and proportion of evaluating the model indexes and each indicator's scores is based on the assessment of the corresponding subfields, namely the assessment of the above foundation, industry and management. Based on the above assessment results in various fields, construct of the score model is constructed in the following comprehensive assessment, namely recording the point from the results of ranking. The first ranking is to record 50 points, and the second is to record 48 points. The scores are maintained as 2 points gap accordingly based on the every ranking difference. An ideal well-ordered ranking is that one who is the top will get 50 points, and

The Assessment Results- **Table 2:** Construction and proportion of evaluating the model indexes and each indicator's scores

Indicator Structure			Proportion
Smart Infrastructure	Internet Space	Internet Access	8
		Broadband Quality	8
	Physical Space	Smart Transportation	8
	Economic Space	Digital Foundation	8
Smart Economy	Digital Creativity	Urban Innovation	6
		Software Development Ability	6
		Digital Content Production	6
	Content Originality	Content and Digital Vitality	6
		Interaction between Real and Virtual	6
		Cultural Experience	6
Smart Management	Smart Service	Citizen Service	8
		Business Service	8
	Smart Management	Public Management	8
		Public Communication	8

Source: EU- <http://www.oecd.org/std/42495745.pdf>

one who is the second will get 12 points. And the ones who are in the same ranking will get the same scores, for example, ones who are both the top will each get 50 points. Ranking interpretation:

① London, New York and Paris are in the first three ranking separately, which reflects the three cities take the lead in the aspects of traditional urban governance as well as IT support among global cities.

② Berlin, Seoul, Tokyo, Singapore, Los Angeles, Hong Kong, Toronto, Chicago, Sydney are the also generally recognized as the central cities of the most powerful economy, the Contemporary Art Centre as well as the global audio-visual production base. In the Internet age, these cities either continue the advantage of the traditional media era or use their first-class information infrastructure and powerful digital industry to become the winner of urban transformation process.

③ Moscow, Dubai, Buenos Aires, Mumbai, Rio, Cairo and other cities, subject to the impact of their economy and political environment, cannot establish an open society of network or provide a stable social order.

④ The ranking of Beijing and Shanghai reflects

their developmental requirements for further breaking the monopoly, commercializing the economy, socializing the organization and other aspects.

Smart Cities and Sustainability Models

In our age cities are complex systems and we can say systems of systems. Today locality is the result of using information and communication technologies in all departments of our life, but in future all cities must to use smart systems for improve quality of life and on the other hand for sustainable development. The smart systems make daily activities more easily, efficiently and represent a real support for sustainable city development.

The Sustainability Concept

The concept of sustainable development may have different meaning by the context in which it is used. For this reason, we will present several descriptions of sustainable development that would include multiple aspects of this concept. In the MACED (2011) (*Mountain Association for Community Economic Development*) sustainable community development is the ability to make

developments which changes Quality of life: Limits of environment the relationship between the three elements: economy, ecology, and equity. So, we can say that the city sustainability is a multi-dimensional concept that includes economic, social and political dimensions. To define sustainable development is better to start from *Brundtland Commission's Report* (2011), which discuss this concept. The main idea is that the sustainable development is the kind of development, which satisfies the current needs without endangering the future generations to satisfy their own. This definition of sustainable development is the most frequently used in literature. The sustainable development has in view the economic and social development but without disturbing the environmental protection. The definition presented in the report of the *Brundtland Commission* contains two essential concepts:

- 1) The concept of needs for everybody but especially the needs of the world's poor, which should be given priority;
- 2) The idea of limitations, if we start from the effect of technologies progress we will say that we don't have limits, but on the other hand we must have in view the ability of the environment to satisfy present and future needs.

In our society is evidence that human activity has caused unprecedented environmental change, and population growth will soon stress the world's natural resources to the breaking point. Global warming, air pollution, land degradation, declining per-capita availability of fresh water, food shortages, and reduced biodiversity are some of the starkest challenges and here we found some limitations. Top priorities for cities include sustaining water, energy, and food supplies, managing water and reducing greenhouse gas emission. The sustainable development concept has three urgent goals:

- a) To improve quality of life - it is the goal of development,
- b) To live in accordance with the limits of the environment - it is the goal of sustainability,
- c) To invest in technological progress.

Sustainability Models

In literature we find different type of models, but before start to discuss about it we can split them in economical suitability and eco-logical sustainability. For the beginning in economical sustainability we must say that the key assumption is that natural capital (fuels, minerals, etc) can be substituted by man-made capital in some extent (machines, buildings, knowledge, etc). The analysis is

better to start with the essential assumption involved in the So-low/Hartwick approach. According to the definition formulated by them, we should think of sustainability as an investment problem, in which we must use returns from the use of natural resources to create new opportunities of equal or greater value. In this theory for example, Harris (2011) cuts down forests but build factories, and thereby we arrive at a good result if the economic value of the new solution exceeds the economic value of the forests. In this theory the consumption is the most important indicator of welfare and on the other hand the amount of investment in produced capital (buildings, roads, knowledge stocks, etc.) that is needed to exactly offset use of non-renewable resources as observed earlier by Chang (2010).

