Universidad Politécnica de Madrid

E.T.S.I. de Caminos, Canales y puertos

Smart cities projects in Spain

Comparative analysis between various cities

Stijn Bossuyt

Máster Universitario en Sistemas de Ingeniería Civil

Professor: Rosa M. Arce Ruiz

School year: 2013-2014

Technology is nothing. What's important is that you have a faith in people, that they're basically good and smart, and if you give them tools, they'll do wonderful things with them.

Steve Jobs

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CONTENTS

1. INTRODUCTION

This first chapter is an introduction to the dissertation submitted in partial fulfilment of the requirements for the Degree of Master of Applied Engineering Construction at the Ghent University and Máster Universitario en Sistemas de Ingeniería Civil at the Universidad Politécnica de Madrid as part of the Erasmus exchange program. This dissertation is the result of a research project focusing on smart cities in Spain.

The importance of smart cities can hardly be overestimated. As more and more people live in urban areas (already more than half of the world's population and that percentage expected to rise to 75 percent by 2050) it is clear that the path to sustainable development must pass through cities.

High density city populations increase strains on energy, transportation, water, buildings and public spaces, so solutions need to be found which are 'smart', i.e. both highly efficient and sustainable on the one hand, as well as generating economic prosperity and social wellbeing on the other. Smart cities emerge not just as an innovative modus operandi for future urban living but as a key strategy to tackle poverty and inequality, unemployment and energy management.

The stage of development of a smart city can vary widely. Some cities have implemented systems that are already in use while the majority is still in a conceptual or development phase. Practically all of them have emerged in the last decade. Therefore it is useful to investigate various smart cities to compare their approach of becoming a smart city.

1.1 Scope and goals

As more and more people live in urban areas the importance of smart cities is increasing for the well-being of our planet. This dissertation examines various Spanish smart cities that are members of the RECI, the Spanish network for smart cities.

The cities were selected by population and population density, trying to represent cities with more than 200 000 habitants and denser than 2000 habitants per square kilometer. It concerns the following cities: A Coruña, Alcalá de Henares, Alcorcón, Alicante, Barcelona, Castellón de la Plana, Gijón, Las Palmas de Gran Canaria, Madrid, Málaga, Móstoles, Sabadell, Santander, Sevilla and Valencia. All of the smart city projects of these cities are displayed in tables with a brief explanation.

In the research of smart cities it is useful to investigate what they are and how cities implement their smart city intentions in practical projects.

The goal is to map and compare the projects between the different cities. During the investigation a ranking was developed based on the achieved results and related to the following questions: Which kind of projects do they have? Which number of projects do they have? Are they big or small initiatives? Are they innovative? Do they have a big impact on the society? In which technologic area are the projects situated? Do they have the same objectives? Do the cities more or less have the same priorities?

2. METHODOLOGY

2.1 Case analysis Spain

In the chapter 'Case analysis Spain' various Spanish cities that are a member of the RECI the Spanish network for Smart Cities (see more later in the introduction of the chapter) are analyzed. The analysis is focused on cities where a lot of people live together in a small space (density) because this requires more challenging projects. Therefore all the cities of the RECI with a population over 200 000 habitants and a population density over 2000 habitants per square kilometer are analyzed. It concerns the following cities: A Coruña, Alcalá de Henares, Barcelona, Las Palmas de Gran Canaria, Madrid, Móstoles, Sabadell, Sevilla and Valencia. Next to those cities also Alcorcón, Alicante, Castellón de la Plana, Gijón, Málaga and Santander are analyzed, cites that only slightly differ from the above criteria and with interesting projects.

First of all the area, population and density and location of each city are depicted to illustrate the size of the specific city. Second a small introduction about the city follows. For those figures data of the INE (Instituto Nacional de Estadística or National Institute of Statistics) and the IGN (Instituto Geográfico Nacional) are used.

Next, the smart city projects of the specific city are depicted and classified in a table. To list the projects of a city, different sources where investigated, going from the websites of the city governments to reports of the European Commission, as can be seen in the bibliography. For the cities in Spain, sources in English and Spanish were investigated, however it still remains possible that some projects were not detected.

Only specific projects are listed. A lot of cities have a strategic plan with intentions but lack sometimes specific projects in practice. The focus is on projects the municipality fulfils whether or not in cooperation with other parties.

Each project is described shortly and classified in of the six dimensions of smart cities (economy, government, environment, mobility, people and living). Those six dimensions are further subdivided in different categories as Table 1 illustrates.

Table 1: Classification of projects

Economy	ICT-enabled manufacturing and services Innovative and digital business and entrepreneurship Public private partnerships
Government	E-government Decision-making Participation Transparency Urban planning
Environment	Buildings Natural resources, green, renewable, energy Public lighting Pollution control Waste management Water management
Mobility	City logistics Info-mobility People mobility

People	Education Integration and plurality Training
Living	Culture & Entertainment Healthcare Hospitality Public security and safety Smartphone applications Social inclusion and welfare Tourism

Of course, some projects can be associated with more than of these characteristics. Therefore the main goal of a project is used to place it in a specific category. To give an example, implementing a bicycle loan system is an environmentally friendly measure because bicycles are not polluting but the main goal is to create a sustainable way of transport so the project is classified under mobility.

2.2 Project index

To calculate the project index of a city each project is given four coefficients for the following properties of the project:

- Size/amplitude of the project (1,2,3) P_a
- Multifarious/transboundary (1,2,3) P_m
- Innovativeness (1,2,3) P_i
- Specificity (1,2) P_s

Some examples can illustrate how the coefficients are assigned.

The **size of amplitude** of a project is about how big the project is. For example organizing a workshop or a training only has a small impact and thus will get coefficient 1 while a system that manages the traffic of the whole city, provides information in real-time and support for decision-making will be assigned a 3.

The **multifarious/transboundary** aspect is about how many different characteristics the projects affects. The construction of a data processing center affects almost all characteristics because data of different domains are processed and the possibilities of applications with these data are endless. On the other hand, an automatic irrigation system doesn't have a big impact on other characteristics except water and energy management in the environmental dimension.

Innovativeness refers to the innovative nature of the project. Online procedures of the city government aren't really innovative anymore nowadays but rather evident while an intelligent parking system that leads the customer to free parking spots in the city is a lot more innovatory.

The last property is the **specificity**. The project is classified as very specific (2) or less specific (1). For example, mobile phone applications are very specific projects with a clear objective and performance, while other projects not always have those very specific measures. For example, Gijón participates in the European Cascade project which is about networking and peer-to-peer learning on local energy leadership. It is a very interesting project and good to improve the knowledge of the city, which can be used in future projects but there is no such clear, obvious line of actions as there is with the mobile phone applications.

2.3 Findings and discussion

In this chapter the rankings developed in the previous chapter are discussed and the projects of the different cities are compared with each other.

3. LITERATURE REVIEW

This chapter takes a closer look at what smart cities are, their importance, what the different theories, concepts, aspects and the fundamentals of a smart city are.

3.1 Introduction and importance of smart cities

The importance of smart cities can hardly be overestimated. As more and more people live in urban areas (already more than half of the world's population and that percentage expected to rise to 75 percent by 2050) it is clear that the path to sustainable development must pass through cities. *(Morier, 2012)*

High density city populations increase strains on energy, transportation, water, buildings and public spaces, so solutions need to be found which are 'smart', i.e. both highly efficient and sustainable on the one hand, as well as generating economic prosperity and social wellbeing on the other. *(Manville et al., 2014)* This is best achieved by mobilizing all of a city's resources and coordinating its actors using new technologies and forward looking joined-up policies.

Major urbanization requires new and innovative ways to manage the complexity of urban living; it demands new ways to target problems of overcrowding, energy consumption, resource management and environmental protection. It is in this context that smart cities emerge not just as an innovative *modus operandi* for future urban living but as a key strategy to tackle poverty and inequality, unemployment and energy management.

Smart city initiatives are clearly a large city phenomenon. Almost 90% of cities with over 500.000 inhabitants have implemented or proposed initiatives whilst this is only 51% (240 cities) of the cities with at least 100.000 residents.

The stage of development of a smart city can vary widely. Some cities have implemented systems that are already in use while the majority is still in a conceptual or development phase. Practically all of them have emerged in the last decade. Although the application of technology in city planning and management is not new an explanation for this increase in efforts to be smart could be more widely available ICTs as well the technology providers increased efforts to partner with cities.

Also Ching (*2013)* highlights that in many cases, smart cities are characterized by the technology that is used and the technology provider. About a third of the current smart cities are working with major global technology providers such as IBM, Cisco and Siemens. Each technology provider also has its own views and opinions about smart cities.

3.2 Smart city definition

The idea of smart cities is rooted in the creation and connection of human capital, social capital and Information and Communication Technology (ICT) infrastructure in order to generate greater and more sustainable economic development and a better quality of life. In a report of the European Union a work definition is brought up. The implementation of the smart city concept follows very varied paths depending on each city's specific policies, objectives, funding and scope. Any useful working definition of a smart city needs to incorporate these highly diverse circumstances while still enabling improved understanding of good practice, the potential for scaling and the development of relevant policy frameworks. In Manville et al. their report for the European Union, the following work definition is proposed:

"A smart city is a city seeking to address public issues via ICT-based solutions on the basis of a multi-stakeholder, municipally based partnership."

