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SERIES Y: GLOBAL INFORMATION INFRASTRUCTURE, INTERNET PROTOCOL ASPECTS, NEXT-GENERATION NETWORKS, INTERNET OF THINGS AND SMART CITIES

ITU-T Y.4000 series – Smart sustainable cities - Setting the stage for stakeholders' engagement

ITU-T Y-series Recommendations – Supplement 34

International Telecommunication Union

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Supplement 34 to ITU-T Y-series Recommendations

ITU-T Y.4000 series – Smart sustainable cities - Setting the stage for stakeholders' engagement

Summary

Supplement 34 to the ITU-T Y-series Recommendations is addressed to a broad audience of city decision makers and practitioners involved in the design and implementation of smart sustainable cities (SSCs). 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 Supplement are in alignment with the series of Supplements to the Y.4000 series.

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1 Introduction

It is suggested that one of the major challenges in the emerging smart sustainable city (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 Supplement 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) and the private sector [b-UN].

Hence, countries, governments, business, and various stakeholders realize that complex issues, such as the establishment of an SSC, cannot be achieved by a single actor. Such complex activities require coordinated effort with multiple stakeholders contributing to innovative and sustainable solutions [b-SEM].

This Supplement, 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 an SSC's goals will be achieved.

This Supplement is addressed to a broad audience of city decision-makers and practitioners involved in the design and implementation of an 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 Supplement are in alignment with the series of Supplements to the ITU-T Y.4000 series.

2 Abbreviations and acronyms

This Supplement uses the following abbreviations and acronyms:

CERT Computer Emergency Response Team

CSIRT Computer Security Incident Response Team

EMF Electromagnetic Field

GSM Global System for Mobile communications

ICT Information and Communication Technology

KPI Key Performance Indicator

LFA Logical Framework Approach

NGO Non-Governmental Organization

R&D Research and Development

SDO Standards Developing Organization

SSC Smart Sustainable City

3 Methodology for SSC stakeholder identification and engagement

In this Supplement, 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 or individual that can significantly influence or be influenced by its deployment.[1]

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; and (ix) equitability of the decision-making process. Keeping in mind the aforementioned aspects, if stakeholder identification and participation are carried out properly, good participation can itself make a significant contribution to the governance. This assumes that policymaking conducted in an interactive way will build on stakeholder knowledge and this process of policymaking would be more contextual, reliable, and easy to implement [b-UNEP]. Based on this assumption, the methodology for stakeholder analysis for SSC has been elaborated in this Supplement.

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) [b-LFA]. 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 in this clause.

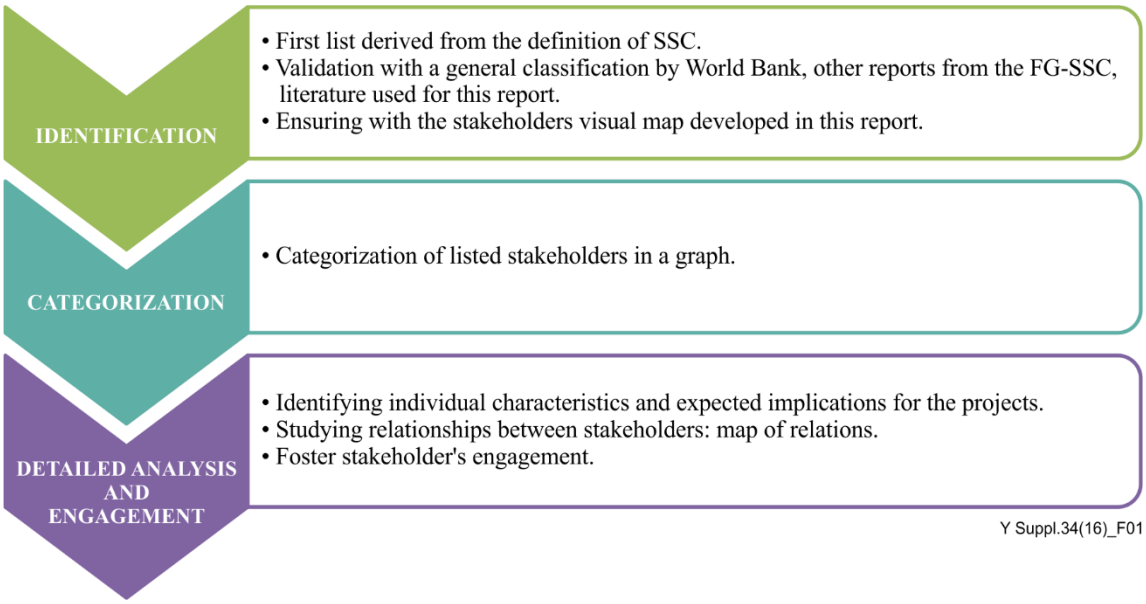

Figure 1 – Steps involved in the analysis of SSC stakeholders

Adapted from World Bank and LFA approach.