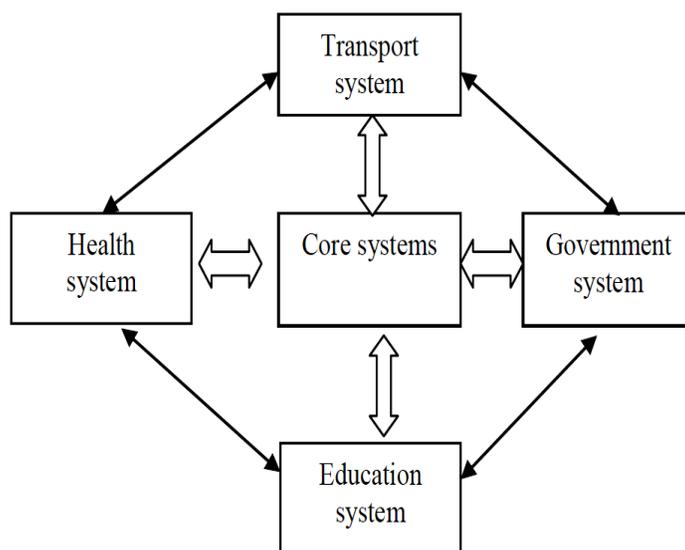
In ecological sustainability the key assumption is that natural capital (fuels, minerals, etc) are not substituted by man-made capital (machines, buildings, knowledge, etc). In this case (Wackernagel et al., 2002) we must calculate the area required to produce the resources consumed and to assimilate the wastes generated by the investment in produced capital. But this model has two problems. The first is the difficulty to quantify diverse resources as the unit of land area and second problem is that not all of resources are substitutable.

Smart Systems

The smart system represents a real support for an urban development which will generate a sustainable development of our cities. To improve the quality and performance of cities is recommended to involve all interested parties to implement efficiently smart systems. The city development depends on the hand by efficiently use of non renewable resource thought smart solutions and on the other hand by efficient use of smart solutions to produce renewable resource. In many countries the telecommunications systems infrastructure currently exists, but is not in use to the real value. About 65% of the world population will be urban until 2025. Problems due to urbanization are becoming increasingly important and require smart solutions especially in the areas that are considered primary. Using smart systems to improve the quality of life of citizens, but also and more efficient consumption of natural resources deemed to be limited. Research has focused on the study areas: education, health, transport and public administration, as clearly depicted in a graphic form in Figure 5.

Applications for an intelligent educational system are:

- data systems that collect, integrate, analyze and present information on key performance factors such as presence, knowledge and



Source:<http://www.uniassignment.com/essay-samples/information-technology/the-history-of-smart-cities-concept-information-technology-essay.php>
Figure 5: The Core Systems of the Smart City

assessment criteria for school transfers;

- education cluster - to involve all stake-holders in the educational preparation of future generations;
- using cloud computing in schools each pupil or student can access the most advanced educational content, software and computing resources and storage.

Smart City Governance for Sustainability

Any study of Smart Cities would be difficult to define conclusively unless examination of three main points of view is well carried out to identify the nature of the research study parameters:

The Governance Viability: The practicality and capability of the government in charge of the city is an important factor in orienting the study and the way it is planned to be carried out. This is essential to make sure that the results the study would lead to, can be pragmatic and realistic. Given the model of Arab cities governments’ structure, characteristics and capabilities, the viability of the study from the city government point of view is reliable and objective.

The Economic Viability: As the Arab cities exist in four major sub-regions of the Arab world, they exhibit wide differences in the economic tenure in their respective national economies. In other words, the economic situation in Arab cities is of four different types, and each

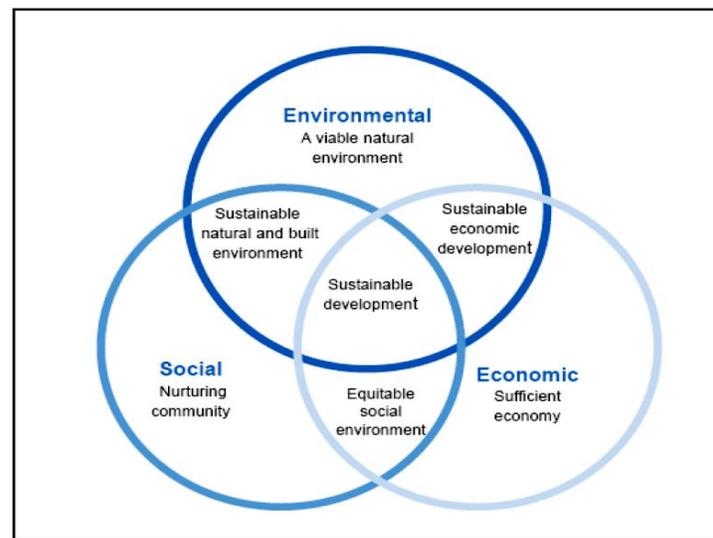
type has different financial and economic capabilities; keeping in mind Smart City transformation is essentially economically-driven in principle.