For example, multi-stakeholder aspects can be the use of social participation to enhance sustainability, quality of life and urban welfare. Information and communications technology (ICT) is a key enabler for cities to address these challenges in a 'smart' manner. In the report a smart city is considered as a city with at least one initiative addressing one or more of the following six characteristics: smart governance, smart people, smart living, smart mobility, smart economy and smart environment. ICT links and strengthens networks of people, businesses, infrastructures, resources, energy and spaces, as well as providing intelligent organizational and governance tools.

Ching states that the definition of "smart" cities is still elusive. It's not clear if it refers to city form, infrastructure and development, or processes in city planning and management, or city governance and organization, or all of the above. The common underlying theme is the application of technology to city management and planning, leading to greater optimization of time and resources and resulting in more efficiency and a better quality of life. While all of them share the underlying theme of ICT applications the fields of application range broadly. ICTs and new technologies are applied in utilities (e.g. smart grids), transportation, city planning, etc.

A lot more definitions can be found in literature. Table 2 shows a summary of other definitions.

Table 2: Summary of other definitions (source: *Manville et al., 2014)*

Type	Definition	Source
Technology focused definitions	The use of ICT [makes] the critical infrastructure components and services of a city – which include city administration, education, healthcare, public safety, real estate, transportation, and utilities – more intelligent, interconnected, and efficient.	Washburn and Sindhu (2009)
	Cities [should be seen as] systems of systems, and that there are emerging opportunities to introduce digital nervous systems, intelligent responsiveness, and optimization at every level of system integration.	MIT (2013)
	In a Smart City, networks are linked together, supporting and positively feeding off each other, so that the technology and data gathering should: be able to constantly gather, analyse and distribute data about the city to optimise efficiency and effectiveness in the pursuit of competitiveness and sustainability; be able to communicate and share such data and information around the city using common definitions and standards so it can be easily re-used; be able to act multi-functionally, which means they should provide solutions to multiple problems from a holistic city perspective.	Copenhagen Cleantech Cluster (2012)
Broad definitions	A city is smart when investments in human and social capital and traditional and modern communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance.	Caragliu, Del Bo and Nijkamp (2009)
	A [smart] city is where the ICT strengthens freedom of speech and the accessibility to public information and services.	Anthopoulos and Fitsilis (2010)
	[Smart Cities are about] leveraging interoperability within and across policy domains of the city (e.g. transportation, public safety, energy, education, healthcare, and development). Smart City strategies require innovative ways of interacting with stakeholders, managing resources, and providing services.	Nam and Pardo (2011)
	Smart Cities combine diverse technologies to reduce their environmental impact and offer citizens better lives. This is not, however, simply a technical challenge. Organisational change in governments – and indeed society at large – is just as essential. Making a city smart is therefore a very multi-disciplinary challenge, bringing together city officials, innovative suppliers, national and EU policymakers, academics and civil society.	Smart Cities and Communities (2013)
	[a city may be called 'smart'] when investments in human and social capital and traditional and modern communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance.	Schaffers et al. (2011)
	Any adequate model for the Smart City must therefore also focus on the Smartness of its citizens and communities and on their well-being and quality of life, as well as encourage the processes that make cities important to people and which might well sustain very different – sometimes conflicting – activities.	Haque (2012)

3.3 Characteristics of smart cities

Smart cities can be defined along six dimensions or characteristics:

- Smart Economy
- Smart Mobility
- Smart Environment
- Smart People
- Smart Living
- Smart Governance

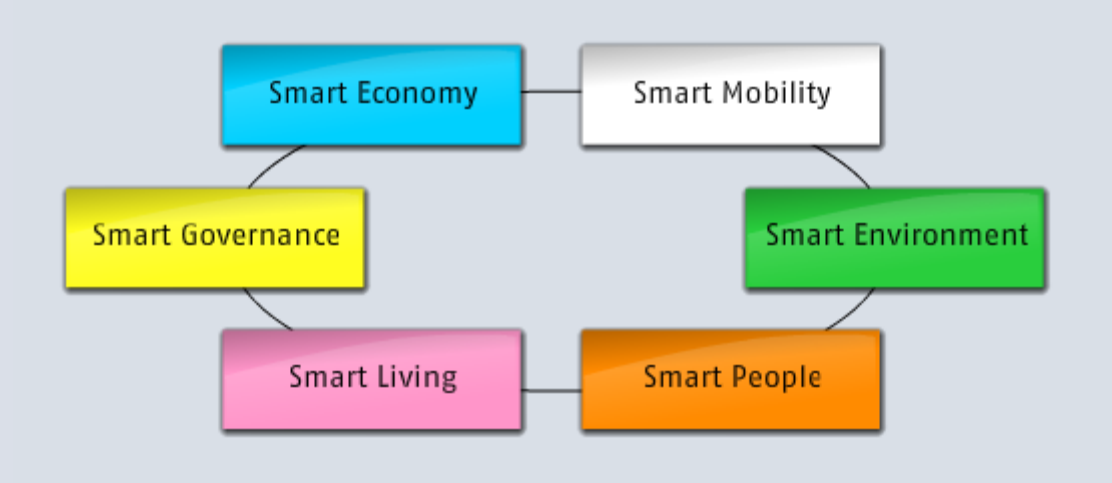

Figure 1: Characteristics of smart cities (source: Giffinger et al., 2007)

This type of characterization framework is well justified and documented, and already used in practice by an increasing number of cities and policy makers.

Including the works of (Parrága, 2014), (Manville et al., 2014), (Giffinger et al., 2007), (Giffinger & Gudrun, 2010), (Schuurman et al., 2012) and (Batty et al., 2012) as well as numerous other sources underpin those six characteristics.

This framework captures the key dimensions while retaining simplicity through specifying a relatively small number of characteristics which cover the range of existing projects. *(Manville et al., 2014)* Thus a smart city project or initiative needs to contain at least one of the six characteristics. Although this is a guideline and we also need to keep in mind the smart city definitions. The most successful smart city strategies might be expected to adopt a multi-dimensional approach to maximize such synergy and minimize negative spill-over effects.

The six characteristics of Smart Cities are described in more detail in Table 3.

Table 3: The six characteristics of smart cities (source: *Manville et al., 2014)*

Characteristic	Description
Smart Governance	By Smart Governance we mean joined up within-city and across-city governance, including services and interactions which link and, where relevant, integrate public, private, civil and European Community organisations so the city can function efficiently and effectively as one organism. The main enabling tool to achieve this is ICT (infrastructures, hardware and software), enabled by smart processes and interoperability and fuelled by data. International, national and hinterland links are also important (beyond the city), given that a Smart City could be described as quintessentially a globally networked hub. This entails public, private and civil partnerships and collaboration with different stakeholders working together in pursuing smart objectives at city level. Smart objectives include transparency and open data by using ICT and e-government in participatory decision-making and co-created e-services, for example apps. Smart Governance, as a transversal factor, can also orchestrate and integrate some or all of the other smart characteristics.
Smart Economy	By Smart Economy we mean e-business and e-commerce, increased productivity, ICT-enabled and advanced manufacturing and delivery of services, ICT-enabled innovation, as well as new products, new services and business models. It also establishes smart clusters and eco-systems (e.g. digital business and entrepreneurship). Smart Economy also entails local and global inter-connectedness and international embeddedness with physical and virtual flows of goods, services and knowledge.
Smart Mobility	By Smart Mobility we mean ICT supported and integrated transport and logistics systems. For example, sustainable, safe and interconnected transportation systems can encompass trams, buses, trains, metros, cars, cycles and pedestrians in situations using one or more modes of transport. Smart Mobility prioritises clean and often non-motorised options. Relevant and real-time information can be accessed by the public in order to save time and improve commuting efficiency, save costs and reduce CO_2 emissions, as well as to network transport managers to improve services and provide feedback to citizens. Mobility system users might also provide their own real-time data or contribute to long-term planning.
Smart Environment	By smart environment we include smart energy including renewables, ICT-enabled energy grids, metering, pollution control and monitoring, renovation of buildings and amenities, green buildings, green urban planning, as well as resource use efficiency, re-use and resource substitution which serves the above goals. Urban services such as street lighting, waste management, drainage systems, and water resource systems that are monitored to evaluate the system, reduce pollution and improve water quality are also good examples.
Smart People	By Smart People we mean e-skills, working in ICT-enabled working, having access to education and training, human resources and capacity management, within an inclusive society that improves creativity and fosters innovation. As a characteristic, it can also enable people and communities to themselves input, use, manipulate and personalise data, for example through appropriate data analytic tools and dashboards, to make decisions and create products and services.
Smart Living	By Smart Living we mean ICT-enabled life styles, behaviour and consumption. Smart Living is also healthy and safe living in a culturally vibrant city with diverse cultural facilities, and incorporates good quality housing and accommodation. Smart Living is also linked to high levels of social cohesion and social capital.

3.4 The relationship between components and characteristics of smart cities

The **components** of smart cities are the areas that their initiatives address. The means that are used to achieve these goals of the **characteristics** are the components. *(Manville et al., 2014)* If, for example, the characteristic of an initiative is smart mobility, the components can be various technologies concerning mobility. Components can signify a wide range of activities resources and methods. They can already exist while others can be created for specific projects. In practice it is not easy to separate the characteristics and the components. Because it is difficult to distinguish them they should therefore be analyzed together.

Components can be seen as the building blocks of smart city initiatives. Some authors declare that the components can be loosely stratified by the six characteristics, which in turn are used to identify whether a city is 'smart'. Cohen sees smart city components as key drivers of specific characteristics. *(Cohen, B. 2012a), (Cohen, B. 2012b) & (Giffinger et al., 2007)* However Manville et al. state that there are components that pertain to a specific characteristic (e.g. 'green buildings' and 'energy sensors', which are specific to the smart environment characteristic), others are of a horizontal or enabling nature (such as 'open data' and monitoring technologies) and cover several characteristics.

