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|  | **International Telecommunication Union** |
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| **ITU-T** | **FG-SSC** |
| TELECOMMUNICATIONSTANDARDIZATION SECTOROF ITU | (03/2015)  |
|  | ITU-T Focus Group on Smart Sustainable Cities |
|  | **Setting the stage for stakeholders’ engagement in smart sustainable cities** |
|  | Focus Group Technical Report |



FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of tele­com­mu­ni­ca­tions, information and communication technologies (ICTs). The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The procedures for establishment of focus groups are defined in Recommendation ITU-T A.7. ITU-T Study Group 5 set up the ITU-T Focus Group on Smart Sustainable Cities (FG-SSC) at its meeting in February 2013. ITU-T Study Group 5 is the parent group of FG-SSC.

Deliverables of focus groups can take the form of technical reports, specifications, etc., and aim to provide material for consideration by the parent group in its standardization activities. Deliverables of focus groups are not ITU-T Recommendations.

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**Setting the stage for stakeholders’ engagement in smart sustainable cities**

Acknowledgements

This Technical Report was researched and written by Daniela Torres (Telefónica), Jara Forcadell Ortiz (MSc on Smart Cities at University of Girona, Spain) and Mythili Menon (University of Geneva) and as a contribution to ITU-T Focus Group on Smart Sustainable Cities (FG-SSC).

Special thanks are due to Angelica Ospina (University of Manchester), Giampiero Nanni (Symantec Corporation), Juan Manuel Sabio Morchio (University of KwaZulu-Natal, South Africa), Marc Gil (MSc.on Smart Cities at University of Girona), Amanda Mc Intosh (Carlo-Schmid Programme), Chris Ip (University of Toronto), José Miguel Fernández Güell (Universidad Politécnica de Madrid), Ziqin Sang (Fiberhome), Guilherme Canela (UNESCO) and Silvia Guzmán (FG-SSC Chairman) for their helpful review and contribution.

Additional information and materials relating to this report can be found at: [www.itu.int/itu-t/climatechange](http://www.itu.int/itu-t/climatechange). If you would like to provide any additional information, please contact Cristina Bueti at tsbsg5@itu.int.

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Setting the stage for stakeholders’ engagement in smart sustainable cities

Executive summary

This Technical Report has been developed as part of the mandate of the International Telecommunication Union's (ITU) Focus Group on Smart Sustainable Cities (FG-SSC). It responds to the need for identifying and mapping the different stakeholders that are involved in the development of Smart Sustainable Cities (SSC), to foster broad cross-sectoral engagement and participation in SSC strategies.

In addition to identifying the key stakeholders' roles and responsibilities within SSC, the report aims at providing a series of recommendations to ensure the effective integration of these stakeholders in the design, implementation and assessment of SSC operations.

This report argues that, despite the potential of SSC to overcome the challenges posed by rapid urbanization and heightened vulnerability due to stressors such as climate change, SSC also face operational, financial, technological and human resource challenges, including the effective engagement and participation of citizens since the inception of SSC strategies.

The analysis suggests that, in order to overcome these aforementioned challenges and take advantage of potential opportunities, SSC decision makers need to effectively integrate multiple key stakeholders in the process of transformation of their cities into smart sustainable cities.

In order to facilitate this integration the report suggests a methodology to identify and map key stakeholders, based on the principles of the Logical Framework Approach (LFA). Building on that, the analysis identifies the role and responsibilities of each of the stakeholders involved in the effective functioning of SSCs, including municipalities and city administration, national and regional governments, city services companies and utility providers, ICT companies, NGOs, multilateral organizations, industry associations, urban planners, academia, scientific community and research organizations, citizens and citizen organizations, and standardization bodies.

This Technical Report indicates that, in order to foster an inclusive approach, city decision makers should take into account the diversity of stakeholders supporting the development of a SSC initiative or project. This report describes three steps to accomplish this: (1) developing an initial stakeholder identification process; (2) categorizing and identifying the relationships among them, and (3) conducting a detailed analysis of all stakeholders' interests to identify their role and contribution to the SSC.

The document concludes with general recommendations on SSC stakeholder integration, by presenting a summary table identifying SSC stakeholders, their scale/sector of operations, their key aims and challenges, strengths and constraints associated with their role, and their expected contribution to the SSC's rollout.

Introduction

In the last 50 years, the world's population has grown exponentially at an average rate of 1.2% per year. Globally, more people live in urban areas than in rural areas. In 2007, for the first time in history, the global urban population exceeded the global rural population, and the world population has remained predominantly urban thereafter. [[1]](#footnote-1)As of 2014, 54 % of the world's population resides in urban environments and by 2050, 66 % of the world's population is projected to be urban.[[2]](#footnote-2) This rapid urbanization is adding pressure to cities, with increasing demand for energy, water, sanitation, as well as for public services, education and health care.

Strategies to implement Smart Sustainable Cities (SSC) are emerging around the globe as a response to the challenges posed by this rapid urbanisation, by integrating Information Communication Technologies (ICTs) into all aspects of the city's planning and operation. Acting as a platform, ICT tools enable information gathering to increase the efficiency of the city's functions, allowing both the municipality and the citizens to make better informed decisions, facilitating the integration of city services, and the cooperation across different sectors.

The Focus Group on Smart Sustainable Cities (FG-SSC) of the International Telecommunication Union (ITU) brings together a variety of SSC stakeholders (e.g. municipalities, academic and research institutes, non-governmental organizations (NGOs), ICT organizations, industry forums and consortia) with the interest of identifying the standardized frameworks needed to support the integration of ICT services in smart sustainable cities. Smart sustainable cities bring together a variety of stakeholders. This is one of the key prerequisites for the success of SSC: the effective integration of private, governmental and public bodies, the citizens, and also the academic and scientific communities. This concurrence of actors also results in high complexity, evidencing the need for an in-depth analysis of the stakeholders involved in the design and implementation of SSC strategies. This includes the design of a comprehensive map of actors involved in this new urban landscape, including their potential role and contribution to the realization of SSC, defined by the FG-SSC as follows:

*"A smart sustainable city is an innovative city that uses information and communication technologies (ICTs) and other means to improve quality of life, efficiency of urban operation and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social and environmental aspects."*[[3]](#footnote-3)

This report is divided into four sections. The first section presents an overview of the main challenges faced by SSCs, including operational, financial and technological aspects, as well as human resource and citizen engagement. The report argues that, in order to overcome these challenges and take advantage of potential opportunities, SSC strategists need to integrate the role of multiple key stakeholders. The second section proposes a methodology for the identification of stakeholders, based on the principles of the Logical Framework Approach (LFA). [[4]](#footnote-4)

Building on that, the third section provides an in-depth analysis of the roles and responsibilities of each of the stakeholders that contribute to the effective functioning of SSC, namely municipalities and city administration, national and regional governments, city services companies and utility providers, ICT companies, NGOs, multilateral organizations, industry associations, academia and scientific community, citizens and citizen organizations, and standardization bodies.

The final section of the report outlines a series of strategic recommendations for multi-stakeholder involvement, aimed at city decision makers working in the design and/or implementation of SSC.

The report concludes by presenting a summary table that identifies SSC stakeholders, their scale/sector of operations, their key aims and challenges, their potential and constraints associated with their role, and their expected contribution to SSC's rollout.

Scope

The FG-SSC Working Group 1 (WG1) suggests that one of the major challenges in the emerging SSC field is the lack of a common framework and understanding of SSC stakeholders, including their roles and responsibilities. Responding to that need, the objective of this report is to strengthen the design and implementation of SSC by providing all interested stakeholders with a clear overview of roles and responsibilities, including a series of recommendations that can help maximize their contributions to SSC goals.

Global human security and development depend on the strengthening of collective action. The many challenges faced (including the establishment process of SSC) cannot be met effectively by individual governments without the active involvement of civil society, non-governmental organizations (NGOs), private sector. [[5]](#footnote-5)

Hence, countries, governments, business and various stakeholders realize that complex issues such as the establishment of SSC cannot be achieved by a single actor. Such complex activities would require coordinated effort with multiple stakeholders contributing to innovative and sustainable solutions. [[6]](#footnote-6) This document based on this fact is expected to help maximize the contribution of each of these actors, prevent overlapping of functions, and facilitate the identification of gaps, so as to increase the likelihood that SSC's goals will be achieved.

It is expected that this document will help to maximize the contribution of each of these actors, prevent overlapping of functions, and facilitate the identification of gaps, so as to facilitate the achievement of SSC's goals.

This report is addressed to a broad audience of city decision makers and practitioners involved in the design and implementation of SSC. It is intended to be as general and inclusive as possible, applicable and relevant to any city, regardless of its size or location, in both developed and developing countries. The concepts and definitions presented in this document are in alignment with the series of Technical Reports on smart sustainable cities produced as part of the deliverables of ITU's FG-SSC.

1 Smart sustainable cities: overview and challenges

The first part of this section provides a brief summary of the work undertaken by the three working groups that form the FG-SSC, in order to highlight the importance of adopting a multi-stakeholder approach in the emerging SSC field. The second part of the section identifies the key challenges faced by SSC and its stakeholders.

