

SMART CITY DISCOURSES VS. IMPLEMENTATION. CONSUMER SMART CITY: THE CASE OF MILAN

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Doctora arquitecta

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Smart City discourses vs. implementation. Consumer Smart City: the case of Milan

Los discursos de la Ciudad Inteligente frente a su implementación. La ciudad inteligente del consumidor: El caso de Milán

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RESUMEN:

El concepto de Ciudad Inteligente ha evolucionado desde marcos sectoriales específicos a otros más holísticos que enfatizan la gobernanza y la participación de las partes interesadas, pero existe una brecha crítica entre las estrategias y la ejecución de proyectos en el mundo real. Se explora la dinámica entre los discursos que rodean a las Ciudades Inteligentes y su implementación tangible, con un enfoque específico en la Iniciativa de Ciudad Inteligente de Milán. Mediante el uso de un modelo conceptual validado, esta investigación identifica (a) a las partes interesadas clave en las iniciativas de Ciudad Inteligente, (b) los proyectos ejecutados y (c) los desafíos encontrados en el camino. El modelo se aplica para el análisis de una visión integrada de los Proyectos de Ciudad Inteligente dentro de una ciudad y, por otro lado, la síntesis de la diversidad de puntos de vista de las partes interesadas sobre la. Opone y compara estos dos enfoques para comprender la brecha entre la visión de las partes interesadas y la implementación de la Estrategia de Ciudad Inteligente. Al emplear un enfoque de estudio de caso centrado en Milán, este artículo no solo aclara las características de una ciudad inteligente del consumidor sino que también aborda las implicaciones más amplias del modelo de gobernanza.

ABSTRACT:

Many initiatives have been developed under the Smart City label in a bid to provide a response to challenges facing cities today by the introduction of new urban technologies. While Smart City concepts have evolved from sector-specific to more holistic frameworks that emphasize governance and stakeholder engagement, there remains a critical gap between idealized strategies and real-world project execution. This research explores the dynamics between the discourses surrounding Smart Cities and their tangible implementation, with a specific focus on the Milan Smart City Initiative. Through the usage of a validated conceptual model, this research (a) identifies key stakeholders involved in Smart City initiatives, (b) delineates the projects executed, and (c) articulates the challenges encountered along the way. The

model is applied for both the analysis of a comprehensive overview of Smart City Projects within a city and the synthesis of the diversity of stakeholders' viewpoints on Smart City initiatives. It opposes and compares these two approaches to understand the gap between the vision of stakeholders and the implementation of the Smart city Strategy. By employing a case study approach centered on Milan, this article not only elucidates the characteristics of a Consumer Smart City but also addresses the broader implications of stakeholder involvement for effective urban governance.

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1 RESEARCH CONTEXT

The Smart City Concept popularized in the 1990s as a proposal for the introduction of new technologies in urban environments to tackle city challenges in a moment of crisis of traditional urban planning models and tools. The concept was not new: the use of new technologies for urban planning evolved gradually since World War II. In this research we go back to the annals of the smart city bringing together the use of technological tools for the analysis of complex systems popularized in the 1950s by the cybernetics movement and) and the description of the city complex system through conceptual models based on a systemic approach (Fernández Güell, 2022).

The concept of a smart city has evolved significantly over the past few decades, yet its definition remains fluid and multifaceted. A smart city is generally understood as an urban area that leverages digital technology and data collection to enhance the quality of life, sustainability, and efficiency of city operations. This includes the integration of Information and Communication Technologies (ICT) and the Internet of Things (IoT) to optimize services such as transportation, energy, and infrastructure. However, the precise parameters that define a smart city can vary widely depending on the context and objectives of the stakeholders involved. The relation of people, technology and institutions within the Smart City is also a pivotal element with the Smart City definitions placing governance at the core (Ben Letaifa, 2015; Colldahl, Frey, & Kelemen, 2013; Nam & Pardo, 2011b). Very few authors focused on one of the key aspects for traditional urban planning, such as a spatial approach (Angelidou, 2014). As cities worldwide strive to become smarter, establishing a clear and universally accepted definition is crucial for guiding policy, investment, and development strategies.

Urban areas are facing unprecedented challenges due to rapid population growth, environmental degradation, and socio-economic disparities. Smart cities offer innovative solutions to these issues by integrating advanced technologies to improve operational efficiencies, reduce resource consumption, and enhance the overall quality of life for residents. For instance, smart traffic management systems can alleviate congestion, while smart grids can optimize energy use and reduce carbon emissions. Different authors highlight the relation of the concept with the use of new technologies (specially ICT) to tackle urban challenges (Albino, Berardi, & Dangelico, 2015; Chourabi et al., 2012; De Santis, Fasano, Mignolli, & Villa, 2014; Meijer & Bolivar, 2015; Nam & Pardo, 2011b). Addressing these urban challenges is not only essential for the sustainability of cities but also for the well-being of their inhabitants. The urgency of these challenges underscores the need for cities to adopt smart technologies and strategies that can transform urban living.

Effective smart city strategies require the active participation and collaboration of various stakeholders, including government agencies, private sector entities, community groups, and residents. Stakeholder engagement is vital for ensuring that smart city initiatives are inclusive, equitable, and responsive to the needs of all urban dwellers. By involving stakeholders in the planning and implementation processes, cities can benefit from a broader knowledge base, improved project acceptance, and enhanced effectiveness of urban interventions. Moreover, stakeholder buy-in is crucial for securing

long-term support and sustainability of smart city projects. The multidimensional nature of smart cities necessitates a holistic approach to stakeholder management, where the linkages between different urban dimensions and stakeholder groups are carefully considered.

While numerous smart city projects have been launched globally, their success often hinges on the underlying strategies that guide their implementation. A strategic approach to smart city development involves comprehensive planning, capability assessment, and continuous evaluation. Projects that are aligned with well-defined strategies tend to achieve better outcomes in terms of performance, sustainability, and impact. For example, the Smart City Projects Assessment Matrix (SC[PAM]) provides a framework for evaluating the relationships between smart city strategies and current urban challenges. This matrix helps cities to benchmark best practices, analyze current states, and design future projects that are tailored to their specific needs. By assessing smart city projects through the lens of strategic planning, cities can ensure that their initiatives are not only technologically advanced but also socially and environmentally sustainable. The multiple aspects of the definition and the different points of views generates gaps that produce misunderstandings, inefficiencies or lack of coherence between the Smart City concept and the real implementation of Smart City strategies and processes. Different authors highlight the differences between the image of the Smart City and its implementation (De Santis et al., 2014) or between the vision of the stakeholders in Smart City development and the development of the cities initiatives and projects on the topic (AlAwadhi & Scholl, 2013).

A holistic perspective is present in the approaches of multiple authors, integrating the different elements of the Smart City such as action fields, stakeholders or challenges to be faced (Alawadhi and Aldama-Nalda, 2012; Caragliu et al., 2009; Castelnovo et al., 2015; Chourabi et al., 2011; Fernández-Güell et al., 2016; Giffinger et al., 2007; Leydesdorff and Deakin, 2010).

In conclusion, defining what constitutes a smart city, addressing urban challenges, engaging stakeholders, and strategically assessing projects are all critical components of successful smart city development. These elements collectively contribute to the creation of urban environments that are efficient, sustainable, and conducive to improved quality of life for all residents.

1.1 Smart Cities Evolution: Consumer Smart City

The evolution of smart cities has been characterized by various models and frameworks, each using different terms and timelines to describe the progression of urban development. According to UN-Habitat (UN-Habitat, 2021), the development of smart cities can be divided into four distinct phases, with a fifth phase emerging in recent years. These phases are known as the "researcher's smart city," the "marketer's smart city," the "citizen's smart city," the "consumer's smart city," and the latest phase, the "people-centric smart city" (Figure 1).

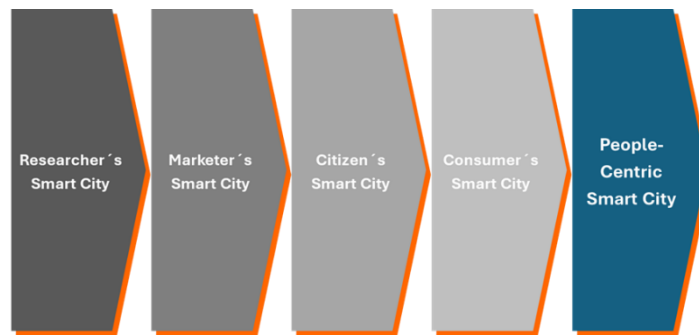


Figure 1: Phases of Smart City Development according to UN Habitat.
Source: Author's own elaboration based on UN-Habitat, 2021.

The Researcher's Smart City: The first phase, the "researcher's smart city," is primarily driven by academic and scientific research. During this phase, the focus is on exploring the potential of digital technologies and data analytics to improve urban management and services. Researchers and academics play a crucial role in developing theoretical frameworks and conducting pilot projects to test new technologies and their applications in urban settings. This phase is characterized by a high level of experimentation and innovation, with universities and research institutions leading the way in smart city initiatives.

The Marketer's Smart City: The second phase, the "marketer's smart city," sees the involvement of the private sector and technology companies. In this phase, the emphasis shifts from research to commercialization. Technology firms and service providers begin to market smart city solutions to municipalities and governments, highlighting the potential benefits of adopting these technologies. The marketer's smart city is characterized by a proliferation of smart city products and services, with a focus on showcasing the latest innovations and attracting investment. This phase often involves large-scale demonstrations and pilot projects to illustrate the capabilities of smart city technologies.

The Citizen's Smart City: The third phase, the "citizen's smart city," places citizens at the center of smart city initiatives. In this phase, the focus shifts to engaging residents and communities in the development and implementation of smart city projects. Citizen participation and collaboration become key components of smart city strategies, with an emphasis on addressing the needs and preferences of urban dwellers. This phase is marked by the use of participatory planning processes, open data initiatives, and community-driven projects that empower citizens to contribute to the shaping of their urban environment.

The Consumer's Smart City: The fourth phase, the "consumer's smart city," is characterized by the widespread adoption and use of smart city technologies by the general public. In this phase, smart city solutions become integrated into the daily lives of urban residents, with a focus on enhancing convenience, efficiency, and quality of life. A key aspect of the consumer's smart city is the integration of the sharing economy,

which leverages digital platforms to facilitate the sharing of resources and services among residents. The sharing economy enables individuals to rent, share, or exchange goods and services, such as car-sharing, home-sharing, and co-working spaces, thereby optimizing resource use and reducing waste. This collaborative consumption model not only enhances the urban experience but also promotes sustainability and economic efficiency.

The People-Centric Smart City: The latest phase, the "people-centric smart city," represents a shift towards a more holistic and inclusive approach to smart city development. In this phase, the focus is on ensuring that smart city initiatives are designed and implemented with the well-being of all residents in mind. The people-centric smart city emphasizes the importance of social inclusion, equity, and sustainability in urban development. It seeks to address the digital divide and ensure that the benefits of smart city technologies are accessible to all, including marginalized and vulnerable populations.

UN-Habitat's People-Centred Smart Cities Programme highlights the need for a collaborative ecosystem that fosters innovation and sustainable urbanization. This phase involves the development of international guidelines and best practices to support the creation of smart cities that are not only technologically advanced but also socially and environmentally responsible. The people-centric smart city aims to create urban environments that are resilient, inclusive, and conducive to a high quality of life for all residents.

Not all cities have developed this complete pathway. Depending on the moment when the Smart City plan was developed, cities followed a different strategy as a driver for the introduction of urban technology. This research focuses in the Milano Smart City Strategy, that could be categorized within the Consumer Smart City Model due to its time of development and its characteristics, with a protagonist role of initiatives based on the "Sharing Economy" concept.

1.2 Research objectives

The main objective of this research is to apply a Smart City Conceptual model validated through scientific literature for the description of the differences between the discourses and implementation of a specific Smart City Stage, the Consumer Smart City. The case study of the Milan Smart City initiative will support the main research objective of the article.

This research presents three sub-objectives:

- The first objective is to apply a validated conceptual model capable of considering the most important topics identified for the articulation of the Smart City Strategies: (a) stakeholders in the initiative, in relation to (b) the projects developed classified into a structure extracted from the literature review, and (c) the challenges cities face.

- Second, to use this model to reflect and compare to different approaches to the Smart City:
 - to synthesize the opinion of the different agents involved in Smart City initiatives and compare their attitudes
 - to elaborate a comprehensive overview of the most relevant projects implemented in a corresponding SC strategy.
- Third, to analyze a representative case study of a specific moment of the evolution of Smart Cities: the consumer Smart City and the case study of Milano Smart City Initiative as an example of this typology.

The combination of these three objectives will support the main objective proposed in this research. The methodology is structured to achieve the main research objective, supported by these three sub-objectives, as described in the next section.

1.3 Research Structure

The first chapter of this document provides an introduction to the research, providing its contextualization and objectives, as well as a general description of its structure.

The second chapter describes the state of the art on the Smart City concept and its approaches across three areas: conceptual models, Smart City evaluation methodologies, and the European framework within which this research is developed.

The third chapter develops a proposed conceptual model based on three elements: Urban subsystems and stakeholders; Smart City dimensions and initiatives; and Challenges and global trends that cities need to face. Finally, the three elements are integrated into a single model and its potential is critically analyzed. This conceptual model has been presented and validated in several scientific articles by the author.

Chapter 4 describes the methodology used to apply the model to the case study and the development of the research.

Chapter 5 describes the application of the methodology to the Milano Smart City case study. It gradually applies the model to analyze the elements described in the conceptual model: stakeholder systems, smart city projects and dimensions, and global trends and urban challenges for Milan.

Chapter 6 discusses the application of the model, and draws specific conclusions and recommendations to bridge the gap between the stakeholder vision and actual implementation in the Milan Smart City case.

Finally, Chapter 7 presents the conclusions of this research, which are drawn by separating conclusions about the conceptual model, the use of the tool, and finally, the analysis results.

2 STATE OF THE ART

In this chapter presents a state of the art on the topics of this research. It is divided into two main elements that are relevant for this work. The first is Smart City conceptual models. It is an extended version of the State of the art of the article "Smart City implementation and discourses: An integrated conceptual model. The case of Vienna." published in the scientific journal "Cities" (See (Fernandez-Anez, Fernández-Güell, et al., 2018). The second one is Smart City assessment. It is an extended version of the article "Smart City Projects Assessment Matrix: Connecting Challenges and Actions in the Mediterranean Region." published in the Journal of Urban Technology (Fernandez-Anez, Velazquez, et al., 2018).

2.1 State of the art on Smart City Conceptual models

Conceptual models have been used in scientific literature to represent ideas in a visually simplified way. Conceptual models can be understood as an abstract representation of a system (either social or physical) through concepts (Barsalou, 2005; Lakoff, 1994). A conceptual model focuses on certain aspects of reality (Brown, 2006). It aims to facilitate the understanding of the represented systems and their simulation (Barsalou, 2005).

In recent years, a range of conceptual approaches to the Smart City have led to different interpretations and thus to differences in its conceptualization. Some authors have used the triple helix conceptual model (Deakin, 2014; Etzkowitz & Zhou, 2006; Lombardi et al., 2011) to understand the role of the stakeholders in the Smart City. The triple helix was used to examine the knowledge base of urban economies, and (Leydesdorff & Deakin, 2010) proposed it as an instrument to study the meta-stabilizing potentials of urban technologies in Smart Cities (Fig.2, left). The work of (Lombardi et al., 2011) expanded its scope to include civil society in a modified triple helix (Fig. 2, right), and a subsequent work (Lombardi et al., 2012) crossed this concept with five city clusters (Governance, Economy, Human Capital, Living and Environment). These relations are used to structure an analysis of interrelations within the Smart City and to extract guidelines for policies.

(Nam & Pardo, 2011a) conceptualized the Smart City in a model that combined institutional, technological and human factors (Fig. 3, left). They applied the model to formulate strategic guidelines for the success of Smart City initiatives. To explore these concepts further, some researchers (Chourabi et al., 2012) increased the complexity of the model. In their proposal, they placed Smart City initiatives at the core. They identified a set of internal factors that affected the Smart City more directly: Technology, Organizations and Policy. The external factors (Governance, People and Communities, Natural Environment and Infrastructures) were on a second level of impact. The purpose of this model was not only to explain the Smart City concept but also to develop a tool to analyse the proposals of local governments and extract guidelines for practitioners and researchers.



Figure 2: Author’s vision of the triple helix model (left) and visualization of the proposal of Lombardi et al., (2012).

Sources: author’s own elaboration (left) and Lombardi et al., (2012).

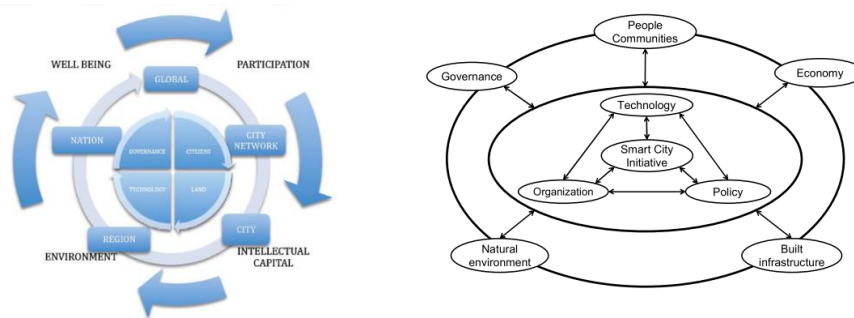


Figure 3: Conceptual models proposed by Chourabi et al., (2012) (left) and Dameri (2013) (right).

Sources: referenced papers.

The proposal of (Dameri, 2013) (Fig. 3, right) highlighted the need for a theoretical approach for a concept (Smart City) developed from empirical experience, and included a multiscale focus on the goals of the Smart City rather than on the means to attain these goals. It placed a set of basic Smart City components (Citizens, Land, Technology and Governance) at the core. The spatial level was the next step, as the multi-scale scope was considered essential for the Smart City, with different influences at the city, regional, city network, national and global scales. Finally, the model proposed a third level with the goals of the Smart City, defined as Environmental Sustainability, Quality of Life and Wellbeing, Participation, and Knowledge and Intellectual Capital. The model sought to support local governments and public administrations in the implementation of Smart City initiatives focusing on these ultimate goals.

In the attempt to represent the transversal and integrative character of the Smart City concept, matricidal models have been developed. This kind of operational models is developed by standards organizations, and they have been followed by cities organizations and local governments. The model proposed by the British Standards Institution (British Standards Institution, 2014) crossed the urban sectors (Fig. 4a)

(energy, water, transport, health) with different steps to the final objective, the customer delivery. From technology and infrastructure to data, later to governance and to services, and finally reaching the customer. It distinguished externally and internally driven innovation. Governance could be understood as placed at the centre, but in the sense of technology management (technology and digital assets, business and services). The view of stakeholders is a variety of universities, start-ups, SMEs, social entrepreneurs, charities and community groups.

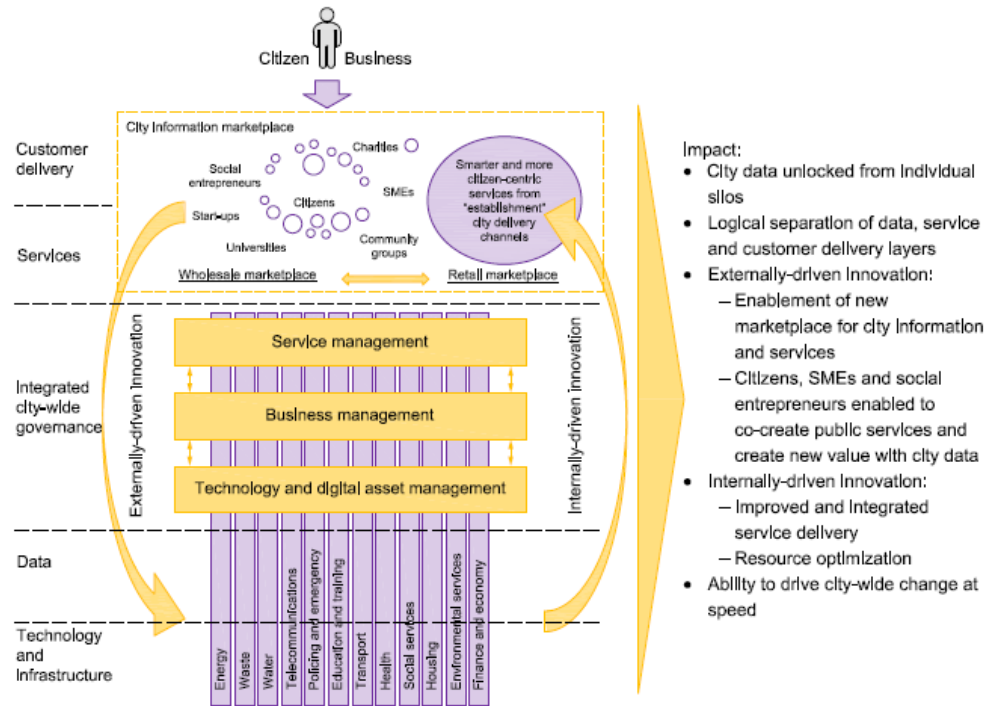


Figure 4a: Conceptual models of the British Standards.
Sources: British Standards Institution, 2014.