The Corporate Citizenship Responsibility Viability: This viewpoint is best described by two quotes from famous personalities in history: William Shakespeare said “what is the city but the people?” and the great Plato made it clear in his saying: “The City is what it is because our citizens are what they are.” Unless we have citizens residing in the city and have a commitment to it and share corporate responsibility, no matter how successful the transformation, the city will not be smart. The commitment of the citizen, affixation and responsibility to be part of the growing and developing a happier life is the key; otherwise the city will dwindle and become less smart every day. So the study has to consider the different nature of citizens, culture, habits and examine how to empower them and manage city-wide awareness campaigns and change management.

The Theoretical Framework

The Smart City Governance

The success of a smart city or, more in general, of a smart project is strictly linked to choices on its governance. In the last twenty years, there was an evolution from the concept of “government”, occurs when those with legally and formally derived authority and policing power execute and implement activities, to a



Source: <https://www.researchgate.net/figure/268823223>

Figure 6: The Three Dimensions of Sustainability

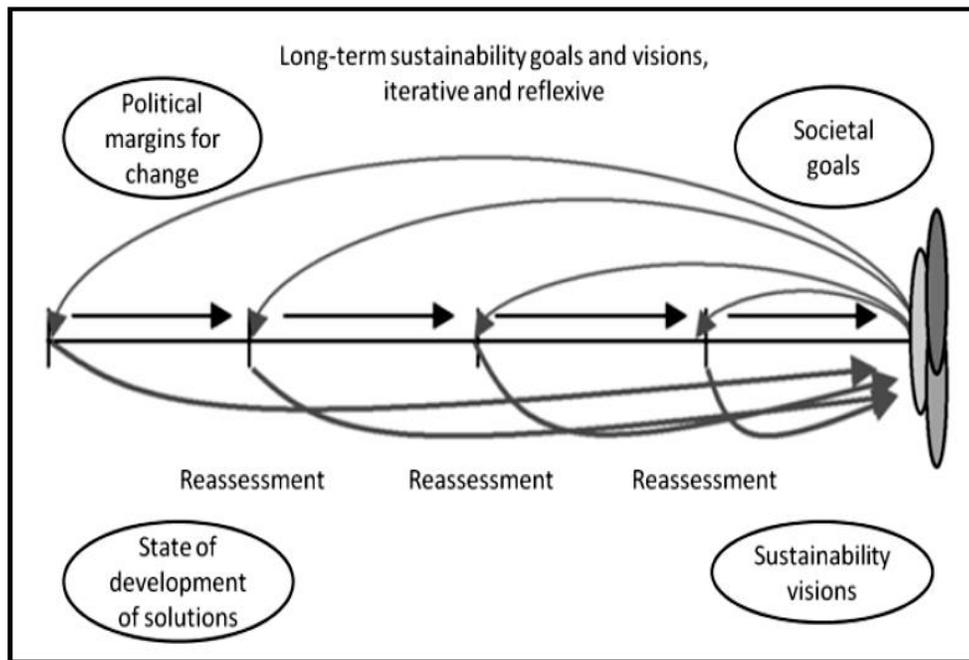
focus on “governance”, that refers to the creation, execution, and implementation of activities backed by the shared goals of citizens and organizations, who may or may not have formal authority and policing power. In other words, the governance can be defined as an activity that seeks to share power in decision making, encourage citizen autonomy and independence, and provide a process for developing the common good through civic engagement, thanks to a different perspective on power and democracy which actually can change from a top down approach to a bottom up one, and vice versa. In the smart context the concept of governance refer to, in particular, “a set of principles to be adopted by urban governments expressing how to control and guide city growth and what principles should apply in internal and external stakeholder relations”. The focus is therefore on collaboration of citizens and all stakeholders in urban life, is on participation-based organizational arrangements and democratic institutions. To reach these objectives is a fundamental the contribution of new technologies; indeed, it can be utilized to develop horizontal networks between different stakeholder groups and city governments. Well-known examples are city web portals, initiatives of e-government, open data. Nevertheless, usually the smart interventions has not been included in a governance model wider that link the different types of interactions in smart cities between citizens, government institutions and local government and allow their sustainability over time.

Sustainability and Smart City

“Sustainable development is development that meets the

needs of the present without compromising the ability of future generations to meet their own needs”. With this WCED definition of 1987, the sustainability concept become more extensive and pervasive than before, when it was considered only related to the environment safeguard. According to this broader and shared meaning the sustainability concept highlights that the economic and social dynamics of modern economies are compatible with the improvement of living conditions and with the ability of natural resources to reproduce them. For this reason sustainability is now considered from three different points of view: economic, social and environmental. The three dimensions of sustainability should not be considered as independent of each other; rather they should be analyzed according to a systemic vision, such as elements that contribute to the achievement of a common goal as shown in Figure 6.