1.1  SSC overview

FG-SSC Working Group 1 has developed a general overview and a standardized definition for smart sustainable cities, as indicated above. Studies conducted by the group experts suggest the existence of a series of attributes that are crucial to better understand the nature and impact of SSC, including those related to goals of sustainability, quality of life, efficient provision of urban services, as well as intelligence or 'smartness.'[[7]](#footnote-7)

In addition to those key attributes, WG1 suggests that the following are the key themes that lie at the core of SSC operations:

– Society – the city is for its inhabitants (the citizens).

– Economy – the city must be able to thrive – in terms of jobs, growth, finance.

– Environment – the city must be sustainable in its functioning for future generations.

– Governance – the city must be robust in its ability to administer policies and put together the different elements.

Building on these foundations, the FG-SSC Working Group 2 has developed a series of Technical Reports that explore the use of ICT in smart sustainable cities. From this series, the report on SSC Infrastructure suggests that the architecture of SSC is composed of different layers (i.e., sensing layer, communication layer, data layer and application layer). These layers relate ICT infrastructure to cities, and are a useful reminder of the complexity that characterizes SSC. It suggests that the successful operation of these cities requires an intricate articulation of multiple fields of expertise and sectoral engagement. This complexity also illustrates the need for an inclusive, multi-stakeholder approach in the design and implementation of SSC infrastructure and several ICT services for smart buildings, for climate change adaptation, and for smart water management, among others.

Also reflecting the need for this approach, the FG-SSC Working Group 3 has developed a series of reports aimed at developing a standard set of Key Performance Indicators (KPIs) for SSC evaluation. WG3 has identified multiple dimensions to assess and measure the performance and impact of SSC (i.e., indicators related to ICT infrastructure, environmental sustainability, productivity, quality of life, equity and social inclusion, and non-ICT infrastructure development) which reflect the wide range of perspectives that need to be considered in SSC.

The next part of the section identifies some of the key challenges faced by SSC. Exploring these areas is crucial to gain a more in depth understanding of the potential contribution of different stakeholders to overcome existing and emerging constraints, and achieving the full potential of SSC.

1.2  SSC challenges

The work developed by the different working groups of the FG-SSC has brought to light several challenges faced that cities need to address as part of the design and implementation of SSC strategies in a complex multi-stakeholder urban environment.

Some of the most likely challenges which SSC stakeholders could possibly face are the following:

* **City vision challenges**

There are various paths to becoming a SSC: each city has its own needs, and starts from a different baseline. In this sense, standards are needed to create a common framework that can continuously support and foster sustainable development as well as allow comparability and evaluation of results for different cities and initiatives. The standards used in SSC would define any necessary baselines and quantify improvements progressively. They would also become the foundations which cities across the globe could develop upon based on their cities' priorities and capacity. This is particularly important in smart sustainable cities as sustainable development policies often involve multiple stakeholders at all levels of government.

The process of becoming a SSC is not a short one, and is a forward looking commitment to be fulfilled in a long-term future. To achieve the successful completion of a long term SSC roadmap it is important that all political parties of the municipality are involved in the definition of the strategy and remain committed to the project.

Finally, the approach to SSC must be holistic and inclusive. This is not easy to achieve because, traditionally, city management is divided into different departments with little cooperation between them. Therefore, it is crucial to increase interdepartmental communication and cooperation. The same issue applies at the national level, where the management could be divided into different ministries or departments. Achieving communication and cooperation at all levels of government is of paramount importance as building the city's a common vision is not restricted to one level only, but it requires a combined effort from at all levels of government.

* **Economic and financial challenges**

The lack of funding for city projects has become a common obstacle in the development of SSC. In the case of developed countries, the recent global and regional economic recession has severely restrained limited their capacity in investing in SSC initiatives. The recession between 2008 and 2012 has "reduced capital accumulation for new investments… these, in turn, affect the pace of innovation and the general development of the green economy… in the U.S. investments in clean technology dropped from 1 billion to 154 million… venture capital investment in clean technology also dropped from 991 million to 791 million."[[8]](#footnote-8) In the case of developing countries, limited resources and widespread poverty simply mean that while these countries do invest in sustainable development initiatives, other areas which require immediate attention become their priorities. With 1.2 billion people still living on less than a dollar a day, and half of the developing world still lacking access to sanitation[[9]](#footnote-9), it is not surprising that investment on a common SSC framework or SSC services may not be a priority item in the development agenda. Additionally, there are difficulties in accessing resources from financial institutions due to the lack of business models that determine the return of the investment.

Considering that citizens' welfare is a priority of any SSC, job creation and maintenance must be rallied as the cornerstone during the developmental stage of SSC. Hence, an important challenge for SSC stakeholders at all levels is to take advantage of the projects and transformations the city will go through to generate employment and promote the creation of new businesses, so that the city's economy can benefit from this transformation. In other words, a multi-stakeholder approach is crucial as a variety of stakeholders working together can not only contribute to the transformation of the city towards becoming smart and sustainable but also in getting though tackling challenges more easily and more effectively.

* **Technological challenges**

While the number of mobile-broadband subscriptions has reached 2.3 million with 55% of them in developing countries,[[10]](#footnote-10) most SSC solutions require the support of ICT infrastructure and services that many cities still lack. This includes widespread Internet broadband, comprehensive mobile network or communication networks for sensors, among others. The deployment of such infrastructure constitutes a major challenge that needs to be overcome. This problem is particularly acute in developing countries where the existing infrastructure is inadequate and connectivity rates remain low, a situation often referred to as the 'digital gap'.

When planning the deployment or the upgrading of ICT technology, it is important to consider the adaptability, scalability, accessibility, safety and flexibility of this infrastructure. Incorporation of technology with the current infrastructure is also a very important issue to be addressed.

Another challenge in this category is the lack of accessibility to information about the technology. This is partly attributed to the novelty of this field and also because companies are protective about their technological knowhow. Collaboration and sharing of know-how could be very beneficial in improving access. For instance, information about the specific technology used in the initiatives that are being carried out in different cities could be of use to others who may want to replicate their actions. It is evident that information sharing is important to ensure success for smart sustainable cities. Stakeholders working together and sharing information will lead to better decision making in the long run.

* **Low levels of citizen engagement and participation**

Citizens' participation in the development of municipal projects is critical for urban development. As core users of city services, it is important that city planning strategies include the vision and expectations of the citizenry. ICT technologies such as mobile applications or social media tools can be very helpful to enable citizen engagement and participation. According to the Eurocities Initiatives Report “Citizen participation: paving the path to new city politics”, citizens' participation improves city management, promotes social cohesion and reinforces political engagement. The integration of the perspective and opinions of city residents into local policies can support the adaptation of city services to their daily needs.[[11]](#footnote-11)

* **Scarcity of natural resources**

Cities are facing serious environmental challenges related to issues such as energy, water, air quality, sanitation, waste management and other city management activities. According to the KPMG report "Expect the Unexpected: Building business value in a changing world", cities will require extensive improvements in infrastructure including basic city services to manage efficiently scarce resources in cities.[[12]](#footnote-12) This resource constraint has brought into focus the need to be more sustainable in all aspects of human living and has been precisely one of the triggers of the transformation to SSC. Rising energy prices, energy security, depleting energy sources and global warming caused due to the impact of energy usage have made energy management one of the key challenges to smart and sustainable cities.

Cities stakeholders demand different type of resources; therefore it is important that decision makers and citizens should understand that resources are limited. In this respect, ICT can play a crucial role in developing services for the efficient management of waste, water and energy in cities, for example with smart buildings, smart water management systems and smart grid technologies.

* **Environmental management challenges**

Cities face several environmental management challenges due to its economic activities, urban expansion patterns and citizens' consumption habits. At present cities are responsible for the management of the environmental quality of the city (air, soil and water) and its pollution control. Cities must provide services such as urban waste management or transportation. With increasing urbanization, cities are enduring various challenges to secure financially sustainable water and sanitation services for it citizens.[[13]](#footnote-13)

The growing demand of goods and services in cities, generate an ecosystem in which economic and industrial activities are carried out. If not controlled effectively, these generate environmental risks especially with reference to potential pollution sources such chemicals, hazardous waste generation, emissions, among others. Controlling and managing these environmental problems is the responsibility of city administration. In this context, any process or solutions that can be improved by ICT based smart sustainable cities solutions should be considered to improve a city`s environmental quality.