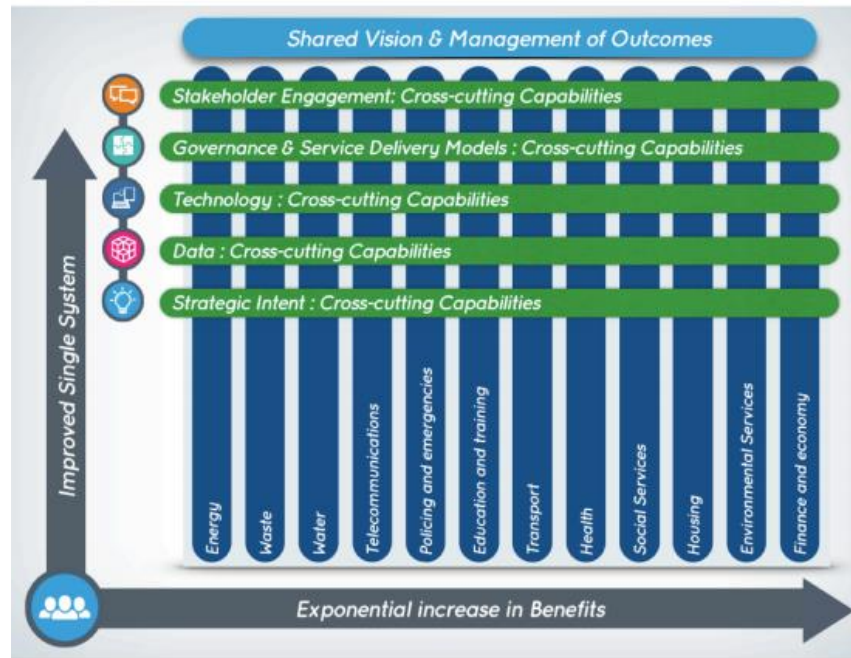


Figure 5b: Conceptual models of the Scottish alliance.
Sources: The Scottish Government et al., 2014.

Other entities, like the Scottish Cities alliance (The Scottish Government et al., 2014) (Fig.4b), have taken this vision as a departure point to develop their roadmap for smart cities. They incorporate the vision of steps, but instead of technology they take the strategic intent as a departure point understanding technology as a tool. The initiatives evolve through different phases to arrive to a final step that is stakeholders' engagement.

The model proposed in the initiative Barcelona Smart City (Ayuntamiento de Barcelona, 2014), also includes vertical "silos" (ICT, water, energy, etc.) and horizontal elements like Open government, public and social services, infrastructures, City scale and environment (Fig. 5). However, elements in these two directions are not overlapping or crossing.

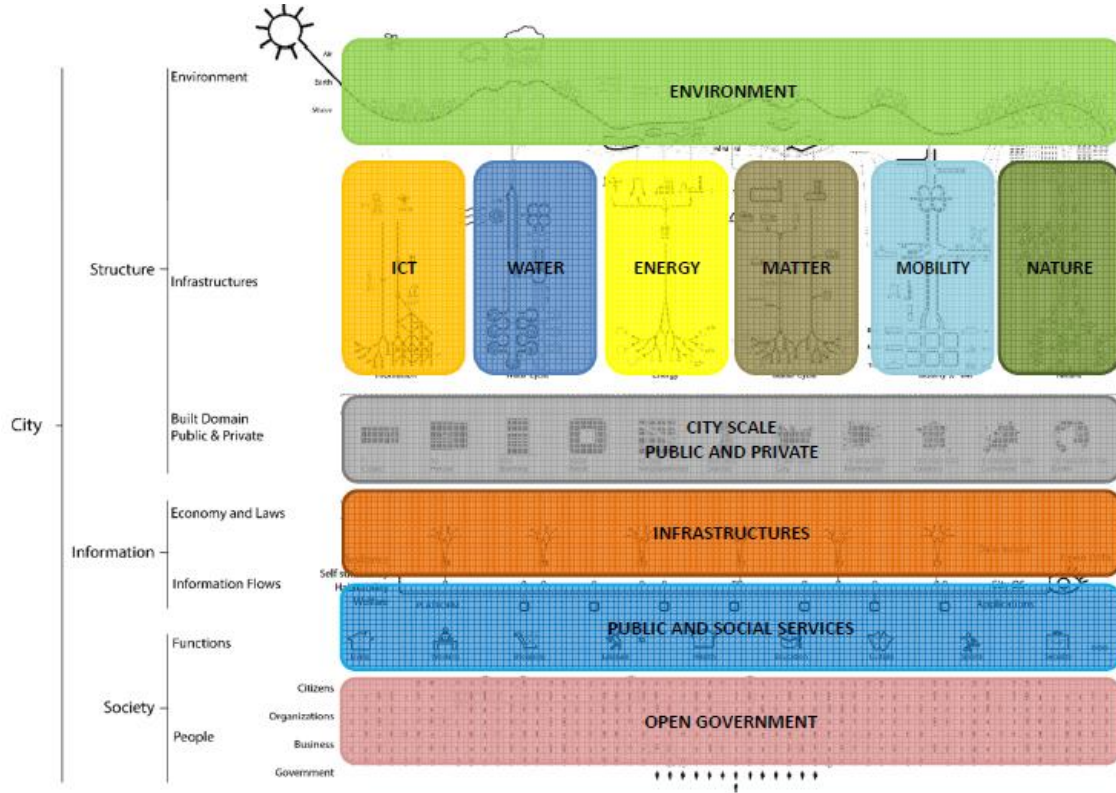


Figure 6: Conceptual model for the Barcelona Smart City initiative.
Source: Ayuntamiento de Barcelona, 2014.

The ASCIMER Project Team also developed a model for their research because of experiences in Smart City projects (Fig. 6). Based on the work of (Giffinger et al., 2007), the model understands the Smart City as the confluence of the dimensions of "Governance", "Economy", "Environment", "Mobility", "People" and "Living" articulated by ICT and technology tools (Monzon, 2015), and proposes a classification of Smart City projects and their integration through a comprehensive and integrative approach (Fig. 6). This Smart city core appears surrounded by a set of urban challenges that are linked to the different dimensions. It is a model developed for the Mediterranean Region, but it distinguished between two areas that are facing different challenges: the north

Mediterranean and the south and east Mediterranean. It connects the challenges of both areas to show that the way we solve challenges can lead to future problems.

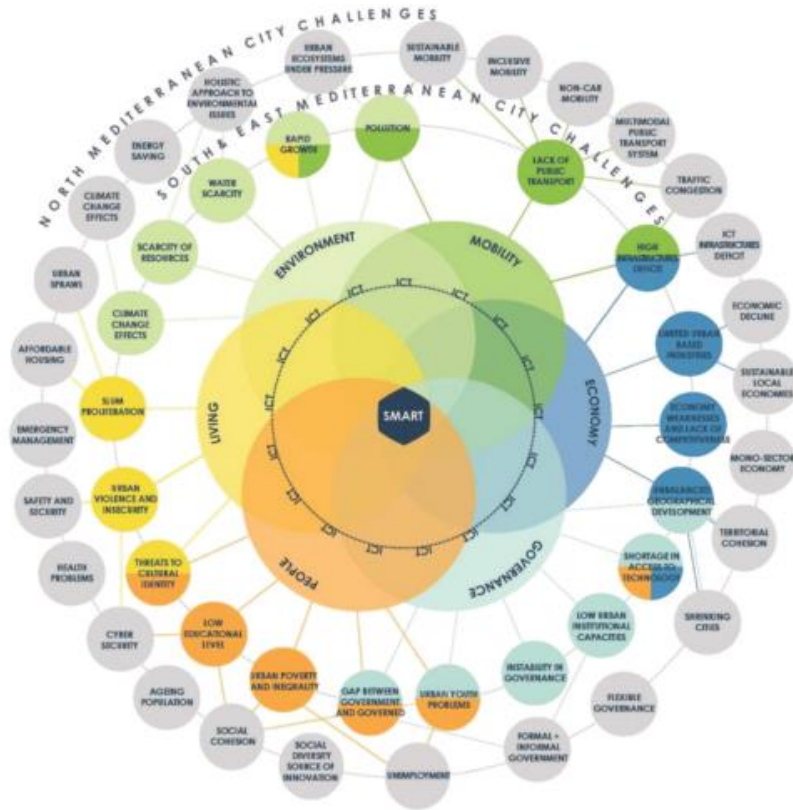


Figure 7: Model proposed by the ASCIMER project (Monzon et al, 2015).
Source: Monzon et al. (2015).

Recent conceptual visions of Smart Cities have focused on governance as the key issue for the success of the initiatives (Meijer & Bolivar, 2015). Conceptual models such as the proposal of (Castelnovo et al., 2015) (Fig. 7) reflect this point of view and propose a citizen-centric approach to Smart governance, placing “Community Building and Management” at the centre of the model. This concept involves four additional dimensions (Vision and Strategy Formulation, Public Value Generation, Asset Management, and Economic and Financial Sustainability), and proposed an integrative approach to the assessment of urban participatory policymaking.

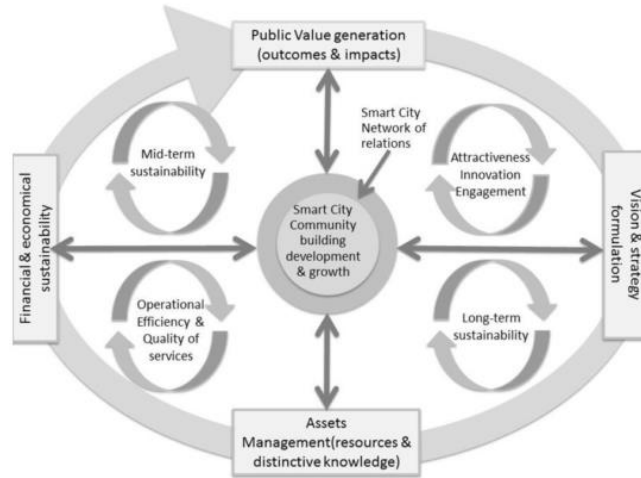


Figure 8: model proposed by Castelnovo et al. (2015).
Source: Castelnovo et al. (2015).

Finally, the work of (Fernández-Güell et al., 2016) proposed an approach to cities based on systems theory (Fig. 8). It places urban demand at the core of the system, surrounded by four subsystems (societal, economic, political and environmental). The city exists in response to the spatial subsystem, including different infrastructures and facilities, and a technological subsystem that supports this spatial subsystem. At another scale, economic, societal, technological and geopolitical changes affect the city and modify the system. The paper conceives the model as a forecasting tool for describing present and future scenarios.

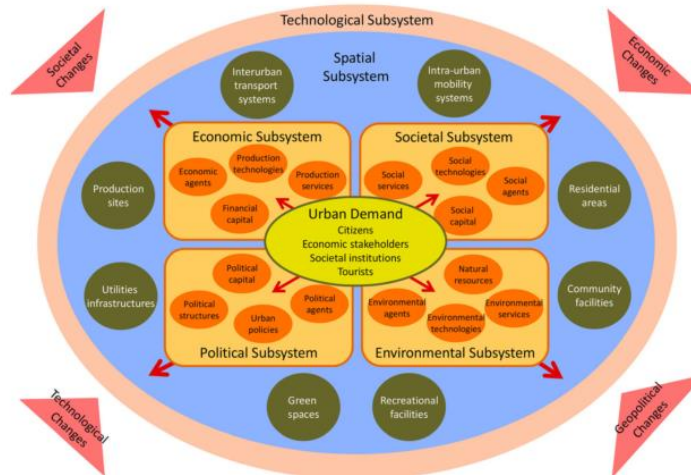


Figure 9: model proposed by Fernández-Güell et al. (2016).
Source: Fernández-Güell et al. (2016).

The findings regarding the conclusions and gaps in these conceptual models have been organized into three topics: (a) stakeholders and governance, (b) identification of projects and dimensions, and (c) relationship with urban challenges.

The evolution of the models reflects the growing importance of governance, the shift to citizen-centric approaches (Castelnuovo et al., 2015; Dameri, 2013; Fernández-Güell et al., 2016), and the key role assigned to stakeholders (Dameri, 2013; Fernández-Güell et al., 2016; Leydesdorff & Deakin, 2010; Lombardi et al., 2011). This does not necessarily mean that there is a change in the governance models, which in some proposals are still top-down focused under the idea of city management for service delivery (Ayuntamiento de Barcelona, 2014; British Standards Institution, 2014) even if in further development of the contents of the model the idea of bottom-up governance is expressed. Despite the growing importance of governance, in the models analysed this cluster has the same importance as other clusters and dimensions (Chourabi et al., 2012; Dameri, 2013; Lombardi et al., 2012; Monzon, 2015), and sometimes takes a central role (Dameri, 2013) or is understood as an external factor (Chourabi et al., 2012). However, the relationships established between the elements of the different models can be implicitly understood as reflecting governance. Stakeholders play a central role in the work of (Leydesdorff & Deakin, 2010) and (Lombardi et al., 2011), but their analysis focuses mainly on the weighting of indicators rather than on a deeper analysis of the discourses (Lombardi et al., 2012). Stakeholders are mentioned in a more generic way in other conceptual models, as "citizens" (Dameri, 2013), "organizations" (Chourabi et al., 2012), and in concepts such as "community building" (Castelnuovo et al., 2015), and do not even appear in some models (Monzon, 2015). (Fernández-Güell et al., 2016) started a classification of demand that is closer to the work of (Lombardi et al., 2011).

The focus on governance is combined with the focus on real projects organized into different dimensions (British Standards Institution, 2014; Chourabi et al., 2012; Fernández-Güell et al., 2016; Lombardi et al., 2011; Monzon, 2015; The Scottish Government et al., 2014). Most of the models analysed include clusters and dimensions that help classify not only Smart City objectives but also their initiatives and projects. The exception is the work of (Dameri, 2013), which directly presents only the objectives. In most cases these clusters appear as separate groups (Chourabi et al., 2012; Fernández-Güell et al., 2016; Lombardi et al., 2012) or focused on one area (Castelnuovo et al., 2015), but the relationships between them are identified and reflected. These clusters only overlap in the case of (Monzon, 2015), which can be seen as a step towards integrating the elements in the model.

The work of (Dameri, 2013) and (Fernández-Güell et al., 2016) highlights the need for a multi-scale perspective to include the inputs, scope and impacts of the projects and their effects on urban challenges. However, the Smart City is not considered as an answer to urban challenges in most of the models, but related to the goals identified by (Dameri, 2013) and (Castelnuovo et al., 2015), and linked to the external changes identified by (Fernández-Güell et al., 2016). The proposal of (Monzon, 2015) is the one that clearly reflects the challenges and relates them to the dimensions of the Smart City, but not to stakeholders.

Finally, another topic of interest when analysing the gaps in current conceptual models is their application to real case studies. The objectives of conceptual models do not only focus on the description of the concept, but rather on their possible use as a support for decision-making. Very few of the models were applied to real cases, with the exception of (Fernández-Güell et al., 2016), which was used generically for Spanish cities. It would be useful to apply them in combination with analytical-statistical assessment, as occurs in the proposal of (Lombardi et al., 2012).

As a conclusion, this state of the art has led to the identification of gaps that need to be filled in the representation of the Smart City. A conceptual model should represent the role of stakeholders in the Smart City as understood in literature, and existing models fail to show this in a comprehensive way. The analysed models are not being able to represent the interrelation of the different dimensions combined with the central role of governance. The boundaries of the dimensions are not clear and overlap, and this fact also needs to be included in conceptual models. The Smart City as an answer to urban challenges posed by stakeholders, and not only by external global trends, has not been included in the analysed models.

As a conclusion, there is a need of conceptual models able to represent stakeholders linked to the real implementation of Smart City projects as an answer to urban challenges in an integrated way.

2.2 State of the art on Smart City assessment

In order to select which project or strategy performs better in the context of the Smart Cities, it is necessary to provide an assessment of their effects on cities. However, there is a lack of standardized tools to assess the impacts of implementing specific Smart City Projects in specific cities or regions.

There are two approaches regarding Smart City assessment methodologies. On the one hand, benchmarking procedures were applied to produce a comparative analysis. On the other hand, several more conceptual assessment procedures are oriented toward measuring city impacts with a multidimensional approach. The first group could be labelled as ranking methods, because they provide for the possibility of ranking cities according to their performance level. This is the case with the Networked Society Index, developed by Ericsson (Networking Society Lab, 2016) or the Smart Cities Index developed by the Smart City Council (Cohen, 2014). There are also works of national interest, like the smart ranking of Italian cities (EY, 2016), conducted every year since 2013, or the IDC Smart City Analysis for Spanish Cities (Achaerandio, Bigliani, Curto, & Galloti, 2012). These studies measured city performance using a large number of indicators. They evaluate improvements in separated performance areas of the Smart City, heterogeneously identified.

An improved ranking methodology is the work "Smart cities Ranking of European medium-sized cities" (Giffinger et al., 2007). This ranking uses a set of indicators to evaluate the performance of a group of European Cities that meet certain requirements

in terms of size and accessibility of data and facilities (universities). This work classified the indicators into the six dimensions already mentioned in section one. Since then, this classification has been used in many scientific or consulting works (Cohen, 2014; Lombardi et al., 2012; Manville et al., 2014; Mattoni et al., 2015)

The second group of assessment methodologies attempts to correlate the basic elements of the Smart City concept. Leydesdorff & Deakin (2010) proposed a triple helix approach, considering three pillars: university, industry and government. Triple helix methodologies are used to analyse the dynamics of knowledge-based systems. Later, other authors such as Lombardi et al (2012) extend this approach by adding civil society and crossing indicators with the areas defined by Giffinger et al (2007) by using ANP (Analytic Network Process) models. It established relationships among the different areas and components, providing an integrated assessment aiming to include the opinion of decision-makers. It includes the opinion of agents through a relative weighting of the dimensions. Lazaroiu & Roscia (2012) also apply the dimensions proposed by Giffinger et al (2007), to design a methodology that uses fuzzy logic to include the opinions of experts. The Kourtit et al. (2012) analysis takes the concept of creative cities and its influence on economic growth as a departure point (Richard Florida, 2003a), assimilating the concept of Smart cities into it. They reduced the number of indicators used with principal component analysis, focusing on economic indicators, and produced an analysis focusing on the temporal evolution of cities.

The lack of consensus on the definition of the Smart City has been already explained in Chapter 2. When it comes to Smart City Assessment, this research has taken as a departure point definitions which are based in a multidimensional vision of the Smart City, assessing different dimension of the smart City. Each of the mentioned methodologies assess Smart Cities. The important difference in Smart city assessment is if what is assessed is technology itself or the impacts of technology. The analysed methodologies analyse either the impacts in the city or a combination of impacts and technological development (Italy). In this research is considered that technology is a means to reach outputs. Therefore, it is focused in the separation of technological means (identified in the classification of projects) and challenges). For this, the assessment through projects is key.

As described in the introduction, smart cities are implemented through projects that should be designed under an integrated urban strategy (Angelidou, 2014). However, the assessment tools analysed fail to consider relevant aspects in the real implementation of smart cities through specific projects. Both the methodologies in the first and second groups provide general sets of indicators aimed at analysing the general performance of the city. These indicators focus on selected areas where Smart City initiatives should have an impact but are not related to real Smart City initiatives and projects in the city but to generic dimensions or areas (i.e. economy, environment, etc.). The impacts could therefore be the result of any kind of project that is part of a different strategy being developed in the city. Even if the impacts of the projects cannot be isolated in the city, more detailed links could be established between specific types of SCPs and indicators at a deeper level than the general dimension they affect. Therefore, there is a need for tools capable of measuring the impacts of SCPs to make informed decisions about Smart City development and implementation. These tools should not only be able to analyse

isolated projects, but also to provide a comprehensive overview of the different projects in, and articulated by, the initiative.

Some attempts are being made in the direction of including the project scale in smart city assessment methodologies. The report "Mapping Smart Cities in the EU" (Manville et al, 2014), or the methodologies developed by Mattoni et al. (2015) or Branchi et al. (2014), become relevant examples in the field. The first one assesses the performance of Smart City Projects implemented in different European cities regarding their capability to affect the six dimensions proposed by Giffinger et al. (2007), as well as to reach the Horizon 2020 objectives. The methodology proposed by Mattoni et al (2015) modifies and adapts these six dimensions to five groups of actions (Energy, Economy, Mobility, Community and Environment), but also includes the scale as a key element of the assessment: regional, city or district levels. The proposal of Branchi et al. (2014) develops a matrix where different urban technologies are evaluated regarding objectives organized in 6 different aspects: user, social, urban, environmental, economic and energy requirements. It analyses specific technologies (not projects) belonging to three areas: mobility, energy and quality of life. It provides a qualification and a score from 1 to 5 according to an analysis that combines qualitative and quantitative methods. The first two proposals are based not on indicators but on the interrelations between areas or actions (Mattoni, 2015), or the interrelations of these areas with objectives (Manville et al, 2014). The last proposal is not based on city indicators but on a specific project analysis method.

