

# Stakeholders Approach to Smart Cities: A Survey on Smart City Definitions

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**Abstract.** The concept of Smart City is not yet statically defined, and thus, in the last years, several scientific articles and papers have been written focusing on the subject. The main objective of this research is to identify and compare the different discourses that stakeholders involved in Smart City projects build around the concept. The definition of the Smart City concept has been the key element selected to be analyzed, being used to stablish the conceptual basis that structures the different points of view that stakeholders have about the topic.

The research about the Smart City definition has consisted in the analysis of 32 different Smart City definitions in which 404 terms have been tagged or classified following a methodology that is divided in 3 steps of definition regarding stakeholders, key issues and text analysis. As a result, a comprehensive definition and different strategies have been developed.

**Keywords:** Smart City · Discourses · Definitions · Text analysis · Stakeholders · Governance

## 1 Introduction

The concept of Smart Cities has been extending since the 90s in parallel with the liberalization of telecommunications and the development of services through internet. The term Smart City has become in recent times synonymous with extensive use of information technology cities, although a Smart City means much more than that [1].

The first public draft of the Operational Implementation Plan for the European Consortium for Innovation in Smart Cities focused efforts in 3 main fields: energy, mobility and ICT [2]. But the scientific literature on the subject was already widening the limits of the concept including other topics that are core in the city, as well as integrating them in a holistic approach. The concept of Smart City is not yet statically defined, and thus, in the last years, several scientific articles and papers have been written focusing on the subject. In the scientific literature, the emphasis on social and environmental capital distinguishes the concept of “Smart Cities” of pure technology-centered approaches, and drives the new goals of ICT as a vehicle to promote the objectives of cities from the multidimensional perspective.

At a theoretical level, methodologies that attempt to correlate the basic parameters of the Smart City concept are being developed. Triple Helix methodologies are used to analyze the dynamics of knowledge-based systems, taking into account three pillars:

university, industry and government, in a highly related interaction with the concept of Smart City with respect to their global positioning [3].

*Which are the discourses of the different stakeholders regarding the Smart City concept?* The main objective of this research is to identify and compare the different discourses that stakeholders involved in Smart City projects build around the concept. It will provide conclusions about the differences and similarities existing among the points of view of stakeholders, providing information that is key to understand the interaction among them. The definition of the Smart City concept has been the key element selected to be analyzed. Being an open concept which does not have a static character, the Smart City definition is being used to establish the conceptual basis that structures the different points of view that stakeholders have about the topic. It includes the main goals and the most important topics and describes the role that technology plays in the approaches of the different stakeholders.

## 2 Methodology

The research about the Smart City definition has consisted in the analysis of 32 different Smart City definitions in which 404 terms have been tagged or classified following a methodology that is divided in 3 steps:

**Definition of the main stakeholders participating in the Smart City through literature.** Firstly, the main stakeholders that take part of the Smart City have been defined. Smart city has been identified as a knowledge based system [1] and thus, the model that has been used is the knowledge-based triple helix models. Four stakeholders groups have been defined: universities, private companies and governmental institutions, both at local level and large scale.

Civil society is defined by several authors as one of these groups [4, 5] but it was not possible to find their provided definitions in this study up to this point. Examples of Smart City definitions have been selected through documents produced framed in each of these groups (Table 1).

**Definition of the key issues to classify the Smart City concepts: Smart City action fields, Smart city main goals and technological approach.** These key issues have been defined through the analysis of the existing literature on the topic.

On a first step, the Smart City projects have been divided into the six main fields that Smart City strategies are considering in the city: *governance, economy, environment, mobility, people and living* [33]. This classification has been chosen being the most used in the literature by different authors and adopted by the European Commission in the report Smart cities in the “Mapping Smart Cities in the EU”.

A second step consisted in identifying the main goals of the Smart City, which have been synthesized into three main goals: *sustainability, quality of life and efficiency*.