3.1 Identification of all stakeholders involved in an SSC

In this first stage, all stakeholders that may be affected or 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;

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1 The definition is a modification of that appearing in [b-WB].

– validation of the list with stakeholders that appear in different Supplements;

– validation of the list with stakeholders that appear in the literature used for this report.

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

a. **Municipalities, city councils and city administrations**: They are responsible for city management and therefore they are the main promoters of SSC initiatives in each specific city.

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

c. **City services companies**: They implement SSC solutions to increase city services efficiency.

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

e. **Information and communication technology (ICT) companies** (telecom operators, start-ups, software companies): They are the providers of global and integrated solutions, city platforms, as well as the ICT and digital 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 SSCs and associated trends, including their impacts on and contributions to sustainable development.

j. **Citizens and citizens' 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 and digital technologies in medium- and long-term city planning, as well as to consider urban complexities.

l. **Standardization bodies**: These organizations are critical to ensuring the application of common terminology and minimum characteristics of an SSC, as well as specifying measurement methods to assess the performance and sustainability of city services based on ICTs and digital technologies.

The roles and responsibilities of each of these stakeholders are further explained in clause 5.

3.2 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 project(s) 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 Supplement, 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 into 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 or the technological solutions.

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

– **Enablers of the SSC**: They facilitate the technical and policy framework needed for SSC by collaborating to some extent in the specification of concepts and key performance indicators (KPIs), 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 differ slightly from one city to another.