As it emerges from both academic studies and the empirical evidence, sustainability can be framed as one of the main objectives to be pursued through the creation of a Smart City, which is an “urban model that can guarantee a high quality of life, personal growth and social development optimizing resources and spaces for Sustainability”. To be smart, a city must be sustainable and this is a challenge for the society, especially compared to some topics, such as the natural resources scarcity, the use of water resources and environmental pollution that motivate the actors of different ecosystems to the achievement of sustainable transitions. According to this vision the creation of a smart city is considered as a tool thanks to it is possible to define sustainable models of economic growth.



Source: <http://sedac.ciesin.columbia.edu/openmtg/docs/kemp.pdf>.
Figure 7: The Governance for Sustainability in Transition Management

A Governance for Sustainability

The linkages between governance and sustainability represent a strong relationship, concerning both the early stages of strategic decision and implementation in smart city projects, and the wider process of smartization. The efficiency of the governance model is measured through indicators of performance, and an incomplete or inappropriate way of carrying out this evaluation activity can hampered the entire path towards the smart city due to the loss of focus on the achievement of the sustainability goals set in the planning phase. So, in a perspective of sustainability, the governance model must include appropriate monitoring activities, in order both to identify and correct the ongoing interventions implemented with low efficiency or effectiveness, and to assess the impacts of the different initiatives on the overall development in the medium-long term. This two-way relationship established between governance and sustainability has been explained in literature through a complete analysis on sustainability indicators, concerning the three dimensions (economic, social, and environmental) and governance as a fourth variable to be taken into account.

In detail, the vision of governance for sustainability is highlighted through the identification of four specific indicators, namely the participation and involvement of citizens, the transparent and efficient governance, the activities of government, and the sustainable management of authorities and businesses. Furthermore,

the searching for a suitable governance model to achieve sustainability has recently been analyzed by a new strand of literature, the so-called transition management, which focuses the attention on the transformation process currently under way in a world characterized by complex and dynamic social-ecological systems in need of sustainable development in a transitory management mode as depicted in Figure 7.

The challenge of this approach is “to use bottom-up initiatives and business ideas of alternative systems, offering sustainability benefits besides user benefits”. This new desirable model of governance for sustainability needs structures and practices that can manage and organize positive work by the wide range of urban stakeholders on a huge complex of issues, through the adoption of a long-term perspective as a framework for short-term actions.

Five Challenges for Smart Sustainable Cities

Smart Sustainable Cities is an underdeveloped concept. In the previous section, we suggested a definition for it. In this section we present five challenges that need to be addressed for smart sustainable cities to materialize.

Strategic Assessment

Once Smart Sustainable Cities are defined, it is evident that assessments in relation to that meaning become

necessary. Methods and practices need to be developed and implemented. Methods are required that can be used to identify which solutions are needed, and that take a systems perspective on evaluating the effects of the proposed solutions. Without this, Smart Sustainable Cities' risks becoming just a label without validated content. In developing assessment methods, it is important to keep in mind that in practice it is the assessment, or the indicators included in an assessment, that defines the important characteristics of a smart sustainable city. As mentioned, it is also important to consider how to prioritize between different objectives in case of conflicting interests. Such conflicts may arise between sustainability dimensions (e.g. the conflict between bio-fuel and food production) or within them (e.g., the conflict between bio-fuel production and biodiversity).

Taking Mitigating Measures

Historically, infrastructure development and investment have led to substantial improvements in wellbeing and wealth. Through the implementation of systems for transport, power, water and sewage management, life for billions of people has been improved. As a part of this, infrastructures have also made it possible to create and develop more efficient systems for trade and businesses of various kinds. Infrastructure development is in many ways a backbone of modern society. However, infrastructures have also made it possible to ruin ecosystems and exploit natural resources to an extent that threatens the existence of that same modern society. ICT is in this sense functioning in the same way as other infrastructures; today it plays an increasingly important role in maintaining and developing society and has the potential to support a resource-efficient sustainable society. But it also has the capacity to be used to make modern society an even more efficient machine for over-exploiting the earth. An example of this is using ICT to increase traffic flows in cities. If measures are "A smart sustainable city uses information and communication technologies (ICTs) to provide enhanced quality of life to its citizens, improved efficiency of services and sustainable development. According to the observation made by the Centre of Regional Science, Vienna in October, 2007, such a city meets the needs of today without sacrificing the needs of future generations with respect to economic, social and environmental aspects" (Centre of Regional Science, 2007). Therefore, the improvements in traffic might need to be paired with other measures. Similarly, counter-measures may be needed to realize the sustainability potential of ICT in other cases as well. Cities must craft mitigating measures at the same time as they encourage technology for efficiency improvements, and they must closely follow how ICT is shaping society.