Technologies play a key role in the development of the Smart City, but there exist different points of view about the role technology play in the city. It can be seen as a *tool*, as a way of *connection* or as a goal, and it is seen whether as a wide concept

**Table 1.** Stakeholders definitions reviewed

<i>Academic institutions</i>	<i>Governmental institutions</i>	<i>Local governments</i>	<i>Private companies</i>
Politecnico di Milano, Università degli Studi di Milano (Italy) and VU University, the Netherlands [6]; Institution of Engineering and Technology (UK) [7]; Technical University of Lisbon [8]; State University of New York, U.S. [9]; University college, London [10]; Bartlett School of Architecture, London [11]; TEI of Larissa and Aristotle University of Thessaloniki, Greece [12]	European Commission [2], Conseil des Communes et Régions d'Europe Council of European Municipalities & Regions [13], and European Innovation Partnership on Smart Cities & Communities. [14] United Smart Cities [15], Intelligent Community Forum [16]	European cities: Amsterdam [17], Barcelona [18], Zaragoza [19], Manchester [20]; Non-European Cities: Boston [21], New York [22], Singapur [23], and Medellín [24]	IBM [25], CISCO [26], Telefónica [27], Ferrovial [28], Indra [29] and Siemens [30]. Boyhugues [31], GE-Allstom [32]

including every kind of *technology* used within the city, or reduced to the use of *ICT*, even sometimes just as the management of *information*.

**Analysis of Smart City concepts through text analysis techniques.** The Smart City definitions have been studied using text analysis tagging techniques, a methodology frequently used in social sciences research. Definitions key words have been separated and analyzed according to the defined key issues. The definitions have been tagged and grouped according to their correspondence with the issues according to cited literature. Excel tables have been used to classify the main words in the definitions to obtain the first outcomes in a non-automatic process.

A total number of 404 terms have been extracted from the 32 definitions and analyzed. Some of them appear several times. Analysis provided an overview of the different terms used to make reference to the categories defined. In the analyzed definitions, terms are not only directly mentioned, but are also referenced through element that configure its identities and structure (i.e. in the analyzed definitions, *governance* is mentioned not only as the term itself, but also referenced through elements that configure governance systems (citizens, stakeholders, leaders, government, agencies, etc.).

### 3 Definitions by Stakeholders

In a first stage of this research, definitions from a first selection of stakeholders have been analyzed separately (Fig. 1).

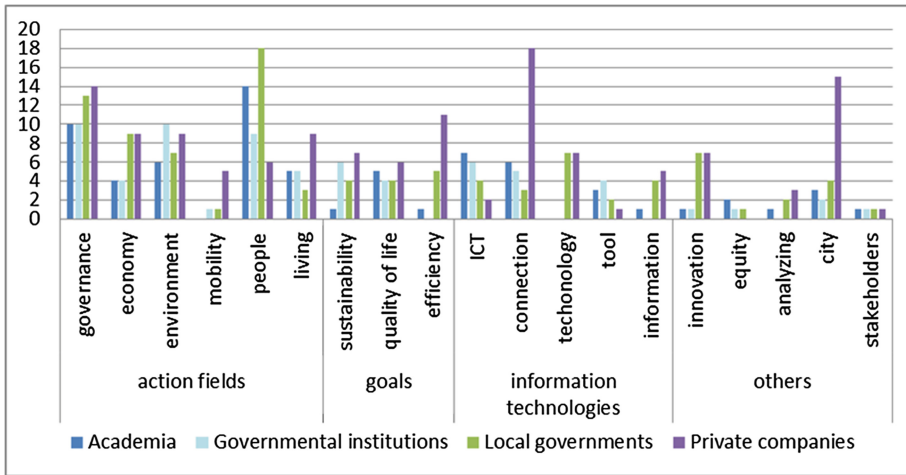


Fig. 1. Classification of terms in academic Smart City definitions.

**Smart Cities from the point of view of Academia.** (See Fig. 1) Among the concepts that appear in the academic papers, the ones related to people present a higher number of mentions. Concepts related to *people* are the key element in Smart Cities, appearing in 6 of the 8 definitions analyzed, appearing in several occasions. “Mobility” does not appear as a topic in any of the analyzed definitions.