* **Climate change challenges**

The role of cities has been increasingly recognized as being key in the implementation of policies and programs to tackle climate change impacts. In the future cities may need to become much more resource efficient and resilient in the face of extreme weather events and other threats. As experts have pointed out, "natural hazards linked to climate change have increased in intensity and frequency… rising sea level, floods, heat waves, and storms are projected to continue to be worsen."[[14]](#footnote-14) Scientists project that the adverse effects may include more floods, windstorms, forest fires, and the melting of permafrost that holds about 1,700 gigatons of carbon.[[15]](#footnote-15)At present, most of the cities of the world are called upon to develop their climate actions plans with a long-term planning vision. These plans usually include mitigation and adaptation policies together with an innovative approach to technologies and financing mechanisms.[[16]](#footnote-16)

Given that land use, buildings, electricity production, industrial energy use, transport, or waste management generate over 90% of GHG emissions sources in cities.[[17]](#footnote-17) Cities face climate change mitigation challenges, particularly to minimize emissions or to optimize services that produce GHG emissions on a local level. At present, existing technologies for climate change mitigation in cities still require major technological shifts, new investments and integrated planning.

From a climate adaptation point of view, cities are the territorial areas of the planet that are the most vulnerable to the impacts of climate change. These specific impacts differ among countries, regions and cities, and can vary from an increase in extreme weather events and flooding, to hotter temperatures in particular locations, negatively affecting social welfare in cities. Floods for example, are impacting major industrial activities or are exacerbating the conditions of poverty for inhabitants of vulnerable areas. [[18]](#footnote-18)

At the same time cities face challenges in implementing climate change mitigation and adaptation policies. However, these challenges can turn into opportunities as cities provide the optimal scenario to lead and foster the use of ICTs for climate change mitigation and adaptation. In this respect, cities will need to invest today to reduce costs to adapt and transform their infrastructure in the future in order to be able to optimize city services. Cities need low-carbon services. Smart technologies supported by ICTs can help achieve these goals (e.g. smart building or smart transport solutions). From an adaptation point of view, the role of ICT infrastructure and services are critical for climate adaptation planning, as well as for the implementation of disaster risk management programs.

Cities that are in the process of becoming smart and sustainable, have a huge opportunity to include in their climate change actions plans, ICT infrastructure and ICT solutions to improve efficiency of their city services. As the intensity of urbanization is expected to increase, most of the urban infrastructure that will exist in 40–50 years has not yet been built. Therefore cities are called on to plan a long term strategy with ICTs in mind that may avoid locking themselves in costly, high-emitting and non-climate resilient infrastructures.

* **Shortage of SSC expertise**

In order to succeed in the implementation of smarter and more sustainable cities, expert professionals in this specific field are needed. This refers to urban planners, technologists, economists, among other types of professionals, who must be prepared to deal with the challenges of the new urban landscape. Apart from being experts on their specific field they should have a general awareness of all the other aspects that define and shape cities. More importantly, this transversal knowledge has to enable them to have a holistic and integrated view of the SSC framework. In this scenario, an urban planner or an environmental expert would also have general knowledge about the capabilities and functioning of the Internet of Things (IoT) applied to cities, and the ICT infrastructure that is needed for that and can therefore have a holistic vision of the SSC.

* **Growing inequality**

The World Economic Forum on its Outlook on the Global Agenda 2014[[19]](#footnote-19), ranked widening income disparities as the second most significant global trend. A recent study by Oxfam suggest that "seven out of ten people live in countries where economic inequality has increased in the last 30 years" and "almost half of the world's wealth is now owned by just one per cent of the population."[[20]](#footnote-20) Since SSC strive for social sustainability is therefore important that the projects developed include all the levels of society.

The range and nature of the multiple challenges that are faced by SSC evidence the need to gain a more in-depth understanding of the stakeholders that play a role in the operation of SSC, that can help overcome obstacles and take advantage of opportunities towards the realization of smart and sustainable city goals.

Having explored the different challenges that cities face, it is important to realize the multi-stakeholder nature of SSC. Accordingly, the next section will propose a methodology to facilitate the identification of these stakeholders, as well as their inclusion into SSC strategies.

2 Methodology for SSC stakeholder identification and engagement

In this report a stakeholder is defined as any entity, an institution or an individual, that has an interest in smart sustainable cities. A stakeholder may also be an entity/institution/individual that can significantly influence or be influenced by its deployment. [[21]](#footnote-21)

Stakeholder engagement may be viewed as a technique of enhancing the (i) relevance, (ii) responsiveness (iii) accountability (iv) transparency (v) inclusiveness (vi) legitimacy (vii) effectiveness (viii) efficiency (ix) equitability of the decision making process. Keeping in mind the aforementioned aspects, if the stakeholder identification and participation are carried out properly, good participation can itself make a significant contribution to the governance. This is based on the assumption that policymaking conducted in an interactive way would build on stakeholder knowledge and this process of policy making would be more contextual, reliable and easy to implement. [[22]](#footnote-22) Based on this, the methodology for stakeholder analysis for SSC has been elaborated in this Technical Report.

The methodology for stakeholder analysis that has been followed in this report is an adaptation of the principles proposed by the Logical Framework Approach (LFA).[[23]](#footnote-23) The methodological approach proposed is general in scope, and aims at obtaining a broad classification of the stakeholders involved in a city that wants to become smart and sustainable. This method can be adapted by a particular city to identify and analyse the stakeholders that play a role at the local level.

The steps proposed are summarized in Figure 1 and further developed during this chapter.

Figure 1 – Steps involved in the analysis of SSC stakeholders

Adapted from World Bank and LFA approach.

2.1 Identification of all stakeholders involved in SSC

In this first stage, all stakeholders which may be affected or which can affect the deployment of the SSC model are identified. The following steps were carried out in order to compile the list of key SSC stakeholders:

* Initial list derived from the definition: agents that are interested, affected or that have power to influence SSC.
* Validation of the list based on a general classification of stakeholders.
* Validation of the list with stakeholders that appear on the different reports from the FG-SSC.
* Validation of the list with stakeholders that appear on the literature used for this report.

Based on those steps, the following non-exhaustive list of SSC stakeholders has been compiled (in no particular order):

a. **Municipalities, City Council and city administration:** They are responsible for city management, and therefore they are the main promoters of SSC initiatives on each specific city.

b. **National and regional governments:** They have remit on policies that can affect SSC implementation.

c. **City services companies:** Would be implementing SSC solutions to increase city services efficiency.

d. **Utility providers:** They are responsible for the deployment of some of the features of SSC such as smart grid or smart water management.

e. **ICT Companies** (Telecom Operators, Start-ups, Software Companies): Are the providers of the global and integrated solutions, the city platforms, as well as the ICT infrastructure to support SSC deployment.

f. **NGOs:** These are involved in all initiatives that can influence society and therefore are considered a stakeholder in SSC, especially on the axis of social sustainability.

g. **International, Regional and Multilateral Organizations:** They include UN agencies and multilateral organizations. They can be promoters of initiatives towards human development, environmental sustainability and improvement of quality of life worldwide. They can offer funding opportunities, and are promoters of SSC initiatives.

h. **Industry associations:** Since industries are interested in the deployment of SSC, industry associations also work towards the success of this new model.

i. **Academia, research organizations and specialized bodies.** They study SSC and associated trends, including its impacts and contributions to sustainable development.

j. **Citizens and citizen organizations:** As inhabitants of cities, citizens are affected both directly and indirectly by SSC deployment.

k. **Urban Planners:** their expertise is important to better understand how to include ICTs into medium and long term city planning, as well as to consider urban complexities.

l. **Standardization bodies:** These organizationsare critical to ensure a common terminology and minimum characteristics of a SSC, as well as to define measurement methods to assess the performance and sustainability of city services based on ICT technologies.

The roles and responsibilities of each of these stakeholders will be further explained in section 4.

2.2 Categorization of stakeholders

The stakeholders included in the list are then categorized according to two different criteria:

a) According to their **role and participation in a project or projects related to SSC**. This classification is based on the LFA methodology, as follows:

– **Active:** This refers to all the actors that have the resources and the power to influence the initiative. In this report all stakeholders have been classified as active because potentially any of them can influence the SSC agenda. When making this classification at the local level this list is usually shorter since not all the actors who potentially could, will have the resources and power to do so.

– **Beneficiaries:** These are the stakeholders that will directly benefit from the deployment of SSC.

– **Affected:** This category includes all actors that will be somehow affected by the deployment of SSC. They can be further divided in potential supporters, and potential opponents.

b) According to their role as drivers or enablers of SSC processes and solutions.

– **Enablers of technology**: They provide the technology and/or the technological solutions.

– **Drivers of technology**: These are the stakeholders that incorporate technology and SSC solutions into their processes, for example in city services provision processes.

– **Enablers of the SSC**: They facilitate the technical & policy framework needed for SSC by collaborating to some extent into concepts and KPIs definition, infrastructure development, standardization, etc.

Figure 2 illustrates a classification of SSC stakeholders at a general level, based on the categories explained above. It is relevant to note that, given the specific context and set of stakeholders that operate in a particular city, the implementation of this method will slightly differ from one city to another.



Figure 2 – Example of SSC stakeholder classification.

Adapted from the LFA Methodology.

This stakeholder mapping exercise will provide cities with an initial framework to identify the stakeholders that will take part of their transformation into smart sustainable cities. It is intended to be a tool to facilitate the coordination activities needed to implement SSC policies and projects. As mentioned before, the stakeholder identification has to be city-specific.