As explained in the introduction, smart cities must be understood as a tool to solve urban challenges. However, none of the assessment methodologies analysed provide a sound multiple-objective assessment of smart cities or smart city projects in terms of the specific challenges facing cities. Almost all organize their objectives according to implementation areas (Acharandio et al., 2012; Branchi et al., 2014; Cohen, 2014; EY, 2016; Giffinger et al, 2007; Kourtit et al.,2012; Lazaroiu & Roscia, 2012; Lombardi et al., 2012; Manville et al., 2014; Mattoni et al., 2015) but do not establish clear relationships with the real problems of urban areas around the world. When they do, they do so generically (the Networked Society Index proposed by Ericsson (Networking Society Lab, 2016) focused on three challenges: climate change, air pollution and fossil-free energy consumption). This also means they are unable to adapt to the challenges of different areas or regions, as they propose sets of indicators to be used universally, and which usually focus on the challenges facing cities in the developed world.

The introduction also highlighted the increasing importance of the role of governance in the Smart City. However, the analysed methodologies do not reflect this fact. Only the methodology proposed by Lombardi et al. (2012) includes the opinion of stakeholders in the results. However, it fails to link their opinion with the final goals of the Smart City: providing an answer to Smart City challenges.

There is therefore a clear need for an assessment tool that serves as a combined answer to these three gaps: first of all, the need to assess smart city initiatives through SCPs as the main tool for their implementation; secondly, the need to establish relationships between the impacts of smart city strategies and the challenges facing

cities today, which differ among urban areas and regions; thirdly, the need of reflecting the increasing importance of governance and including the opinion of stakeholders in the evaluation.

As a conclusion, there is a need for an assessment tool capable of identifying impacts of smart city implementation projects on each city's specific challenges and integrating all of them into a comprehensive view. This tool should also be able to include the opinion of stakeholders to reflect their points of view.

2.3 European Framework

The Smart City concept have been widely implemented in cities all around the world. However, due to the lack of consensus on the definition of the topic and their implementation at a local scale, they have been implemented with very different perspectives. Different kind of institutions have established guidelines for unifying criteria about the Smart Cities conceptualization, development and implementation at an international or national level. At international level, there are examples like Supra-governmental institutions like the European Union or the United Nations, networks like the Smart City Council, organizations like the International Telecommunications Union or financial institutions like the European Investment Bank (Berst, Enbysk, & Williams, 2013; Cohen, 2014; International Telecommunication Union - Focus Group on Smart and Sustainable Cities, 2014; The European Commission, 2013). At national level, governments and cities organizations have made also different attempts like the Spanish network of Smart Cities or Belgium.

Today 78% of European citizens live in cities, and 85% of the EU's GDP is generated in cities, according to the (European Commission, s. f.). In European Cities, the concept of Smart Cities has been extensively implemented with different levels of intensity (Fig. 8). It became a brand for many European cities, which have made of the Smart City label a driver for their different objectives, such as technological implementation, urban development or city marketing. Due to the lack of consensus on the definition of the Smart City, it is also difficult to reach an agreement on the number of Smart Cities are being developed in Europe. The implementation of new technological solutions in municipalities takes place in most cities. Therefore, reports on the topic have proposed different criteria for defining which, and how many cities are becoming Smart. The report "Mapping Smart Cities in the EU" (Manville et al., 2014) considered cities over 100.000 inhabitants and identified 240 cities in the EU-28 that had "significant and variable Smart City activity". They focused mainly on cities developing projects about urban technological innovations financed by the European Union. Another characteristic can be the Smart City labelling. The Report on Urban policies for building smart cities (Collins, Alan; Leonard, Alan; Cox, Adam; Greco, Salvatore; Torrisi, 2017) identified 114 self-proclaimed "smart city projects" for the time period 2005-2016. In June 2018, Andrea Strachinescu, Head of Unit, New energy technologies, innovation and clean coal, DG Energy at European Commission provided data about Smart Cities under the framework of the European Innovation Partnership on Smart Cities and Communities (EIP SCC) (Claire Taylor, 2018). Under the programme, 78 cities in Europe have undertaken smart

city development, but the program aims to reach the number of 300 by the end of 2019 (Fig.9).

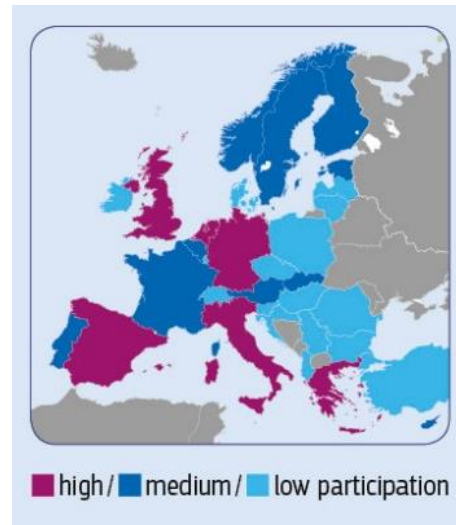


Figure 10: Intensity of participation in the calls of the European Marketplace of Smart Cities.
Source: EIP-SCC (2016).

The definitions of different samples for the study and assessment of Smart City cases in Europe has also produced different numbers depending on the chosen characteristics. One of the characteristics used to define these sample has also been the size of cities, as in the Ranking for European Smart Cities, which focused on Medium-sized cities (70 cities were analysed) and larger cities (90 cities between 300.000 and 1 million inhabitants from 21 countries). (Fig. 10)



Figure 11: 90 Larger cities analyzed in the European Smart Cities ranking by TU Wien.
Source: Giffinger et al., 2007.

The availability of data about the cities were the characteristics used to define a sample of 94 Smart Cities in Europe, (Caragliu & Del Bo, 2012) for the study of the European Smart Cities proposed by the authors.

Therefore, according to literature there is no consensus about the number of Smart Cities developed in Europe. However, there is an agreement among author in the wide spread of the concept among European cities and the importance of the implementation within the Smart City framework.

But it is not only a matter of number of Smart Cities. Different worldwide commercial rankings on smartness in cities are led by European Cities. (Cohen 2014; IESE 2016; Networking Society Lab 2016). Even if these rankings cannot be considered as proof of the quality of the cities, they are important for the marketing of cities.

The case of Europe is not only particular because of the number of cases or the level of implementation. Smartness is one of the priorities for the Europe 2020 Strategy. The European Union also developed specific policies and financing instruments for the development of the Smart City concept. These two facts, the implementation and the political focus in the topic, have fostered each other.

The framework of the European Union Policies on Smart Cities is explained by (Russo et al., 2014), that developed a diagram to explain it (Fig. 11).

The Europe 2020 strategy was launched in 2010 as "A strategy for smart, sustainable and inclusive growth" (European Commission, 2010). Therefore, the strategy defines three priorities smart growth, sustainable growth and inclusive growth. Smart Growth is understood as "developing an economy based on knowledge and innovation". Five headlines' targets are defined: employment, research and innovation, climate change and energy, education and fighting poverty and social exclusion. Finally, seven flagship initiatives were proposed under this strategy, three of which are related to Smart Growth: "Innovation Union", "Youth on the move" and "A Digital Agenda for Europe".

This first flagship initiative, the "Innovation Union", is key for the development of Smart Cities in the European Union. The initiative focuses on: tackling the unfavourable framework conditions; avoid fragmentation of effort; focusing on innovation that address Europe 2020 societal challenges; Pursuing a broad concept of innovation and Involving all actions and all regions in the innovation cycle. The initiative has among its objectives "pooling forces to achieve breakthroughs" through the European Innovation Partnerships (EIPs) (European Commission, 2011b). The partnership will be "challenge-driven", will "act across the whole research and innovation chain" and will "streamline, simplify and better coordinate existing instruments and initiatives", and attention to governance and working methods has been highlighted. Therefore, strategic planning and efficiency through a holistic approach are key, as well as the involvement and coordination of the different agents in innovation, are key for the initiative and the basis for the EIPs.

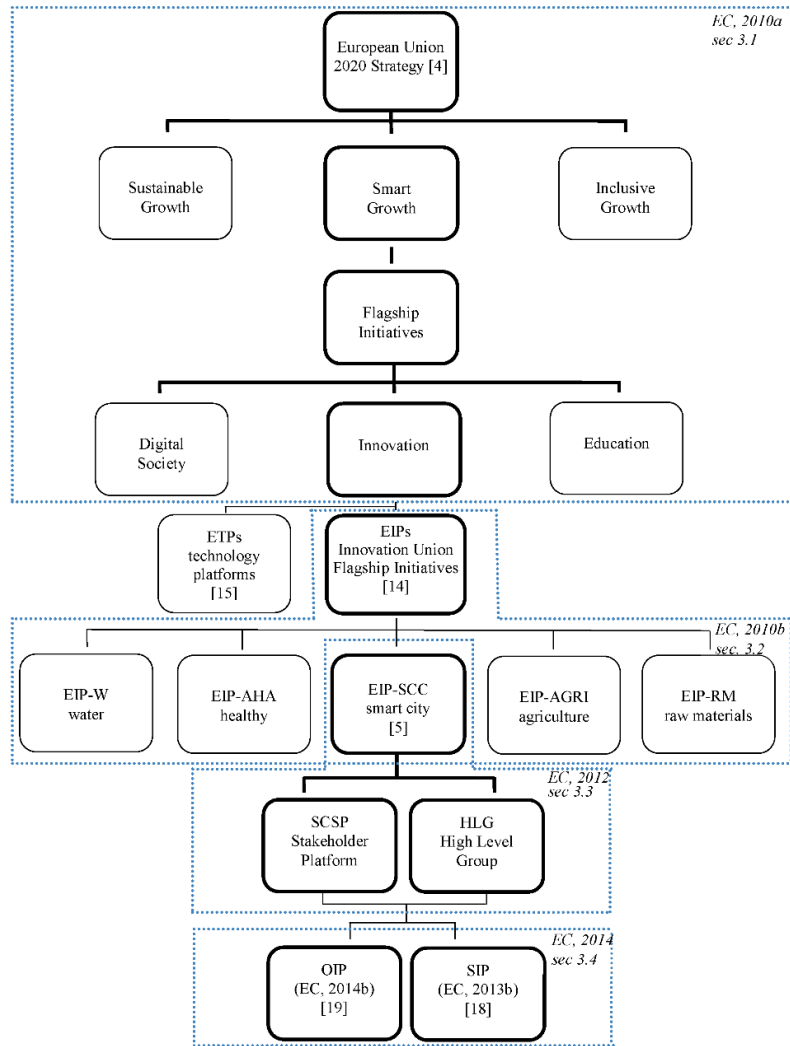


Figure 12: The Smart City European Process.
Source: Russo et al., 2014.

One of the partnerships selected for its implementation is the European Innovation Partnership for Smart Cities and Communities, launched on July 2012 (European Commission, 2012) focused at the convergence of Energy, Transport and ICT in the Urban Context (Fig. 12).

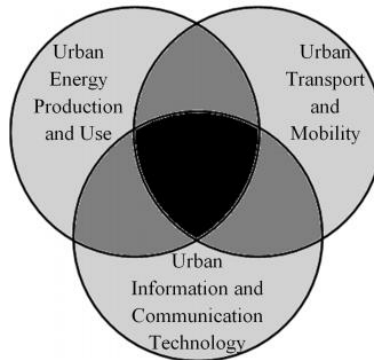


Figure 13: Vision of the areas of the SCC, that focuses on the interaction of the three areas.
Source: European Commission, 2012.

The European Innovation Partnership on Smart Cities and Communities actions is coordinated by two plans: the Strategic Plan and the Operational Plan. The Strategic Plan defines the objectives of the EIP-SCC, proposes a structure in three areas and eight action clusters and defines eleven actions for its successful implementation. (EIP-SCC, 2013)

The three areas are Sustainable Urban mobility, Sustainable Districts and Built Environment and Integrated Infrastructure and processes across Energy, ICT and Transport. Eight transversal action clusters are developed: citizen focus; business models, finance and procurement; integrated infrastructures and processes; integrated planning, policy and regulations; sustainable districts and built environment; sustainable urban mobility.

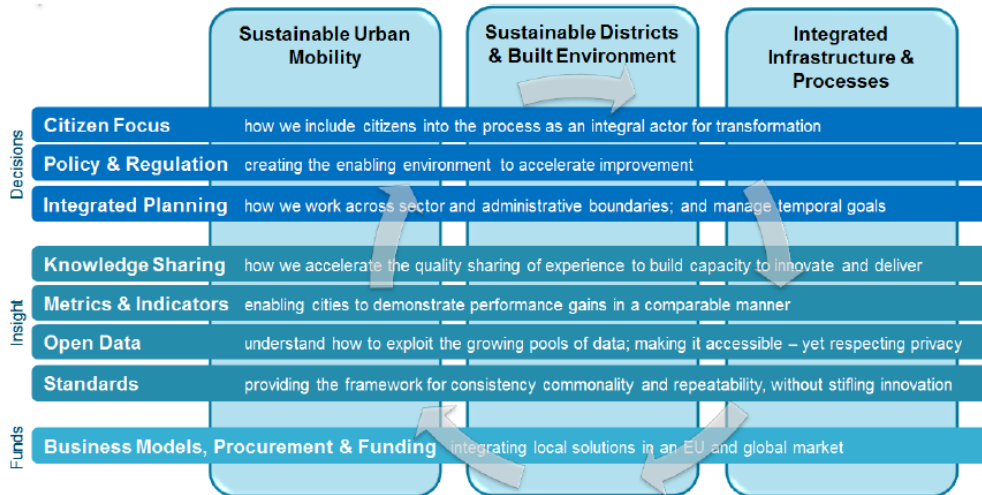


Figure 14: Structure of the EIP-SCC.
Source: EIP-SCC (2016).

Therefore, the main instrument for the European Union for pushing the Smart City concept is a Partnership among stakeholders, governance being the key element. Decision making plays a key role with three Action Clusters: Citizen Focus, Policy and Regulation and Integrated planning. The integrated vision is also crucial for the Innovation Union, as said before.

The Operational Implementation Plan (OIP) (The European Commission, 2013) is a companion document to the Strategic Implementation plan. It develops in detail the eleven priority areas proposed in the SIP (corresponding to the three main areas plus the eight action clusters) and proposes general implementation modes. It defines potential actions for each of the priority areas.

Governance is key not only for the development of Smart Cities in the European Union, but also for the implementation (Fig. 13). In fact, according to its website (EIP-SCC & European Commission, 2016), the EIP-SCC consists of the High Level group (supported by its Sherpa group) and the Market place.

- The High level group is confirmed by the High level representatives of industry, research and cities, that includes associated members to conform its Sherpa Group (Russo et al., 2014). The HLG focuses on barriers for the development of Smart Cities and societal needs and advises the European Commission. The HLG supported by Sherpa group developed the Strategic Implementation plan (EIP-SCC, 2013). The Sherpa group oversaw the Operational Implementation plan.
- EIP-SCC Marketplace brings together cities, industries, SMEs, investors, researchers and other smart city stakeholders. It aims to “Engaging cities, industry and financiers in interest matching activities, leading to project design and delivery” (EIP-SCC, 2016) (Fig. 14).

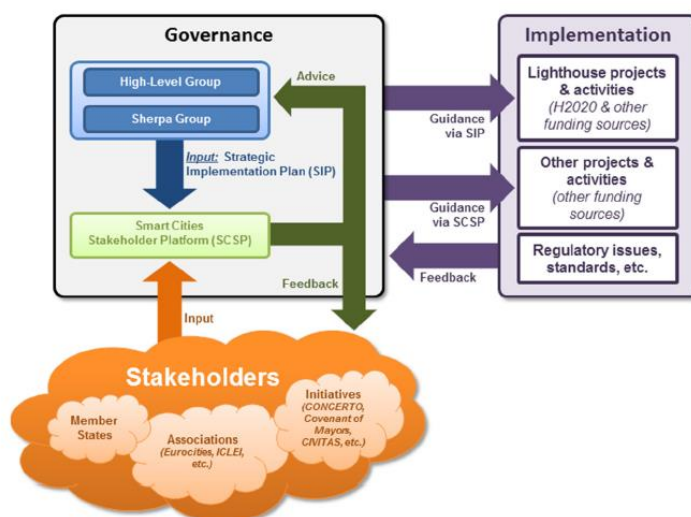


Figure 15: Governance structure of the EIP-SCC.
Source: Russo et al., (2014).

It is important to remark that the EIP-SCC is not a financing instrument. However, the European Union offers specific financial tools for Smart Cities. According to the Operational Implementation plan, Smart City initiatives were initially implemented through small projects with disbursement at project level. On a second wave, projects of a bigger scale were implemented and financed through public grants, i.e. through the FP7. In 2013 a new wave was considered to start framed in the EIP-SCC. This wave is characterized by the collaboration of public-private sectors and co-financing of public funds.

The Strategic Implementation Plan proposed the “Lighthouse initiatives” establishing city groupings to achieve (together with industries and other stakeholders) smart city solutions. They aim to achieve the 20/20/20 goals based on integrated technologies across the mobility, ICT and energy sectors. They are partly financed by Horizon 2020, the European Commission’s research and innovation programme on the area’s low energy districts; integrated infrastructures and sustainable urban mobility. From 2014 to 2018, a total of twelve Smart Cities and Communities ‘Lighthouse’ projects were funded, reaching €270 million (Claire Taylor, 2018).

Other public and private funding sources can finance other Smart City projects and activities, like JESSICA (Joint European Support for Sustainable Investment in City Areas), Risk Sharing Financing Facility (RSFF) or ELENA (European Local Energy Assistance) (Russo et al., 2014).

As a partial conclusion, instead of focusing on financing, the EIP-SCC has focused on bringing together Cities, Industries and funders/financers (Fig. 15). This shows the importance of bringing together the different stakeholders for the European Union cities. The financial tools for the implementation of Smart City initiatives for the period 2014-2020 are focused to the combination of public and private fundings, and the involvement of diverse stakeholders.

Stakeholders’ involvement is therefore one of the key elements of the development of the Smart cities in Europe. The definition of the Smart City as a “multi-stakeholder, municipally-based partnership”, appearing in the report of the European Commission “Mapping smart cities in the EU” (Manville et al., 2014), clearly reflects this idea. Different initiatives aim to bring together stakeholders in European cities for the development of Smart City projects. The European Marketplace for Smart Cities and communities focuses on three groups of stakeholders: Cities, Industries and funders/financers (Marketplace of the European Innovation Partnership on Smart Cities and Communities (EIP-SCC, 2016).

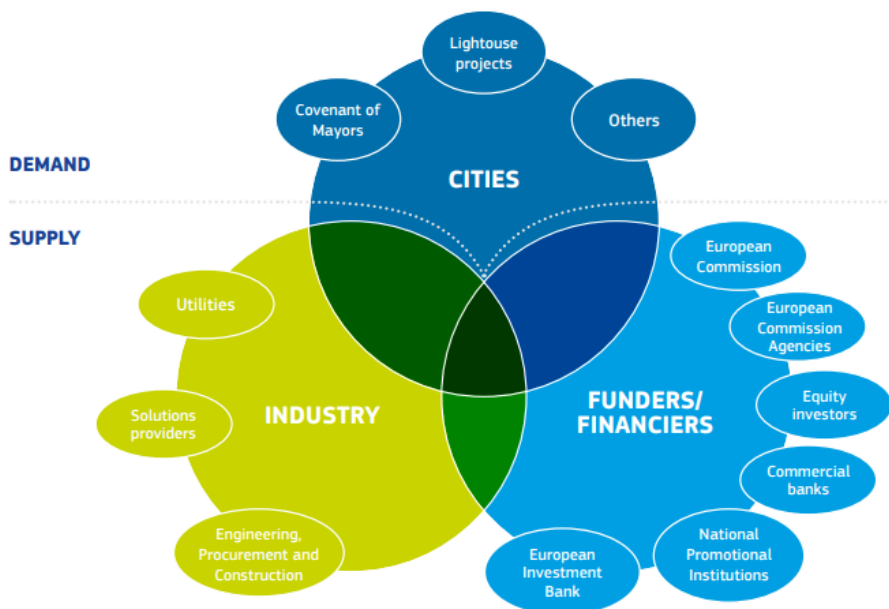


Figure 16: Main stakeholders according to the EIP-SCC.
Source: EIP-SCC, 2016.

The analysis of the share of organisations leading the smart city projects belonging to the European Innovation Partnership for Smart Cities and Communities shows the main role of public authorities (Fig. 16). But also business have a great importance in the promotion of Smart Cities.



Figure 17: Classification of lead organizations leading smart city projects belonging to the European Innovation Partnership for Smart Cities and Communities.
Source: European Commission, n.d.-b.

NGOs and private individuals reach together an 8% of the share of leadership. A small share if we compare it to the other groups. Institutions and business are having trouble to communicate and spread the Smart City concept among civil society, and to reach their involvement.

There is also a difficulty for the Smart City concept to reach citizenship. In 2016 study of the British IET (The Institution of Engineering and Technology, 2016) asked citizens about their definitions of the Smart City. Some of the citizens definitions does not go much further than "Wi-fi and techno stuff" or "A place where electronics firms gather", even if some others revealed an understanding of their own role, like "city where people are smart ". However, in general terms, their idea of the Smart City was very fuzzy and unclear. No research of this kind was made at a European level, but the British case serve as an example of the existing gap between the Smart City and citizens.

The concept of Smart City is widely spread and implemented in European Cities. European Union has developed policies and financing tools for the development of the concept, which are mainly focused on the cooperation of stakeholders. However, not all stakeholders share the same vision, and they are not involved at the same level in the platforms. The visions of the different stakeholders must be considered to foster their involvement. Their ideas should be compared with the implementation of the Smart City concept to see if they are being listened and included. As a conclusion, there is a need to bridge the gap between Smart City implementation and discourses in the European Region.