Regarding the goals of Smart cities, to reach a higher *quality of life* is highlighted as their main objective (5 terms), being *efficiency* and *sustainability* mentioned each in just one of the analyzed definitions. Another conclusion is that in this kind of definitions, objectives are being focused on the processes more than in the goals.

The theoretical point of view of technology within the Smart City is mainly focusing in *ICT* (7 times mentioned) as a *tool* (3 times) for *connection* (6 times) within the city. *Connection* and *tool* are also important in the definitions, whether directly mentioned or implicitly expressed. For the academic institutions researched, the topics selected are the main ones, and urban and city concepts are the only ones slightly outstanding among the other concepts included in the classification.

**Smart City approaches by Governmental Institutions.** (See Fig. 1) Concepts related to *governance* and *environment* are the main ones highlighted by the analyzed definitions of Smart Cities provided by institutions followed by concerns about *people*. The city as a services provider, in the *living* action field, does not appear to have such an important role in the definitions provided by Inter-governmental institutions. *Economy*

appears to be less important, becoming the social aspect the part of sustainability enhanced in these definitions. Finally, *mobility* appears just once.

The main goal of Smart Cities, as described by inter-governmental institutions analysed definitions, is related to the enhancement of more *sustainable* cities, but besides *quality of life* also appear to have a key role in Smart City definitions. Concepts related to *efficiency* do not have any relevance in the definitions proposed by the Inter-governmental entities.

Definitions of Inter-governmental entities do not consider *technology* from a wide point of view to become as part of the Smart City, but understands *ICT* as the main technological element to be considered. Supporting this focus in *ICT*, its role as a *connection*, becoming a *tool* in the approaches of 4 of the definitions and not and objective itself.

*Innovation*, *equity* and *stakeholders* are other terms mentioned in this set of definitions.

**Local governments and Smart Cities.** (See Fig. 1) Local governments Smart Cities definitions are mainly focused in concepts related to *people* (society and citizenship), even though governance concepts also play a key role. Other aspects of sustainability (*economy* and *environment*) appear mentioned in a smaller number of occasions. *Mobility* is mentioned in only one of the analyzed definitions.

Local governments approach of Smart cities is almost equally driven by the goals of *sustainability*, *quality of life* and, mainly, *efficiency*. But it is also important to highlight that the definitions local government provide are not highly focused in the objectives, but in the elements that compose a city and in the citizens that inhabit it.

Local governments definitions have a wider perspective of *technology* within the city, mentioning any type of technology as key for a city to become Smart. Despite this fact, *ICT* is also appearing in 4 of the 8 analyzed definitions. The use of technology and *ICT* as a *tool* is appearing a smaller number of times than in the definitions previously analyzed. *Innovation* for local governments is a key topic, appearing in 6 of the 8 definitions and being as important as technology, and even being a substitute of this concept considering technology to be the element behind the term of innovation.

**Private companies defining Smart Cities.** (See Fig. 1) Concepts related to *governance* are the most highlighted by private companies among the ones referring to the different action fields. *Economy* and *environment* terms appear in 7 of the 8 analyzed definitions, being also an important element. Terms related to *people* and services that can be provided (*living*) do not play an important role. *Mobility* appears as a topic in the half of the analyzed definitions. The goals are mostly focused on *efficiency*, which appears in all definitions, but *sustainability* and *quality of life* also appear in 7 and 6 of the analyzed definitions respectively.

While in the previous analyses the most important concepts were *people* or *governance*, included in the action fields, in the Smart City definitions provided by private companies, the term that is mentioned a higher number of times is a technological one. *Connection* is the most important aspect highlighted by Private companies in their definitions about Smart Cities. *ICT* only appears in 2 of the definitions, not limiting the scope of private companies to a type of technology. It is important to

highlight that technology is not understood as a *tool*, this concept only appearing in one of the analyzed definitions.