3 Detailed analysis of selected stakeholders

3.1 An analysis of selected stakeholders

This is one of the most important phases of the stakeholder's identification process for SSC, because it establishes a methodological approach to analyse the role and potential contribution implications that one stakeholder may have on a city. This analysis can been done considering two approaches, described as follows:

a. By identifying their individual characteristics and their potential contribution expected implications for the project, which can be illustrated in a matrix of stakeholders containing the following dimensions:

‒ **Scale and Sector**: The scale at which the stakeholder operates (e.g., local or supra-local scale); and, when relevant, the sector in which they operate (e.g., public or private sector).

‒ **Aims and Challenges**: The aims refer to the key objectives or advantages they seek from their involvement in SSC strategies, while challenges refer to the problems, unsatisfied needs or concerns they might have.

‒ **Potential and Constraints**: Potential refer to issues such as stakeholders' resource endowment, knowledge, experience and know-how. Constraints refer to issues that limit the realization of their role within SSC, including lack of coordination, lack of expertise, limited financial resources, among others

‒ **Role and Contributions**: This refers to the role of the stakeholder with respect to SSC's goals, and the contributions towards their achievement.

A summary table that illustrates this classification has been included as part of the reports' conclusions in Annex 1.

b. The graph below provides an overview of the stakeholders involved in SSCs, and how they relate with each other.



Figure 3 – Example of SSC stakeholder's (interaction) map

Both analyses should be developed together in order to better understand stakeholders roles and relationships. The next section of this report provides an analysis of these dimensions per SSC stakeholder.

3.2 Analysis of stakeholder engagement progress

After selection of the potential stakeholders for SSC, it is essential that the engagement progress is also mapped carefully to avoid pitfalls. Perils that may impede SSC progress may include the following:

* As the identified stakeholder reflect various power structures within a city, some of the stakeholders may wield more power (monetary as well as administrative) than others. For example. The business and industry group tend to more well-funded and influential and may overpower the influence of other groups and prioritize their own interests. Care needs to be taken to maintain a balance between competing interests.
* Potential SSC stakeholder engagement comes at a price- the process described in this report of SSC stakeholder engagement could become bureaucratic, labour intensive and may never be perfect or completely inclusive. As such care need to be taken to ensure that the process may needs to be reviewed, updated and monitored continuously.
* Stakeholder process may even become “exclusive” and privileged groups and the large number of social segments and rights holders who are organized within a formalized group may be excluded from the process of SSC establishments.[[24]](#footnote-24)

To promote effective stakeholder engagement, there are common guiding principles for effective stakeholder engagement that facilitate this process:

* The consultative process should recognize diversity of stakeholder and must include a wide range of relevant stakeholders at national, sub-national and local levels
* These consultations must be conducted with transparency in mind along with timely access to required information. The relevant stakeholders should have prior access to the information before the consultative process starts.
* Consultations should be conducted with the aim of building consensus and should facilitate dialogue and exchange of information
* Impartial, accessible and fair mechanisms for grievance, conflict resolution must be established before the consultative process.[[25]](#footnote-25)

3.2.1 Core values of stakeholder participation

Given the apparent pitfalls of the stakeholder engagement progress, it also is essential to outline the core values of principles to be followed during stakeholder participation. These core values include:

* All the identified stakeholders should be allowed to a stand on all decisions about SSC based actions that could affect the life of the inhabitants.
* The contribution of each stakeholder will in principle be heard and will influence the final decision
* Stakeholder participation should include communication and recognizing the needs and interests of all participants including the decision makers themselves.
* Stakeholder participation would provide the participants with the required information needed to contribute to the policymaking process in a meaningful way.
* Stakeholder participation seeks out and facilitates the involvement of actors either likely to be affected by the decision making process or those actors interested in contributing to the process.
* Stakeholder participation would also include communicating to the participant how their input affected the final decision making process.[[26]](#footnote-26)

4 Stakeholders' roles in SSC

This section explores in further detail each of the SSC stakeholders, including a brief definition of, and an outline of the roles they are meant to take.

4.1 Municipalities, city council and city administration

Municipalities are the basis for SSC management, and are at the core of the SSC framework. Municipalities and its departments must be the body that coordinate all the system within an integrated technological platform. Municipalities are constantly involved in development strategies and will hence play a pivotal role in SSC initiatives. They would also serve as a convenient contact point for the inhabitants regarding SSC establishment.

Municipalities have to deal with the everyday problems and demands of citizens and the challenges of city management. Shrinking municipal budgets on one side, and the need to reach national and international targets of reduction of emissions on the other, are pushing municipalities to become more sustainable, both environmentally and economically. Additionally, the growing demand of the voters for transparency and citizen participation in municipal issues triggers the development of more socially sustainable cities.

As the main promoters on the idea of becoming a SSC[[27]](#footnote-27), municipalities have the responsibility to decide which path to follow, from the long-term roadmap to the specific solutions to implement. There is not a unique path, so each city can choose theirs depending on the qualities of the city, its state of affairs, strengths and opportunities available. It is important that they do so thinking on the long run, with a holistic approach, transparency and the citizen interests at its core.

One way to increase efficiency in city services is to evaluate them through objective indicators agreed between the municipality and the service provider. To achieve this there has to be a change from the tendering model that is currently based on assets to a model based on Key Performance Indicators (KPIs). As the main consumers of solutions, municipalities are ideally placed to lead this change to KPIs-based public tender offers. For the model to work, municipalities should act as the examiner on the performance of the services, starting by choosing what KPIs will apply, what values have to be achieved and under what conditions and continuing with periodical evaluations. Otherwise, the city service companies would be acting as judge and judged on their own evaluation.

Another important responsibility this stakeholder has is to engage public participation and include the citizen on any SSC initiative. As it will be seen later, citizen engagement is pertinent to many urban projects and even more importantly, the final objective of SSC is to enhance the satisfaction and the quality of life of the citizenry. Most SSC projects entail benefits for the population at several levels, but often these benefits are not perceived by the citizens. Consequently, it is recommended that municipalities conduct efforts to communicate the decisions taken, as well as the advantages and consequences these entail.

Regarding public participation, the city administration has to ensure that all the population is informed and has the means needed to take part on the programs and initiatives being carried out.

Another important aspect in this area is the accessibility to public data by the citizenry. An "Open Data" platform where the citizen can access all public data, except confidential or critical, is primordial in any SSC to ensure transparency and will also act as a catalyser for innovation and business generation.

One of the keys for the success of SSC strategies is that they must have a holistic vision, so all departments of the city administration must be involved at some level on the project. Collaboration among them is also critical for a successful SSC implementation. This is not an easy task, due to traditional governance models and separation of powers that divide city functions into separate independent departments with little interaction[[28]](#footnote-28), which compromises the efficiency and hinders the synergies that can emerge with new services for the city.

It is expected that some departments would have a stronger role to play in leading the city's transformation to a more sustainable and smart model. Some of these key departments have been identified in Table 1, including examples of possible collaborations between them. Since city departments are organized differently across cities, some of the departments listed below may be named differently, or may be grouped together with others.[[29]](#footnote-29)