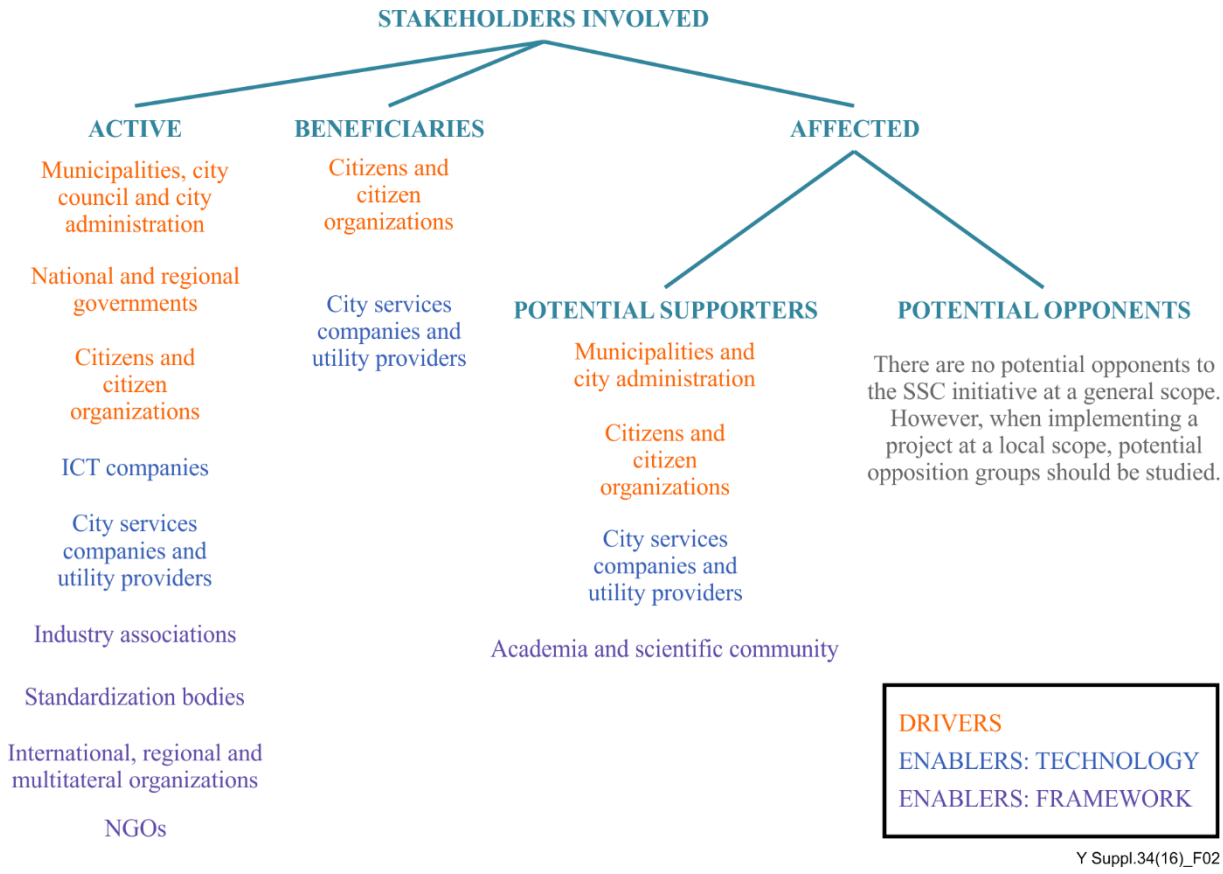

Figure 2 – Example of SSC stakeholder classification

Adapted from the LFA Methodology.

This mapping exercise will provide cities with an initial framework to identify the stakeholders that will take part in 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 must be city specific.

4 Detailed analysis of selected stakeholders

4.1 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 be undertaken considering two approaches that are described as follows:

a. By identifying their individual characteristics and their potential contribution, the expected implications for the project 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 refers to issues such as stakeholders' resource endowment, knowledge, experience, and know-how. Constraints refer to issues that limit the realization of their role within the SSC, including lack of coordination, lack of expertise, limited financial resources, among others.
- *Role and contributions*: This refer to the role of the stakeholder with respect to the SSC's goals, and the contributions towards their achievement.

Table I.1 illustrates this classification.

Figure 3 provides an overview of the stakeholders involved in SSCs, and how they relate to each other.

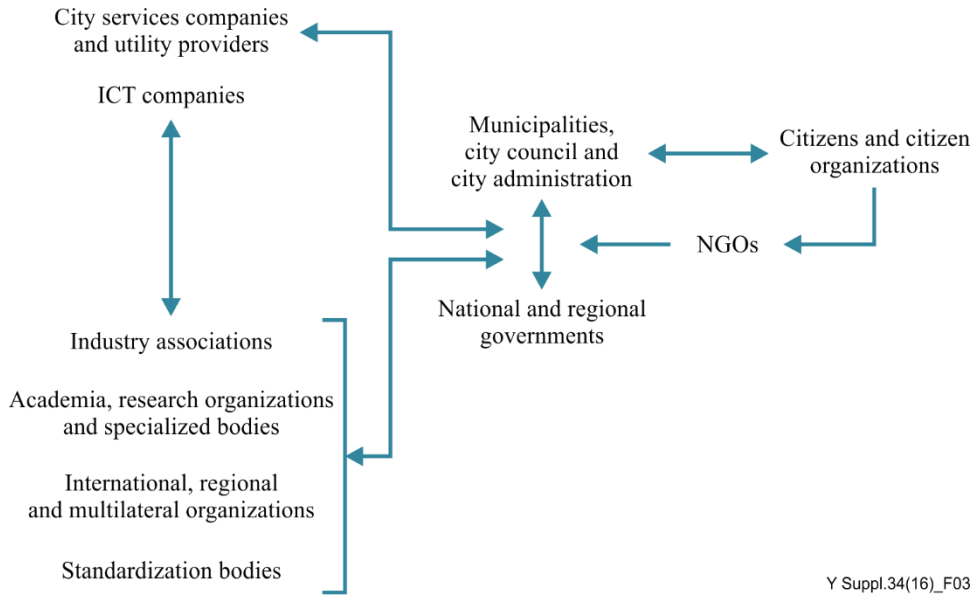

Figure 3 – Example of an SSC stakeholder's (interaction) map

b. Another stakeholder mapping technique called a stakeholder onion diagram can also be used, that depicts the level of stakeholder involvement with the overall SSC development project, i.e., which stakeholders will directly interact with or participate in the project, and which are part of the larger stratosphere. The stakeholders at the onion's core will be the most **involved**, with the ones furthest away the most **passive**.