Employing Top-Down and Bottom-Up Approach

The actual products, services and systems of the smart sustainable city may originate as large-scale suggestions from big companies such as Cisco, Ericsson, IBM or Siemens. One potential benefit of such top-down solutions is that these giants have the economic capacity to fully implement the assessments called for above, and they can function as concrete suppliers of the tools and services that city administrations may want to implement. However, there is also a risk that the strength of the corporate giants can enable them to monopolize smart sustainable city development to the extent that it kills creativity. The bottom-up approach can be represented by hacker communities and other types of grassroots or small-scale initiatives. Many cities have great expectations on the potential for innovation through involving people in formulation and solving of problems. A weakness of this approach is that it can be very difficult to take the solutions to the next level, thus leading to many fragmented small-scale solutions without the power to actually make a big change. Another weakness of this approach is that it can be very difficult to assess the actual outcome. It may be argued that supporting many initiatives will increase the chance of yielding successful ones. This may be true, but it is also likely that others will turn out to be bad from a sustainability perspective.

Focus on Competence: The Key Differentiator

As mentioned in the previous challenge, initiatives from big enterprises can be very effective. They may also be efficient ways of implementing good solutions. However, currently ICT knowledge among companies is so much higher than among city governments that the cities become weak customers. They do not have the capacity to adequately specify their needs or to properly evaluate the offers they receive. This can lead to either bad investment decisions or paralyzed decision making. It is probably in the interest of both city administrations and ICT companies to increase city administrations' competences with regard to ICT solutions for Smart Sustainable Cities. This need has been recognized by the EU Smart Cities Stakeholder Platform, which has developed guidelines for public procurement for smart cities (Kramers et al, 2013, 2014).

Governance of the Smart Sustainable City

The smart sustainable city calls not only for interconnecting devices but also organizations, requiring a reconsideration of which actors need to be involved in the planning and governance of the city. Moreover, for the diverse ICT in the city to work through concerted

action, a coordinating body must play a role. This is also important from the perspective of sustainability because of the aforementioned need to strategically assess and evaluate the effects of ICT investments. Lee et al. propose a “dedicated smart city team formed with diverse roles and skills to promote smart city development also recognized by other city's agencies”. With a focus on Smart Sustainable Cities, this team could then be given the assignment to promote smart sustainable city development. Over time, such a body could also develop the competence needed to scrutinize offers from ICT companies as well as play a role in balancing top-down and bottom-up approaches.

A Summing-up

Smart Sustainable Cities is an aggregate concept. In this chapter we have shown that each of the constituent concepts – smart, sustainable, and cities – is important in its own right. Cities can be made sustainable without the use of smart (ICT) technology, and smart technologies can be used in cities without contributing to sustainable development. Smart technologies can also be used for sustainable development in venues other than cities. It is only when all three aspects are combined, when smart (ICT) technologies are used to make cities more sustainable, that we can speak of Smart Sustainable Cities (SSC). Indeed, the concept of Smart Sustainable Cities is not relevant for all actors and perspectives. For example, from sustainability perspective it could be argued that whether or not a city uses ICT is a rather unimportant issue as long as it becomes more sustainable. Therefore, the concept of a sustainable city would be enough. And from an ICT industry perspective it could be argued that industry works with smart solutions, while the sustainability part is not their business, and therefore the concept of the smart city is appropriate and sufficient. Those standpoints are valid, but from a more holistic perspective, the concept of Smart Sustainable Cities is needed, exactly because of the two standpoints above. Connecting the concepts of sustainable cities and smart cities may also raise awareness about the potential of using ICT to promote urban sustainability among planners, IT companies and policy makers.

The concept of Smart Sustainable Cities can thus be used as a common framework or joint vision for elaborating new collaborations, business models and ways of carrying out urban development. This in turn highlights the need to avoid getting caught up only in the technological challenges of developing Smart Sustainable Cities and rather taking a proactive approach to actor networks, governance, and policy innovations. Defining Smart Sustainable Cities is also important because of the ongoing competition on how to interpret this concept. It has become a concept with positive

connotations, and thus it is seen as good to be associated with it. In practice, this can lead to a loss of power for the concept the concept losing its power. By focusing the definition, ICT development based on sustainability concerns can get a competitive edge. By simultaneously emphasizing both smart and sustainable, ICT development could be driven more by sustainability problems, instead of by a pure technical development in which newly developed “solutions” may not actually be solutions to any specific problem.

The Key Pillars for Cities

All cities have something in common, in-as-much as they all strive to achieve three objectives, presented here as city sustainability pillars. The first is economic sustainability, i.e. a dynamic, productive city with numerous business opportunities generating wealth. This requires from the one hand high productivity and wealthy cities and healthy and well-financed public services. The second is social sustainability, guaranteeing access by all citizens to basic services and avoiding social exclusion. The third is environmental sustainability.