Table 1 – Examples of the role of different municipal units/divisions in SSCs

|  |
| --- |
| **• Urban planning unit** |
| The urban planning unit has many responsibilities regarding the implementation of SSC. Since it has the mandate to manage the territorial setting of the city and establish the respective use of the land, this unit is one of the most important when SSC projects are to be implemented at a city level. It is important that they consider the ICT infrastructure as part of their long term city planning. Due to its integrative capacities and transversality, this unit should be the one that manages the city platform that integrates the different city services, as well as the data gathering and analysis of the city.This unit should also work towards the spread of more efficient, safe and smart buildings, facilities and businesses across the cities. Finally, it is an ideally placed unit to implement public participation programs where citizens can contribute to the design and planning of the city. This can be done, for instance, in the case of rebuilding a square, modifying a street, finding a new use for a public owned building or simply proposing changes in planning or design that the city needs. |
| **•** **Security and emergency services unit** |
| The main role for this unit within the SSC model is to implement solutions that increase the city's resilience. To do this is recommended that ICT technologies are included in their planning and response activities. This will mean an increase of information, especially real-time information, that will enable this unit to better anticipate risk situations, and if they take place, to have a quicker reaction to limit their financial, environmental and human costs, as well as speed up restoration of normal living conditions. This unit has to be prepared to coordinate the other units in case of an emergency, especially with the health, infrastructure, transportation and citizen services units.  |
| **• Citizen services unit**  |
| This is the unit that is responsible for informing the citizens and increasing their participation and involvement within the municipality. In this sense, this unit should include new ICT based services in their technology roadmap, to promote efficiencies and cost savings on a city level. This unit will have to be in touch with all the others in order to report to the citizens on the projects that are being carried out in the city. |
| **• Unit dealing with infrastructure and ICTs**  |
| The deployment of SSC requires significant new infrastructure, especially technological such as communications networks or the addition of smart meters on the existing water and energy infrastructures. This unit will have a very important role on integrating the different city systems and technologies based on a holistic ICT-based management approach. |
| **• Environmental unit** |
| In line with the focus of SSCs, this unit must promote, coordinate and evaluate the actions taken by other units to achieve the environmentally conscious and efficient use of scarce resources at the city level. ICT technologies will help to optimize resource management. For example, it can collaborate with the transportation unit in smart transport programs such as the regulation of the access to the city by car depending on the pollution values measured in real-time. With the cooperation of the housing unit, they can also lead campaigns to promote efficiency in buildings through smart buildings, or measure the improvements that are achieved as well as cooperating in the deployment of new ICT-based environmental quality sensors in green areas within the city like parks or green corridors. SSC technologies should be considered as part of the technology alternatives in climate change action plans. |
| **• Transportation unit** |
| Mobility is one of the most important issues that cities have to tackle. Many of the projects implemented in SSC are related to this unit. The objective of this unit must be to build a smart transportation network that meets the requirements of the population maximizing the efficiency and comfort and minimizing the environmental impact.  |
| **• Financial unit** |
| This is a very transversal unit. Considering that municipal treasuries must face heavy financial burdens, the units of finance have to evolve to more innovative business models and make partnerships with private enterprises, based on sustainability performance KPIs. Innovations can be also made regarding collection of taxes, increasing the level of personalization of the due amount to pay in order to achieve behaviour changes in the population. ICTs can become a great tool to improve efficiency in financial processes on a city level. New SSC projects must impact the financial performance of the municipalities on a positive way. |
| **• Legal affairs unit**  |
| This unit is responsible for establishing the legal and operational framework needed to guarantee the new city services development. In this sense, it is very important that these legal units understand the new vision that smart sustainable cities must have.  |
| **• Water & sanitation management unit** |
| Some municipalities have this unit, and some others delegate this function directly to a service company. The function of managing water resources and sewage system of a city is a challenging task. Cities are experiencing a growing stress in relation to the water resources and a proper and effective use of ICT can help deal with this issue in a sustainable manner. It is therefore a responsibility of this unit to implement smart and sustainable management of the water resources that guarantees access to water and sanitation services to current and future city dwellers. |
| **• CERT/CSIRT unit** |
| The role of the Computer Emergency Response Team (CERT) or the Computer Security Incident Response Team (CSIRT) is to provide services and support for preventing, handling and responding to computer security incidents. To do so, it is key that this unit acts as a central trusted point of contact for cyber security incident reporting and for general security issues. This unit should also build expertise in information security, incident management and computer forensics as well as enhancing information security awareness.Other functions this unit can also develop are to assist in improving the cyber security law, disseminating information about threats, vulnerabilities, and cyber security incidents and coordinating with other domestic and international CERT/CSIRTs and related organizations as well as sharing information and lessons learned with them.For more information, please see Annex 2.  |

Finally, municipalities can make alliances with others to share knowledge and good practices. Examples of this are the Covenant of Mayors and Energy Cities, the mainstream European movement involving local and regional authorities, voluntarily committing to increasing energy efficiency and use of renewable energy sources on their territories.[[30]](#footnote-30) Energy Cities is the European Association of local authorities in energy transition. It was created in 1990 and represents now more than 1,000 towns and cities in 30 countries.[[31]](#footnote-31)

4.2 National and regional governments

National and regional governments have remit on many issues and policies that affect cities and therefore are considered a SSC stakeholder. For instance, policies related to deployment of new infrastructure such as optic fibers or mobile connectivity, or related to subjects like health or education that without being specific to cities are also included in the SSC; usually belong to the national government. Similarly, much of the information that can be made available to the citizens through the open data platforms belongs to the central administration.

In order to drive the transition to SSC, national governments should define legal frameworks that enable the implementation of many of the smart sustainable cities features. For example in China, the National Development and Reform Commission (NDRC), designs the macro policies of national economic and social development. In order to build SSC, NDRC also leads the strategy planning for smart cities, coordinating with dozens of units of central government. Another clear example can be found in Spain, where the policies that regulate low-voltage distribution in multi-family blocks prevents the installation of electric vehicle charging points in communal parking areas. A modification to this policy that includes a solution to this issue will be essential to allow the widespread adoption of electric vehicles on a city level.

Discussions have begun about on the application of the principles behind SSC to regions, either to analyse urban regions around a big city, or agglomerations of small towns. In the first case, it is about coordinating the urban area as a whole since usually many people from the surrounding areas work at the city centre and there is a lot of mobility around the entire urban area. In the second case, the idea is to generate efficiency by creating collaborations between the towns and villages in an area. For instance, if they want to provide a service that would not be cost-effective for a town of their size, they can provide it together and benefit from economies of scale. In these cases, regional governments can have a leading role helping the mayors of the municipalities involved, and acting as coordinators of these clusters, and as promoters of the initiatives.

As in the case of municipalities, it is also interesting to analyse the different units or ministries involved, as illustrated in Table 2. As in the case of city units, government units or ministries are not the same in all countries, so the names used in the examples may differ in some cases.

Table 2 – Examples of the role of different national Ministries and units in SSCs

|  |
| --- |
| **• Ministry of Infrastructure, Industry and Information Technology**  |
| This is the ministry that has to fulfil the challenge of creating or modifying the policies related to infrastructure deployment and therefore can be decisive in the development of SSC. Issues regarding Electromagnetic Field (EMF) planning considerations on a national level must be transmitted by this unit to local governments and their particular units dealing with this issue.  |
| **• Ministry of Science and Technology** |
| This is the ministry that launches or should promote the research of SSC within the high technology research programmes. |
| **• Ministry of Environment**  |
| Similarly to the municipal unit, the Ministry of Environment must work transversally to ensure that actions are taken across the other ministries towards a more sustainable country, considering and integrating the role of ICTs. They should also be involved in monitoring and measuring the current state as well as the improvements achieved. This ministry also organizes awareness campaigns to encourage sustainable habits, sometimes together with other ministries like the transportation or energy ministries. Climate change units must also work on the inclusion of ICTs into national and local climate change programs. |
| **• Ministry of Energy** |
| Even if there are examples of cities deploying first pilot projects of the so-called smart grids, the electrical grid, faring system and policies, is still remit of the central government. Therefore the support of the Ministry of Energy is needed for the deployment of smart grids at the national level. The same can apply regarding other energy systems such as the natural gas network with the deployment of smart meters. This ministry should develop policies that promote and regulate the upgrade of the energy networks to become smarter and more efficient. |
| **• Health Unit** |
| The health unit can benefit from the features developed in the frame of the SSC in order to provide a better service to the patients or service users, and at the same time, increasing its efficiency. There are the technological solutions that can be comprised in the term "e-Health". This includes solutions such as telemedicine, healthcare information systems or health apps on smartphones to name a few. At the same time, the health unit can benefit from applying the concept of cooperation that is intrinsic in SSC initiatives. For instance, it can be synchronized with the emergency units both to react quickly to an emergency that will need medical resources, and/or alert emergency services in case of a pandemic.  |
| **• Ministry of Education** |
| Similarly to the health unit, the Ministry of Education can take advantage of technological solutions to improve its services. This includes e-learning which can be useful for children that cannot attend school or to make long life learning more accessible to adults, among others. |
| **• Transportation Unit or Ministry** |
| Although urban mobility is usually remit of the municipal government of each city, regional or national governments are entrusted with ensuring good connectivity between cities and towns as well as international destinations. Thus, multiple units will have to get together and collaborate in order to cover the transportation-related requirements of SSC. |
| **• Ministry of Public Security** |
| The Ministry of Public Security (MPS) is the principal police and security authority, as well as the [government](http://en.wikipedia.org/wiki/Government_of_the_People%27s_Republic_of_China) agency that exercises oversight and is ultimately responsible for day-to-day law enforcement. The Ministry operates the system of [Public Security Bureaus](http://en.wikipedia.org/wiki/Public_Security_Bureau), which are broadly the equivalent of police forces or police stations. The MPS must work transversally to ensure the safety and security of the cities, as well as emergency responses that rely on the wide usage of ICTs. |

Adapted from the author's analysis and reviewed contributions.

4.3 City services companies

Among the companies that provide services for the SSC, it is possible to identify two main groups. The first are the traditional providers of city services, such as water management, waste collection or transportation, which should add new functionalities to become more efficient and smart. This first group is usually contracted by the municipality. The second group are the new companies that specialize in SSC and provide new services derived from SSC such as (but not limited to) mobile applications, sensor deployment or software for fleet management. The companies in this second group, depending on the services they offer, can either be contracted by the municipality or offer their services directly to the citizens. In most cases, these companies are the ones that provide the equipment and deploy the sensors.

To help on the implementation of SSC, city service companies must learn to work with KPI based business models and work together with municipalities in this transition. As a result, these companies will have to increase the efficiency of their solutions, as their performance will be quantified and evaluated. This will increase competitiveness of the service companies.

When creating their vertical solutions, city services companies should try to build these solutions in a way that they can adapt to standard transversal platforms, so that information from all the services can be accessed and disseminated.