Human or social **factors** , such as education and social capital, or institutional factors surrounding the role of stakeholders and funders must also be taken into account because smart city initiatives go beyond the application of technology. This is necessary to achieve a workable conceptualization of the relationship between components and characteristics.

Nam and Pardo point out three core factors to categorize smart city characteristics. They adopt a more holistic view as shown in Figure 2.

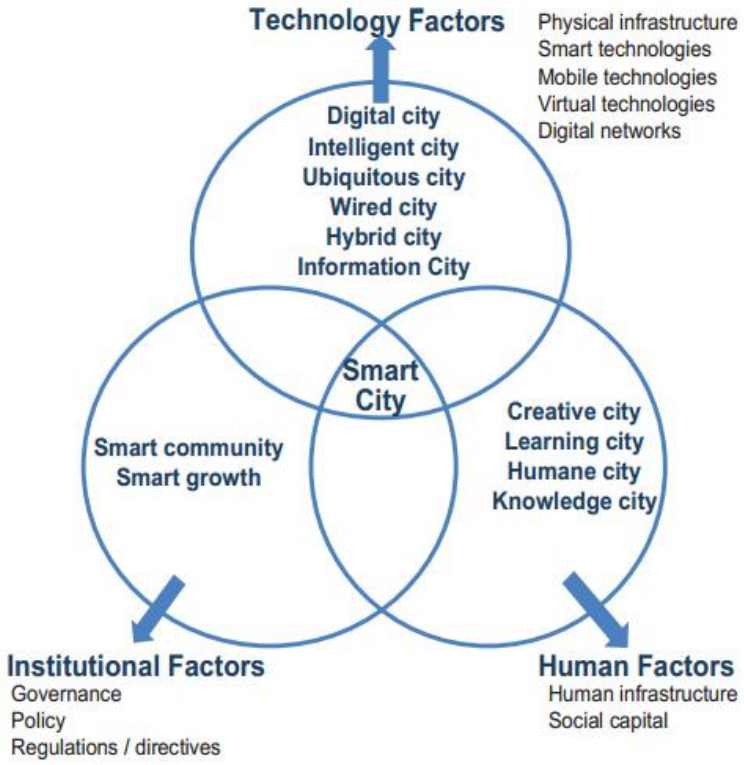

Figure 2: The three core factors of smart cities (source: Nam & Pardo, 2011)

Figure 3 shows the relationship between characteristics and components. The outer ring shows the components, and the inner ring the characteristics. Not each component is mapped onto a specific characteristic but a range of technological, human and institutional factors underpins all characteristics.

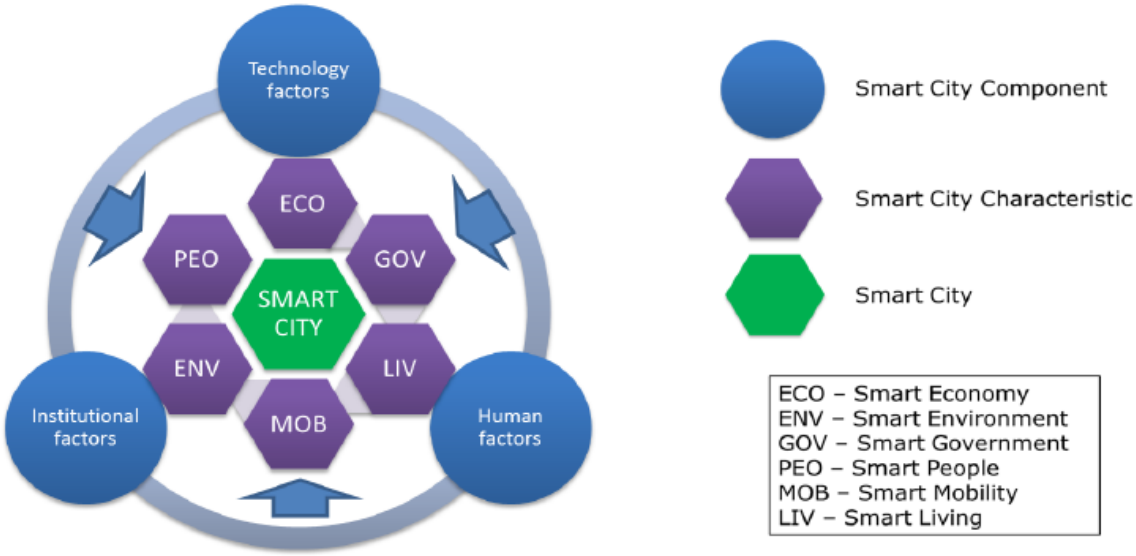

Figure 3: The relationship of components and characteristics of smart cities (source: Manville et al., 2014)

Thus like Manville et al. state components and characteristics can have a direct or an indirect relationship. In a direct relationship, an objective is furthered by a specific initiative with an associated characteristic that necessitates and justifies the use of a particular component. Take, for example, the objective of improving energy efficiency within the city. This objective may be associated with an environmental initiative (characteristic), which makes use of smart buildings (component) to permit energy network managers to adjust load in order to make efficient use of existing supply capacity.

In an indirect relationship a specific component contributes to more than one characteristic, altering the way those characteristics are pursued across other initiatives and their associated components and objectives. Thus, in the above example, smart meters could help individual energy users to optimize their demand patterns (contributing to the environmental characteristic). But this information will also raise their awareness of the price implications of their behavior (people) leading them to factor energy considerations into their appliance purchase (economy) and residential and job location (mobility) decisions.

3.5 Defining success of smart cities

Careful analysis to define the 'success' of a smart city is required. As a report of the European Union *(Manville et al., 2014)* states:

"As most current discussion of smart cities is framed in terms of the six axes mentioned above, the simplest approach would be to equate success with demonstrated activity across the full range of these dimensions. However, this approach ignores the differing nature and severity of the problems cities face, the presence or absence of existing initiatives and infrastructures, and the critical need effectively to engage and involve a suitable range of stakeholders. The focus and balance of the smart city ought, in principle, to reflect the specific challenges faced by the city and the priorities and capabilities of those involved. Moreover, the success of a Smart City depends on the depth and effectiveness of targeted improvement within each area or initiative and on the coherence or balance of the portfolio of initiatives across the city."

In the same report the following definition of successful initiatives and cities are proposed:

Successful initiatives: observable indicators through the life cycle of the initiative: attracting wide support, having clear objectives aligned to policy goals and current problems, producing concrete outcomes and impacts, being imitated or scaled.

Successful cities: having meaningful objectives (aligned with Europe 2020 and actual outcomes) covering a mix of policy targets and characteristics; having a balanced portfolio of initiatives; attaining maturity (on our scale); actively joining in smart city networks.

As shown in Figure 4 smart city projects are considered a sub-category of smart city initiatives which in turn are a sub-category of smart cities.

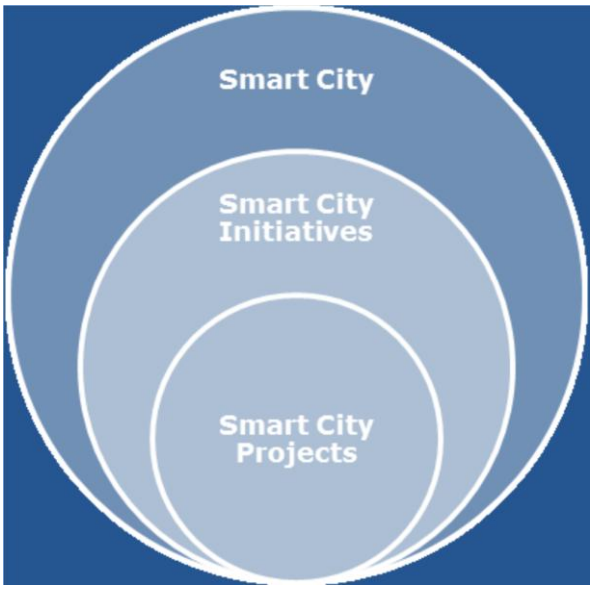

Figure 4: The relationship between projects, initiatives and cities (source: Manville et al., 2014)

To value a particular initiative a range of questions needs to be considered. Are the objectives relevant, appropriate and aligned with broader city development objectives? Does the initiative address problems of importance to the city in question? Is the mix of funding, participation, components and characteristics likely to produce the hoped for outcomes? And if possible the expected impacts should be examined as well.

3.6 Smart cities in Europe and the rest of the world

There are smart cities all over the world because it's an important basis for future city expansion. Other continents than Europe, including for example emerging economies in Asia as China and India, are developing large smart city programs.

Melchor III *(2012)* informs that in China, the smart cities are part of the strategy to conquer poverty and develop economic stimulation. The smart cities could serve as giant urban employment hubs because poverty in China is largely a rural problem.

Other countries build smart cities from the ground up, for example New Songdo City in South Korea and King Abdullah Economic City in Saudi Arabia.

Europe does not suffer problems such as rural poverty or runaway mega-city development on the same scale as China or India, but smart cities are nonetheless highly necessary. Experience with smart cities makes Europe able to assist developing countries, which reduces the risk of exported problems and make them better trading partners. More importantly however Europe needs its own smart cities. *(European Commission, 2013b)* The power of smart cities is indispensable in order to compete with global economies as well as to tackle poverty, unemployment and environmental damage. Therefore, Europe invests in ICT infrastructure and human and social development as a part of their Europe 2020 strategy. The goals set in this strategy could be partly achieved by smart cities as they increase effectiveness, reduce costs and improve quality of life.