All these analyses should be developed together in order to better understand stakeholders' roles and relationships. Clause 4.2 provides an analysis of these dimensions for each SSC stakeholder.

4.2 Analysis of stakeholder engagement progress

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

– As the identified stakeholders 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 be better funded and influential, may overpower the influence of other groups and prioritizes their own interests. Care needs to be taken to maintain a balance between competing interests.

– Potential SSC stakeholder engagement comes at a price – the SSC stakeholder engagement process described in this Supplement could become bureaucratic, labour intensive and may never be perfect or completely inclusive. As such, care needs to be taken to ensure that the process is reviewed, updated, and monitored continuously.

– The stakeholder process may even become "exclusive" and privileged groups and a large number of social segments and rights holders who are organized within a formalized group may be excluded from the process of SSC establishment [b-UNEP].

The following stakeholder matrix and accompanying table combine to depict the relationships of all stakeholders (internal and external) to the SSC development process and the best high-level engagement strategy for each.

Specifically, the stakeholder matrix maps the level of stakeholder power (authority) against the level of stakeholder interest (concern) for SSC project outcomes.

The table accompanying the matrix includes a column for current engagement level. Measuring the engagement level of stakeholders is important throughout the SSC development process. Stakeholders can generally be categorized as being one of the following[2]:

Unaware: Unaware of the project and its potential impacts on them

Resistant: Aware of the project yet resistant to change

Neutral: Aware of the project yet neither supportive nor resistant

Supportive: Aware of the project and supportive of change

Leading: Aware of the project and its potential impacts and actively engaged in helping it succeed

[2] Schwalbe, Kathy. "Project Stakeholder Management." Information Technology Project Management. 8th ed. Print.

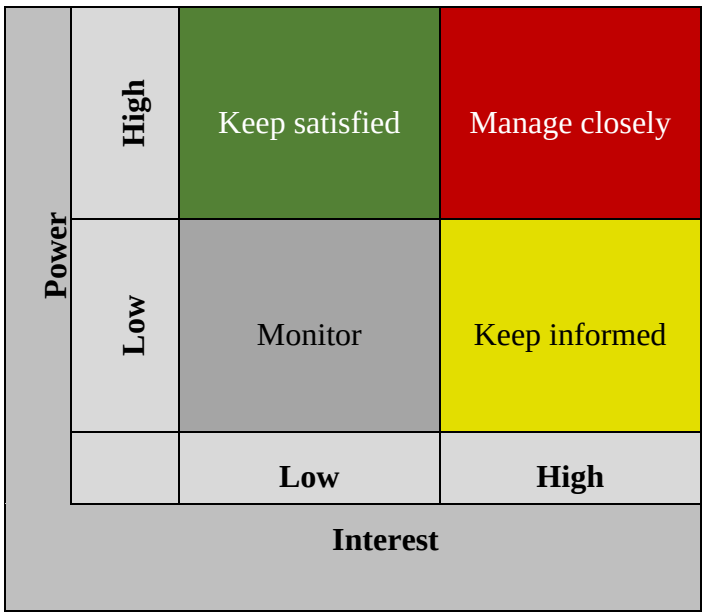

Figure 4 – Stakeholder matrix: Power/Interest grid

Table 1 – Stakeholders and Power/Interest

Stakeholder	Current engagement level	Potential engagement and management strategies	Power | Interest level
E.g., Business Owners	Supportive	Must keep engaged closely to ensure the local business owners continue to approve of and champion the overall SSC development project	High | High

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

– The consultative process should recognize stakeholder diversity 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 and conflict resolution must be established before the consultative process [b-REDD+].

4.2.1 Core values of stakeholder participation

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

1) All the identified stakeholders should be allowed to a stand on all decisions about SSC-based actions that could affect the life of inhabitants.

2) The contribution of each stakeholder will in principle be heard and will influence the final decision.

3) Stakeholder participation should include communication and recognizing the needs and interests of all participants including the decision-makers themselves.

4) Stakeholder participation should provide participants with the information needed to contribute to the policymaking process in a meaningful way.

5) 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.

6) Stakeholder participation should also include communicating to the participant how their input affected the final decision-making process [b-CSM].