Economic and Financial Sustainability

By economic sustainability, this paper refers to the business environment and wealth generation capacity of the city. It is a proxy for gross domestic product (GDP) growth, but encompasses wider criteria than just GDP. Population growth, the quality of private undertakings, the attractiveness as in investment location as well as the ability of city authorities to tax the citizens for public services, all depend of the city's ability to attract business and capital. The development of smart cities, the financing of change and the fullest adoption of innovations by city inhabitants, require an understanding of the economic fabric of the city and the market for smart solutions. Understanding the market allows for the development of new approaches to infrastructure financing, as well as influencing citizen's behavior through those approaches. For cities requiring public private partnerships (PPPs) and systems of cost recovery using user charges, this knowledge is of paramount importance.

Smart city services contribute to the economic sustainability and the resilience of cities to economic shocks, as those generate a new level of economic diversification. Economic sustainability is also closely linked to financial sustainability, particularly in the wake of the financial crisis. Many cities have seen their access to capital curtailed and their credit rating deteriorate, while financial institutions have restricted the access to credit. Thus even though well-designed investments in improved

efficiency can make cities more sustainable financially; short-term investment capital may be unavailable at the required scale. Nevertheless, investing in the city structures of the future can be done using novel financial models, which monetize savings and use them to finance the reimbursement of capital expenditures. In addition, the cities of the future are expected to have much more decentralized energy services and supply provision systems, creating new economic activities and allowing PPPs. The right models should be able to combine financial sustainability with higher investment rates. Depending on the circumstances of each city, the need for special support by donors, governments and international financial institutions may arise. Cities in richer countries with limited credit access may need state guarantees or guarantees by public financial institutions to help reduce the risk rating, and thus interest rate costs. Poorer countries may in addition need financial aid by donors and international financial institutions. Financial models need to be well designed, aiming ultimately at developing cost effective and sustainable solutions, and also at attracting foreign investment. Importantly, financing models must be based on solid cost-benefit analysis, including wider socio-economic benefits where necessary.

Social Sustainability

When large numbers of people live in agglomerations, actual or perceived social inequalities and social exclusion of sections of the population can lead to social unrest. City authorities have a key interest to ensure social inclusion, which starts with a basic level of services for all citizens. In a smart city, it is important to take into account the risks of alienating important groups of citizens. This may happen because smart services are limited to richer areas of the town, or because user charges make many important services unaffordable for certain parts of the population. All models of development of cities have to ensure that public transport, water, power etc.

The present framework conditions for cities sanitation, electricity, and telecommunications are affordable and accessible to all population groups. Citizens are also the ultimate beneficiaries and users of “smart” changes. Inclusiveness can be achieved by involving all relevant stakeholders from the start, and ensuring that new changes are understood and accepted, and thus inclusive. Smart city infrastructures or services need to respond to the following questions:

- Are the expected objectives of the planned changes taking into account real behaviour of the city stakeholders?
- How can it be guaranteed that basic city

services are affordable?

- Who is paying for the services? Are the users that can afford them the right target group?
- Can the new services and infrastructures be understood and used by all citizens targeted?
- Are the social and cultural values of the citizens taken into account?

Smart city approaches strongly focus on technology and often rely on sophisticated applications. Badly understood or poorly implemented, they may be pursued for their own sake and divert cities from real issues (employment, education, crime, etc.). Ideally, smart city projects should be carried out only if they help cities to meet their needs, with a quantifiable added value facilitated by technology integration, usability or cost reductions.

Environmental Sustainability

Environmental concerns are growing in cities. Three pressures arise. The first is on resource limitations, such as water scarcity and quality, or fuel requirements. The second is on QoL and health. Not only are citizens and authorities more environmentally aware, but the economic implications of pollution can be serious, due to the impact on health and the attractiveness for businesses to operate from the city. The third is risk management and resilience to environmental shocks (such as heat waves and flooding caused by climate change). One of the first stages to address sustainability is to increase resource efficiency in all domains, such as energy efficiency in buildings and networks, fuel efficiency in transport, water efficiency and new methods to transform waste to energy. Technology is not the only aspect required for sustainability, but is an important and necessary step forward. Efficiency gains can need significant investments, and the integration of different technologies can be complex. Resilience and risk management need to be integrated in city planning, based on estimated future risks. The smart city is essential and possibly our best bet to move towards sustainability. The integration of different technologies in the areas of ICT, transport, energy, water etc., which form the infrastructure backbone of cities, currently offers the best prospect for sustainability.

Demographic change and the implications for Smart Cities

Many challenges will come from within the city itself, and one of the key challenges will be demographic change and the impact of ageing. According to a recent study by the Global Cities Indicators Facility by the United Nations Department of Economic and Social Affairs (2012), the

number of people over 65 years of age will increase by 183 % globally in 2050 compared to 2010, with astonishing spikes expected in certain regions. In West-Asia and North Africa the increase is expected to be of 366 %. In 2045, the projections show that elderly people will outnumber children under 15 for the first time in history. The countries with the largest shares of elderly population will still be Europe and North America, but in Asia-Pacific and Latin America the shares are expected to be similar in 2050, which means a stronger increase in percentage terms. Cities are responsible for 70 % of the world GDP, and the impacts of ageing on productivity, labour supply, income security and housing security bring important political and economic policy challenges to cities.