3.7 Theories and concepts of being smart

Considering smart cities there are different theories and concepts to define smart. According to ching being 'smart' within the city context can be grouped under four key theories.

Theory A – In the age of Smart Machine: Smart Machines and Organization
Theory B – Beyond "Smart Machines": Engaging Communities, Organizations & Businesses
Theory C – Cities that Learn, Relearn and Adapt
Theory D – Investing for the future

3.7.1 Theory A – In the age of Smart Machine: Smart Machines and Organization

This theory assumes being a smart city involves the use of ICTs for automation and intelligent functions. Organization and governance can be reorganized to take advantage of new technologies and the way its processes.

According to Zuboff *(1988)* there are two big dimensions in the application of intelligent or information technology (IT). 'Automation' is the first one and 'generating information about the underlying productive and processes through which an organization accomplishes its work' the second one.

In the automation process, human tasks need to be translated into software instructions. Using sophisticated sensors and algorithms machines are able to perform tasks repeatedly, reliably and with more control. When those smart machines are used to take over city functions they should be able to perform the task more accurately and reliable than possibly could have been done by humans, if humans could perform such functions at all. Smart machines could also be used to make models and predictions about the effect of city plans and thus as decision support tools.

However smart machines alone are not sufficient. Combinations of smart machines and humans and how well humans work together with the machines are important factors to improve business organizational models. *(Kelly, 2012)* For example Kasparov, stated after an online chess game where amateur players using normal laptops beat human grandmasters and chess machines that a weak human in combination with a machine and a better process is superior to a strong computer alone and even to a strong human in combination with a machine but an inferior process.

The most productive companies reinvented and reorganized there whole system, going from decision rights to information flows and hiring systems to get the most of the technology. *(Ching, 2013)* So using smart machines alone in handling city functions could lead to more efficiency however combined with humans (for example to retool organization structures) it may lead to greater benefits.

Several authors point out that a good organization, governance and public organization are fundamental issues for a smart city. For example World Bank manager Joshi-Ghani says "the concept of smart cities is really about good governance" *(Morier, 2012)* and Bolissent states "the real key to being smart is to have an overall management system that allows leaders to coordinate across these smart systems, capturing and sharing the data generated and using it to inform new policies and city programs" *(Bolissent, 2012).* An Open Cities article puts it this way: "The smart city concept brings together all the characteristics associated with organizational change, technological, economic and social development of a modern city". *(Gonzilez & Rossi, 2011)*

3.7.2 Theory B – Beyond "Smart Machines": Engaging Communities, Organizations & Businesses

This theory explained by Allwinkle & Cruickshank *(2011)* assumes collaboration between city governance and communities, businesses, research institutions … to create an environment that drives innovation and transformation.

The focus shifts beyond smart machines to governance. “The emphasis also shifts from the corporate to the civic, from the market to the community and from the bureaucratic administration of the economy to a liberal democratic governance”.

In an interview Townsend *(2011)* illustrates his vision stating that he prefers smart cities involving more social and inclusive processes of grassroots innovation and warns for that ICTs “might be harnessed by technocrats in places like China or Singapore to further tighten their grip on how cities function”. Sennett *(2012* also underlines the importance of the social aspect “A city is not a machine … this version of the city can deaden and stupefy the people who live in its all-efficient embrace” and “If they have a choice, people want a more open, indeterminate city in which to make their way; this is how they can come to take ownership over their lives”.

Haque *(2012)* states that cities should foster and encourage their citizens efforts for example through making data openly available. “Cities will be places that foster creativity, where citizens are generators of ideas, services and solutions, rather than subservient and passive recipients of them”. The key to a smart city is good communication between the government and the citizens and thus to engage city communities and local organizations in decision making and service delivery. *(Hoornweg, 2011*)

3.7.3 Theory C – Cities that Learn, Relearn and Adapt

This theory assumes that the smart city learns, relearns and adapts itself, through learning networks, as well as using metrics, monitoring and feedback processes.

Campbell *(2012)* explains that this theory expands the engagement of local networks and communities to larger networks of cities. This way cities can learn from each other and strive together for innovative applications. Already some of these large city and institutional networks have been set up to achieve this goal. Examples are smart cities supported by the European Regional Development Fund (www.smartcities.info), European Smart Cities which outlines a model for ‘smart cities’ and shows benchmarking results (www.smart-cities.eu), the European Initiative on smart cities (setis.ec.europa.eu **)** etc. Cities and their planning organizations have the capability to learn, and with the aid of ICTs, may even extend their potential to incorporate double loops for re-learning and adaptation.

To improve smart cities must set goals and try to achieve them. To measure the progress towards a specific goal Cohen developed the ‘Smart Cities Wheel’ rubric, which includes more than 100 indicators grouped into six categories of ‘Smart Economy’, ‘Smart Environment’, ‘Smart Governance’, ‘Smart Living’, ‘Smart Mobility’ and ‘Smart People’. Cohen intends to use those performance indicators as a framework to track the performance and progress towards their goals and adapt their policies and plans accordingly *(Cohen, 2012c).* As earlier discussed in ‘Defining success of smart cities’.

The processes of monitoring, managing and using gathered data for future simulations and design can be described as ‘virtuous cycles in city planning and operation" that lead to more innovative solutions’. *(Walters, 2012)*

3.7.4 Theory D – Investing for the future

This theory assumes that the smart city is cognizant of its human, social and physical stocks of capital, and it invests in ‘smart’ technologies and functions that have the potential to reap greater economic, social and environmental benefits. *(Ching, 2013)*

Several authors approach smart cities from a business perspective. As the writers of ‘Smart cities in Europe’ *(Caragliu et al., 2009)* conclude after their analysis of the performance of 70 European cities: “We believe a city to be smart when investments in human and social capital and traditional (transport) and modern (ICT) infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance.”

Kotkin *(2009)* states “I have determined my ‘smartest’ cities not only by looking at infrastructure and livability, but also economic fundamentals. And cities can demonstrate their intelligence “by exploiting their locations and resources to make savvy business and development decisions”.

According to Kuk and Janssen *(2011)*, long-term city business processes are strongly influenced by the underlying information architecture, in turn influenced by the cities technological capabilities and resources.

The overall conclusion of a report of The Climate Group *(The Climate Group et al, 2011)* is that savings can be realized through smart applications. For example, the report mentions “The monitoring and reduction of emissions through a smart city approach will drive immediate cost-savings as well as the long-term benefits of monitoring the impact of the city’s operations on greenhouse gas emissions”.

The above demonstrates that both economic performance and long-term sustainability as the business performances can be a motivation and driver for the development and application of smart applications.

4. CASE ANALYSIS SPAIN

4.1 Introduction

Spain is one of the biggest countries in Europe and has a lot of big cities. Spain has with Madrid the third-largest city in Europe, after London and Berlin, and has about 30 cities with more than 200 000 habitants.

The country counts 47 265 321 habitants and covers an area of 505 968,36 km². The density amounts 93,42 habitants per square kilometer.[1] Most of the area exists of the mainland but the country also has several archipelagos in the Mediterranean and the Atlantic Ocean and three exclaves in North Africa.

Spain is a democracy organized in the form of a parliamentary government under a constitutional monarchy. It is composed of 17 autonomous communities and two autonomous cities with varying degrees of autonomy.

Castilian or Spanish is the only language that has official status for the whole country while there are several co-official languages that are spoken in specific territories. It concerns Aranese (co-official in Catalonia), Catalan (co-official in Catalonia, the Balearic Islands and, as a distinct variant (Valencian), in the Valencian Community), Basque(co-official in the Basque Country and northern Navarre) and Galician (co-official in Galicia).

According to the Eurobarometer survey in 2013 of the European Commission 91% of the people have a mobile telephone and 52% have a mobile phone with internet subscription. The rate regarding the internet subscription is amongst the highest rates in Europe. [2]

Figure 5: Spain (source: maps.google.com)

[1] (INE & IGN, 2012)

[2] (European Commission, 2013a)

4.1.1 RECI

In Spain the RECI [3] (La Red Española de Ciudades Inteligentes or The Spanish Network for Smart Cities) combines the cities that do efforts to become a smart city. To join the network a city needs to have a strategic plan with specific actions to promote innovation and the use of new technologies and needs to be willing to put their resources and experiences available to the other members of the network.

The RECI began to take shape in June 2011 with the signing of the 'Manifest for Smart Cities. Innovation for progress' whose commitment was to create an open network to promote economic, social and business progress of cities through innovation and knowledge, based on Information Technology and Communication (ICT). The Network was formally constituted in June 2012 in Valladolid. The RECI is headed by the mayor of Santander, Iñigo de la Serna.

Its purpose is to share experiences and work together to develop a sustainable management model and improve the quality of life of citizens, focusing on aspects such as energy saving, sustainable mobility, eGovernment and people care or safety.

Currently , 49 cities are RECI members: A Coruna, Albacete, Alcala de Henares, Alcobendas, Alcorcón, Alicante, Alzira, Aranjuez, Avila, Badajoz, Barcelona, Burgos, Cáceres, Castellón, Córdoba, Guadalajara, Elche, Fuengirola, Gijon, Huelva, Las Palmas de Gran Canaria, Logroño, Lugo, Huesca, Madrid, Majadahonda, Málaga, Marbella, Móstoles, Motril, Murcia, Palencia, Palma de Mallorca, Pamplona, Ponferrada, Oviedo, Rivas- Vaciamadrid, Sabadell, Salamanca, Santander, Segovia, Sevilla, Tarragona, Torrejón de Ardoz, Torrent, Valencia, Valladolid, Vitoria and Zaragoza.