A difficulty that can be encountered in some cases, especially in companies that belong to the first group, is the lack of expertise or capacity to integrate ICTs on their processes since the "know-how" of these companies is usually focused on the specific service they provide. At the same time, these companies are used to work independently in their vertical solution and the change to a more collaborative and interdependent model of service provision is not always easy.

4.4 Utility providers

Utility providers offer services, such as electricity and gas, directly to the citizen. They usually integrate production, distribution and commercialization aspects, which provide them with expertise in all the different links of the value chain.

They are responsible for the deployment of smart grids, smart metering systems and deployment of charging points for electrical vehicles, and therefore, their involvement in SSC initiatives is essential for their success.

Utility providers cover extensive parts of the city’s territory. For this reason, the upgrade of their systems and the inclusion of ICT in their infrastructures implies a massive rollout and requires a considerable investment. One of the problems that they face nowadays is the morphology of the demand curve, which has peak and valley hours with very different consumption values. In the case of the electricity providers is complex to adapt to this curve, which is one of the issues that constraints the development and implementation of renewable energies. With the implementation of ICT based solutions, a smarter and sustainable network could flatten the demand curve and also increase the predictability of the demand.

4.5 ICT companies (e.g., telecom operators, start-ups, software companies)

The main role of ICT companies is to provide the ICT infrastructure and solutions that will support and integrate the services of SCC. It is important that these technological solutions are global and standard in nature, so that different vertical solutions can be easily integrated throughout the SSC.

Due to the diversification they have experienced, Telecom operators, for example, can provide experience and expertise on the development of the platforms needed to integrate SSC services, as well as on the services themselves[[32]](#footnote-32). Because of their transversal nature, these platforms can encourage cooperation between services, and enable the creation of efficiencies. In order to drive the change towards SCC, ICT companies have to develop new financially sustainable business models that guarantee the implementation of smart solutions.

They also have to keep researching and innovating in order to provide even better technical solutions. In this regard, big Telecom operators or mature software companies which are usually more financially stable, could redirect more resources toward the R&D budget, and act as important actors in the SSC implementation phase.

New and innovative ICT companies and start-ups can also provide also particular solutions to smart sustainable cities challenges. Local companies can understand in a better way city operation and have proximity with citizens.

It should also be acknowledged that the ICT companies' compliance with standards plays a key role in the achievement of compatibility, replicability and scalability of the SSC solutions implemented in different cities.

4.6 Non – governmental organizations (NGOs)

One of the aims of SSC is to increase social sustainability. NGOs, with their expertise on social inclusiveness and equity, are a key asset to achieve this goal. One of their roles should be to raise awareness on the concerns of the population, especially in regards to challenges left unattended or that affect the weakest sectors of the society. As they already do regarding other issues, NGOs would be ensuring that all society is and feels included in new SSC strategies. NGOs can also benefit from the solutions and the technology adopted by the SSC in order to widen their scope, improve their services, reach out to broader audiences, and thus expand their impact.

4.7 International, regional and multilateral organizations

There are different ways in which international, regional and multilateral organizations can help move forward SSC initiatives. They include UN agencies with specialized mandates in various fields that contribute to the implementation of SSC models. Examples include (but not limited to) ITU, UNESCO, UNEP, UNDP, UNFCCC and UN Habitat. They can be promoters of initiatives towards human development, environmental sustainability and improvement of quality of life worldwide. They can provide funds, though their raising awareness and technical assistance programs, to help kick-starting SSC projects.

An example of a multilateral program that fulfils these two objectives is the "City energy Efficiency transformation initiative" a three-year technical assistance program with an initial budget of US$9 million. This program is led by the World Bank's Energy Sector Management Assistance Program (ESMAP).[[33]](#footnote-33) It provides technical assistance to city governments in developing countries to integrate energy efficiency into the core of city planning through programs that build their capacity, map out citywide efficiency strategies, and facilitate access to development financing.

Another example of an international and multilateral technical assistance program is the "Emerging and Sustainable Cities Initiative (ESCI)", a program by the Inter-American Development Bank (IDB) that helps intermediate cities in Latin America and the Caribbean in identifying prioritizing and structuring projects to improve their environmental, urban and fiscal sustainability.[[34]](#footnote-34) This program provides emerging cities with a set of tools to identify key bottlenecks that they may face in their path towards sustainability, to weigh and prioritize the identified problems to guide investment decisions in the sectors that may generate more positive impacts and to find specific and adequate solutions according to a cost-benefit analysis.

Lastly, by creating knowledge exchange platforms, these organisations can drive collaboration between stakeholders, and promote the replication of successful initiatives. An example of that is the Smart Cities Stakeholders Platform created by the European Commission or the ITU’s Focus Group on Smart Sustainable Cities.[[35]](#footnote-35)

4.8 Industry associations

This category includes some industry associations from the ICT and electrical sectors. Many of these industry associations work to promote the deployment of SSC with the objective of extending this new market.

A clear example of this is the Asociación Iberoamericana de Centros de Investigación y Empresas de Telecomunicaciones (AHCIET)[[36]](#footnote-36), the main organizer of the Ibero-American Meeting of Digital Cities (In Spanish, Encuentro Iberoamericano de Ciudades Digitales).[[37]](#footnote-37)

Another example is China's Strategic Alliance of Smart City Industrial Technology Innovation, founded in 2012 under the guidance of the Ministry of Science of Technology (MOST). The alliance is a non-profit organization with 68 members from enterprises, government institutions and academia. Through the study of common technologies of smart cities, the alliance aims to innovate on the standardization and on dedicated technologies, in order to apply them in pilot smart cities and projects. It is also very active in international collaboration on behalf of MOST.[[38]](#footnote-38)

Another example can be found with the GSM Association (GSMA), an international association of mobile operators and related companies that has created the GSMA Smart Cities initiative focused on accelerating the adoption of mobile based solutions and services.[[39]](#footnote-39)

The Institute of Electrical and Electronics Engineers (IEEE) also aims to assist municipalities in the correct use of technology and to raise awareness of the benefits of its deployment to overcome the challenges presented by urban population growth. Towards that aim, they have created the IEEE Urbanization Challenge[[40]](#footnote-40), an initiative that brings to selected cities assistance and advice from experts, workshops, education resources (including support for Masters and PhD students), the organization of an international conference on smart cities, and a knowledge repository. The initiative selects a city per continent each year. The requisites includes the existence of an strategic plan and availability of funding, willingness of the administration to share the experience during the process, existence of a local section of IEEE and of a university interested in the field of smart cities. The first city to be included to the program was Guadalajara (Mexico).

There are also associations of companies that cluster companies from different sectors. This is the case of the Smart Cities Council, which defines itself as an advisor and market accelerator that promotes the move to smart, sustainable cities with the objective of contributing to its partners' business success.[[41]](#footnote-41)

4.9 Academia, research organizations and specialized bodies

The academia is a crucial piece on the SSC landscape, and has many roles to play. It has to educate a new wave of city professionals: urban planners, technologists and economists that are prepared to deal with the challenges of the new urban landscape. This has already started to occur; as different universities around the world are launching specific post-graduate programs aimed at creating professionals specialized in this field. The University of Girona (Spain)[[42]](#footnote-42) has been a pioneer in this regard, followed by others such as the University of Madrid[[43]](#footnote-43) and the University of London[[44]](#footnote-44), who are launching their own programs.

Research organizations also have a role to play by participating in the on-going conversation on how to better drive cities to the smart and sustainable model, and it must have a voice on the standardization processes.

Building on documented experienced and conceptualizations, the academia and research organizations can even make a science of cities. For example, researchers at the Santa Fe Institute are already doing so through a research initiative titled Cities, Scaling and Sustainability, aimed at developing theoretical insights about that can inform quantitative analyses of the cities' long-term sustainability.[[45]](#footnote-45) There are also universities that have created labs specially focused on this subject, like the Senseable Cities Lab from MIT[[46]](#footnote-46) and the Smart city Lab from the University of Bologna.[[47]](#footnote-47)

Universities, associated labs and research parks, can be very helpful in the development of SSC models by driving research and creating innovation. Research in other fields, not specifically focused in cities, such as mathematics, data mining, analytics, economics, and computer vision, among others, can help develop useful solutions and tools for SSC.

Specialized bodies such as consulting firms, with expertise on SSC projects are able to assess and propose new ideas for SSC. They are also able to assess the initial situation before a project takes place and define the baseline upon which the improvements can be measured. This is essential on any urban and SSC project, to be able to prove and quantify the improvements achieved. With their expertise in measuring methods and framework definition, these bodies can assist city managers and policy makers on the transition to this SSC new model.

Finally, through technology transfer programs and partnerships with the private sector, universities, research organizations & specialized bodies can also be a source of innovation for the private sector, and promote new business creation in the form of spin offs.

4.10 Citizens and citizen organizations

Citizens are the key to transform a digital city into a smart city.[[48]](#footnote-48) Citizens are the ultimate users of SSC services, covering the associated costs via taxes or, in some cases, via fees. Therefore, it is important that they are informed on the features and the benefits of each of those services, so they can value them. Without achieving this, citizens could perceive SSC projects as an unnecessary expenditure, rather than as a proper investment of their taxes.