Economic Development and the Financial Change

Urban productivity is considered to be of key importance in determining the prosperity of any city, as it reflects the efficiency with which a city uses its resources to produce outputs that can generate additional income and thereby improve living standards. This is the reason that GDP per capita is generally used as a leading indicator of urban productivity. The use of GDP as a leading indicator of urban productivity and prosperity has been criticized for not addressing other notions of urban well-being such as QoL, social cohesiveness, environmental sustainability and availability of opportunities for business and residents (Perlman and O'Meara Sheehan, 2007). However, the limited availability of data is considered to be one of the principal reasons for not adopting a broader concept of productivity, which would incorporate other factors of production, beyond land, capital and labour, such as human, intellectual and social capital (Intergovernmental Panel on Climate Change: Climate Change, 2013) . Urbanization has generally been accompanied during the past 50 years by an increase in national productivity, as measured by GDP per capita. This increase in productivity is important to facilitate the necessary investments in smart solutions. As mentioned, smart solutions can generate new opportunities and reduce costs through economies of scale. Appropriately tailored solutions for cities using new innovative financial systems can produce economic results that outweigh investments.

Scanning the Global Scene of Good Governance and Sustainability of Model Smart Cities

This section highlights some of the International experiences in providing good governance and long-term sustainability of some representative smart cities in the world scene.

Amsterdam Smart City

Since 2009 the capital city of the Netherlands launched a program called Amsterdam Smart City (ASC) in which the municipality was a founding partner in the execution together with the Amsterdam Economic Board, Liander, KPN, and Hogeschool van Amsterdam (<http://amsterdamsmartcity.com>). This model of governance as public-private partnership (PPP) has been enriched through the selection of a wide range of partners for the development of the different projects launched during the ASC activities. Among the industry players it is possible to find ABB, Accenture, Cisco, IBM, Philips and Siemens and they all have been chosen by the governance of the city on the basis of their experience. Until now the ASC platform has involved more than 100 partners with over 50 smart projects (ASC, Together on the road to a Smart City, 2014. Available at http://issuu.com/amsterdamsmartcity/docs/drieluik_asc_engels), which are all linked to the achievement of a sustainable urban life, as it has been established since 2011 with the Sustainability Programme 2011-2014 (<http://www.amsterdam.nl/gemeente/organisatie-diensten/dienstruimtelijke/making-amsterdam/portfolio/sustainability-progr/>). This plan has brought to the creation of the so-called Amsterdam Sustainability Index (ASIndex), made up of ten indicators (<http://www.amsterdam.nl/publish/pages/511242/sc2012.pdf>) two general indicators related to CO₂ emissions and air quality, and eight indicators related to the most important projects related to the four pillars of the Sustainability Programme (climate and energy, mobility and air quality, sustainable innovative economy, and materials and consumers).

Forum Virium Helsinki

The capital of Finland is the home of the Forum Virium Helsinki (FVH), a subsidiary (limited company) owned by the City of Helsinki and an official part of the Helsinki City Group, born in 2006 for the development of new digital services and urban innovations in cooperation with companies, other public sector organizations, and residents (<https://www.forumvirium.fi/en>). All these different stakeholders involved in the projects, in particular Elisa and Nokia as the main ICT players, have been collected in a PPP model of governance. By the end of 2009 FVH has developed 23 projects concerning five main areas (FHV, Forum Virium Helsinki - Annual Review 2009, 2010): traffic and location based services, healthcare and wellbeing, learning and education, media, and innovation communities. Among these initiatives, the most significant ones have been focused on the creation of innovative public services through the collection and

use of open data, which represent also a source to apply the sustainability indicators developed as a part of the Local Agenda 21 of Helsinki (http://www.hel.fi/hel2/tietokeskus/julkaisut/pdf/02_02_15_kestava_kehi_tys.pdf). The FVH activities have reached an economic long-term sustainability thanks to the increasing sources of funding from the Innovation Fund (City of Helsinki), membership fees, assignments from the cities, and project funding (i.e. Tekes - Finnish Funding Agency for Innovation, and the European Union programs (Salminen, V. Forum Virium: Brokering smarter cities, 2014).