5 Stakeholders' roles in SSC

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

5.1 Municipalities, city councils and city administration

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

Municipalities have to deal with the everyday problems and demands of citizens, as well as 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 voters for transparency and citizen participation in municipal issues is a trigger for the development of more socially sustainable cities.

As the main promoters of the idea of becoming an SSC [b-Telefónica], municipalities have the responsibility to decide which path to follow, from the long-term roadmap to the specific solutions to implement. There is no unique path, so each city can choose its own route depending on the qualities of the city, its state of affairs, strengths, and available opportunities. It is important that municipalities proceed while thinking of the long term, with a holistic approach, transparency, and citizen interests at its core.

One way of increasing 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 KPIs. As the main consumers of solutions, municipalities are ideally placed to lead this change to KPI-based public tender offers. For the model to work, municipalities should act as the examiner of the performance of the services, starting by choosing which KPIs will apply, what values have to be achieved and under what conditions, and conducting periodical evaluations. Otherwise, city service companies would be acting as judge and judged on their own evaluation.

Another important responsibility of this stakeholder is to encourage public participation and include citizens in any SSC initiative. As 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 must ensure that all the population is informed and has the means needed to take part in the programmes and initiatives being carried out.

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

One of the keys to 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 [b-SCC-1], which compromises efficiency and hinders synergies that can emerge with new services for the city.

It is expected that some departments will have a stronger role to play in leading the city's transformation to a more sustainable and smarter model. Some of these key departments have been identified in Table 2, including examples of possible collaborations between them. Since city departments are organized differently across cities, some of the departments listed in [b-Barcelona], [b-Boston], [b-Chicago], [b-Rio de Janeiro] and [b-Santiago] may be named differently, or may be grouped together with others.

Table 2 – 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 an SSC. Since it has the mandate to manage the territorial setting of the city and establish the appropriate use of land, this unit is one of the most important when SSC projects are to be implemented at the 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 city. Finally, it is an ideally placed unit to implement public participation programmes 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 publicly 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, it is recommended that ICT technologies be 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 to 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 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 the city level. This unit will have to be in touch with all the others in order to report to citizens on projects that are being carried out in the city.
• **Unit dealing with infrastructure and ICTs**
The deployment of an SSC requires significant new infrastructure, especially technological items, such as communication networks or the addition of smart meters on the existing water and energy infrastructures. This unit will have an especially important role in integrating the different city systems and technologies based on a holistic ICT-based management approach.

Table 2 – Examples of the role of different municipal units/divisions in SSCs

• **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 programmes, such as the regulation of access to the city by car depending on pollution values measured in real-time. With the cooperation of the housing unit, the environmental unit 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 spaces. 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.
• **Finance unit**
This is a very transversal unit. Considering that municipal treasuries must face heavy financial burdens, finance units have to evolve to more innovative business models and make partnerships with private enterprise, 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 for improving efficiency in financial processes at the city level. New SSC projects must impact the financial performance of municipalities in a positive way.
• **Legal affairs unit**
This unit is responsible for establishing the legal and operational framework needed to guarantee new city services development. In this sense, it is particularly important that these legal units understand the new vision that smart sustainable cities must have.
• **Water and sanitation management unit**
Some municipalities have this unit, while 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 growing stress in relation to 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 act 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 develop are to assist in improving cyber-security law, disseminating information about threats, vulnerabilities, and cyber-security incidents, as well as coordinating with other domestic and international CERT/CSIRTs and related organizations as well as sharing information and lessons learned with them.

Finally, municipalities can make alliances with others to share knowledge and good practice. Examples of this are the Covenant of Mayors [b-CoM] and Energy Cities [b-EC], the mainstream European movement involving local and regional authorities, voluntarily committing to increasing energy efficiency and the use of renewable energy sources on their territories. Created in 1990, Energy Cities is the European association of local authorities in energy transition.

5.2 National and regional governments

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

In order to drive the transition to an SSC, national governments should define legal frameworks that enable the implementation of many SSC features.

Discussions are ongoing 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 many people from surrounding areas usually work in 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 in helping the mayors of the municipalities involved, 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 3. 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 3 – Examples of the role of different national ministries and units in SSCs

• **Ministry of infrastructure, industry, and information technology**
This is the ministry that is responsible for fulfilling 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 respective units dealing with this issue.
• **Ministry of science and technology**
This is the ministry that launches or should promote the SSC research within high-technology research programmes.
• **Ministry of the environment**
Similar to the municipal unit, the ministry of the 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 and digital technologies. They should also be involved in monitoring and measuring the current status, as well as the improvements achieved. This ministry also organizes awareness campaigns to encourage sustainable habits, sometimes together with other ministries like those of transportation or energy. Climate change units must also work on the inclusion of ICTs and digital technologies into national and local climate change programmes.
• **Ministry of energy**
Even if there are examples of cities deploying pilot projects of so-called smart grids, the electrical grid, tariff system and policies, is still within the remit of 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.