Of these cities 15 cities were selected. All the cities of the RECI with a population over 200 000 habitants and a population density over 2000 habitants per square kilometer are analyzed. It concerns the following cities: A Coruña, Alcalá de Henares, Barcelona, Las Palmas de Gran Canaria, Madrid, Móstoles, Sabadell, Sevilla and Valencia. Next to those cities also Alcorcón, Alicante, Castellón de la Plana, Gijón, Málaga and Santander are analyzed, cites that only slightly differ from the above criteria and with interesting projects.

[3] (Red Española de Ciudades Inteligentes, 2014a)

4.2 A Coruña

Table 4: A Coruña (INE & IGN, 2012)

City	A Coruña
Autonomous community	Galicia
Area (km²)	37,83
Population (habitants)	246 146
Density (hab/km²)	6 506,61

Figure 6: A Coruña (source: http://en.wikipedia.org/wiki/A_Coru%C3%B1a)

A Coruña is a city in Galicia. The strategic plan of the city is called 'Coruña Futura'. The city has a commitment which has resulted in a set of projects to be developed in a coordinated manner in the short, medium and long term, to address the complex transformation process required to move towards a management and development of what we call a smart city.

Table 5 shows the specific projects in A Coruña.

Table 5: A Coruña

A Coruña	Characteristic	Project
Environment	**Energy**	Energy Improvement in ETAP ('Estación de Tratamiento de Agua Potable' or 'Drinking Water Station'). This project includes a detailed analysis of the current operation of the ETAP and an initial audit of its energy consumption. Analyze the information obtained to meet the main needs improvement and ETAP identify actions. This analysis reveals the main needs and specific actions that needs to be taken. Measuring devices and sensors are installed to capture information and improve processes. (Ayuntamiento de A Coruña et al., 2012) & (Comunicación CSC, 2014)
		Monitoring and control of energy efficiency in public buildings. (Ayuntamiento de A Coruña et al., 2012)
		Remote measuring system of water and gas. (Ayuntamiento de A Coruña et al., 2012)
	Waste management	Intelligent management of urban waste. (Ayuntamiento de A Coruña et al., 2012)
	Water management	Continuous monitoring and quality alert of bathing waters and reservoirs. (Ayuntamiento de A Coruña et al., 2012)
		Remote intelligent irrigation in parks and gardens. (Ayuntamiento de A Coruña et al., 2012)

Government	**E-government**	Digitalization of the administration including a virtual tax office. (Ayuntamiento de A Coruña et al., 2012)
Living	**Participation**	Organisation of a Smart Weekend where people can participate in workshops and come up with innovating ideas. (Ayuntamiento de A Coruña, 2014c)
		Introdcution of a technical platform This platform is associated with technologies such as Big Data, Open Data, 3D advanced visualization and Business Intelligence. It can be used by entrepreneurs or students to improve their research or business. (Ayuntamiento de A Coruña, 2014b)
	Healthcare	Ambulatory Telecare System System for offering remote care of elderly and physically less able people, providing the care and reassurance needed to allow them to remain living in their own homes. (Ayuntamiento de A Coruña et al., 2012)
		Information system with information about the emergency services. (Ayuntamiento de A Coruña et al., 2012)
	Public security and safety	Remote control of air quality and noise. (Ayuntamiento de A Coruña et al., 2012)
	Tourism	Guided system with augmented reality and information services in real time. (Ayuntamiento de A Coruña et al., 2012)
		Information system about events. (Ayuntamiento de A Coruña et al., 2012)
Mobility	**Info-mobility**	Traffic optimization system Initiatives of this new system are regulated walking areas and providing information to citizens. To improve mobility and optimize the capabilities of the streets, cameras and detection devices are installed which are connected to the traffic control system. This system collects all the information and details about the traffic situation in real time. This information will be useful for municipal managers who can make decisions in real time in case of a problem on the road and also to the citizens, as they will be informed about the traffic situation and can decide which is the best route to reach their destiny. (Ayuntamiento de A Coruña, 2014a)
	People mobility	Intelligent parking system. (Ayuntamiento de A Coruña et al., 2012)
		Information system about the public services. (Ayuntamiento de A Coruña et al., 2012)

4.3 Alcalá de Henares

Table 6: Alcalá de Henares (INE & IGN, 2012)

City	Alcalá de Henares
Autonomous community	Madrid
Area (km²)	87,72
Population (habitants)	203 924
Density (hab/km²)	2 324,67

Figure 7: Alcalá de Henares (source: http://en.wikipedia.org/wiki/Alcal%C3%A1_de_Henares)

Alcalá de Henares is a Spanish city whose historical centre is one of UNESCO's World Heritage Sites and is located in the Autonomous Community of Madrid, 35 kilometers northeast of the city of Madrid. They are a member of the RECI since November 2013. The Local Government adopted an agreement with the company 'Telefónica' to boost innovation and new technologies, with special emphasis on ICTs and to prepare a master plan for ICT innovation and define the strategic objectives and how to achieve them.

All projects have Ayuntamiento Alcalá de Henares as source unless otherwise stated.

Table 7: Alcalá de Henares

Alcalá de Henares	**Characteristic**	**Project**
Environment	**Buildings**	Building of a center of 'eco-efficient' data The centre is focused on getting the more efficiently significant reductions in the consumption of water, energy and CO2 emissions compared to conventional data centers. The air conditioning of the rooms of the new data center Telefónica carried out using Free Cooling technology a solution that uses the outside air when the temperature is lower than in the halls, thereby significantly reducing power consumption and reaching one of the best energy efficiency standards. In its new data centre, Telefónica will provide outsourcing services infrastructure, hosting, backup, storage, monitoring, etc. There is also a special focus on the new cloud services. (Network World, 2011)
Government	**E-government**	Adjustment of computer equipment and software , through the acquisition of PC 's and high-performance servers and the implementation of high-speed networks to interconnect the Municipal Offices
		eGovernment Planning with the creation of a municipal website and online procedures
Living	**Smartphone applications & wifi**	Creation of WiFi access in cultural and youth centers, libraries and public spaces

4.4 Alcorcón

Table 8: Alcorcón (INE & IGN, 2012)

City	Alcorcón
Autonomous community	Madrid
Area (km²)	33,73
Population (habitants)	169 773
Density (hab/km²)	5033,29

Figure 8: Alcorcón (source: http://en.wikipedia.org/wiki/Alcorc%C3%B3n)

Alcorcón is a city in the south-west of the Madrid metropolitan area. The city is a member of the 'Comisión de Ciudades Digitales y del Conocimiento' or 'Committee on Digital Cities and Knowledge'.

Table 9 shows the specific projects of Alcorcón.

Table 9: Alcorcón

Alcorcón	**Characteristic**	**Project**
Environment	**Buildings**	Installing LED lights in the Municipal Institute of Employment and Economic Development (IMEPE). (Ayuntamiento de Alcorcón, 2013a)
	Energy	Reduced schedules in the operation of ornamental fountains in the city. (Ayuntamiento de Alcorcón, 2013a)
	Public lighting	The use of low energy lighting on public roads. (Ayuntamiento de Alcorcón, 2013a)
Government	**E-government**	Within the administrative modernization plan of the city launching a data processing centre in order to improve the quality of municipal services and bring the digital administration to the residents and the implementation of a document management system and an electronic signature. (Ayuntamiento de Alcorcón, 2013d)
		The city has also implemented a virtual office application through which neighbors of Alcorcon can do their paperwork electronically and send their scanned documents to other authorities without physically moving. This makes life easier for the residents of Alcorcón, administration is more effective and also generates immediate savings. (Ayuntamiento de Alcorcón, 2013d)
	Decision-making	Establishment of an innovative management model through which the proposals, ideas and projects from other cities, universities and research centres, companies and its own staff can be analysed and forward useful information to the management team for decision-making. (RECI, a)

Living	**Healthcare**	Pediatric service online by which any citizen may rise doubts, make appointments and seek advice. (RECI, a)
	Public security and safety	Creation of PPI ('Planes Previos al Incendio' or 'Previous Plans to Fire') of schools and public buildings Each PPI is composed of a data sheet of the building or facility and, second, a collection of plans and positions of key elements for making decisions in case of emergency: fire hydrants, emergency exits, access through doors and windows, gas and electric facilities, possible fuel or water tanks, etc. PPIs are therefore an essential instrument to support first aid in any disaster, reducing uncertainty and improving the speed and effectiveness of the response of the emergency services. This will not only reduce the damage or injury, but also ensure more safety and security to emergencies. (Ayuntamiento de Alcorcón, 2013b)
	Smartphone applications & wifi	Incorporation through the smartphone app SafetyGPS, new services for citizen interaction with the city management, reporting incidents, urban maintenance, safety or the location of defibrillators. (RECI, a)
		Guidance Access System in all municipal buildings: this system facilitates blind people access to city buildings and services provided to them by a mobile application. They can read a series of QR codes. These codes are located in specific areas and provide the necessary information to guide the visually impaired, in particular. Also for those with hearing disabilities or wheelchair users can it be an improvement. (Ayuntamiento de Alcorcón, 2014)
Mobility	**People mobility**	System of tax credits for alternative fuels (biogas, compressed natural gas, methane, hydrogen or electricity) & 'green taxation' with tax credits to encourage the use of less polluting vehicles. (Ayuntamiento de Alcorcón, 2013a)
People	**Education**	EdCivEmerg Educational school program for assistance in first aid and risk prevention. (Ayuntamiento de Alcorcón, 2013b)
	Integration and plurality	Job Club as a meeting of all those seeking employment. (Ayuntamiento de Alcorcón, 2013d)
	Training	Organizing occupational training and mixed employment programs (employment workshops and student workers). (Ayuntamiento de Alcorcón, 2013d)
		Career guidance to help people find the right jobs and vice versa. (Ayuntamiento de Alcorcón, 2013d)

4.5 Alicante

Table 10: Alicante (INE & IGN, 2012)

City	Alicante
Autonomous community	Comunidad Valenciana
Area (km²)	201,27
Population (habitants)	334 678
Density (hab/km²)	1662,87

Figure 9: Alicante (source: http://en.wikipedia.org/wiki/Alicante)

Alicante is a city and port in Spain on the Costa Blanca. The City Council intents to improve continuous in the city in the areas of inter alia energy efficiency, reclaiming public spaces, environmental sustainability and E-government. In 2011 Alicante organized a smart cities meeting. And leads the 'SCW2: Smart Cities Water & Waste' project submitted to the European Community under the 'Horizon 2020' program. That projects aims to define a strategic plan (roadmap) for the European smart cities in the field of waste and water management, setting future priorities.