The definition of the Smart City they provide emphasizes the *city*, the urban aspects. They define the Smart City from the point of view of providers of *management* solutions aiming to improve the efficiency of the city, and present a strong relationship with the local governments definitions. *Innovation* is also important, appearing in 5 of the 8 analyzed definitions and being mentioned more than once in some of them.

### 4 Comparative Analysis

The final step is to compare the results of the semantic analysis of the Smart City definitions provided by Universities, Institutions, Local Governments and Private Companies. These comparisons aim to help understanding the differences and the common approaches among the different stakeholders taking part in the Smart City.

Classification of topics (Fig. 2) is distributed in a similar way in the definitions of Academia, Institutions and Local Governments paying special attention to the action fields, composed of more elements and thus of more terms. Private companies definitions include a more balanced approach to the topics. In their definitions, weight is less placed in the variety of action fields and more in other concepts.

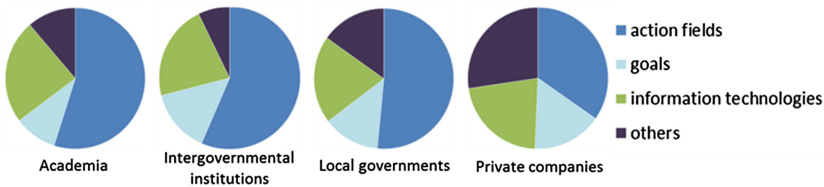


Fig. 2. Distribution of concepts among the analyzed aspects

Secondly, key words have been classified into the defined Smart City dimensions (*governance, economy, environment, mobility, people and living*) (Fig. 3). Regarding the definitions provided by Academia and local governments, *people* is the most mentioned element of a Smart City. The analyzed definitions of Inter-governmental Institutions focus in *environment, governance* and *people*, while for private companies, *governance* concepts play a major role, followed by the *economy* and *environment*.

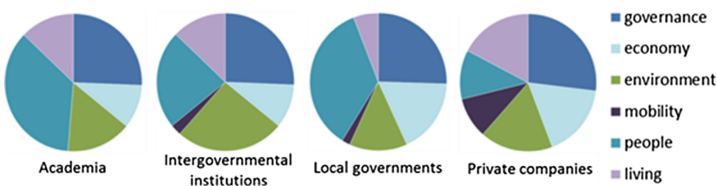


Fig. 3. Comparison among approaches regarding Smart City action fields

*Environment* is not such an important element, even if it is the focus of great investments and the concepts of the initial definitions of Smart City where highly related to this field [2]. *Mobility* appears mainly in the discourses of companies, and it is mentioned once in definitions of Academia and Local governments.

Regarding the main goals of the Smart Cities (Fig. 4), in analyzed academia definitions, the *quality of life* is the most important objective of a Smart City, while governmental institutions state that *sustainability* is the key goal of a Smart City, followed by *quality of life*. Local Governments and Private Companies focus on *efficiency* as the main issue that the Smart City concept should address, local governments having a slightly more balanced vision of the goals of the Smart City. *Efficiency* does not play a key role on the definition of the Smart city provided by institutions, and has the same importance as *sustainability* for Universities.



Fig. 4. Comparison among approaches regarding Smart City goals

In definitions of Academia and Governmental Institutions, a Smart City is defined by the use of *ICT* (Fig. 5). Regarding *technology*, *connection* is the principal issue for them. On the other hand, Local Governments and Private Companies approaches to *technology* are wider and include many other possibilities. Understanding technology as a *tool* to reach the Smart city goals does not appear as an important issue to Local Governments and Private Companies, but is one of the main approaches presented by Institutions.



Fig. 5. Comparison among approaches regarding technology in Smart City definitions

## 5 Conclusions. Defining Smart City: A Cooperation and Agreement of Stakeholders

One of the basis of the Smart City concept as defined by the European Commission [2] is to be a “multi-stakeholder, municipally based partnership”. The approach of the different stakeholders varies in the fields to act in, the objectives and their point of view

about technology. Only understanding the differences and providing guidelines for the connection of the different stakeholders to include all points of view it will be possible to get the holistic approach that is essential to the Smart City, providing this multi-stakeholder partnership. A comprehensive definition that involves all the approaches must be established.