Table 3 – Examples of the role of different national ministries and units in SSCs

• **Health unit**
The health unit can benefit from the features developed in the framework of the SSC in order to provide a better service to 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, or alert emergency services in case of a pandemic.
• **Ministry of education**
Similar 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 life-long learning more accessible to adults, among others.
• **Transportation unit or ministry**
Although urban mobility is usually within the 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 the SSC.
• **Ministry of public security**
The ministry of public security is the principal police and security authority, as well as the government agency [b-EICD] that exercises oversight and is ultimately responsible for day-to-day law enforcement. The ministry operates the system of Public Security Bureaux [b-PSB], which are broadly the equivalent of police forces or police stations. The ministry of public security 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.
NOTE – Adapted from the author's analysis and reviewed contributions

5.3 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 smarter. This first group is usually contracted by the municipality. The second group are the new companies that specialize in the 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 citizens. In most cases, these companies are the ones that provide the equipment and deploy the sensors.

To help in the implementation of an 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 the competitiveness of 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 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 and digital technologies into their processes since the know-how of these companies is usually focused on the specific services they provide. At the same time, these companies are used to working independently in their vertical

solution and the change to a more collaborative and interdependent model of service provision is not always easy.

5.4 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 the 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 ICTs and digital technologies 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 different consumption values. In the case of electricity providers, it is complex to adapt to this curve, which is one of the issues that constrains the development and implementation of renewable energies. With the implementation of ICT- and digital-based solutions, a smarter and sustainable network could flatten the demand curve and also increase the predictability of the demand.

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

The main role of ICT companies is to provide the ICT and digital infrastructure and solutions that will support and integrate the services of the SSC. It is important that these technological solutions are global and standard in nature, so that different vertical solutions can easily be 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 [b-Telefónica]. 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 that are usually more financially stable, could redirect more resources toward the research and development (R&D) budget, and act as important actors in the SSC implementation phase.

New and innovative ICT companies and start-ups can also provide specific solutions to SSC challenges. Local companies can understand city operation in a better way 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.

5.6 Non-governmental organizations

One of the aims of an SSC is to increase social sustainability. NGOs, with their expertise on social inclusiveness and equity, are key assets to achieving this goal. One of their roles should be to raise awareness of the concerns of the population, especially regarding challenges left unattended or those that affect the weakest sectors of society. As they already do regarding other issues, NGOs would ensure 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 to widen their scope, improve their services, reach out to broader audiences, and thus expand their impact.

5.7 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 awareness-raising and technical assistance programmes, to help kick-starting SSC projects.

Lastly, by creating knowledge of exchange platforms, these organizations can drive collaboration between stakeholders, and promote the replication of successful initiatives.

5.8 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), the main organizer of the Ibero-American Meeting of Digital Cities ([b-EICD]; in Spanish, Encuentro Iberoamericano de Ciudades Digitales).

Another example is China's Strategic Alliance of Smart City Industrial Technology Innovation [b-SASCITI], founded in 2012 under the guidance of the Ministry of Science of Technology (MOST). The alliance is a non-profit organization with 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 continually active in international collaboration on behalf of MOST.

Another example can be found with the Global System for Mobile communications (GSM) Association [b-GSMA], an international association of mobile operators and related companies.

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.

There are also associations of companies that cluster companies from different sectors. This is the case for the Smart Cities Council [b-SCC-2], 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.

5.9 Academia, research organizations and specialized bodies

Academia is a crucial piece of 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 launch specific postgraduate programmes aimed at creating professionals specialized in this field.

Research organizations also have a role to play by participating in the ongoing conversation on how to better drive cities to the smart and sustainable model, and they must have a voice in the standardization process.

Building on documented experience and conceptualizations, academia and research organizations can even make a science of cities.

Universities, associated laboratories 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 on cities, such as mathematics, data mining, analytics, economics, and computer vision, 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 policymakers in the transition to this SSC new model.