3 PROPOSAL OF A SMART CITY CONCEPTUAL MODEL

In this chapter proposes a Smart City conceptual model. It is an extended version of section 3 of the article "Smart City implementation and discourses: An integrated conceptual model. The case of Vienna." published in the scientific journal "Cities" (See (Fernandez-Anez, Fernández-Güell, et al., 2018). In this chapter the basis for the proposed conceptual model is defined taking as a basis the definitions of conceptual model in chapter 2. This conceptual model is an abstract representation of the Smart City system, gathering both physical and social aspects. It takes as a basis the principles defined in chapter one. Therefore, it is focused on representing the complex reality of the Smart Cities according to the defined concepts. It aims to enhance understanding of the reality, as well as to simulate different stages and points of views about it.

After analysing the use of conceptual models in the scientific literature on Smart Cities, a new model is proposed. This research understands the Smart City as an integrated and multi-dimensional system that aims to address urban challenges based on a multi-stakeholder partnership. The conceptual model proposed follows a comprehensive and integrative approach to Smart Cities that links the three main issues identified: (a) the key role of governance and stakeholders' involvement (see 3.1.); (b) the importance of displaying a comprehensive vision of Smart City projects and dimensions (see 3.2.); and (c) the understanding of the Smart City as a tool to tackle urban challenges (see 3.3.). Finally, in 3.4., the three parts of the conceptual model are shown interrelated. The model is described from the centre to its outer limits, but not necessarily in a linear sequence, in order to aid its understanding.

3.1 Subsystems and stakeholders

The model places the stakeholders at the centre (Fig. 17), as governance structures are considered the core of the Smart City. Several authors (Albino et al., 2015; Batagan, 2011; Castelnovo et al., 2015; Fernández-Güell et al., 2016; Nam & Pardo, 2011a) consider citizen-centric approaches to be at the heart of governance in the Smart City. Other authors view quality of life as the main goal for Smart Cities in a human-centric vision (Caragliu et al., 2011; Dameri et al., 2016; Misuraca et al., 2010). Citizens are therefore placed at the centre of the model.

The literature on Smart Cities uses the university-industry-government triple helix model (Leydesdorff & Deakin, 2010) to study the stakeholder structures operating within it. Some authors also include civil society as one of the groups in an extended triple helix model (Etzkowitz & Zhou, 2006; Lombardi et al., 2011). Four stakeholder groups are therefore at the core of the conceptual model: political, social, economic and knowledge stakeholders (Fig. 17). Political stakeholders include government institutions and political parties; social stakeholders are civil society experts and institutions; economic stakeholders comprise a wide range of public and private companies; and finally, knowledge stakeholders are universities and research centres in the city. All these groups overlap, and experts and institutions may belong to more than one. Citizenship overlaps all the subsystems.

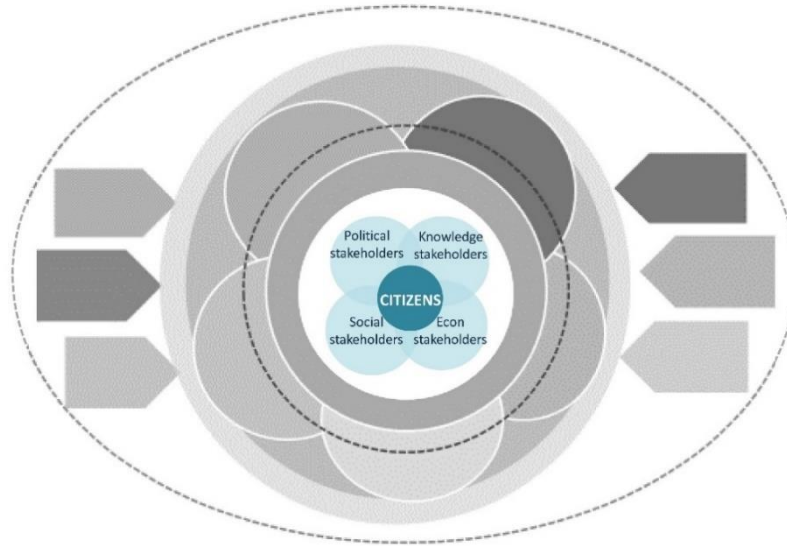


Figure 18: Basis for the conceptual model.
Source: Fernandez-Anez, Fernández-Güell, et al., 2018.

3.2 Smart City dimensions and initiatives

The Smart City stands at the confluence of the spatial and technological subsystems as an answer to urban challenges. Many authors use the work of (Giffinger et al., 2007) as the basis for systematizing the approach to the complexity of the Smart City. This work conceptualizes six Smart City dimensions: "Governance", "Economy", "Environment", "Mobility", "People" and "Living". Smart City initiatives are organized around stakeholder groups and urban challenges to respond to the requirements of different stakeholder groups (Fig. 18). Initiatives can (and should if they aim to be integrative) affect more than one group, thus increasing efficiency in urban management. Governance issues gradually move to centre stage in discussions on the Smart Cities (Meijer & Bolivar, 2015), and some authors identify them as essential for their success (Albino et al., 2015; Nam & Pardo, 2011a). SC governance initiatives are placed at the centre of the conceptual model since they tend to lead the development of other SC dimensions.

This structure is the basis for classifying the projects to be included in Smart City Initiatives, as in the proposal of the ASCIMER project (Monzon, 2015; Monzon, Andres; Fernandez-Anez, Victoria; Velazquez-Romera, Guillermo; Perez-Prada, 2017). It was developed taking as a departure point the best practices survey developed in mentioned project. Table 1 shows the final structure of this taxonomy for Smart City Projects proposed in (Fernandez-Anez, Velazquez, et al., 2018).

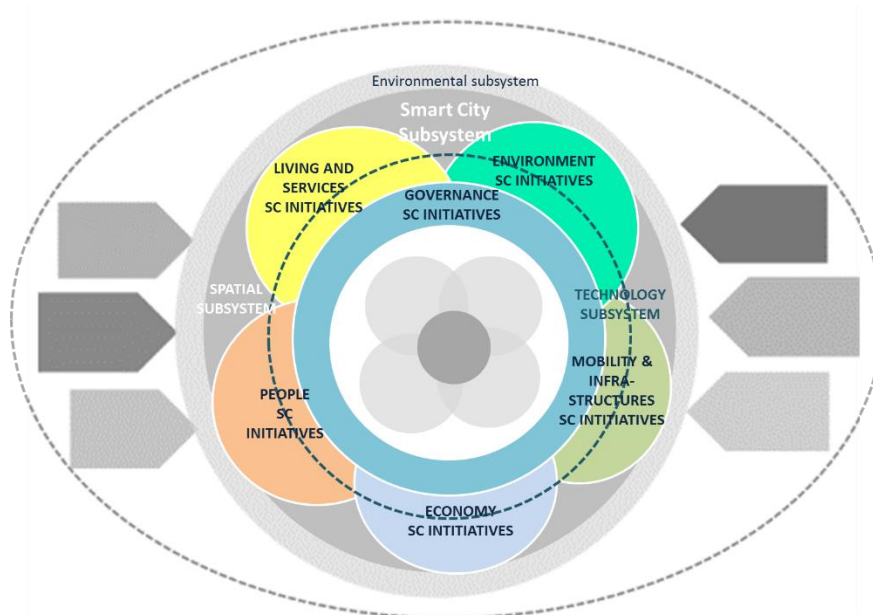


Figure 19: Smart City dimensions and initiatives.
 Source: Fernandez-Anez, Fernández-Güell, et al., 2018.

	PROJECT AREAS	PROJECT ACTIONS			
Smart Governance	SGo1. Participation	Complaints and suggestions	Participation in decision making	Collaborative production of services	
	SGo2. Transparency and information access	Open data.	Governmental transparency	Representation and access to information	
	SGo3. Public and Social Services	Online public and social services.	Services integration and interconnection.	Public entities in social networks.	
	SGo4. Multi-level governance	Integration of governmental levels	Interconnectedness of governmental levels		
	SGo5. Efficiency in municipal management	Efficiency in management, regulations and instruments.	Efficiency in the provision of services		
Smart Economy	SEc1. Innovation	Policies and plans for enhancing innovation.	Physical infrastructure for innovation.	Services for innovation.	New business based on innovation
	SEc2. Entrepreneurship	Entrepreneurial education and training.	Creation of entrepreneurial environments.	Entrepreneurial support policies and actions	
	SEc3. Local & Global interconnectedness	City internationalization.	Business and commerce networks.	Presence of business in the internet.	Globalization risk management.
	SEc4. Productivity	Physical and technological infrastructure for productivity	Management for adaptation		

	PROJECT AREAS	PROJECT ACTIONS			
	SEc5. Flexibility of labour market	Measures to improve accessibility to labour market	Measures to combat unemployment.	Technological improvements for flexibility	
	SMo1. Traffic management	Strategic corridor and network management	Incident management	Safety enhancement	Real time traveler information
	SMo2. Public Transport	Real time traveller and operator information	Safety and security enhancement.	Public transport alternatives.	Integrated payment systems
	SMo3. ICT Infrastructure	Systems for data collection	Systems and protocols for data communication	Systems and procedures to ensure quality of the data	Payment systems&Ticketing
	SMo4. Logistics	Improvement on the traceability of goods	Fleet tracking&management	Stock management	Last mile solutions
	SMo5. Accessibility	Enhancing physical accessibility	Enhancing digital accessibility	Enhancing socio-economical accessibility	Enhancing cultural accessibility
Smart Mobility	SMo6. Clean and non-motorized options	Clean energy in traffic and parking.	Cycling options.	Walking options.	Alternative motorized options
	SMo7. Multimodality	Passenger multimodality	Freight multimodality		
	SEn1. Network and environmental monitoring	Environmental monitoring	Network monitoring.	Applications to visualize the information collected	
	SEn2. Energy efficiency	Smart grids.	Renewable energy.	Energy efficiency in buildings and districts.	Energy efficiency in public devices.
	SEn3. Urban planning and urban refurbishment	Urban planning in new developments.	Urban Refurbishment.	Urban management related to planning.	Participation in urban management and planning
	SEn4. Smart buildings and building renovation	Sustainability in new buildings.	Sustainability in building renovation.		
	SEn5. Resources management	Waste management.	Water management.	Food management.	Consumption patterns.
Smart Environment	SEn6. Environmental protection	Natural resources protection.	Ecosystems protection.	Biodiversity protection.	
	SEn7. Awareness and behavioural change	Tools for behavioural change	Awareness rising tools	Involvement in sustainable measures in buildings and urban spaces	
Smart	SPE1. Digital education	Technology and learning methods.	Skills for technology.		

PROJECT AREAS	PROJECT ACTIONS			
SPe2. Creativity	Fostering creative activities	Creative networks.	Partnerships including creative entities.	
SPe3. ICT - Enabled working	Measures and platforms for employment.	Home-based work and workplace flexibilization.	Timetable flexibilization.	
SPe4. Community building and urban life management	ICT-enabled bottom up initiatives.	Community based organizations networking and platforms.	Community and urban life information spreading and sharing	
SPe5. Inclusive society	Human rights watch.	Inclusion policies and measures	Civil society organizations support	
SLi1. Tourism	Tourism information via	Tourism accommodation	Online tickets or tourist card	Integration of tourism with
SLi2. Culture and leisure	Culture information via Internet.	On-line tickets, reservations and inscriptions.	Cultural heritage management.	Participation in municipal cultural program
SLi3. Healthcare	Disease prevention.	Promoting healthier lifestyle and well-being.	Improve access to healthcare.	Health information and education.
SLi4. Security	Urban security.	Security services online	Digital security	
SLi5. Technology accessibility	Accessibility to people with disabilities and	Overcoming technological barriers	Measures to solve environmental	Measures to solve cultural and income
Smart Living	SLi6. Welfare & Social inclusion	Improving accessibility to labor market	Gender inclusion; family and children aid	Services for immigrants. online volunteering and Interconnection with services
	SLi7. Public spaces management	Integration and connection of uses	Adaptation of public space to users	Public space management

Table 1: List of project groups in the different dimensions.

Source: Fernandez-Anez, Fernández-Güell, et al., 2018.

The taxonomy is structured into 3 levels: Smart City dimensions, Project Areas and Project actions. The first level has been described in the previous paragraph: the six Smart City dimensions (Governance, Economy, Mobility, Environment, People and Living). The second level, named Project Areas, aims to group the main initiatives that have been identified in the surveyed project. It provides a first level of classification that can be used to simplify the description of the Smart City projects and initiatives. Five to seven Project Areas have been described in each of the dimensions, reaching a total number of 36 project areas. The third level, named Project Actions, described the main actions developed by the Smart City projects. A total number of 118 Project Actions has been described (82 to 4 per project area). This taxonomy is not a closed system, and it aims to be in permanent revision and evolution, as urban technology is fastly changing. New project actions and areas can be added to the proposal in the future.

The taxonomy is a tool that allows to describe the complexity of Smart City projects considering their multiple dimensions. It can be used either to describe existing projects or to develop new proposals. A Smart City initiative can combine projects belonging to more than one of the defined dimensions, mixing Project actions belonging to different Project Areas and dimensions. This multi-dimensional perspective and complexity lies at the core of the definition of the Smart City.

A Smart City initiative can combine projects belonging to more than one group and more than one of the dimensions defined in (Fernandez-Anez, Velazquez, et al., 2018).

In order to demonstrate the use of the tool, and example of the classification of two projects of different characteristics and sizes is provided.

The first example is the app of the Vienna Municipal Department 48: MA48 App. The MA 48 (Fig. 19) is in charge of waste management, cleaning of streets and fleet of vehicles. The application offers all the key information on waste disposal in Vienna. The public access facilities of the waste management, street cleaning and vehicle fleet divisions (MA 48) can be easily located in the city plan. A calendar lists upcoming collection dates for mobile waste collection points for problematic waste, the "yellow bag" collection for single-family homes included in the 22nd District 22 area, as well as upcoming MA 48 events.



Figure 20: Logo of the application.
Source: Vienna Smart City strategy webpage.

The "Waste ABC" of the application provides clear information on environmentally correct waste separation, news updates and easy contact with MA 48: the complete package. In addition, you can access important information about the central services of lost objects in Vienna. More than 13,000 users have already downloaded the application, this took place in approximately 14 months. Approximately 100 new users are added every week. The following classification is proposed in Table 2:

	Project Areas	Project actions	Specific actions
SMART ENVIRONMENT	SEn1. Network and environmental monitoring	Network monitoring. Applications to visualize the information collected.	monitoring of the elements of waste management.
	SEn5. Resources management	Waste management.	It is the main objective of the tool.
	SEn7. Awareness and behavioural change	Tools for behavioural change	Contains guidelines on waste separation.
SMART GOVERNANCE	SGo1. Participation	Complaints and suggestions	Provides direct communication with the council.
	SGo2. Transparency and information access	Open data.	Provides information about the service.
	SGo5. Efficiency in municipal management	Efficiency in the provision of services	Provides information about the service.

Table 2: Classification for the project MA48 app.
Source: author's own elaboration.

The second example is the urban development "Aspern Urban Lakeside Vienna". The integrated design of the public space is the backbone of the prospective urban development. "Aspern Urban Lakeside Vienna" is a project of new dimensions. The project area of 240 hectares makes it one of the largest urban developments in Europe, it is a city within the city. Quality of life and cooperation are at the top of the agenda.

Aspern Urban Lakeside in Vienna will be built in the northeast of the city by 2028. In the future, 8,500 housing units will accommodate 20,000 people. In addition, 20,000 jobs will be created in the fields of service, commerce and industry, science, research and education.

A project of this scale, almost a city in itself, needs a very complex classification that provides multiple examples, and for that reason it has been selected. We can see it in table 3:

	Project Areas	Project actions	Specific actions
SMART GOVERNANCE	SGo1. Participation	Participation in decision making.	Creation of the masterplan with citizen participation
		Collaborative production of services.	Citizen collaboration in the implementation through "city labs"
SMART ENVIRONMENT	SEn1. Network and environmental monitoring	Network monitoring.	Monitoring of the electrical network
	SEn2. Energy efficiency	Smart grids.	Sensorized low voltage network managed by Siemens.
		Renewable energy.	incorporation of renewables in urban lampposts.
		Energy efficiency in buildings and districts.	Management of buildings by Siemens.

	SEn3. Urban planning and urban refurbishment	Urban planning in new developments.	Smart and sustainable urban planning.
		Participation in urban management and planning.	Citizen participation in urban design.
	SEn4. Smart buildings and building renovation	Sustainability in new buildings.	New buildings' construction according to sustainable criteria.
	SEn5. Resources management	Waste management.	Management of construction waste integrated into landscape design.
	SEn6. Environmental protection	Natural resources protection.	Protection of the natural environment
		Biodiversity protection.	Creation of a lake for birds, being in a migratory passage.
	SEn7. Awareness and behavioural change	Tools for behavioural change.	Energy efficiency and mobility guidelines are provided.
Involvement in sustainable measures in buildings and urban spaces.		Participation in the design of urban spaces.	
SMART MOBILITY	SMo1. Traffic management	Strategic corridor and network management.	Pedestrianization and restricted traffic areas.
	SMo2. Public Transport	Public transport alternatives.	Oriented since the beginning to its access in public transport, with information available through the apps of the City of Vienna.
	SMo3. ICT Infrastructure	Fleet tracking&management.	Implementation of a "big data" collection system associated with energy.
	SMo4. Logistics	Last mile solutions.	The use of bicycles has been incorporated for the local distribution of goods.
	SMo5. Accessibility	Enhancing physical accessibility.	Urban design with accessibility criteria
	SMo6. Clean and non-motorised	Cycling options.	Public bicycle service.
		Walking options.	Pedestrian ways.
SMo7. Multimodality	Passenger multimodality.	Combination of public transport with private and public bicycles.	
SMART PEOPLE	SPe4. Community building and urban life management	Community and urban life information spreading and sharing.	Platforms for dissemination of participatory meetings.
	SPe5. Inclusive society	Inclusion policies and measures.	Social inclusion in discussion platforms.

Table 3: Classification for the project "Aspern Urban Lakeside Vienna" (continues in table 15).
Source: Author's own elaboration.

SMART LIVING	SLi7. spaces management	Public	Adaptation of public space to users.	Co-creation of public spaces through workshops.
SMART ECONOMY	SEc1. Innovation		Policies and plans for enhancing innovation. New business based on innovation.	Creation of an innovation center
			Physical infrastructure for innovation.	20,000 jobs will be created in the fields of service, commerce and industry, science, research and education. Spaces for companies based on innovation
	SEc2. Entrepreneurship		Entrepreneurial education and training.	Training courses-
			Creation of entrepreneurial environments.	Spaces for new businesses in the innovation center.

Table 4: Classification for the project "Aspern Urban Lakeside Vienna" (continues table 14).
Source: Author's own elaboration.

Finally, support subsystems for the Smart City are defined in the conceptual model:

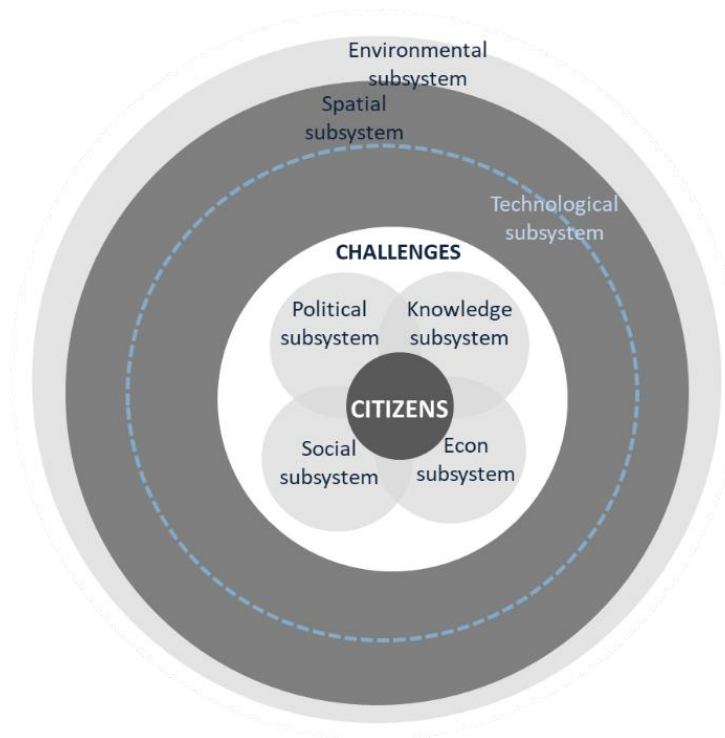


Figure 21: Stakeholders at the core, surrounded by the spatial, technological and environmental subsystems.
Source: Author's own elaboration.

Stakeholders are at the core of the city system and are supported by two main urban functional subsystems –spatial and technological–, where the city is understood as the confluence of these two spaces (Castells, 2004) (Fig. 20). The elements in the human-built urban environment form the urban spatial subsystem: streets and urban infrastructures, housing, buildings, facilities, open spaces, etc. The technological subsystem consists of the various technological tools developed in the city, and –in the Smart City literature– is mainly based on ICT and information transfer (Batty et al., 2012). It articulates and connects the elements in the spatial subsystem. In the next step, the Smart City is seen as the confluence of these two different subsystems. Lastly, the environmental subsystem remains outside the model as the basis and support for any urban development.