Table 11 lists the projects in Alicante.

Table 11: Alicante

City	Characteristic	Project
Economy	**ICT-enabled manufacturing and services**	Fiber broadband networks throughout the city The optical fiber technology deployment in Alicante will allow direct transmission of high-speed signals. The company 'Telefónica' will grant individual homes and enterprises the access to optical fiber, and will provide faster internet connection. (ImpulsAlicante, 2013)
Environment	**Natural resources, green, renewable, energy**	Photovoltaic floor of 20 000m² in Mercalicante The solar plant consists of 5,676 photovoltaic modules covering an area of 20 000 square meters and generates 1 599 400 kWh of energy per year the equivalent of the energy expenditure of 468 homes. (DiarioInformacion, 2010)
	Water and waste management	SCW2: Smart Cities Water & Waste Developing a strategic plan for the water management and renovation works of sanitation infrastructure such as collectors, continuing flood park ' La Marjal', etc. (Aguas de Alicante, 2014)
Government	**E-government**	Modernization of municipal structures This includes promoting and disseminate new tools to access the new services and better accessibility of the website of the city, mobile payments of taxes, administrative procedures that can be performed through the internet, etc. (Ayuntamiento de Alicante)
Living	**Smartphone applications & WiFi**	Disabledpark It is a website and a free mobile application that facilitates the geolocation of parking spaces for disabled persons. (Fundetec, 2014)
People	**Training**	Promote technological literacy of citizens, businesses and social organizations in order to break the digital divide between administration and citizens. (Ayuntamiento de Alicante)
		Free monthly forum meeting with high-level training in on-line marketing and social networks. (Fernández, 2013)

4.6 Barcelona

Figure 10: Barcelona

Table 12: Barcelona (INE & IGN, 2012)

City	Barcelona
Autonomous community	Cataluña
Area (km²)	98,21
Population (habitants)	1 620 943
Density (hab/km²)	16 504,68

Barcelona is the capital city of the autonomous community of Catalonia and the country's second largest city, after Madrid. It has one of the highest population densities in Spain. Barcelona is also the leading city of 'City Protocol Society', which aims for international collaboration in defining protocols that accelerate the sustainable transformation of cities. In March 2014 the European Commission has granted the award of European Capital of Innovation (iCapital) to Barcelona. The city is also a member of Polis, a network of European cities and regions working together to develop innovative technologies and policies for local transport.

All projects have (Ayuntament de Barcelona) as source, unless otherwise stated.

Table 13: Barcelona

City	Characteristic	Project
Economy	**ICT-enabled manufacturing and services**	City OS: 'Sistema Operativo de Ciudad' or 'Operating System of the City' Technology platform of services and solutions able to acquire and process information fast, efficient, reliable and sustainable of different systems (sensors, applications, control centres, ...) scattered throughout the city. This platform will be able to relate, combine, complete, process and store events. You can build and run city processes, generate and send messages to other parts, applications or control centres. There is the ability to predict and anticipate any emergency to help coordinate resources more quickly and efficiently, and to support decision making in real time. This platform will be used to design, model and better manage the urban environment.
		The Smartquesina A bus station that features a touch screen with municipal public services, applications, contactless technology ... These new technologies offer the citizen interactive services to improve the user experience. Next to the interactive digital display that allows interactive queries, provides help on routes and destinations and offers a ticket sales service there is also a video casting system on the bus and metro network that provides service information, news and georeferenced advertising. The installation is powered by solar energy and futures also smart advertising panel. A panel with a camera that identifies the number, sex and age of the people standing in front of it. The content displayed varies according to these factors. (Ayuntament de Barcelona, 2013)

		Creating a new single telecommunications network that integrates all preexisting vertical networks, including remodeling urban streets/neighborhoods and deploying new sensors
		Punt BCN They are 'electronic kiosks' and offer services related to the city administration and are located in the office of citizen services and other facilities such as libraries, community centers, shopping malls and subway stations.
		Barcelona 3D Barcelona 3D is an initiative oto visualize the city in three dimensions. Tis is useful to unify the spatial information and it improves the understanding of the city through visual art tools. It can be used to make visual trips through the city or simulate new infrastructure projects.
	Innovative and digital business and entrepreneurship	Carpeta del Profesional' or 'Professional portfolio' This application for professional use allows telematic management of a wide range of procedures associated with the government. Thus necessary movement of managers and costumers can be reduced.
Environment	**Buildings**	Creating self-sufficient blocks Barcelona promotes a new building model based on autonomous production of energy resources with new principles of management, design and financing of urban networks, enabling energy independence and a more sustainable management. The program intends to apply these principles of self-sufficiency in areas of new construction, where items such as solar covers, joint district heating, water recycling and use of electric vehicles will be incorporated. The focus is also on energy generation from renewable sources that approach zero emissions (solar, wind, geothermal, biomass, etc.); the efficient use of natural resources, insulation and shading devices; the introduction of smart management (for example control of the water cycle), promoting green urban presence through micro-gardens or green roofs and selective garbage collection and prepare building adapted to the use of electric vehicles. To this end two blocks are build; Valldaura, which occupies 12,633 square meters in the Nou Barris district, and Cristobal de Moura, which occupies 12,000 square meters in the district of Sant Martí.
		MEDIA-TIC Building at the 22@ district The medIa-TIc building is a good example of the new smart and sustainable architecture in Barcelona, which uses the latest technology. The building is shaped by large iron beams covered in a plastic coating of inflatable bubbles. This covering has a functional utility as as way of regulating light and temperature. This 'skin' is activated using pneumatic mechanisms thanks to 'luxometer' sensors that automatically adjust depending on how much solar energy there is. These luxometers are energy independent.

	Barcelona Solar Thermal Ordinance The installation of thermal and photovoltaic solar collectors in public and in big new or renovated buildings. The Solar Bylaw makes the installation of solar heating panels compulsory for new or renovated buildings since 2000.
Natural resources, green, renewable, energy	Installing solar panels throughout the city for example the panel by the Forum in Barcelona that produces 550,000 KWh a year, which can generate power to over 160 000 households.
Public lighting	Pla Director d'Il·luminació de Barcelona' or 'Lighting Master Plan' Plan defining accurate luminance criteria for the city(Ajuntament de Barcelona, 2012)This plan defined the lighting for each street in Barcelona. It consists of remotely managed low energy LED luminaires connected directly to the city's communications network, which enables the lighting to be adjusted to the needs of the moment. About fifty streets have already LED lighting. The lighting in the Josep Tarradellas Avenue is also equiped with presence sensors that enhance the power of light when they recognize pedestrians.
Pollution control	Environment Smartsensors Sensors connected to the city's WiFi-network report in real-time temperature, noise levels, humidity, gases dust particles, etc. concentrated in a particular environment. These sensors provide real-time information about the air quality in the city. (Ayuntament de Barcelona, 2013)
	Create low-emission zones where only vehicles that meet certain standards of pollutant emissions can circulate, and dessiminate information about air quality and its impact on health.
Waste management	Smartsensors in waste management Sensors installed inside containers to monitor the fill level. This data is sent in real time to a control centre, which enables optimal management of collection. Also inspectors of waste containers have mobile PDA devices that allow them to visualize the list of inspections performed, inspection schedule and inspection forms and the valuation. (Ayuntament de Barcelona, 2013)
	Containers with a subterranean vacuum network through the pipes, sucking up trash below the ground. This automated waste collection system decreases noise pollution made by trash trucks.
	Improve waste managemant with reduction, reuse and recycling of waste. Moving towards a zero waste with taxes, packaging reuse and return systems etc. Eliminate food waste by linking food retailers and food collection associations.