However, this definition means that multiple stakeholders have to be involved in the smart city, but local governments have the role of establishing the basis for the development of the concept. Local government analyzed definitions, when compared in the analyzed fields, show a close approach between the objectives of municipalities and the ones of private companies. This can seem obvious regarding the customer-provider relationship they have, seeming that private companies are being better able to understand local governments needs, but poses two questions. First of all, it is not clear who is influencing who and remarks the danger of municipal investments being driven by market interests. But it also highlights the challenge that Academia and Inter-governmental institutions must face in better understanding which are the real needs of municipalities.

Meanwhile, there exist important similarities among the definitions provided by universities and inter-governmental institutions, presenting a wider point of view that places the citizen and the *quality of life* in the center of the Smart City concept. In the analyzed definitions, all stakeholders focus in *governance* and *people* as the main action fields in which a Smart City must be based and focus on, leading to citizen centric approaches.

Results also show independence between the results of Academia and Inter-governmental institutions and the ones of private companies in all the analyzed fields.

However, regarding technology, the definitions of these three groups of stakeholders understand connection as key, while municipalities definitions express a wider need of technology implementation and is thus not so focused in the idea of integration.

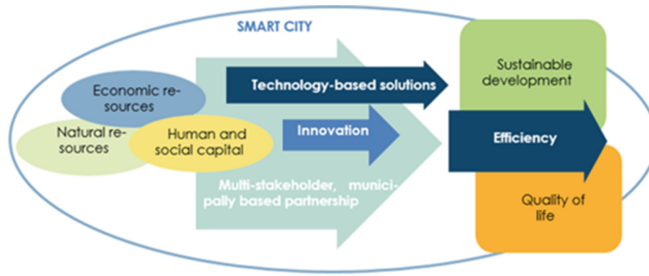
As a conclusion, a definition is provided aimed to set the basis for future works in the field of Smart cities:

**A Smart City is a system that enhances human and social capital wisely using and interacting with natural and economic resources via technology-based solutions and innovation to address public issues and efficiently achieve sustainable development and a high quality of life on the basis of a multi-stakeholder, municipally based partnership.**

This definition includes the main action fields (governance (multi-stakeholders, municipality)), economy, environment, people and living (services and public issues). Technology appears in the definition following the wide idea of analyzed municipalities definitions, but also as a tool for connection and in a wide perspective that include several kinds of technologies. Innovation is an important vector mentioned by definitions by all groups of stakeholders. Finally, the goals of the Smart City (Sustainability, quality of life and efficiency) must be included in a balanced way (Fig. 6).

This research has a limited scope including only a small part of existing definitions, and will be extended by automatizing the research through software to reach a wider number of definitions. However, some guidelines for the future are already suggested by the results.





**Fig. 6.** Proposed Smart city definition

Firstly, tools for assessment are necessary to enhance a balanced implementation of Smart City strategies and initiatives, specially tools that allow local governments and local decision makers trace the guidelines for the development of their cities if they are supposed to lead the way to a smarter city. This approach would avoid a strong influence of market interests driving municipal investments.

Another conclusion is that to get the citizen centric approach that can be extracted from definitions, awareness and participation of citizenship and civil society should be enabled, creating and promoting their own visions.

Besides, inter-governmental institutions must be able to reach municipalities in order to materialize their policies. Economy plays a key role for municipalities according to this analysis. Financing provided according to criteria of Governmental Institutions like UN or EU through their financing entities (World Bank, European Investment Bank) can play a key role in the development of Smart Cities through the projects they support, getting a more balanced approach to the Smart City concept aligning local projects with policies that these institutions develop.

Finally, a close research about municipalities and their needs can help to align Academia objectives with the ones of municipalities, helping to improve the benefits that research can have in the whole society, in a world that is increasingly urbanized.

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