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

5.10 Citizens and citizen organizations

Citizens are the key to the transformation of a digital city into a smart city [b-ITU-T TR Overview]. 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 be informed of the features and the benefits of each of those services, so they can appreciate their values. 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, as a sensor of local or real-time information, as a source of ideas through citizen participation mechanisms, as a receiver of information and as an end user of city services.

We can find many examples of citizens as sources of data, including the use of ICT applications that, with the user's permission, gather data from the sensors embedded in smartphones to identify issues such as the state of the road [b-StreetBump], or that allow users to report incidents on the street [b-CityRepair]. Data mining from social networks can predict events, assess the opinion of the population on key issues and even collect environmental parameters from automated sensors that anyone can install at home [b-CSK]. 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 in conducting mass opinion surveys and participatory processes, but it is important to ensure that everyone can participate. This can be achieved by providing the means of participation to sectors of the population, like the elderly or those economically constrained, that may not have easy access to communication technologies.

Citizens as information receivers and users of services refer to information from the city such as real-time traffic conditions, 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 they who will benefit from a shift towards a smarter, more sustainable urban model.

5.11 Urban planners

Urban planners develop plans and programmes 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 [b-UrbPlan].

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 the city's complexities and dynamics may put into question, and even render useless, large investments made on smart initiatives [b-UM-FG-SSC]. Consequently, it is important that urban planners

participate actively in the design and implementation of SSC projects to foster a broader understanding of the 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.

5.12 Standards developing organizations

Standards developing organizations (SDOs) are essential as they can provide a standardized framework and a minimum set of characteristics to define and implement an SSC. One of their priorities should be the development of a common terminology for all stakeholders to bring clarity and harmonization in this field [b-ISOFoc].

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 [b-ISOFoc].

ITU, with its Focus Group on Smart Sustainable Cities, developed [b-ITU-T TR Roadmap], which identifies the standardization gaps for SSC.

Having identified the multiple stakeholders and the diverse roles that they play in SSCs, clause 6 provides a series of specific recommendations in order to ensure that these multiple views and contributions are effectively integrated as part of SSC strategies.

6 Conclusions

As described throughout this Supplement, 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 aim 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 important to develop an initial list of stakeholders for SSC project development. This list is not a closed list and can be updated.

– Step 2: Categorization of the stakeholders

  It 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 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 an SSC project or initiative. It is important to have a final summary table reflecting stakeholders' aims, challenges, potentials, and constraints, and especially their role and contribution to the SSC challenge (as reflected in Appendix I). This will set the basis for proper stakeholder’s engagement.

For an SSC 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 an SSC, stakeholders interact to build a resilient city that is smart, sustainable, and innovative. In addition, it must also be considered that cities from developed and developing countries differ in terms of their existing infrastructure as well as their stakeholders' ability to implement ICTs and digital technologies within the city. In other words, what may be feasible for one city may be challenging for another.

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

Appendix I

As indicated in clause 6, this appendix provides a final summary table reflecting stakeholders' aims, challenges, potentials and constraints, and especially their role and contribution to the challenges to the SSC.

Table I.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	Local public	– Increase efficiency (energetic as well as economic) – Increase environmental sustainability – Aim to give the best service to citizens	– Shrinking budgets – Growing demand of 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 inter-departmental coordination – Lack of professionals with specific knowledge of SSC – Constraints 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 the benefits of SSC to them – Monitor city services: define KPIs and evaluate them – Promote SSC service provision and integrated management
National and regional governments	Supralocal public	– Increase efficiency guarantee security of resources (natural and economic)	– Growing demand of the voters for transparency, citizen participation – Pressure by international	– In charge of policies that can directly affect SSC deployment – To promote the intensive use of ICTs facilitating	– Lack of coordination among ministries – Lack of professionals with specific SSC knowledge	– Define policies and legal frameworks that enable SSC deployment – Promote and manage implementation of "smart regions"

Table I.1 – Summary of stakeholder identification, categorization and analysis

Stakeholder	Scale/ sector	Aims and challenges		Potential and constraints		Role/contribution to SSC rollout
		– Increase environmental sustainability of the country – Aim to give the best service to all citizens, including and above all ICTs	agreements and targets for sustainable development and climate change	technology development		– Facilitate ICT technology development and competition
City services companies	Local private	– 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 or capacity to include ICT in their processes – Some of them are used to working independently in vertical solutions, not cooperating with other 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	Supralocal private	– Increase efficiency of their processes	– Considerable resource losses (water, gas, or	– Expertise in all the links of the value chain:	– Due to their size, the upgrade of their systems	– Responsible for the deployment of some SSC features: smart grid