	Water management	Centralized remote management of automated irrigation infrastructure and optimizing the use of rainwater.
Government	**E-government**	Developing a paperless administration Barcelona intents to develop a paperless administration with different initiatives such as a eFirma; electronic signature used to sign electronic documents, eContrato; electronic contracting allows to attach all information and documentation records of governement contracts electronically as well the bidding, eDocumento; the generation, storage, access, preservation, and custody of all electronic documents generated by the city and those contributed by citizens and business, e-pagot; electronic payment different means of payment that allow you to pay all taxes, fees, charges and fines the city of Barcelona, eRegistro; allows you to handle municipal procedures or services performed by the city electronically and eNotificació; allows the governemnt to create a notification in electronic format, and store the file securely in the folder of the citizen or company. The city also keeps electronic files about inspections, subsidies and licenses for artworks.
		Barcelona Contactless Barcelona contactless provides specific information regarding the precise time and place location of the user when accessing a virtual platform. Depending on the item, you can view information on the equipment/service itself or information from other facilities/services nearby, view the related agenda, download related mobile applications (apps), check events in the city, etc. To access the platform you need to have a device with internet connection and connect via one of the QR (Quick Response) code or NFC (Near field communication) technologies.
		Identidad digital móvil' or 'Mobile digital identity' The mobileID system allows citizens to safely remotely identify through a digital identity on your mobile phone. It is based on a record of mobile digital identities to associate a mobile phone number to any citizen who wishes to have this new type of digital accreditation. Any user of a smartphone connected to the internet may request and use the digital identity mobileID through an application.
		Mobility services platform on a PDA (Personal Digital Assisstent) for staff By equiping the police, inspectors, social workers, etc. with an PDA or a new smartphone they can report and make decisions in real-time.
	Participation	Consulta ciudadana Diagonal' or 'Diagonal Public Consultation' With this public consulting people can give their opinion about the transformation of Barcelonas most important street 'La Avenida Diagonal'

	Transparency	Videorecording of the city council meetings Recording the city council meeting leads to more transparency. The secretary takes notes, signs with his electronic signature and attaches the necessary documents. Storage and creation of overviews of the meetings all happens electronically.
		OpenData BCN The OpenData Barcelona project makes data held by the city council available for public use. The data are provided in digital, standard and open formats, following a clear structure that allows automated use and understanding the data.
		El Tablón de Edictos Electronic' (TEE) or 'The Electronic Bulletin Board' This bulletin board allows citizens to see so official communications of the City of Barcelona. Citizens can filter content based on their interests, for example art or administration and use the search option.
	Urban planning	Maintaining and creating green areas and expanding green urbanery. Collserola is one of the great lungs of the city, a unique natural area of great ecological value and it covers an area of 8,300 hectares. Also conservating the costal and marine environments and river systems.
		Diagonal Besòs -22@ Campus or Barcelona's innovation district In the 22@ district, Barcelona has consolidated a diverse, balanced, sustainable environment, in which the most innovative companies and universities coexist with housing, facilities and green zones. On one hand, the area features the Smart City Campus-22@, which will be home to companies, universities, entrepreneurs and research centers in ICT, ecology and urban-planning, with the aim of becoming a benchmark technology center for smart cities. On the other, the UPC and administrations are promoting the Diagonal Besòs -22@ Campus in order to create an area of excellence in internationally renowned research in the energy, sustainable mobility, materials technology and biomedical engineering sectors.
Living	**Smartphone applications & WiFi**	App4bcn Creation of the website 'http://apps4bcn.cat/esp/' which gives an overview of all the applications that are useful to enjor and/or live in Barcelona. One of the most significant applications is ApparkB. A smartphone app with which to pay for green and blue zone parking, which replaces the traditional parking metre. Payment can be made in real time and for the actual period for which the service was used. The app alerts you when you reach the maximum parking time allowed and identifies the exact location of the vehicle. (Ayuntament de Barcelona, 2013)
		Barcelona WiFi Barcelona WiFi is a service that allows you to connect to the Internet via WiFi access points located throughout the city.

		Mobile services With a mobile phones arrangements can be made and information received with applications of the city council for smart phones or with SMS or WAP services.
	Social inclusion and welfare	Bienvenida a Barcelona' or 'Welcome to Barcelona' Welcome to Barcelona is a service package that combines in a single procedure all the claims and common needs of people who are registering new in town or people who move. Before the package you had to make several procedures separately but now they are unified in a single request.
		New model of care The new model of care and information systems allow incorporating an integrated social care that fits in the city vision. New technologies are included so all the workers have access to the necessary data and applications.
Mobility	**City logistics**	Design of a new bus network The new bus network includes vertical buslines through the city. Also new technologies are used for advanced information systems for users, to provide WiFi access, to decrease travel time and to obtain better sustainability criteria regarding the consumption of resources (for example with hybrid motors).
		Boost deterrents to the use of private motor vehicles (cars, motorcycles, vans, etc.): regulate traffic in strategic areas of the city (30 km/h zones, schedules, constraints, etc.), creating peripheral parking spaces, HOV lanes, etc. Promote efficient driving.
	Info-mobility	Smart Parking Pilot test to assess sensors installed on streets that enable real-time query via smartphone on availability of parking spaces. (Ayuntament de Barcelona, 2013)
	People mobility	Promoting the use of electric vehicles in the city with providing charging stations (already 262 throughout the city) and promoting electric vehicle rental. Barcelona has already a fleet of almost 700 electric vehicles. Implemenation of electric taxis and developing specific electric taxi stops and a preferential queuing system at airports and railway stations.
		Bicycle rent system A bicylce rent system with multiple bicycle parkings throughout the city combined with an application that lets you check where the nearest bicycle parkings are and shows in real-time the availability of bikes and parkings through a mobile device. The application can also calculate the fastest and safest route.
		Web platform allowing potential users with similar origin/destination and schedules to get in touch with the final goal of sharing their journeys by the vehicle of one of the users. It is addressed to both public and private users. It includes energy savings tool for user's awareness raising.

People	**Education**	Fab Lab Barcelona The Fab Lab Barcelona, one of the leading fabrication laboratories in the world, is part of the Institute for Advanced Architecture of Catalonia (IAAC), a cutting edge education and research centre for the development of architecture capable of meeting the challenges of habitability in the early 21st century.
	Integration and plurality	Using urban waste collection and recycling as an oppurtunity to provide work and training for people with social-integration and job-placement difficulties

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4.7 Castellón de la Plana

Table 14: Castellón de la Plana (INE & IGN, 2012)

City	Castellón de la Plana
Autonomous community	Comunidad Valenciana
Area (km²)	108,78
Population (habitants)	180 204
Density (hab/km²)	1 656,53

Figure 11: Castellón de la Plana (http://en.wikipedia.org/wiki/Castell%C3%B3n_de_la_Plana)

Castellón de la Plana is a city in the East of Spain. In November 2013 they organized the international congress 'Smart cities and public safety: Preventing crime and antisocial behavior'. They are engaged to improve and transform their administration according to the needs of the citizens.

Table 15 shows the specific projects in Castellón de la Plana.

Table 15: Castellón de la Plana

Castellón de la Plana	Characteristic	Project
Economy	**ICT-enabled manufacturing and services**	Application of new technologies in the production of ceramics. (Ayuntamiento de Castellón, 2014)
Environment	**Public lighting**	Lighting shutdown during dispensable lighting phases. (Ayuntamiento de Castellón, 2014) Replacing old lights with leds
Government	**E-government**	Improving and transforming the administration by digitizing procedures and interoperability services. (Ayuntamiento de Castellón, 2014)
Mobility	**City logistics; Info-mobility;** **People mobility**	Construction of an urban mobility control center and a traffic light installation maintenance service. The platform will enable coordinated management of all of the city's mobility-related systems and will initially focus on the centralized monitoring of traffic infrastructures and traveler information panels. The ICM platform will facilitate the coordinated management of events that have an impact on mobility, such as road construction, incidents, and political, social or sports events. The platform also affords capabilities that include real-time supervision of traffic conditions, analysis of historical evolution, and short-term situation forecasting. As well as the ICM platform, the company will implement a travel-time monitoring system, which will enable the city's authorities to optimize urban planning and mobility resource management. Using Bluetooth and WiFi signals, the system will provide data on: traffic status, vehicle flow, capacity estimation, pattern identification, congestion and incident detection alarms, historical data records and forecasts. The system will have an additional internet platform which will provide the public with information regarding mobility, municipal services and tourism. Through the city's internet portal, users will be able to: calculate routes and travel times in real time traffic conditions and compare different routes and modes of transport. (Traffictechnologytoday, 2012)
	City logistics	The implementation of electric cars and an efficient public transport with the TRAM (Transporte Metropolitano de la Plana) which is the name of a trolleybus that assures rapid transit flows through the city. (Ayuntamiento de Castellón, 2014)
		Bicycle hire service (BICICAS) Service consists of a network of bikes that can be automatically parked to make bikes available for public use in the city. (Ayuntamiento de Castellón, 2014)

4.8 Gijón

Table 16: Gijón (INE & IGN, 2012)

City	Gijón
Autonomous community	Asturias
Area (km²)	181,71
Population (habitants)	277 733
Density (hab/km²)	1 528,40

Figure 12: Gijón (source: http://en.wikipedia.org/wiki/Gij%C3%B3n)

Gijón is a city in the North of Spain. They hosted already multiple conferences about smart cities such as SmartMILE in 2013 and are a RECI member since November 2012. The city indicates the following fields as priorities: energy, sustainability, e-government, transparency, energy efficiency, public private financing, paperless administration, internet of things ...

The Gijón city council in 2011 signed the Covenant of Mayors (Pacto de los Alcaldes) which is the main European movement involving local and regional authorities that have voluntarily committed to exceed the EU target of 20% reduction in emissions of carbon dioxide (CO2) by 2020, committing to develop a baseline Inventory of Carbon Emissions and an Action Plan for sustainable Energy. The city is also part of Network monitoring air quality (Red de vigilancia de la calidad del aire).

Table 17 shows the projects of Gijón. Alle projects have (Ayuntamiento de Gijón, 2013) as source, unless otherwise stated.