3.3 Challenges and global trends

As explained in chapter 1, Smart Cities must be understood as a response to urban challenges, according to different authors (Albino et al., 2015; Anthopoulos et al., 2015; Chourabi et al., 2012; De Santis et al., 2014; Meijer & Bolivar, 2015; Nam & Pardo, 2011b). The conceptual model of a Smart City can only be defined by understanding the challenges and trends that affect the city. Citizenship and stakeholder groups pose important challenges that the different urban functional subsystems need to answer.

The main global trends and challenges affecting cities in the European region were identified in the literature review (European Commission, 2011a; Fernández-Güell et al., 2016; Nijkamp & Kourtit, 2013) and compared with the opinions of the stakeholders interviewed to complete the selection. The challenges raised by the stakeholder groups are entered in the model as a new element that surrounds these groups (Fig. 21) and are closely related to more general global trends also affecting European cities, which are identified and placed outside the model. Table 5 shows the list of identified challenges grouped by global trends (Fernandez-Anez, Fernández-Güell, et al., 2018). They were identified through a literature review (European Commission 2011; Nijkamp & Kourtit 2013; Fernández-Güell et al. 2016). Modifications on the table were made according to the suggestions of the experts interviewed in the pre-validation stage

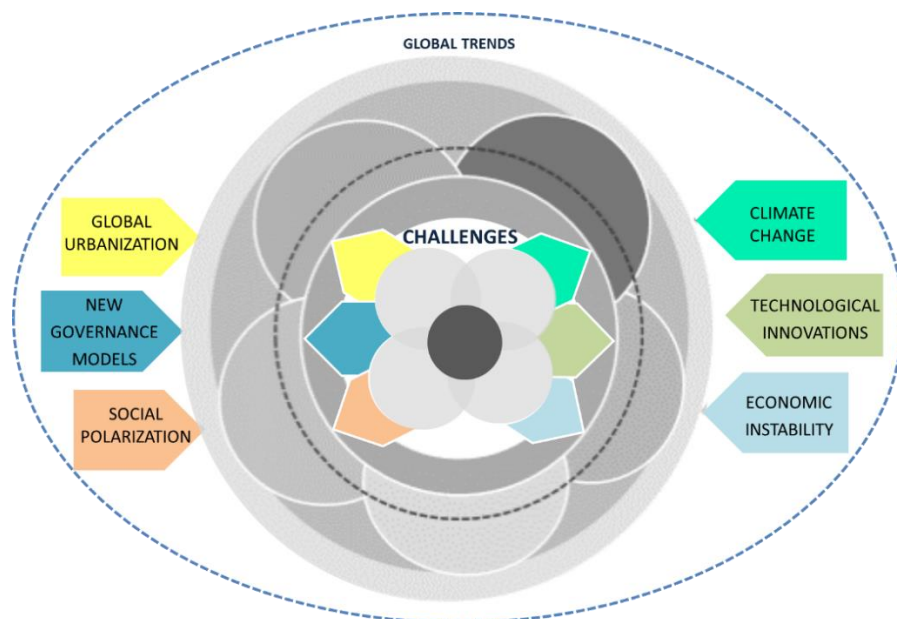


Figure 22: Global trends and urban challenges affecting the conceptual model.
Source: Authors' own elaboration

GLOBAL TRENDS	URBAN CHALLENGES
1. CLIMATE CHANGE	1.1. Reducing ecological footprint and pressure on ecosystems, promoting ecological functions of land
	1.2. Increasing efficiency in resource management (energy, water, etc.) and promoting a circular economy
	1.3. Fostering cities' resilience to climate change and disaster risks
	1.4. Developing eco-friendly urban environments and responding to growing environmental concerns
	1.5. Implementing a holistic approach to environmental issues
2. SOCIAL POLARISATION	2.1. Promoting social inclusion, cohesion and equity
	2.2. Enhancing the inclusion of migrants and refugees
	2.3. Adapting the city's economic and social life to an ageing population while attracting young people and children
	2.4. Promoting equity in access to the labour market and the work-life balance
	2.5. Eradicating spatial exclusion and promoting equity in access to housing and quality urban environments
	2.6. Enhancing social diversity as a dynamic asset
3. NEED FOR NEW GOVERNANCE MODELS	3.1. Changing to a more participative and inclusive democracy
	3.2. Promoting citizenship via urban co-creation and co-management combining top-down and bottom-up models
	3.3. Increasing the flexibility and resiliency of governance models
	3.4. Improving the effectiveness of institutions, coordination among public bodies and multilevel governance (leading to more integrated sector policies)
	3.5. Incorporating and regulating innovative management systems at the local level while improving capacity building (i.e. PPP or PPPP, e-governance, etc.)
	3.6. Enhancing territorial cohesion

GLOBAL TRENDS	URBAN CHALLENGES
4. GLOBAL URBANISATION	4.1. Managing the urban population growth while reducing negative externalities
	4.2. Maintaining quality of life in cities, ensuring access to services in line with changes in demand (education, health, culture, safety, etc.)
	4.3. Promoting interurban variety and cities' identity by protecting cultural heritage
	4.4. Developing new planning tools for sustainable development (less urban sprawl, polycentric plans, increased density and diversity, mixed land use, urban refurbishment...)
	4.5. Fostering sustainable accessibility in cities and promoting sustainable, inclusive and healthy mobility when needed
	4.6. Balancing urban growth and territorial development (managing the urban-rural balance)
5. ECONOMIC INSTABILITY	5.1. Improving the resilience of economic systems and adaptation to changes in global and local economies
	5.2. Improving the sustainability and diversity of local economies in balance with cities' specialization
	5.3. Managing adaptation to innovation and knowledge-based economies while providing solutions to a broad skill base
	5.4. Fostering human and social capital as source of innovation
	5.4. Enhancing integration in global economies, promoting cooperation among cities and territories
	5.5. Fostering employment creation with high quality standards
6. INCREASING IMPORTANCE OF NEW TECHNOLOGIES	5.6. Achieving balance between competitiveness and quality of life
	6.1. Enhancing the adaptation of society, governance and economy to transformation through ICT
	6.2. Coordinating new technologies for energy saving and reducing emissions through planning and governance tools
	6.3. Articulating mobility planning tools and policies with innovations in the sector
	6.4. Promoting technological innovation driven by social and human capital
	6.5. Reducing externalities in the implementation of new technologies (i.e. cybersecurity)

Table 5: Global trends and associated urban challenges identified.

Source: Fernandez-Anez, Fernández-Güell, et al., 2018.

3.4 Diagram of the global vision

Based on the discussion above, the conceptual model shows the various stakeholders and urban subsystems in relation to the different Smart City dimensions and initiatives and the contextual challenges affecting cities (Fig. 22).

Following the sequence previously described (4.1., 4.2. and 4.3.). Figure 29 displays the three elements according to the three main issues identified:

- At the core, citizens and stakeholders (Political, knowledge, Economic and social) are placed
- They are surrounded by the different dimensions that classify the Smart City projects: Governance, Environmental, Mobility and Infrastructures, Economy, People and Living. Of these dimensions, Governance plays a central role

coordinating the other dimensions. They are articulated by the technological subsystem and rely on the Spatial subsystem.

- Global trends is the third main issues and surround the other two affecting and modifying them.

The description of the case study of Milan Smart City (5.1., 5.2. and 5.3.) will also follow this sequence, finally showing the complete model (5.4.).

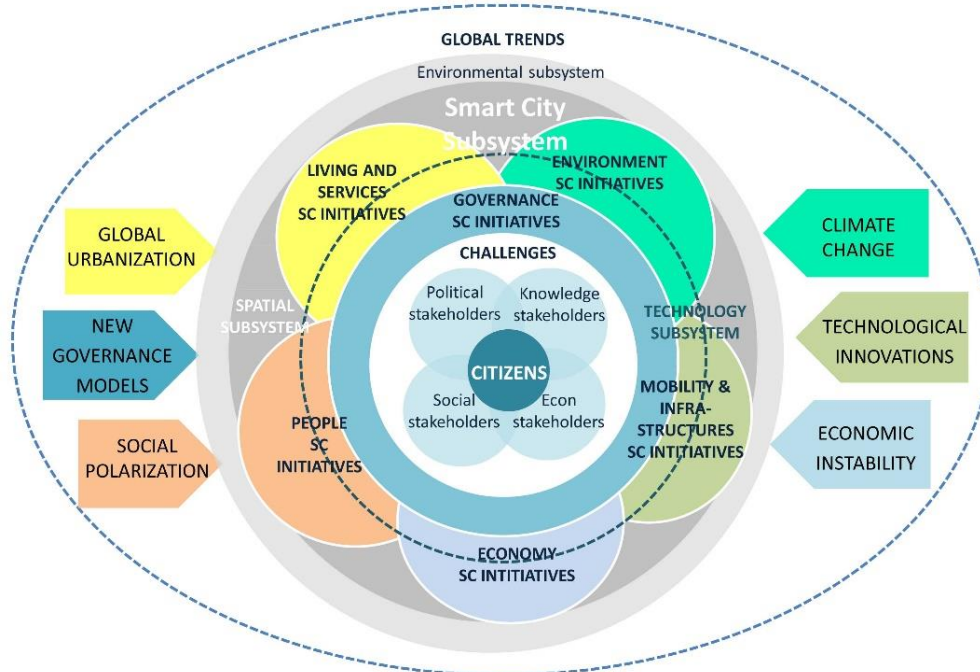


Figure 23: Smart City conceptual model.
Source: Fernandez-Anez, Fernández-Güell, et al., 2018.

This model offers a comprehensive vision of a city and serves as an instrument to achieve greater coherence in Smart City initiatives. It allows understanding the interrelations among the three layers and to extract conclusions about their intertwined influence in changes in cities. The report "Mapping smart cities in the EU" defines a Smart City as a "multi-stakeholder, municipally-based partnership" (Manville et al., 2014), and highlights the engagement of multiple stakeholders, coordinated by a municipality, as a key factor for the Smart City. The pre-validation phase of this research also confirms that local government stakeholders are the main potential users of SC initiatives.

3.5 Benefits and limitations of the proposed model

The proposed model pretends to provide a systemic and holistic overview of the elements of the Smart city and their interactions. The model represents different theories in the field in an interrelated way. It aims to support the understanding of the complexity of the Smart City. A conceptual model, according to Kuhn and Solvberg (1986) should satisfy four principles:

- “Enhance an individual's understanding of the representative system
- Facilitate efficient conveyance of system details between stakeholders
- Provide a point of reference for system designers to extract system specifications
- Document the system for future reference and provide a means for collaboration

The proposed conceptual model complies these requirements, as we will see in the following chapters, and we will discuss in the research conclusions. The conceptual model aims at helping the understanding of the Smart City elements in an intertwined way. The main benefit of the model is to allow a systemic representation of a complex system, the Smart City, in a simplified way. Following the previous principles and focusing on the possible uses of the model, some of its benefits would be:

- Serve as a basis for individual understanding to different stakeholders. Stakeholders can place themselves and other stakeholders in the system, understand the different elements and define their position according to them. Another benefit derived from this one can be the collective communication, using the model to communicate the strategy to the public or to the different stakeholders. The benefits of the model as communication enabler can also be used for dissemination and communication strategies, but also for capacitation of municipality staff and professionals in the different fields.
- Allow discussion among stakeholders, in order to understand the details (but also the general aspects) of their vision of the Smart City. Discussions can enrich the model and the real strategy it is based on and help to achieve consensus on the approaches.
- The system display constitutes a general reference for the development of specific proposals or strategies. Furthermore, it also allows a general and integrated vision that can serve as a basis for the re-design or the design or future steps of the Smart City strategy by the municipality
- To represent the past, current and future stages of the Smart City strategy of a city. This can facilitate collaboration among stakeholders participating in the initiative in the different stages. Allowing the comparison between different cities, it can also foster collaboration among cities facilitating the understanding of the context for the correct replication of the initiatives.

As a summary, the main model benefits are fostering understanding and communication of the strategy for discussion, communication, capacitation or design. This research will explore the use of the model for discussion with individual stakeholders and for the representation of past and current stages of the Smart City strategies of cities, allowing comparison. The model should be in permanent evolution to include changes in the governance structure, innovations in the sector and new global trends.

This model presents also certain limitations. This research could be framed in the middle range theory concept (Merton, 2007). The middle range theory is an approach developed in the field of sociology to define the theories that bridge theory and empirical research. This conceptual model pretends to be a tool for connecting the general urban and specific Smart City theories with their empiric survey. The main flaws of the proposed model relay on this intermediate scale:

- The proposed conceptual model does not present an innovation in the field of general urban theories. It takes as a departure point existing theories in the field. It mainly focuses in stablishing a comprehensive overview that interrelates existing knowledge.
- This conceptual model is a macro-representation of the Smart City. It is not a mathematic model aimed to support complex simulations. However, it can be used as a departure point of a very simple empirical research, as following chapters will present. This can lead the obtention of general overviews of the case studies and help the creation of general guidelines. But decision-making needs also further empirical support and the use of specific indicators.

Other limitations of the model could be related to the benefits previously described:

- The difficulties to enhance individual´s understanding in people with different skills and visions. This is especially difficult for people with visions focused on general global theories and with very specific knowledge, who may find it difficult to reach the individual scale. Individual understanding might also be a problem for people with no previous knowledge about the Smart City or with difficulties for understanding abstract representations of reality.
- The relationship between the specific scale and the intermediate scale has been developed in this research and included in the form of a multi-scalar project classification proposal (See chapter 4). However, it only reaches a certain scale. Further levels of specification might have to be defined by professionals of the different sectors.
- The documentation for future reference might have to be revised according to future models. Collaboration is only possible if stakeholders accept the system as a basis for their understanding. This is only possible if the model takes their opinion as a departure point and is able to represent them. This research is focused at using the model to overcome this limitation.
- The need of permanent revision of the model to include innovations and changes might become a problem for comparison. The model is flexible to include innovations and changes, however if the model can only be modified between certain limits to allow comparison. When disruptive knowledge in the field arrives, the model can need to be completely reformulated, developing new models. This can disable the capacity of the model for comparison of different cities and stages of the strategies.

These benefits and limits will be further discussed in the conclusions section under the light of the conceptual model application to various case studies.

4 METHODOLOGY

This chapter explains the methodology of this research. This methodology was published in the article "Smart City implementation and discourses: An integrated conceptual model. The case of Vienna." published in the scientific journal "Cities" (See (Fernandez-Anez, Fernández-Güell, et al., 2018). This chapter is an extended version of the methodology proposed in the article.

Figure 23 shows the methodology for the development of the conceptual model and its application divided into six steps: Hypothesis and research questions; State of the art; Conceptual model; Methodology development; Application to case studies and Conclusions.

Firstly, we will explain the stages described in the previous sections (Sections 1, 2, 3 and 4).

The first step is the formulation of the research hypothesis and the research questions. This step is developed in chapter 1. A research framework is developed to explain the relevance of the problem. Taking it as a departure point, the research hypothesis is formulated: "Smart Cities are not being able to materialize the discourses and visions of the different stakeholders involved". To prove this hypothesis, two research questions need to be answered. The first one focuses in the development of a methodology for analysing and providing data that can lead to the confirmation (or not) of the hypothesis. The second one is aimed at proving the hypothesis in a specific context (the European Region) using case studies (the selected cities).

The development of the state of the art on the questions that affect this research constitutes the second and third chapter. Firstly, in chapter two, the importance of how different Smart City stakeholders define the subject is explored. For this purpose, a methodology is proposed, that will be included in the final methodology used in the main research. Definitions by different stakeholders are explored in existing literature, and institutions and corporation webpages and reports. Secondly, through an extensive literature review, the state of the art is extended to three more areas: conceptual models, assessment tools and the development and policies about the Smart City in the European Region. As a conclusion of this state of the art, four main ideas are extracted, that will stablish the basis to answer the research questions:

- The importance of Smart Cities definitions by different agents
- The need of an integrated Smart City conceptual model
- The need of the use of the conceptual model as a tool for comparison and pre-assessment
- The need to bridge the gap between Smart City implementation and discourses in the European Region

According to the literature review, three main ideas were extracted to build the conceptual model in Chapter 4:

- The importance of involving stakeholders and the central role of governance.
- The implementation of Smart Cities through projects in different fields or dimensions.
- The orientation of the Smart City towards facing urban challenges.

These key ideas reflected in chapter 3 became the backbone of this study and led to the development of a conceptual model of Chapter 4. The model combines three elements: stakeholders, projects (classified by dimensions) and challenges they face.

In chapter 5, the current chapter, the complete methodology of this research is explained. Therefore, the methodology for using the proposed conceptual model to prove the hypothesis is also explained.

The stage of pre-validation of the methodology is explained in detail in this chapter. The conceptual model was pre-validated by a group of experts, and changes were made. The purpose of this first set of interviews (Interviews I, June 2016) was twofold: to validate the survey methodology and to validate the conceptual model. The methodology uses text analysis through coding and is based on the work of (AlAwadhi & Scholl, 2013), using a set of semi-structured interviews (Callejo Gallego et al., 2009) as the main instrument, in what is usually considered a participatory method. Stakeholders were rationally selected to work with a small but representative sample (Mitchell et al., 1997) The interviews focused on the three main ideas previously described and on validating the first version of the conceptual model. They were semi-structured to allow the identification of additional concepts. The sample was composed by selecting a group of stakeholders following two criteria: they belonged to different stakeholder groups in similar numbers; and they were specialized in different Smart City dimensions and in transversal areas of technology and planning (at least one expert in each dimension (6) and area (2)). A total of nine experts were chosen from international and local government institutions, universities and research centres, private companies of different sizes, and national and international NGOs. The experts interviewed came from Spain, Austria, Luxembourg and France. Data was collected through interviews in person or via videoconference, lasting between 50 to 70 minutes. They were audiotaped and partially transcribed and coded (questions on definitions, challenges and goals), and notes were taken to support the conclusions. 23 codes and 79 different sub-codes were used for data coding. The codes (with their respective sub-codes) were extracted from previous works (Fernandez-Anez, 2016; Fernández-Güell et al., 2016) (11 codes), from the theoretical basis of this work (6 codes) and from data (6 codes). The main results were the modification of the model according to the results of these nine interviews to obtain the final vision presented in this paper, and the definition of the interviews and surveys to apply the model.

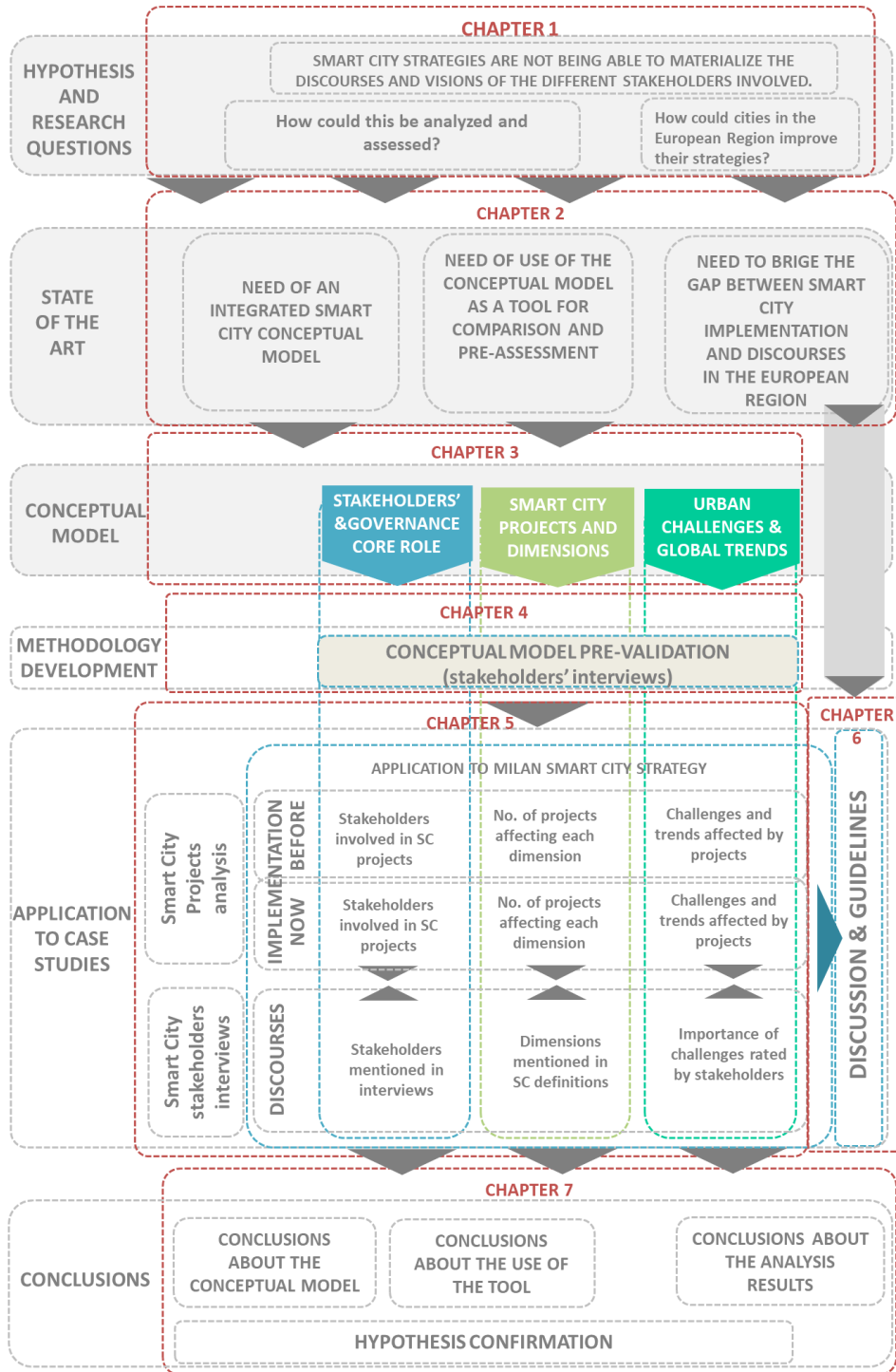


Figure 24: Research structure (previous steps in grey colour).
Source: Author's own elaboration.