Barcelona Smart City

The city of Barcelona is one of the most important smart cities, a benchmark at international level. The approach that since 1990 has linked the city of Barcelona to the concept of smart city, is the choice of governance based on the cooperation among politics and business, as well as among academic institutions and residents, all involved in smart cities project development. The governance choices' main aim is to use ICTs to achieve smart services and transform public administration business processes (both internally and externally) to make them more accessible and effective. One of the most famous and quoted smart initiatives carried out in the Catalan city is the district 22@Barcelona (City of Barcelona, Barcelona works towards sustainability, 2009; Available at <http://www.sostenibilitatbcn.cat/>). It is an urban-renewal plan designed to transform the 200-acre former industrial area of Poblenou, fallen into disuse, in an innovative district. Thanks to a change in the Regulatory Plan relating to the list of buildable area it was possible to attract the big players operating in the real estate. The project has had considerable impact in terms of sustainable development. It has in fact allowed to realize about 3.2 mln m² of production activities, 800,000 m² for housing and 120,000 m² of green areas, which have enabled over 7,000 companies (4,500 since 2000, of which approximately half start-up) and 4,400 employed workers to work in the district (the equivalent of 15% of total economic activity of Barcelona). The area is also inhabited by 90,000 people. It has created jobs in a region where unemployment had reached high levels, it has created green spaces having a positive impact on both the environmental dimension in the social, it has created homes helping to decongest the centers always very crowded, allowing to the economy to restart despite the economic crisis.

Copenhagen Smart City

The city of Copenhagen's quest to become a smart city

has developed from the ambitious vision of becoming the world's first carbon-neutral capital by 2025. In order to reach this ambitious goal, the city is determined to implement new and innovative solutions within transport, waste, water, heating, and alternative energy sources. To reach this aim Copenhagen has choose as governance decision a collaboration (co-creation) between public authorities and private companies that together would like to make Copenhagen as a sustainability benchmark. To demonstrate that a smart city has a positive relationship with sustainable development, the Copenhagen Cleantech Cluster released a study that highlights, for each driver, that how smartization led to economic, social and environmental benefits for the entire community (about mobility solutions: 230 million € health expenses saved by cycling per year; healthier citizens reduce health care costs at an estimated rate of € 0.77 per km cycled; about alternative energy solutions: the Danish wind turbine industry has grown into a multibillion euro industry with over 350 companies producing turbine towers, blades, generators, gear boxes and control systems; Middelgrunden wind farm annually eliminates: 232 tonnes of sulphur dioxide emissions 208 tonnes of nitrogen oxide emissions 68,000 tonnes of carbon dioxide emissions and 4,400 tonnes of dust and clinker).

The carbon emissions reduction in Copenhagen is, therefore, the ultimate goal that at the same time determines the engagement of many stakeholders and a positive impact on all sustainability dimension (economic-social-environmental) because leads to an improvement of quality of life, innovation, job creation and investment (Copenhagen Cleantech Cluster, 2013; Available at http://publications.arup.com/Publications/C/Copenhagen_Solutions_for_ustainable_Cities.aspx).

Manchester Digital City

The city of Manchester has started his smartization process with the implementation of "Manchester Digital Strategy" (<http://www.manchesterdda.com/>). The principal aim of this strategy is provide a framework within which practical proposals for developing "next generation" broadband across the city and the city-region as a whole can be developed. Manchester is undertaking a number of initiatives to encourage its development as a "smart city" especially, through the use of Living Lab approach. The governance of many of these smart projects is assigned at Manchester Digital Development Agency that representing Manchester City Council and working with partners in the university, business and not-for-profit sectors to trial new products and services. It is a multi-stakeholder approach in which were born actors created ad hoc, such as "Manchester Digital", the trade association for digital and new media, "Future-Everything", the pioneering Manchester festival

innovation organisation, and MadLab, (the Manchester Digital Lab) a community hack space in the Northern Quarter. For the future the city would reinforce its own green growth, by creating increased demand for its successful products and solutions. In detail, it has set a number of objectives related to: “economic performance”, creating markets for new technology products and applications, providing opportunities for demonstration and market-testing and improving the efficiency of doing business; “quality of life”, increasing access to health services in the home, reducing the cost of keeping homes comfortably heated and engaging people more in how their city is managed; “environmental impact and improved resilience”, with a target to achieve a 40% reduction in carbon emissions by 2020.

Smart City Wien

The big Smart City Wien Initiative was launched in 2011 (<https://smartcity.wien.at/site/en>). In 2013, the city has defined a framework strategy for its processing route in a smart city with the time horizon extended at 2050 (City of Wien, Smart City Wien; Framework Strategy, 2014: Available at https://smartcity.wien.at/site/files/2014/09/SmartCityWien_FrameworkStrategy_english_doublepage.pdf). This strategy is based on combination of three elements: resources (energy, mobility, infrastructure, and buildings), quality of living (social inclusion, participation, healthcare, and environment) and innovation (education, economy, research, technology). For each driver Alfano, et al, (2014) defined some objectives both qualitative and quantitative. The governance of entire project is based on public-private partnership with the involvement of Municipal Departments, firms of project management, holding company, ICT players (such as Siemens), university and centre of research. Moreover, to ensure all stakeholders inside and outside the City Administration are involved in the process, the project structure is essentially made up of general and specific consultation teams on population development, environment, administration, economy, energy and mobility and the coordination for these relationships is assigned to Smart City Wien Agency (<http://www.tinavienna.at/>). For the implementation and sustainability of Smart City Wien strategy was established a coherent monitoring and reporting process with a set of core indicators assigned to each key objective.

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