The value of the citizens' role can be viewed from multiple perspectives: as a source of data, the concept of citizen as a sensor of local/real-time information, as a source of ideas through citizen participation mechanisms, as a receiver of information and as end users of city services.

We can find many examples of the citizen's as sources of data, including the use of ICT applications that, with the user permission, gather data from the sensors embedded in smartphones to identify issues such as the state of the road[[49]](#footnote-49), or that allow users to report incidents on the street.[[50]](#footnote-50) Data mining from social networks allows to predict events, or to learn the opinion of the population on key issues and even automated sensors to collect environmental parameters that anyone can install at home.[[51]](#footnote-51) There is a lot of innovation taking place in this field, with new applications and projects appearing every day and allowing citizens to contribute to make their cities more sustainable.

Citizen participation is key to enable a citizen-centred approach in cities. Technology can be of help to carry out mass opinion surveys and participatory processes, but it is important to ensure that everyone can participate. This can be achieved by providing means of participation to sectors of the population that may not have easy access to communication technologies like the elderly or economically constrained sections of the population.

Citizen as information receivers and users of services refer to information from the city such as real time traffic state, the public transport timetables and safety alerts, to name a few.

It is important to emphasize that the citizen is the final user of the city and the city services, and therefore, it is who will benefit from a shift towards a smarter, more sustainable urban model.

4.11 Urban planners

Urban planners develop plans and programs for the use of land in cities. Their plans help create communities, accommodate population growth, and revitalize physical facilities in towns, cities, counties, and metropolitan areas.[[52]](#footnote-52)

Urban planners are key actors for smart sustainable cities. In some instances, these stakeholders perceive smart city strategies with some degree of reluctance and scepticism due to the dominant role given to technology over other city dimensions. To most planners, the lack of understanding of city's complexities and dynamics may put into question, and even render useless large investments made on smart initiatives.[[53]](#footnote-53) In this sense it is important that urban planners participate actively in the design and implementation on smart sustainable city projects to foster a broader understanding of three basic characteristics of contemporary cities: complexity, diversity and uncertainty. A closer look at those three aspects may provide a clearer and more in-depth understanding of the cities' nature and identity, particularly to stakeholders that lack an urban background.

4.12 Standards Developing Organizations (SDOs)

SDOs are essential to the deployment of SSC as they can provide a standardized framework and a minimum set of characteristics to define and implement SSC. One of their priorities should be to develop a common terminology for all stakeholders to bring clarity and harmonization in this field.[[54]](#footnote-54)

In addition, the success of SSC implementation will depend on the definition of measurement methods to assess the performance, smartness and sustainability of city services based on ICT technologies.

There is a need to develop specific standards that can allow the various technologies involved in SSC to be able to interoperate.[[55]](#footnote-55)

ITU with its Focus Group on Smart sustainable Cities has developed a Technical Report which identify the standardization gaps for SSC.

Having identified the multiple stakeholders and the diverse roles that they play in SSCs, the following section provides a series of specific recommendations in order to ensure that these multiple views and contributions are effectively integrated as part of smart sustainable city strategies.

5 Conclusions

As described throughout this report, the identification of SSC stakeholders is a critical component in the design and implementation of SSC strategies and projects.

Cooperation between stakeholders is key for cities that want to become smart and sustainable. A thorough study of the characteristics and roles of the stakeholders can be useful to identify the relationships that exist among them, create useful synergies, and allow the integration of stakeholders' views on SSC projects and initiatives.

In order to successfully develop an analysis of SSC stakeholders in a given city, the following three steps should be considered:

 Step 1: Identification of all stakeholders involved. – It is very important to develop an initial list of stakeholders for a SSC project development. This list is not a closed list and can be updated.

 Step 2: Categorization of the stakeholders. – Is important to categorize stakeholders based on their interests and to identify all the relationships among them. It is advisable to develop a stakeholder diagram and a map of their relations and interactions so as to facilitate further analysis.

 Step 3: Detailed analysis of selected stakeholders and engagement. – This is the most important step of the process. In order to succeed, a detailed analysis of all stakeholders must be done. This is a reiterative process that can be repeated as new stakeholders emerge and new projects and initiatives are carried out in a SSC project or initiative. It is important to have a final summary table reflecting the stakeholders' aims, challenges, potentials and constraints, and especially their role and contribution to the SSC challenge (as reflected in Annex 1). This will set the basis for proper stakeholder’s engagement.

For a smart sustainable city initiative to succeed, it is important to identify all the stakeholders involved in order to guarantee its success and sustainability. Cities are complex systems with several stakeholders. In a smart sustainable city, stakeholders interact together to build a resilient city which is smart, sustainable and innovative. In addition, it must also be taken into account that cities from developed and developing countries differ in terms of their existing infrastructure as well as the multi-stakeholders' ability to implement ICTs within the city. In other words, what may be feasible for one city may be challenging for another.

It is imperative that a multi-stakeholder approach is applied to achieve the highest rate of success by working together as a team irrespective of the city they are based in.