Finally, the following research stages, explained in chapters 6 and 7, will be explained.

Application of the conceptual model to case studies is explained in chapter 6 (the next chapter). The model was applied to the Smart City strategies to compare the past and ongoing implementation of the initiative and the discourses of relevant stakeholders on the concept and the initiative. The summary of the number of interviews and projects analysed is synthesized in table 6.

The past and current projects in the municipal strategy for the implementation of Smart City were analysed in terms of the stakeholders, type of projects developed and the challenges and the global trends they were addressing (See annexes 3, 4 and 5 for the complete details). The information was extracted from the official websites of the analysed strategies. For this reason, the dates are not the same in all cities, depending on the availability of documents and the time frames of the research. The Information was extracted on (a) the project stakeholders, (b) the projects in each dimension, and (c) the challenges and trends addressed by the projects.

		Projects		Coincident projects	Total number of projects per city	Interviews
		Before	Now			
Prevalidation						9 (May 2016)
Validation	Vienna (2016-2018)	64	83	45	102	14 (June 2016)
	Milan (2013-2017)	77	44	18	103	16 (February 2017)
	Barcelona (2015-2017)	76	39	10	105	15 (June 2017)
		TOTAL			310	54

Table 6: Number of analyzed projects and interviews stakeholders in each phase and city, and dates.
Source: Author's own elaboration.

To study the stakeholders' visions, a new sample of interviews (Interviews II) was conducted following the methodology used in the pre-validation, modified by incorporating the lessons learned in the previous phase. The interviews took place in February 2017. A combination of fixed and open questions in a semi-structured interview was mixed with a survey in which respondents were asked to provide their own definitions of the Smart City concept and answer a similar set of questions to the previous phase. The two main additions were a new question on other relevant stakeholders to identify the respondents' view of the main agents involved in the initiative; and a survey with scores of 1 to 5 for each challenge to determine the importance of the challenges and trends. The sample consisted of 16 interviews with relevant stakeholders in Milan. The stakeholders were selected following similar criteria to the previous phase from among experts in the various institutions participating in the municipal strategy, belonging to 4 groups: Municipal government, Private companies, Academia and Civil Society. A new selection criterion was their involvement in the local Smart City strategy. The participants in the Smart City projects were analysed and selected according to the number of projects they were involved in, together with the

two criteria described in the pre-validation stage Data was collected as in the previous phase. Data analysis and coding consisted of partially analysing the interviews (definitions) through text analysis techniques following the methodology described in the pre-validation phase. The survey results and stakeholders' identification were classified, and conclusions were extracted. Three types of results were obtained: the identification and classification of the stakeholders in the initiative into groups (quantitative/qualitative); the survey results (quantitative); and the identification of the terms corresponding to each dimension from the analysis of the Smart City definitions (qualitative/quantitative). This last step allowed the qualitative information to be transformed into quantitative information. These results are used to modify the conceptual model. Further conclusions can be drawn from the complete analysis of the interviews and will be described in future work.

At the end of chapter 6, guidelines for Milan Smart City are extracted. The analysis of the implementation was compared with the discourses of the relevant city stakeholders and conclusions were drawn. The result consists of a proposal of guidelines for a Smart City Strategy that narrows the gap between the visions of the different stakeholders with the actual implementation of the strategy.

Finally, Chapter 7 presents the conclusions of this research. According to the questions formulated in chapter 1 and the topics explored in the State of the Art conclusions were classified into three groups:

- Conclusions about the conceptual model
- Conclusions about the use of the tool
- Conclusions about the analysis result

As a result, the research hypothesis is (or not) validated and the research questions answered.

5 THE CASE OF MILAN SMART CITY INITIATIVE

Milan Smart City initiative has been analysed in two different moments of its development. Different stakeholders have been asked about their idea of the Smart city and results have been compared. The methodology explained in chapter 4 was applied.

Milan started its way to become a Smart City at the end of 2011 with the participation of the Municipality in the European calls, and from this point on the city has also participated in territorial projects and developed its own initiatives at local level.

At a European level, the city participated in the calls for the "Smart Cities and Communities" initiative. This initiative was promoted by the EU Commission, within the Europe 2020 Strategy. Its aim was to make European cities more efficient and sustainable from different points of view: energy, transport, information, communication technologies, economic development and social policies. At an international level Milan has become an active member of different Smart city networks, like Smart Cities Stakeholders Platform, C40 and Eurocities.

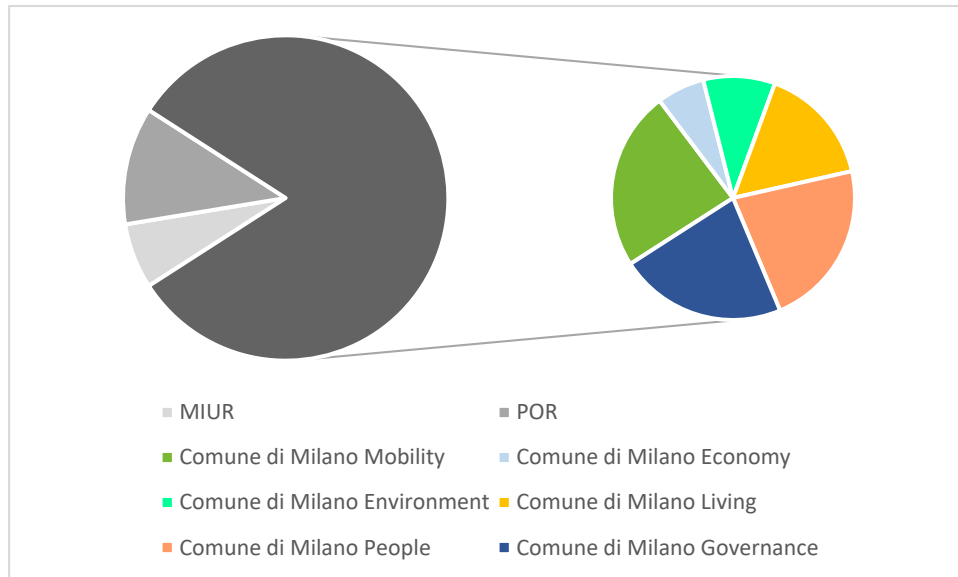
The local government has participated with the province in different calls and projects. Some of them were funded by the European Structural funds. At a local level Local government and the Milan Commerce Chamber have established a partnership for collaboration in research and social innovation, business and high financing.

In May 2013, the document of guidelines for Milan Smart city (Comune di Milano, 2013a) was published, providing a general idea of which are the main focuses of the initiative (Table 7). The structure is divided into seven areas. Six of them are coincident with the areas proposed by (Giffinger et al., 2007) plus a first one focused at internationalization.

Milano Smart City guidelines	Area of focus
1. global city, national and European lab	Internacionalization
2. lab for sustainable urban mobility	Mobility
3. lab for environmental and energy policies	Environment
4. lab for social inclusion and diversity	People
5. lab of well-being in the city	Living
6. lab for decluttering and simplifying public administration	Governance
7. incubator for business models	Economy

Table 7: Milano Smart City guidelines.
Source: author's own elaboration

All the efforts that Milano city had made to achieve a Smart City were summarized in the document “Milano Smart City. Progetti e principalmente interventi”, elaborated at the end of 2013 (Comune di Milano, 2013b). This document includes a list of all the projects that Milan was developing at the moment.



Graph 1: Share of projects developed by MIUR and POR financing and by Comune di Milano (divided into the different dimensions).

Source: author's own elaboration.

Around 20% of the projects were financed though MIUR (Ministero dell'Istruzione dell'Università e della Ricerca) and POR projects (POR FESR 2007-2013 (structural funds) (see graph 1 and Table 8). But the biggest share was financed by Comune di Milano. Projects were distributed among the areas as follows (Tables 9 and 10)

BANDO MIUR ""SMART CITIES AND SMART COMMUNITIES AND SOCIAL INNOVATION""	1	S[m2]ART
	2	URBe-LOG
	3	DECISION THEATRE
	4	PSC GIUSTIZIA
	5	SWaRM-Net
PROGETTI POR FESR 2007-2013 (FONDI STRUTTURALI).	6	SCUOLA -smart campus as urban open labs
	7	SPAC3
	8	SIMULATOR
	9	CITY-WISE-NET
	10	OPTI-LOG
	11	PROACTIVE
	12	E-WASTE
	13	ABILITY
	14	GIOCOSO

Table 8: Milan Smart City Projects financed by MIUR and POR in the document of 2013(Comune di Milano, 2013b).

Source: Author's own elaboration.

ELENCO PROGETTI "SMART" DELL'AMMINISTRAZIONE COMUNALE	Smart Mobility	15	Area C
		16	TIDE (Transprot innovation deployment for Europe)
		17	preferenza semaforica
		18	bike sharing BIKEMI
		19	CIinSC-City mobil 2
		20	Guidami
		21	Infopaline
		22	Portali della mobilita e infoalert
		23	Indirizzamento di parcheggi
		24	LINK-SE-Isole Digitali
		25	Converse
		26	CIinSC-PE-FR-Evue
		27	Aree carico scarico
		28	Merci pericolosi
29	Infomobilita per la citta di milano		
Smart Economy	30	Ticketing payment	
	31	Fare impresa	
	32	Iride	
	33	E015	

Smart Environment	34	CIinSC-smart spaces
	35	CIinSC-PE-EUGUGLE
	36	Cestino intelligente
	37	Smart IP
	38	DOMO GRID
	39	Piano di teleriscladamento
Smart Living	40	MET (Museo esteso nel territorio)
	41	Musei.net
	42	MiTo
	43	Media Librari on line
	44	Servizi online
	45	DigitaMI
	46	App eventi
	47	App guida milano
	48	Mobile QR code
	49	Portale turismo
Smart People	50	LIA (libro italiano accessibile)
	51	autoprestito RFID
	52	Real IT
	53	CIinSC-my neighbourhood my city
	54	Mappatura delle reti informali
	55	CROWDFUNDING
	56	Centro per le migrazioni
	57	Carta identità sociale
	58	Punt sociali
	59	Agenzia uni
	60	Ambrogio
	61	Multa semplice
	62	LINK-SE-WI-fi area
	63	Anziani piu coinvolti e piu securi

Table 9: Milan Smart City Projects financed by the local government (A) in the document of 2013(Comune di Milano, 2013b).

Source: Author's own elaboration.

Smart Governance ELENCO PROGETTI "SMART" DELL'AMMINISTRAZIONE COMUNALE	64	Smart ciber
	65	Messa in rete delle istituzioni del welfare
	66	Semplifica mi
	67	Caronte
	68	Icaro
	69	Geo school
	70	Piano dei tempi e degli orari
	71	Genitori i video
	72	PMUS
	73	PUGGS
	74	PGTe NIL
	75	Open data
	76	Nuovo portal insittuzionale
	77	MOC-main operation center

Table 10: Milan Smart City Projects financed by the local government (B, continuing table 19) POR in the document of 2013(Comune di Milano, 2013b).

Source: Author's own elaboration.

These projects and initiatives have been boosted by the EXPO 2015, an International exhibition that took place in Milan from the 1st of May to the 31st of October 2015 under the motto "Feeding the planet, energy for life". This event supposed a great impact in the city, attracting 22.200.000 visitors. Providing services to this number of visitors was a great challenge for the city and fostered Milan Smart City initiative development.

After EXPO2015, the initiative has changed its focus, even if apparently it maintained the guidelines proposed in 2014. The Milano Smart City webpage (Comune di Milano, s. f.) was studied to describe the new approach to the initiative. The structure of projects in the webpage is completely different to the document explained and the new focus to innovations in the area is clear. The webpage shows a structure that is much less transversal among areas than before. It is focused in areas like Incubator's networks, Innovation in Milan, Social innovation, Crowdfunding and Sharing economy, and a Milan-NYC business exchange. There is also a section for projects which only included 4 projects at the moment of consultation, and a section of MIUR and POR projects, which maintains the project referred in the summary of projects of 2013 (Comune di Milano, 2013b). In the general section, both the document of guidelines (Comune di Milano, 2013a) and the document of projects (Comune di Milano, 2013b) are included. See table 11.

SMART CITY	NETWORK DI INCUBATORI	1	NETWORK DI INCUBATORI
	INCUBATORI	2	Polihub
		3	SpedMiUp
		4	Parco tecnologico Padano
		5	LEM*, Maker Space
		6	Arte e Messaggio
		7	Centro Quarenghi
		8	Incubatora d'azeglio (Also included in Sharing Economy)
		9	SMART CITY LAB
	Progetti MIUR E POR	10	S[m2]ART
		11	URBe-LOG
		12	DECISION THEATRE
		13	PSC GIUSTIZIA
		14	SWaRM-Net
		15	SCUOLA -smart campus as urban open labs
		16	SPAC3
		17	SIMULATOR
		18	CITY-WISE-NET
		19	OPTI-LOG
		20	PROACTIVE
		21	E-WASTE
		22	ABILITY
		23	GIOCOSO
MILANO IN		24	MILANO IN
INNOVAZIONE SOZIALE		25	FABRIQ
PROGETTI		26	Milan young Citizens
		27	BOOSTINNO
		28	Sharing cities
		29	Open Care
CROWDFUNDING		30	CROWDFUNDING
Sharing economy		31	SHARING ECONOMY PLAN
		32	COHUB
		33	SE-bando makerspaces-fablabs-comune dimilano
		34	SE-bando coworking-camera di comercio
		35	SE-INC-Incubatora d'azeglio
		36	SE-bike sharing BIKEMI
		37	SE-Spazi inutilizzati

	38	SE-allogi ospidale solidale-camera di commercio
	39	SE-giardini condivisi
	40	SE-tira su la cler
NYC-Milan business exchange	41	NYC-Milan business exchange
Links	42	Isole Digitali (Also included in Sharing economy)
	43	link-SE-Open data (Also included in Sharing economy)
	44	LINK-SE-WI-fi area (Also included in Sharing economy)

Table 11: Milano Smart City projects according to the webpage as consulted in January 2017. Projects in grey colour are coincident with the previous stage of the initiative.

Source: Author's own elaboration.

Milano Smart City was led by the Smart City Service, specifically created for this purpose inside the Economic Innovation, Smart City and University sector of the Labour, Economic development, University and Research Council (Servizio Smart City, Settore Innovazione Economica, Smart City e Università - Direzione Centrale Politiche per il Lavoro, Sviluppo Economico, Università e Ricerca). From the Summary of projects developed in 2013 (Comune di Milano, 2013b) it can be deduced that, even if the Economy council was leading the initiative, it aimed at being integrative among different departments. However, the evolution in time shows a new approach in which this integrative purpose is lost. The projects included in the initiative show an approach from the field of economy instead of a collaboration among departments. However, the initiative shows in this second stage the purpose of involving social and economic stakeholders though different call focusing on incubators or sharing economy.

Therefore, this research is analysing Milan Smart City initiative implementation though its focus before the EXPO, at the end of 2013, and after the EXPO2015, in February 2017. We will refer to these different moments as Implementation (before, in 2013) and Implementation (now, in 2017). Furthermore, a sample of experts have been interviewed as explained in the methodology. The three visions will be compared and conclusions will be extracted.

5.1 Interviews analysis: Smart City definitions

The strategy of Milan started in 2011, but was raised in 2014 under the Directorate of Urban Economics and Labor of the town hall, in cooperation with the Chamber of Commerce of Milan. At that time there was a powerful boost to the strategy, which had a multidisciplinary cut, thanks to the Expo Milan 2015. Later layers were added. The model has been used to explain how the initiative is currently presented and what projects are really under way, in a non-disruptive evolution (See Fig. 24). Thus, the image that is offered with the 12 projects advertised on the web (1), is that most of the current initiatives are focused on the area of *economy*, followed by the area of *people*. *Governance* also plays an important role. *Environment* and *mobility* are clearly relegated to a secondary role with a single publicized project. If we also consider the projects

coordinated by the Smart City department (2), the focus is clearly on *people*, followed by *governance*, habitat and *economy*. A large number of projects affect the *environment*, while *mobility and infrastructure* is the least affected area.

However, if we go deeper into the Smart initiative investigating its ongoing projects since 2014 (110 projects) (3) we find that there are many more projects and that the focus of the initiative is different. The largest number of projects focused on *governance*, especially in improving the internal functioning of the municipality. *People and Habitat and services* are the second most important groups. The other three groups have similar importance in the number of projects dedicated to them.

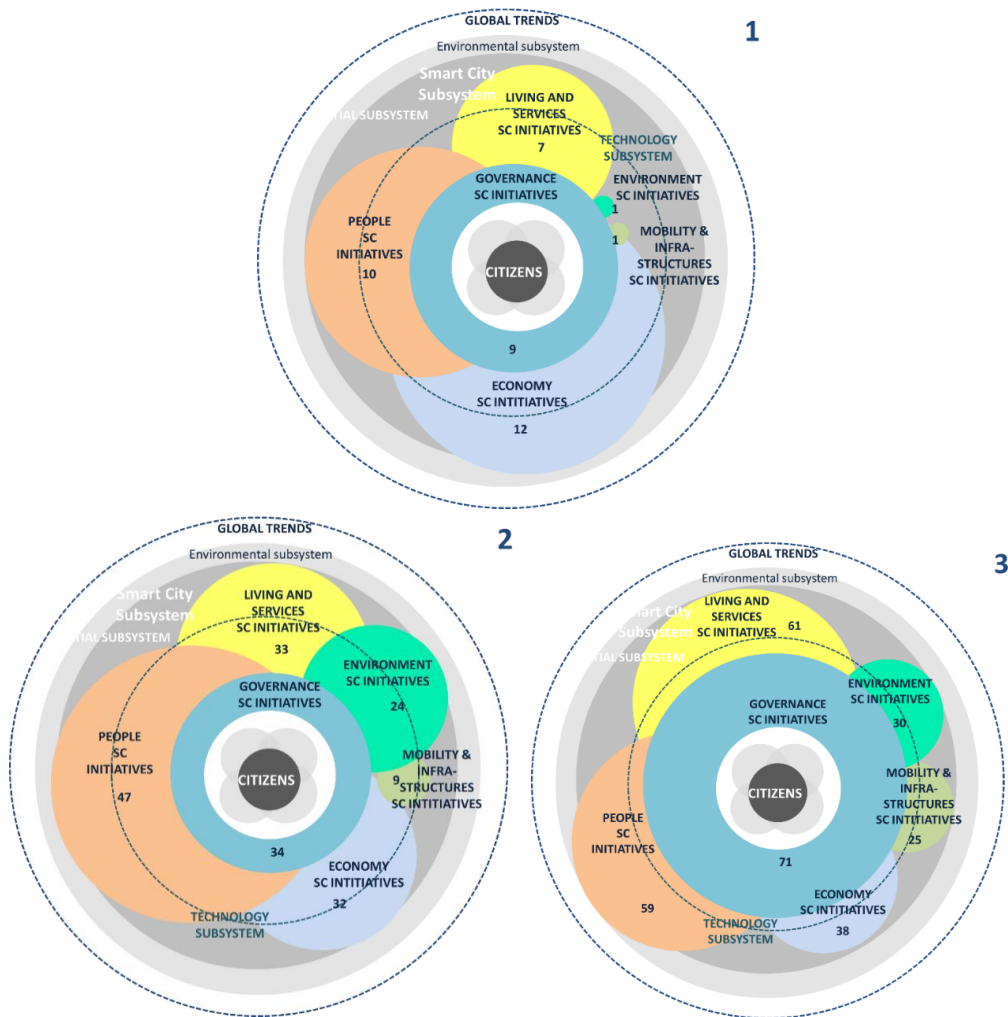


Figure 25: projects advertised on the Milan Smart City web (1), projects coordinated by the Milan Smart City department (2) and ongoing projects since 2014 (110 projects) (3).
Source: Author's own elaboration.