Table I.1 – Summary of stakeholder identification, categorization and analysis

Stakeholder	Scale/ sector	Aims and challenges		Potential and constraints		Role/contribution to SSC rollout
		– Flatten the demand curve – Increase the predictability of consumers' needs	energy) in their supply chains – Challenges for massive deployment of new technologies, especially time and economic resources	production, distribution, and commercializatio n	and the inclusion of ICT in their infrastructures could be a challenge	(energy, gas, etc.) and smart water management – Can also implement SSC solutions outside the city, in their value chain
ICT companies	Supralocal private	– Finding new fields for business development – To provide services based on positive business cases	– Difficulties in accessing city services, contests to offer SSC projects that are still directed to vertical city services – Lack of legal and 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 customer demand	– 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 implementation
NGOs	Local and Supralocal	– Ensuring social sustainability, inclusiveness, and equity on a local and national level	– They do not have an active role in SSC solution deployment – With increasing urban	– Experience in raising awareness of concerns of the population, on watching over the weakest sectors of society	– Limited resources: (economic, human, etc.) – Limited power of influence on local, national,	– Give advice on how to achieve social sustainability – Raise awareness of concerns of the population

Table I.1 – Summary of stakeholder identification, categorization and analysis

Stakeholder	Scale/ sector	Aims and challenges		Potential and constraints		Role/contribution to SSC rollout
			– population, inequity, poverty, and social strains will increase in cities	– and developing initiatives – Knowledge of social sustainability – Impartiality and legitimacy to raise issues	– and international agendas	– Ensure inclusiveness of all society in the SSC model
International, regional, and multilateral organizations	Local and 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, and technical advice to local governments	– Expertise in 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 create promotion programmes to drive SSCs – Provide technical assistance and documentation – Create knowledge exchange platforms
Industry associations	Supralocal	– Promote an initiative their members are interested in – Finding new fields for business development	– 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 members	– Bring SSC issues to the table for debate – Build forums for discussion – Facilitate financing options for the development of SSC

Table I.1 – Summary of stakeholder identification, categorization and analysis

Stakeholder	Scale/ sector	Aims and challenges		Potential and constraints		Role/contribution to SSC rollout
		for their associates				
Academia, research organizations and specialized bodies.	Local and Supralocal	– Lack of experience and resources for implementing SSC projects including business and local government vision	– To study SSC as a new trend that has an impact in the sustainable development of society and has a very technical component – To develop new fields of research and associated studies (new degrees or masters programmes)	– 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 – Distance from 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 in SSC standardization activities – Drive research and innovation in fields related to SSC – Include the social aspects in the debate – Assist city managers and policymakers with the transition to the new model regarding measuring methods, baseline definition
Citizens and citizen organizations	Local	– Achieve better quality of life – Need for access to better city services	– Need for more active participation in decision-making – Suffer the strains of urban growth: traffic	– Source of data – Users of the city: they can provide information on what they need – Source of innovation	– Lack of knowledge of the ICT implications of SSC models – Lack of knowledge of the benefits that	– Key to go from "intelligent" to "smart sustainable" city: adoption of the new applications – Source of data – Participation, engagement in the SSC project

Table I.1 – Summary of stakeholder identification, categorization and analysis

Stakeholder	Scale/ sector	Aims and challenges		Potential and constraints		Role/contribution to SSC rollout
		– Final beneficiaries of SSC	congestion, pollution		SSC could bring to them	– Recognition that SSCs need business models that include the service price
Urban planners	Local	– Achieve better quality of life – Promote city sustainability	– 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	– Resistance to a technology-only approach for SSC – Unaware 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 guidance to SSC stakeholders on city planning needs
Standardization bodies	Supralocal	– Develop standards in a new field, previously not standardized, to assess SSC performance	– Develop a common language for all stakeholders involved	– Expertise in development of standards for ICTs and sustainability	– Reliance on their members (from private and public sectors, academia) to reach consensus – Lack of expertise in city management	– Set the framework for SSC and defining standards for this new model – Identify standardization gaps in the SSC field

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