Annex 1
Summary of Stakeholder Identification, categorization and analysis

| Stakeholder | Scale/sector | Aims and challenges | Potential and constraints | Role/contribution to SSC rollout |
| --- | --- | --- | --- | --- |
| Municipalities, City Council and city administration | LocalPublic | – Increase efficiency (energetic as well as economic).– Increase environmental sustainability– Aim to give the best service to citizens. | – Shrinking budgets.– Growing demand of the voters for transparency, citizen participation.– Pressure by local, national and international agreements and targets for sustainable development | – Expertise on city management.– In charge of city services provision. | – Lack of interdepartmental coordination.– Lack of professionals with specific knowledge on SSC.– Constrains in allocating budget. | – It is a strong driver of SSC.– Promote SSC initiatives and decide the roadmap to follow and specific solutions to be implemented.– Engage citizens and communicate them benefits of SSC.– Monitor city services: define KPIs and evaluate them.– To promote SSC services provision and integrated management. |
| National and regional governments | Supralocal Public | – Increase efficiency guarantee security of resources. (natural & economic resources).– Increase environmental sustainability of the country.– Aim to give the best service to all citizens; including and above all ICT technologies.  | – Growing demand of the voters for transparency, citizen participation. – Pressure by international agreements and targets for sustainable development and climate change. | – In charge of policies that can directly affect SSC deployment.– To promote the intensive use of ICTs facilitating technology development. | – Lack of coordination among ministries.– Lack of professionals with specific knowledge on SSC. | – Define policies and legal frameworks that enable SSC deployment.– Promoting and managing implementation of "smart regions".– To facilitate ICT technology development and competition. |
| City services companies | LocalPrivate | – Increase efficiency of their processes.– Provide a service with a greater added value (or a new service in some cases).– To grow their business and provide SSC solutions.  | – With their current functioning, city services will not be able to cover the future demand due to population growth.– City services are not efficient enough to fulfil the sustainability challenges cities are facing. | – Expertise on city services functioning, needs and characteristics. – Know-how on the service they provide and citizens' needs. | – Some of them do not have enough expertise and/or capacity to include ICT in their processes.– Some of them are used to work independently in vertical solutions, not cooperating with the rest of the services.– Some of them may require innovation transformations. | – Provide their expertise to collaborate with municipalities and ICT companies to develop integrated collaborative models.– Change towards "smart" and "KPI-based" city service models.– In some cases: create a new service that covers a new or an uncovered urban need. |
| Utility providers | SupralocalPrivate | – Increase efficiency of their processes. – Flatten the demand curve.– Increase the predictability of the consumer's needs.  | – Considerable resource losses (water, gas or energy) on their supply chains.– Challenges for massive deployment of new technologies, especially time & economic resources. | – Expertise in all the links of the value chain: production, distribution and commercialization | – Due to their size, the upgrade of their systems and the inclusion of ICT in their infrastructures could be a challenge. | – Responsible for the deployment of some SSC features: smart grid (energy, gas, etc.) and smart water management.– Can also implement the SSC solutions outside the city, in all their value chain. |
| ICT Companies | Supralocal Private | – Finding new fields for business development.– To provide services based on positive business cases.  | – Difficulties to access cities services contests to offer SSC projects that are still directed to vertical city services. – Lack of legal & commercial framework to provide SSC services. | – Experience and expertise on transversal solutions and integration of services. – R+D departments with significant budgets.– Expertise in developing business models. | – Lack of expertise in city management services.– Urgency to deploy ICT services due to customers' demands. | – Provide the ICT infrastructure to support and integrate SSC services. It has to be standard, compatible and scalable.– Research and innovate to provide better technical solutions.– Develop innovative and financially sustainable business models to enable SSC implementations. |
| NGOs | Local & Supralocal | – Ensuring social sustainability, inclusiveness and equity on a local and national level.  | – They do not have an active role in SSC solutions deployment.– With increasing urban populations, inequity, poverty and social strains are going to be increased in cities. | – Experience on raising awareness of concerns of the population, on watching over the weakest sectors of society and developing initiatives.– Knowledge on social sustainability.– Impartiality and legitimacy to raise issues. | – Limited resources: (economic, human...)– Limited power of influence on local, national and international agendas. | – Give advice on how to achieve social sustainability. – Raise awareness of concerns of the population. – Ensure inclusiveness of all society in the SSC model. |
| International, Regional and Multilateral Organizations | Local & Supralocal | – Improving quality of life of citizens worldwide. – Ensuring social sustainability, inclusiveness and equity. – Promoting new business models on city administration.  | – To support sustainability management technical advice to local governments. | – Expertise on developing initiatives and driving change. – Workforce of experts in different fields. – Technical and economic resources. | – Lack of expertise in SSC models. – They have to rely on the bodies they are supporting (national or municipal governments and administrations) since they have no decision-making capabilities. | – Provide funds and make promotion programs to drive SSC.– Provide technical assistance and documentation.– Create knowledge exchange platforms. |
| Industry associations | Supralocal | – Promote an initiative their associate industries are interested in. – Finding new fields for business development for their associates. | – Same problems as the industries they represent. | – Legitimacy to raise the subjects on behalf of the sector. | – Lack of expertise in SSC models. – They have to rely on their associated. | – Bring the SSC issues to the table for debate.– Build spaces for discussion. – Facilitate financing options for the development of SSC. |
| Academia, research organizations and specialized bodies. | Local & Supralocal | – Lack of experience & resources for implementing SSC projects including business & local government vision. | – To study SSC as a new trend which has impact in the sustainable development of society and has a very technical component.– To develop new field of research and associated studies (new degrees or masters). | – Experience in developing "science"– Research facilities, workforce and know-how.– Capacity to innovate.– A certain level of impartiality and an external and holistic vision of SSC. Experience in measuring, defining baselines,– Teams of specialized professionals | – In some cases, difficulties when cooperating with the private sector.– Distancing from the reality when delving into more theoretical issues.– Often they are not recognized as stakeholders in the SSC model.– Lack of funding for investments | – Develop a science of cities, to study them as the complex systems they are.– Participate on SSC standardization activities. – Drive research and innovation in fields related to SSC. – They have to include the social aspects on the debate.– Assist city managers and policy makers with the transition to the new model in regard to measuring methods, baseline definition. |
| Citizens and citizen organizations | Local  | – Achieve better quality of life.– They need access to better city services.– They are the final beneficiaries of SSC.  | – Need for more active participation in decision making.– They suffer the strains of urban growth: traffic congestion, pollution. | – Source of data.– Users of the city: they can provide information on what they need.– They can be a source of innovation. | – Lack of knowledge of the ICT implications of SSC models.– Lack of knowledge of the benefits that SSC could bring to them. | – Key to go from "intelligent" to "smart sustainable" city: they have to use the new applications.– They are a source of data.– Citizen participation, engagement in the SSC project.– Citizens must recognize that SSC need business models that include the service price. |
| Urban Planners | Local | – Achieve better quality of life.– Promote city sustainability.  | – To develop short- and long-term plans to create, grow, and revitalize communities and areas in cities. | – Experience in city planning. – Understanding of city needs from a non-technological perspective. | – Reluctant to a technology-only approach for SSC.– Not aware of smart technologies for cities. | – Include in their studies and city planning processes the use of ICTs to promote SSC as a part of a broader approach.– To give the guidance to SSC stakeholders on city planning needs. |
| Standardization Bodies | Supralocal | – Define standards in a new field that has not been standardized yet to assess the performance of SSCs. | – To develop a common language for all stakeholders involved.  | – Expertise in development of standards of ICTs & sustainability. | – They have to rely on their members (from private and public sector, academia...) and reach consensus.– Lack of expertise in city management. | – Laying the framework for SSC and defining standards for this new model.– Identify standardization gaps on SSC field. |

Annex 2

SCC – CERT/CSIRT/SOC

Definitions

* The term **CERT** (Computer Emergency Response Team) refers to a team of IT security experts whose main business is to respond to computer security incidents. The term CERT is a registered service mark of Carnagie Mellon University (CMU)
* The term **CSIRT** (Computer Security Incident Response Team) also refers to a team of IT security experts designated to respond to computer security incidents. This term, however, is more accurate since it reflects a broader array of security services provided, beyond reactive functions.
* Term like **SOC** (Security Operations Center) is also used. Although his name suggest mainly an operational responsibility, it is often tasked with similar broad duties as a corporate CERT or CSIRT.

Description

* A CERT/CSIRT is an organization or team that provides services and support, to a defined constituency, for preventing, handling and responding to computer security incidents.
* This means that should work proactively as well as reactively and will play a critical role in the coordination of several subjects working like a bonding in order to provide a quick and effective response to any security issue.

Objectives

* Enhance information security awareness
* Build expertise in information security, incident management and computer forensics
* Enhance the cyber security law and assist in the creation of new laws
* Provide a central trusted point of contact for cyber security incident reporting and for general security issues
* Establish a center to disseminate information about threats, vulnerabilities, and cyber security incidents
* Coordinate with other domestic and international CERT/CSIRTs and related organizations
* Share information and lesson learned with other CERT/CSIRT/response teams and appropriate organizations and sites.
* Become an active member of recognized security organizations and forums

Type of services

The portfolio of services that is widely used as the de facto set of CERT/CSIRT services is organized in three categories:

* **Proactive Services**: performed before an incident occurs or is detected.
* **Reactive Services**: executed when an incident becomes known.
* **Security Quality Management Services**: continuously executed in order to ensure incidents can be dealt with.

Type of Authority

* The best approach suggested to build the City CERT/CSIRT is to build it using the Shared Authority model
* A CERT/CSIRT Manager need to be nominated to lead the CERT/CSIRT
* CERT/CSIRT Manager should available on call on 24/7 basis
* CERT/CSIRT Manager is responsible for coordinating all emergencies that can be raised by SOC and by any other department inside the City IT
* Initially the CERT/CSIRT team can be virtual, meaning that some resources will be identified in each team involved to be available to join the CERT/CSIRT Manager in case of emergency
* If these approach is not totally effective a dedicated team need to be built to aid the CERT/CSIRT Manager for managing emergencies faster

Mission and scope

When CERT/CSIRT are created:

* The Manager should clearly define a mission statement for CERT/CSIRT.
* The Mission Statement should clearly define the intentions of CERT/CSIRT including services they will handle and the scope/region which is covered.

CERT/CSIRT constituency (scope) could be defined/limited to:

* Covers the entire City
* Is responsible for providing security related solutions to all City employees.
* In collaboration with SOC is responsible for handling Security infrastructure (like Firewall/IDS, etc.) and Security Breach related security incidents in City services and components

CERT/CSIRT Stakeholders

* Incident Handling and response is not a self contained process.
* Relationship, communication channels, data sharing agreements , policies and procedures must be established across the organization
* Strong commitment is needed from High Management
* CERT/CSIRT Manager is the prime actor to work on this specific task

Suggested Services

* Alert and Warning

CERT/CSIRT responsibilities includes:

* In collaboration with SOC and Risk Team CSERT/CSIRT will collect share all the latest security alerts/information from internet sites with the main goal of:

 • Coordinating with different teams to maintain highest security level at ISMD

 • Patch Management, Anti Virus Management etc.

 • Trend Analysis for possible emergency scenarios

 • Problem Management Security Update report

 • Security Assurance audit reports

* Vulnerability Handling and Artifact Handling

CERT/CSIRT responsibilities includes:

* In collaboration with Risk Team CSERT/CSIRT will:

 • Identifying relevance of the information to the City ICT

 • Conduct impact analysis of the identified/reported vulnerability

 • Gather information about systems vulnerable to identified/reported vulnerability

 • Support the involved team in implementing controls based on priority

* Artifact Handling

CERT/CSIRT responsibilities includes:

* Technical examination and analysis of any artifact found on a system
* Determining the appropriate actions to detect and remove artifacts from a system, as well as actions to prevent future similar issues (this may involve creating signatures that can be added to antivirus software or IDS)
* Coordination and sharing the information collected with other CERT/CSIRT, similar security organization as well as vendors
* Incident Handing

CERT/CSIRT responsibilities includes:

* Management of emergencies at City ICT
* Coordination between all the team involved

 The coordination work may involve collecting contact information, notifying subjects of their potential involvement (as victim or source of an attack), collecting statistics about the number of subjects involved, and facilitating information exchange and analysis. Part of the coordination work may involve notification and collaboration with legal department, human resources and/or public relations departments.

 It would also include coordination with law enforcement.

* Announcements and Technology watch

CERT/CSIRT responsibilities includes monitor of:

* New technical developments, intruder activities, and related trends to help identify future threats.
* Announcements and Technology watch inform constituents about new developments with medium to long-term impact, in order to allow proactive protection to be enable
* The outcome of this service might be some type of announcement, guidelines, or recommendations focused at more medium to long-term security issues

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