		Government institutions	Universities and research centers	Companies	Civil society
Transv Dimensions	<i>Governance</i>	(1) President of Participation popular initiatives and Open Data Commission	(6) Associate professor, Department of Architecture and Urban studies, Politecnico di Milano. Project coordinator Open4citizens.		
	<i>Economy</i>	(2) Project Manager, Department of Economic Innovation, Smart City and University			
	<i>Environment</i>			(10) Head of A2A Smart City lab	(13) President, Legambiente Lombardia
	<i>Mobility</i>	(3) <i>Mobility</i> Planning Area Director, <i>Environment</i> , <i>Mobility</i> and Territory Agency (AMAT)	(7) Director of Poliedra Research Group and Professor at the Department of Industrial Design, Arts, Communication and Fashion, Politecnico di Milano		
	<i>People</i>				(14) Coordinator FGB Learning, Fondazione Giacomo Brodolini, (15) Co-founder at WEMAKE
	<i>Living</i>			(11) Partner at AVANZI	
	Technology	(4) Chief Information officer		(12) Chief Executive	

				Officer and Scientific Director of CEFRIEL and Vice President of CEFRIEL USA Inc	
	Planning	(5) Deputy Mayor Urban Planning, Green spaces and Agriculture	(8) Professor and Director of Architecture and Urban Studies Department; (9) Assistant professor in Urban design		

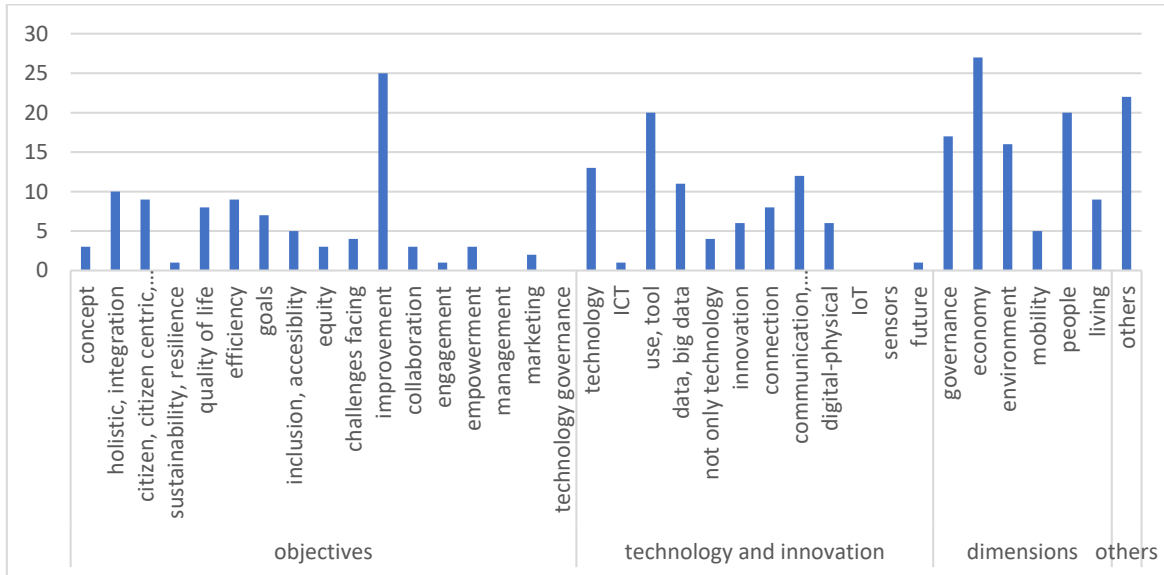
(1) Emilia Bossi; (2) Piero Pelizzaro; (3) Valentino Sevino; (4) Guido Albertini; (5) Pierfrancesco Maran; (6) Grazia Conciglio; (7) Alberto Colorni; (8) Gabrielle Pasqui; (9) Eugenio Morello; (10) Pierpaolo Palazzoli; (11) Matteo Bartolomeo; (12) Alfonso Fugetta; (13) Damiano DiSimine; (14) Fabio Scaragli; (15) Costantino Buongiorno

Table 12: Selection of stakeholders in Milan, according to three criteria: they belong to different stakeholder groups; they specialize in different Smart City dimensions and in the transversal areas of technology and planning, and the number of Milan Smart City projects the stakeholders are participating in. Source: Author’s own elaboration.

A total of 16 relevant agents (Table 12) were interviewed. They were asked about their vision of the Smart City and about which of their visions came closest to the models described. The result was a variety of opinions in which, although the majority chose transition model B (31.5%), models A and C were also selected largely by agents (25% each). In the municipality, the agents selected the first model, except for the Smart City team member, who selected the second one for the current state although he declared the C model as the model to which they are directed. See annex 4 for detailed results of the interviews.

However, it was difficult for them to understand the differences between the models and the information they were trying to represent. For them, comparing three models was too complicated. For further research, there should be another way of extracting information and comparing it to clarify a) the extraction of information and b) the number of models that are being produced.

When analysing the definitions provided by the different interviewed experts, we find that they refer to the different dimensions, especially to *economy*, followed by *people*. Other interesting topic is the idea of improvement as a major goal of the Smart City (Graph 2).



Graph 2: Classification of terms included in Smart City definitions by interviewed stakeholders in Milan.
Source: Author's own elaboration.

Thus, the idea of improvement, mentioned as "better", "enhance" "improve" etc. is present in several definitions as one of the main goals of the Smart City. Other objectives, like integration, citizen centric approaches, efficiency and quality of life are also quite important to interviewed experts.

For the experts interviewed in Milan, technology is mainly a tool to reach the described goals. They also mention technology in a wide sense, but they usually speak about the importance of communication and information. Data and big data are also present in their idea of Smart City.

Regarding the different dimensions, *economy* becomes the one that is the most mentioned by the different experts in their definitions. *People*, *governance* and *environment* are also quite present in their idea of what a Smart City is.

5.2 Subsystems and stakeholders in the Milan Smart City initiative

Important differences appear when comparing the three models: stakeholders involved in the Milan Smart City initiative in two different moments (Implementation before and now) and the vision of the interviewed experts regarding the most important stakeholders of the initiative (Fig. 25).

Stakeholders belonging to companies (economic stakeholders) are the main group in the projects of Milan Smart City initiative before and now, and their number is growing. Political stakeholders are the second group in number. Knowledge agents, and especially Political stakeholders, were represented in a higher number in the projects of Milan initiative before than now. However, the number of Social stakeholders involved in the Smart city initiative has increased. In the initiative now there is a more balanced presence of political, knowledge and social stakeholders.

The interviewed experts have mentioned in a higher number of political stakeholders, followed by civil society organizations and members. Companies are mentioned in a smaller number, and knowledge stakeholders are the group that is mentioned a smaller number of times.

Even if political stakeholders have decreased their protagonist role in the Smart City initiative and economic stakeholders have always been very present, the perception of interviewed experts is that political and social stakeholders are the most important groups. Knowledge stakeholders have reduced their number during the time, and they are not perceived as key in the process.

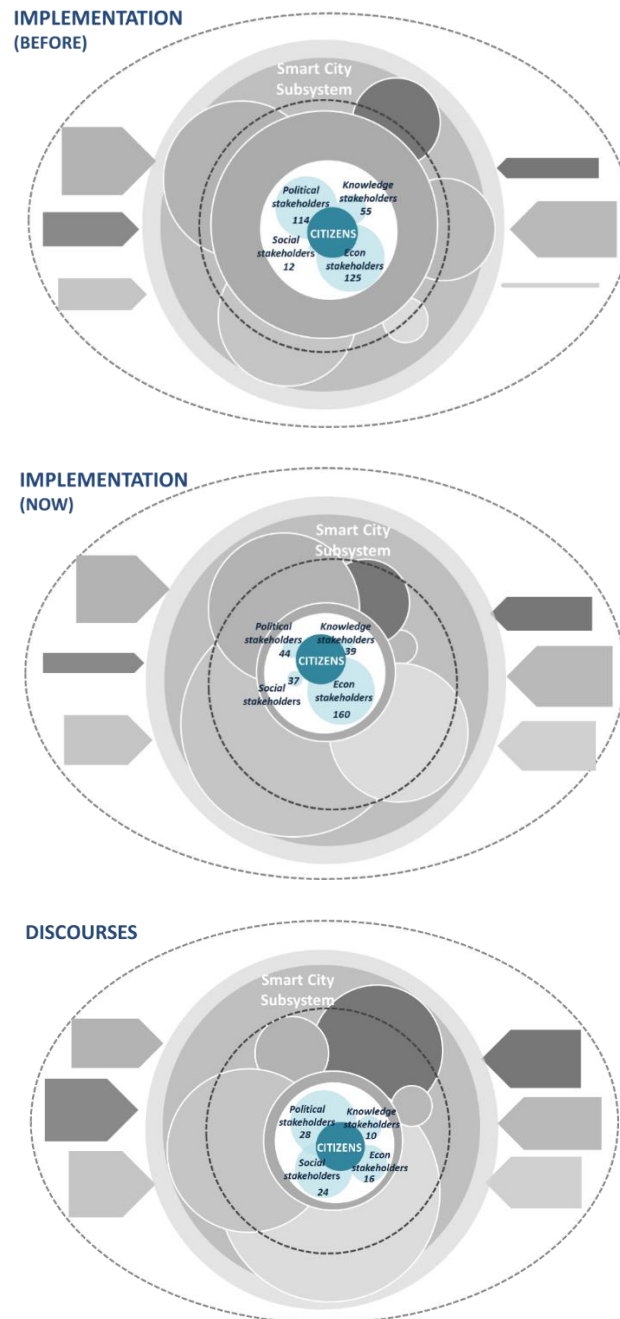


Figure 26: Conceptual model. Stakeholders involved according to the project analysis (implementation) before (2013) and now (2017), and the interview analysis (discourses).
Source: Author's own elaboration.

5.3 Milan Smart City projects and dimensions

In the evolution of the Smart City initiative, the focus of the projects has drastically changed (Fig. 26). See Annex 4 for details. Projects focused on *Governance* were the most important regarding the number in the Milan Smart city initiative before the EXPO. They were followed by *Living and services* and *people* initiatives. *Environment* and *mobility and infrastructures* played a less important role. Finally, very few projects were focused on the *economy* dimension.

Looking at the projects after the EXPO, *People* is the dimension on which the higher number of initiatives are focused. *Living and services*, *economy* and *governance* become the second in number of initiatives. The initiatives on *governance* have been reduced, while the initiatives focused on *economy* have increased their number. The initiatives focused on *mobility and infrastructures* have been drastically reduced.

When analysing the definitions provided by the interviewed experts, we found out the *economy* was core in their views of the Smart city, together with *people*. *Governance* and *environment* also played an important role in their vision of the Smart City. *Living and services*, and especially *mobility*, were much less important for them.

Therefore, Milan Smart city initiative has evolved in a direction that is more coincident with the vision of the different interviewed stakeholders. The focus has been redirected to *People* as a base for a change in *economy*, which is the most important dimension to interviewed stakeholders. *Governance* has lost importance, as well as *mobility*, which fits with their vision. But *environment*, which has also lost a part of its weight, is for stakeholders more important and should be better balanced.

Not only has the number of initiatives affecting each dimension changed, but also their focus (Table 13, -fig. 27). Milan Smart City initiative before the EXPO had a strong focus in *governance*, but mainly on two topics: increasing the efficiency of municipal management and increasing transparency in the provision of services and information. In 2017, the initiative changed its focus, and *governance* is not the main dimension anymore, changing also the approach to the topic. Today, it is paying special attention to participation and community building, producing a switch from a top-down to a bottom-up *governance* model. The target on *economy* increased and focused to innovation, entrepreneurship and productivity. Projects focusing on *mobility* reduced their number. Before they focused on traffic management and clean and no-motorized options, but now only the second aspect partially remained. A smaller number of initiatives affect Smart *Environment*. Beforehand, it was focused on monitoring and energy efficiency, but the spotlight has changed to smart buildings and building renovation, especially due to the new hubs and incubators. Research keeps being one of the main focus of the *people* dimension, but now it goes together with creativity and education and digital training. When it comes to Smart *living*, the number of projects affecting welfare and social inclusion and on technology accessibility has been increased, but the focus on culture and leisure, reduced.

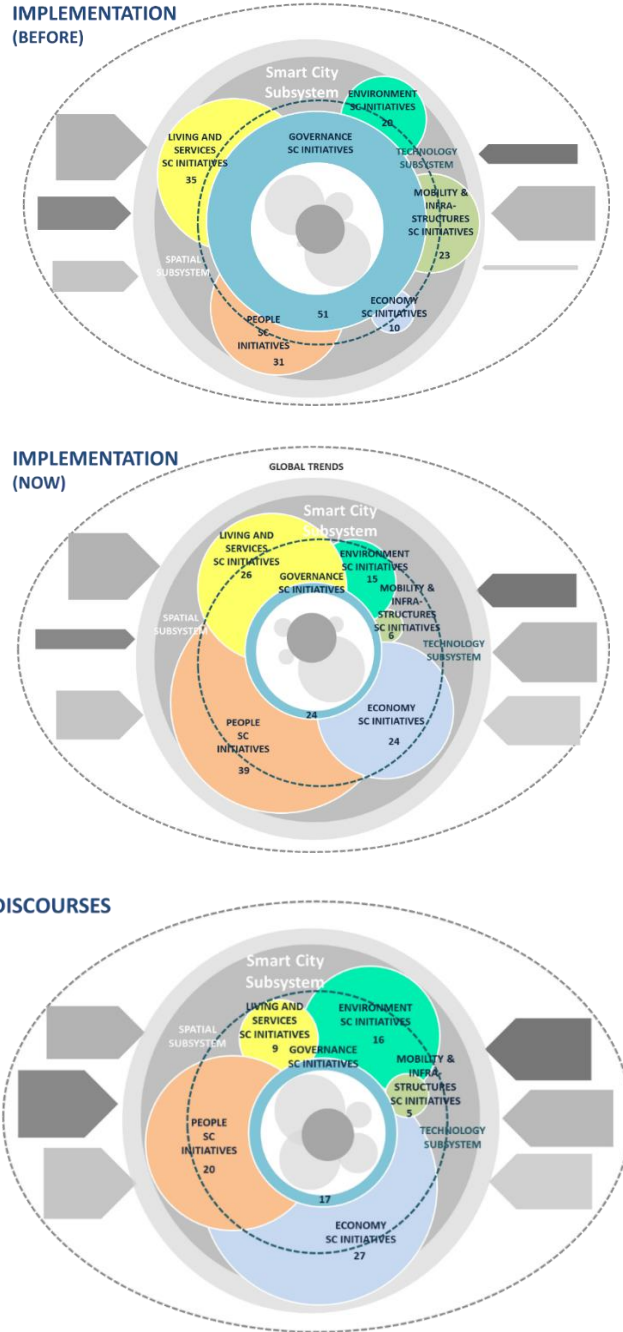
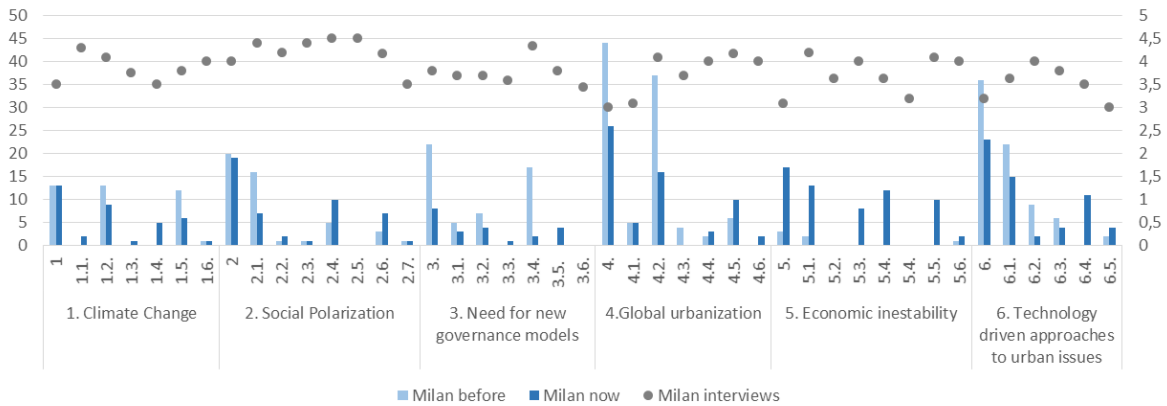


Figure 27: Conceptual model modified according to the number of projects in each dimension (implementation) before (2013) and now (2017) and the terms appearing in the Smart City definitions by different stakeholders (discourses).

Source: Author's own elaboration.

		BEFORE	NOW			BEFORE	NOW
Smart Governance	SGo1. Participation	9	15	Smart Environment	SEn1. Network and environmental monitoring	10	6
	SGo2. Transparency and information accessibility	13	4		SEn2. Energy efficiency	10	6
	SGo3. Public and Social Services	12	7		SEn3. Urban planning and urban refurbishment	3	5
	SGo4. Multi-level governance	3	3		SEn4. Smart buildings and building renovation	1	14
	SGo5. Community building and urban life management	6	12		SEn5. Resources management	5	5
	SGo6. Efficiency in municipal management	24	7		SEn6. Environmental protection	5	4
Smart Economy	SEc1. Innovation	2	21	Smart People	SPe1. Awareness rising and behavioural change	7	4
	SEc2. Entrepreneurship	3	17		SPe2. education and digital training	13	20
	SEc3. Local & Global interconnectedness	2	5		Spe3. Research	22	21
	SEc4. Productivity	2	14		SPe4. Creativity	1	15
	SEc5. Flexibility and conciliation in labor market	2	1		SPe5. ICT - Enabled working	0	0
Smart Mobility	SMo1. Accessibility	2	0		Smart Living	SPe6. Inclusive society	9
	SMo2. Clean, non-motorised options	9	6	SLi1. Culture and leisure		16	2
	SMo3. Public Transport	6	2	SLi2. Healthcare		4	2
	SMo4. Multimodality	1	0	SLi3. Security		5	1
	SMo5. Logistics	7	2	SLi4. Technology accessibility		7	11
	SMo6. ICT Infrastructure	3	1	SLi5. Welfare & Social inclusion		13	17
	SMo7. Traffic management	9	0	SLi6. Public spaces management		4	3
				SLi7. Tourism	8	1	

Table 13: Classification of Milan Smart City projects before (2013) and now (2017) by project actions following the methodology proposed by (Fernandez-Anez, Velazquez, et al., 2018). Source: author's own elaboration.



Graph 3: Comparison of the number of projects addressing each challenge and trend (columns; left y-axis: number of projects addressing each challenge or global trend) in Milan Smart City strategy before (2013) and now (2017), and the results of the survey of their importance in the case of Milan (points; right y-axis: importance value provided by experts (1-5)).
Source: author's own elaboration.

Milan Challenges: analysis (before)	1. CLIMATE CHANGE						2. SOCIAL POLARIZATION							3. NEED FOR NEW GOVERNANCE MODELS						4. GLOBAL URBANIZATION					5. ECONOMIC INSTABILITY						6. TECHNOLOGY DRIVEN APPROACHES TO URBAN ISSUES				
	1.1	1.2	1.3	1.4	1.5	1.6	2.1	2.2	2.3	2.4	2.5	2.6	2.7	3.1	3.2	3.3	3.4	3.5	3.6	4.1	4.2	4.3	4.4	4.5	4.6	5.1	5.2	5.3	5.4	5.5	5.6	6.1	6.2	6.3	6.4
1 CROWDFUNDING																																			
2 UNi-SE-Topic Digitali	1																																		
3 link-SE-Open data																																			
4 UNi-SE-Wi-Fi area																																			
5 SE-Dike sharing BIKEM																																			
6 MIUR-URBe-LOG																																			
7 POR-OPTi-LOG																																			
8 MIUR-2iWARM-Miet																																			
9 POR-SQUOLA -smart campus as urban open te																																			
10 POR-CITY-WISE-NET																																			
11 POR-E-WASTE																																			
12 MIUR-0EGION THEATRE																																			
13 MIUR-PSC GIUSTIZIA																																			
14 POR-SPACS																																			
15 MIUR-2(m2)ART																																			
16 POR-ABILITY																																			

Figure 29: Image of the classification table for challenges of Milan. See Annex 4 for more details.
Source: Authors own elaboration.

6 DISCUSSION

New conclusions from the different stages and the point of view of stakeholders can be extracted when observing all the analysed elements together.

Political stakeholders are very important in the development of the Milan Smart City initiative, and *governance* projects were the most important in number (Fig. 29). However, they were not addressing the switch to new *governance* models, but mainly the increase of the efficiency in the local administration through the adaptation to technological innovations. Therefore, challenges addressing technological innovations have been faced through *Governance* projects, and not only by *mobility and infrastructures* initiatives. The provision of services, addressing problems derived from *global urbanization*, has been core in this phase of the Milan Smart City strategy. However, this has been made without the participation of social actors and with the involvement of a high number of companies instead. Economic stakeholders have an important weight in the initiative, providing technological solutions to reach the objectives, but projects and challenges focused on *economy* were the less important group. *People* initiatives were the third in importance, even if there is a low involvement of social actors. *Environmental* challenges and projects play a small role in the initiative.

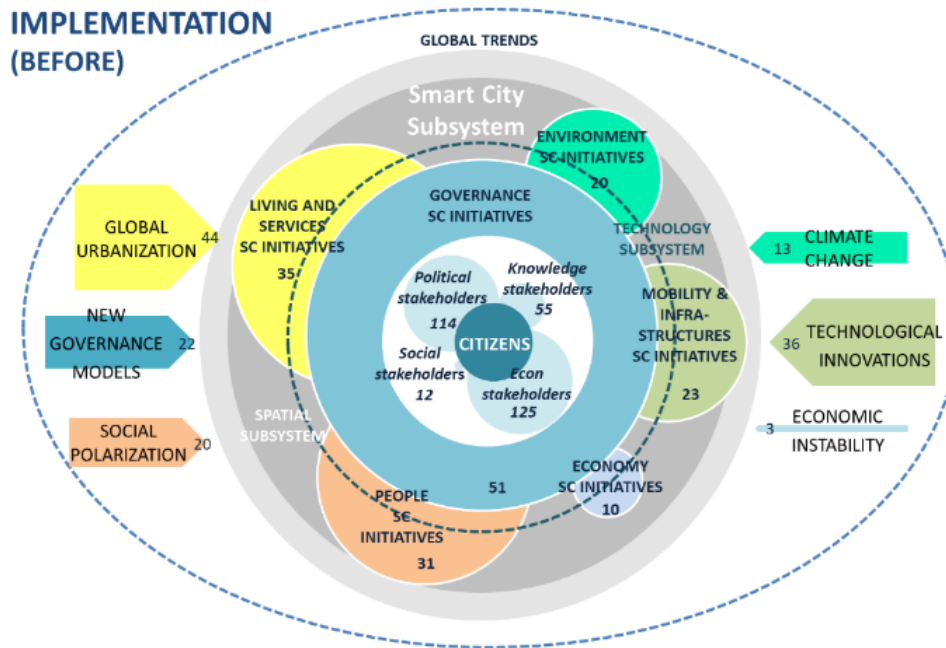


Figure 30: Synthesis of the modifications made to the conceptual model in the analysis of implementation before(2013). Values explained in sections 6.2.1., 6.2.2. and 6.2.3.

Source: author's own elaboration.

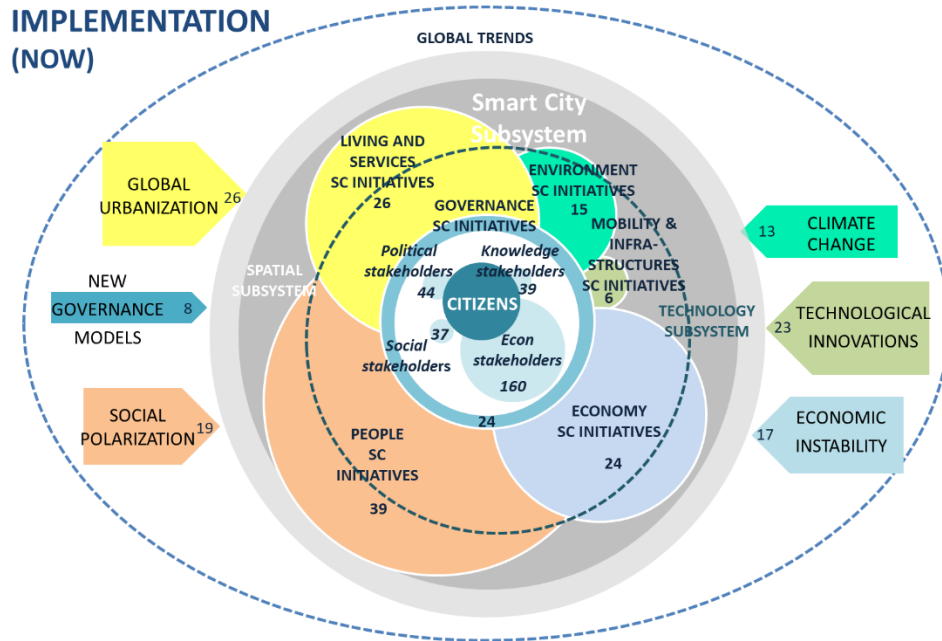


Figure 31: Synthesis of the modifications made to the conceptual model in the analysis of implementation now (2017). Values explained in sections 6.2.1., 6.2.2. and 6.2.3.
Source: author's own elaboration.

Economic stakeholders are the most important ones with a big difference, and their number is increasing even more (fig.30). There is a better balance among the other stakeholders, since project' stakeholders focused on *economy* have also grown in number. This combination has led to an increase on the projects focused on *People*, followed by *living and services*. Projects focused on *economy* have reached in number the ones focused on *governance*, which were the most important ones in the strategy before. The main groups of challenges being addressed by the initiative now are the ones of *Global urbanization* and technological innovations. Technological innovations challenges are being addressed not only by the *mobility and infrastructures* projects, but especially by other types of projects linked to *economy* and *people*, like the ones linked to the sharing *economy* or the entrepreneurs' hubs. *Governance* has passed to have a secondary role, both in the number of projects and in the challenges addressed. *Climate change* and *environmental* issues maintain a low weight in the initiative.

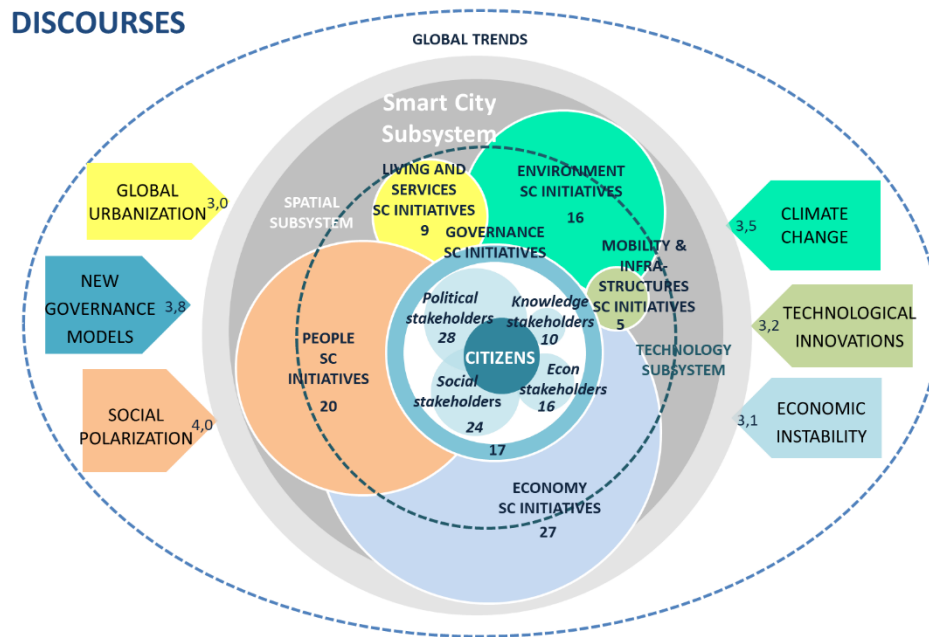


Figure 32: Synthesis of the modifications made to the conceptual model in the analysis of discourses. Values explained in sections 6.2.1., 6.2.2. and 6.2.3.

Source: author's own elaboration.

The Smart City is perceived by the interviewed stakeholders to be based on Political and social stakeholders (Fig. 31). It aims to address *Social polarization* and the *need of new governance models* as the most important challenges. However, in their definition of the Smart City *economy* initiatives play a core role, even if followed by *People*, and *economic instability* is among the less important challenges for them. *Governance* is the third in importance in their definitions, having almost the same importance as *environment*. *Global urbanization* is the global trend that worries them less and *Living and services* is mentioned very few in their definitions.

The comparison of these three visions can be summarized in the Guidelines for the Milan Smart City strategy aiming to:

- See if the evolution of the Smart City strategy is closer to the vision of the interviewed stakeholders and, therefore, it can make it easier their involvement.
- Identify elements from both models (before and now) that can improve the strategy and make it closer to the stakeholder's vision.

It can be said that, in general terms, the evolution of the Milan Smart City strategy is closer to the visions of the interviewed stakeholders than before. Therefore, the guidelines extracted are:

- **Redistributing the weight of stakeholders.** It would be important to increase the involvement of political and social stakeholders. The main political

stakeholders involved are the direction of economic policy and labor, so an opportunity to increase this group could be to include other political stakeholders. -There is a very big number of economic stakeholders involved, however interviewed stakeholders are not aware of this. The number of companies could be reduced and the aware about their involvement increased in order to increase transparency. Knowledge stakeholders have been reduced and this fits with the vision of interviewed agents. Civil society stakeholders linked to *economy*?

- **Balance among dimensions.** However, it is important to consider that they evaluate all the global trends to be very important for the city, and the difference in the values given to the importance of the different challenges is not big (1 point average). This confronts their idea of the smart city as focused on *economy* and *people*. It could be interpreted other problems to be solved by other initiatives, and not the Smart City. If we want the Smart City to be taken into account by stakeholders in a holistic way, we will need to get a bigger balance among areas. A possibility could be to recover some initiatives of the strategy before the EXPO, which was more balanced (except for *governance*, which was enhanced).
- **People as a basis to a change in the economy dimension.** The *people* dimension has evolved from being the third in importance to be the first. This is linked to the evolution of the *economy* dimension from being the last in importance to be the third (together with *governance*). *People* and *economy* projects are tightly interrelated: *People* projects are fostering digital education, research and creativity, while *economy* projects are based on innovation and entrepreneurship. This is connected to the vision of stakeholders, where *economy* and *people* are the most important dimensions, and this aspect of the strategy should be maintained.
- **Addressing governance challenges.** *Governance* challenges is the second group of challenges in importance according to stakeholders. In the Milan Smart city initiative before, the *governance* dimension gathered the higher number of projects. However, *governance* challenges were not being addressed in this proportion, reflecting the weight of *e-governance* and the introduction of technology. The number of projects that address *governance* challenges has even been reduced in the strategy. The future development of Milan Smart City should focus on addressing these challenges.
- **Revising the vision of Smart City as an initiative providing services.** *Living and services* is the second dimension in importance in the Milan Smart City strategy before and now. But in the vision of the interviewed stakeholders, it is among the less important dimensions. Even if services can be key to address challenges like the Global polarization ones, the importance and weight of the projects focused to this dimension should be revised.
- **Climate change is still important: addressing the challenges.** Among the lasts in importance in the initiative in both the visions of the initiative before and now, and *Environment* dimension is also the second last in importance in. However, *climate change* is the third in importance in the stakeholders' vision. So the weight of *environmental* projects should be rebalanced, increasing the number of projects addressing *Climate change*.
- **Mobility as a way of addressing climate change and increasing quality of life.** The weight of *mobility* projects has been reduced in the initiative, from being the fourth to be the last in importance. This is coincident with the opinion for

interviewed stakeholders. However, in line with the previous recommendation, the role of *mobility* in reducing *climate change* impacts in the city needs to be taken into account.

- **Technology as a crosscutting element.** The trend of technological innovation in urban issues has been the second in importance in the initiative both before and now. This is because technology is a crosscutting element among the dimensions of the Smart City, and it was being addressed by different dimensions. Addressing these challenges is the fourth trend in importance according to the interviewed experts. Reducing its weight can only be done in a transversal way, reducing the role of technology in the different dimensions.

As a conclusion, Milan should rebalance both the importance of the different stakeholders and the weight of the dimensions of the Smart City. Regarding the stakeholders' groups involved in the initiative is key, giving back the main role to political stakeholders without forgetting social agents. *People* and *economy* need to keep on being key in an interrelated way. The provision of services may not be so key. However, *environment* and *mobility* dimensions need to regain weight and keep on being connected with the other dimensions. Technology should be understood as crosscutting element among all dimensions, reducing its weight and becoming a tool that underlies the strategy.

7 CONCLUSIONS

This final section is structured into three groups of conclusions: firstly its extracts conclusions about the conceptual model and its application; secondly, specific conclusions about the use of the tool are developed; and finally, specific conclusions about the analysis results are explained. In the final section, integrated conclusions and next stages are presented.

7.1 Conclusions about the Conceptual Model

The conceptual model developed in this research aims to offer a comprehensive understanding of Smart Cities, encapsulating their complexity and multidimensional nature. This model draws on insights from an extensive review of existing literature on Smart Cities, synthesizing various perspectives on governance, stakeholder involvement, and urban challenges into a coherent framework. One of the significant insights gleaned is the recognition of Smart Cities as integrated systems that encompass both physical and social dimensions. This model does not merely serve to represent Smart Cities visually; it provides a foundational understanding of the intricate relationships among different stakeholders, the diversity of projects, and the challenges faced in urban environments.

In the context of the Milan Smart City Initiative, the conceptual model plays a pivotal role in reflecting the city's strategic approach to integrating technological advancements with the needs of its residents. Milan's governance structure has made significant strides in stakeholder engagement, exemplifying the model's emphasis on the critical involvement of local governments in Smart City initiatives. The engagement of various stakeholders, including citizens, businesses, and academia, aligns with the model's assertion that governance is central to the effectiveness of Smart City strategies. By analyzing the interplay of these actors, the model aids in uncovering the nuances of their roles—balancing interests and fostering collaboration to meet urban goals.

Moreover, the model highlights how the specific characteristics of each stakeholder can inform and enhance the governance structures within Milan. For instance, it underscores the importance of actively incorporating citizen feedback into the city's planning processes, ensuring that their voices shape the urban landscape. This alignment with the conceptual framework prompts a deeper understanding of the governance mechanisms needed to facilitate effective decision-making in Smart City projects. Ultimately, the proposed model serves as a roadmap for other cities aspiring to reach similar milestones, making it clear that a multifaceted approach that includes the varied interests of each stakeholder is essential for effective governance and project implementation.

7.2 Conclusions about the Use of the Tool

The application of the conceptual model as an analytical tool has demonstrated its effectiveness in mapping the complexity of Smart City projects. By employing the tool, researchers and urban planners can synthesize and compare the myriad perspectives presented by different stakeholders involved in Smart City initiatives. This functionality is particularly evident in the Milan case study, where the model facilitated a deeper understanding of the interactions among stakeholders. Stakeholders described their perceptions and expectations regarding the Smart City concept, which allowed researchers to identify pivotal gaps between aspirations and actual implementations.

The findings from the Milan Smart City analysis reveal significant insights regarding the challenges faced during the initiative's execution. For example, participants highlighted a lack of clear communication strategies, which often resulted in misunderstandings between various stakeholders. By employing the conceptual model, it became easier to visualize these communication gaps and identify ways to bridge them. This resonates with the model's claim that effective stakeholder engagement and communication are vital for successful Smart City strategies. Through the application of the conceptual model, strategies for enhanced collaboration and information sharing can be proposed, thereby creating a more coherent framework for urban development.

The tool also underscores the necessity of a participatory approach, highlighting how stakeholder engagement enhances local ownership and trust in Smart City initiatives. In Milan, different stakeholders emphasized that their involvement in the initiative is crucial not just for project success but also for ensuring that the initiatives respond effectively to urban challenges. Thus, the conceptual model provides decision-makers with actionable insights—allowing them to adapt strategies seamlessly based on stakeholder feedback and to promote initiatives that resonate with public concerns. Such adaptability is not just beneficial; it is essential in ensuring that Smart Cities evolve in alignment with the needs of their citizens.

To sum up, the conceptual model serves not only as a theoretical framework but also as a practical tool that aids in the robust evaluation of Smart City initiatives. The case study of Milan emphasizes that when applied thoughtfully, the model fosters a collaborative environment, providing pathways for stakeholders to navigate complexities in urban strategy development. This bodes well not just for Milan but for cities across Europe and beyond aiming to embrace the Smart City paradigm.

7.3 Conclusions about the Analysis Results

The Smart City confirmed its holistic character providing complex answers to urban problems. There exist positive and negative correlations among the main issues considered in this research: stakeholders, Smart City projects and challenges addressed. In general terms, the global terms need to have balanced answers, and the balance among stakeholders is contributing to it. But when it comes to the materialization of the initiatives, balance is not always the answer, and solutions need to be tailored to the

specific need of each city. The results of the analysis conducted on the Milan Smart City Initiative yield critical insights into the nuances involved in the implementation of Smart City strategies. A striking conclusion drawn from the study is the significant discrepancy that often exists between the ideation and execution phases of Smart City projects. Stakeholders from various sectors expressed concerns that while there was a well-articulated strategy at a conceptual level, the realities of implementation fell short due to fragmented communication and lack of cohesive action plans.

This gap highlights the importance of referring back to the conceptual model, which serves as a guiding element for aligning the discussions and actions among stakeholders. The model, as applied in Milan, helps to elucidate the importance of citizen engagement throughout the planning and execution stages, addressing the challenges of attracting active participation from the community. Surveyed stakeholders noted that without sufficient engagement from residents, even the most well-intentioned initiatives might falter due to skepticism or resistance from the public.

Furthermore, Milan's case study reveals how urban challenges often extend beyond mere technological upgrades; they embody broader social, economic, and environmental implications. For instance, stakeholders identified urban mobility as a core issue that requires comprehensive solutions involving public transport, cycling infrastructure, and pedestrian-friendly areas. The conceptual model's embedded focus on interrelations among different dimensions allows for a more nuanced approach to tackling such multifaceted challenges. By adopting a holistic perspective, Milan can not only implement technological interventions but also ensure that these efforts are contextually relevant and socially accepted.

Another notable finding is that urban challenges must be considered in light of local conditions rather than global trends alone. The analysis of the Milan Smart City Initiative shows that while global best practices provide a valuable benchmark, the specific demands and aspirations of Milanese citizens must ultimately inform local urban strategy. The model's emphasis on stakeholder roles signals that the success of Smart City projects lies significantly in their ability to consider and incorporate local contexts and conditions.

Ultimately, the research reinforces the notion that the journey towards a Smart City is not merely about adopting advanced technologies; rather, it involves a commitment to social equity, stakeholder engagement, and a continual dialogue between citizens and decision-makers. The lessons drawn from Milan serve as a reminder that while the pursuit of technological sophistication is important, the broader goal should be to create urban environments that are inclusive, sustainable, and responsive to their citizens' needs. The analysis results thus support the view that Smart City strategies can only succeed when they are designed collaboratively and reflect a shared vision among all stakeholders involved.

7.4 Final Thoughts and next steps

The aim of this research was triple: (A) to design an integrative and comprehensive conceptual model for Smart Cities, and (B) to propose a methodology to analyze the implementation of Smart Cities and the discourses and (c) to extract guidelines to develop initiatives in the field. The research complied with these different approaches as described in the previous stages. Combining insights across the three sections reveals that the journey toward Smart City initiatives, such as that undertaken in Milan, is deeply interconnected with concepts of governance, stakeholder engagement, and the practicalities of implementation. The conceptual model developed through this research serves as a vital tool for navigating these complexities, facilitating stakeholder interactions, and ultimately leading to the development of more responsive urban strategies.

As cities around the world continue to explore the Smart City paradigm, the lessons learned from Milan's experiences elucidate the significance of creating an integrated approach that duly contemplates local contexts and embraces a collaborative ethos. By harnessing the insights from this research, urban planners and policymakers can craft Smart City initiatives that are not only technologically advanced but also inclusive, sustainable, and attuned to the unique needs of their communities. In doing so, they can pave the way for future urban developments that are not just smart in nature but smart in design, fostering resilience and vitality in the urban landscapes of tomorrow.

The next stages of this research could consider the implementation of technological tools such as text analysis and artificial intelligence for the elaboration of models and the synthesis of information gathered; another stage of research could include the analysis of cities in the current state of development of the Smart City and comparison with previous stages, analysing also the influence of the last advances in technology in the gap between the perception of the initiatives and its real implementation. Finally, the use of the conceptual model could be extended and adapted to other concepts and to the exploration of their evolution through time. The methodology exposed could this way expand its purpose of helping to bridge the gap between the vision of stakeholders and the implementation of urban strategies and initiatives, increasing their adaptation to real needs of citizens and its effectiveness.

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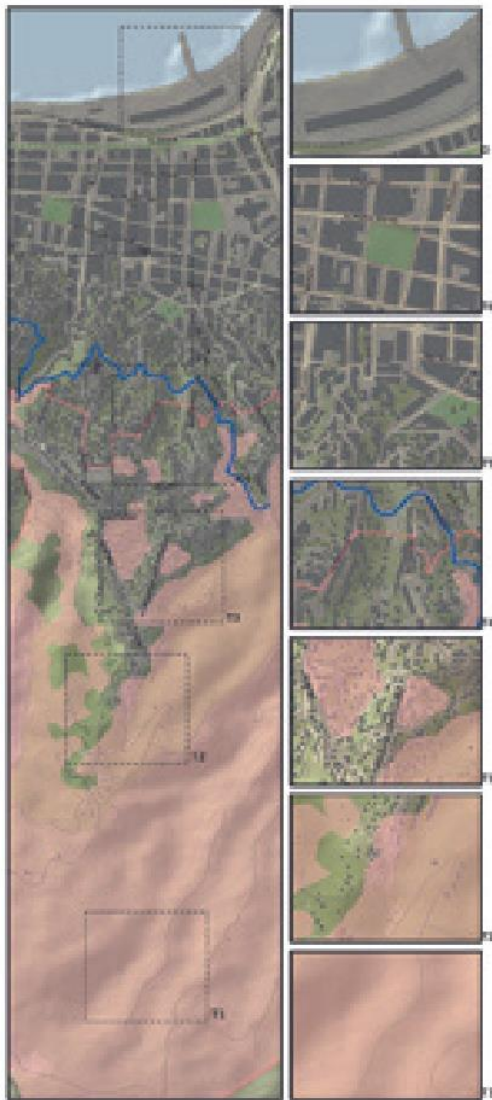


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