Table 17: Gijón

City	Characteristic	Project
Economy	**ICT-enabled manufacturing and services**	Communications infrastructure for the internet of things For data transport that connect the sensors installed on public roads, equipment and furniture and buildings. These devices communicate with each other and be instructed. For example it can be used for lighting if someone approaches a street light or natural light is insufficient, irrigation if rain is detected or whether or not a container is full.
	Innovative and digital business and entrepreneurship	Oficina Te-CREA CREA is an office to meet the needs of people interested in starting a business in our city. Its aim is to integrate in a single office the procedures and various services that an entrepreneur needs to launch its initiative and also to meet the needs of entrepreneurs as people who already have started a business or economic activity.

Environment	**Buildings**	Control instalations for heating of comunity buildings.
	Natural resources,	Installation of photovoltaic elements in the main building of the Science and Technology Park. (Gijón City Council, 2013)
	green,	Participation in the CASCADE-project
	renewable energy	CASCADE is project about networking and peer-to-peer learning on local energy leadership. Multiple cities in Europe learn from each other. It supports cities in delivering the Europe 2020 targets for energy and climate change.
	Public lighting	Intelligent management of public lighting Allows control of each individual light point as well monitoring and analyzing their consumption and status.
	Water management	Project with the Empresa Municipal de Aguas (Municipal Water Company) for an efficient management of leaks in the supply network (In-pipe system)
Government	**E-government**	Citizen card It is a multipurpose document that identifies its holder, allowing you to access the various municipal services such as pools and libraries, replacing the old membership cards, pay bills, traveling on public transport or conduct transactions online through the website of Gijón. The citizen card is part of the ASPA (Ayuntamiento sin papelos or City Council without papers) project.
	Transparency	Accessibility for any citizen to the Open data generated (in the portal datos.gijon.es there are 187 of them available and upgradeable)
Living	**Smartphone applications & WiFi**	WiFi-access in public spaces
		Smartphone application so people can make suggestions or report incidents detected on the public road, such as damage to sidewalks and streets, street lamps, furniture, signs, woodlands…
	Tourism	Plan de Acción Turismo (Touristic actions plan) Plan with touristic actions including for example a marketing program.
Mobility	**City logistics**	Participation in the Site (Smart Integrated Ticketing for Europe) project The SITE project establishes a network of local and regional transport authorities representing the 5 member states in the Atlantic Area (Spain, Portugal, France, Ireland and the United Kingdom) to work together on the development of new smart ticketing products and identify barriers to interoperability of smart ticketing across regions of the Atlantic Area. The ultimate goal is to enable residents of one region to purchase a smart ticket that can be used in the transport networks of the other regions of the Atlantic Area thus facilitating the continuity of transport networks, increasing mobility and contributing to transport sustainability.

	People mobility	Fleet of electric cars shared by the muncipal staff
		LabCityCar LabCityCar is a Living Lab project based on the sustainable mobility of private cars, developed in the city of Gijon. It proposes the fulfilment of a set of actions that begin with the analysis of the impact of the mobility of these vehicles in the different zones of the city and the ideas for improving their impact with benefits for the citizens and therefore for Gijon. In this project, the citizens are the main source of information thanks to their active participation, and in this way each one becomes a “citizen-researcher”. Also the city bus company Bus Gijón and EMTUSA (EMpresa de Transporte Urbano S.A) actively joined the project with their respective vehicles.
	Info-mobility	Intelligent Parking application The number and location of parking spaces, free blue zones is displayed and it allows payment.

4.9 Las Palmas de Gran Canaria

Table 18: Las Palmas de Gran Canaria (INE & IGN, 2012)

City	Las Palmas de Gran Canaria
Autonomous community	Islas Canarias
Area (km²)	100,55
Population (habitants)	382 296
Density (hab/km²)	3 801,97

Figure 13: Las Palmas de Gran Canaria (source: http://es.wikipedia.org/wiki/Las_Palmas_de_Gran_Canaria)

Las Palmas de Gran Canaria is the largest and most populous city of the Canary Islands and is the capital of Gran Canaria. Their strategic plan provides strategic lines of action related to the increased efficiency of administration, the actual deployment of e-government and development of smart city projects.

All projects have (Ayuntamiento de Las Palmas de Gran Canaria, 2012) as source.

Table 19: Las Palmas de Gran Canaria

Las Palmas de Gran Canaria	Characteristic	Project
Government	**E-government**	Comprehensive tax management and generating the electronic signature This system ensures a tax managment without paperwork. It also allows statistical control of waiting times in which every citizen is served, allowing streamlining and improving responses almost immediately.
		Online certificates of residence
	Participation	The publication of a portal for citizen participation
	Transparency	The implementation of a Web TV channel municipal, through which relayed, among other content, the town meetings live.
		Implementation of appointments for all administrative procedures This measure reduces waiting times and ensures more efficiency in the administration.
		Open data portal This portal allows to present information and data about various municipal services as municipal buses, traffic and accessibility related to the interest areas of other parties
Living	**Smartphone applications & WiFi**	Las Palmas de Gran Canaria developed multiple applications. These are the most significant ones: LPA Tip An application allowing to report incidents in public spaces easily and quickly, with the possibility of including georeferencing and image of the reported fault. LPA accessible Application to report architectural barriers and points with difficult accesability of the city. LPA Park Application for quick management of regulated parking which prevents the driver to carry coins, move to the meter to renew the ticket, plus it's possible to check and pay penalties. LPA Avisa Application with information about the city facilities and activities. LPA Visit Application with information about the turistical highlights, opening hours, events, etc.
		Providing public WiFi access in rural areas.

4.10 Madrid

Table 20: Madrid (INE & IGN, 2012)

City	Madrid
Autonomous community	Madrid
Area (km²)	605,77
Population (habitants)	3 233 527
Density (hab/km²)	5 337,86

Figure 14: Madrid (source: http://en.wikipedia.org/wiki/Madrid)

Madrid is the capital and largest city of Spain. It is the third-largest city in the European Union, after London and Berlin. The city participates together with eight other European cities in the STARS (Sustainable Travel Accreditation and Recognition for Schools) project. STARS is a European program designed to promote and support active travel to school among children and young adults. It is also a member of Polis, a network of European cities and regions working together to develop innovative technologies and policies for local transport.

Table 21shows the projects of Madrid. All projects have (Esmartcity, 2014c) as source, unless otherwise stated.

Table 21: Madrid

Madrid	Characteristic	Project
Economy	**ICT-enabled manufacturing and services**	SmartCity Glass It consists of a system to obtain efficient control of incidents in the city by using the Google Glass and Occipital sensor structure. The city staff can report incidents of a wrong parked vehicle, rough pavement, warning of an accident, etc. through the glasses. The incidents are examined by experts that are located in other places and they can verify the situation and make decisions as if they were in the scene, in less time and at a lower cost. (Fundetec, 2014)
		Integrated 'Centro Integrado de Seguridad y Emergencias' (CISEM) or 'Security and Emergency Centre', which coordinates and organizes interventions of the police or emergency services and achieved response times of less than 8 minutes. (ABC, 2012)
		Integrated control system in Madrid Río. The system can perform tasks such as opening and closing gates or measuring water levels. (ABC, 2012)

		Launch of a Centre for ICT Services to offer support, communication and infrastructure The establishment of 'Centro de Servicios TIC' (CESETIC) or 'Centre for ICT Services' will serve to provide the infrastructure, communications and support services in the capital and services such as cloud model infrastructure. It will also be responsible for communications with the headquarters of companies and services. Additionally there is the development of 'Suite de Sistemas de Información para Madrid Inteligente (Suite MiNT)' or 'Suite Information Systems for Intelligent Madrid (MiNT Suite)', which will combine existing tools with new ones, such as monitoring indicators, inventories of the city, fleet management, billing, quality control, management of specific services, etc. It also brings together the different analysis and monitoring systems of the city and systems for measuring the quality of services, for data analysis and financial management of contracts and billing. The last element is the integration system, monitoring and orchestration. This is the main pillar on which rests the success of this model, which is responsible for information to flow from where it is produced to where it is needed, and also to be the facilitator, through the establishment of standards. These standards will allow connections and interacting between different systems and make it possible to add new initiatives in the future. This system needs to define, design and catalogue the set of protocols available for all concerned units of the city and interested companies. (Computing, 2013)
	Innovative and digital business and entrepreneurship	La Catedral 'La Catedral' is a centre bind the innovation and development of new technologies. It's the headquarters for innovators, technologists, artists and entrepreneurs. The idea is to turn the neighbourhood of Villaverde in the 'digital neighbourhood' of the capital. The centre has an exhibition where you can learn more about the latest technologies when it comes to robotics, automation and information technologies and communication. It includes also a convention centre where conferences and workshops and can be held and the 'Innovation Factory' the place where innovators and entrepreneurs can find support to create more efficient and profitable business through the use of new technologies.
	Public private partnerships	Sistema informático P3PAT' or 'Computer System P3PAT' This computer system promote the processes of public-private partnerships and the revitalization of industry in the city. The new system aims at the comprehensive management of all processes related to the public private partnerships, aligning interests and common goals and benefits for all parties involved: municipality , companies and society. The objective is to promote and develop private participation in projects of the city of Madrid, providing resources for managers. The system provides a comprehensive view of the relationship between Madrid and the company, experiences, contact persons, areas for improvement and an analysis of results. as well as continuous updating of information of all the areas.

Environment	**Buildings**	Development of a underfloor heating system that combines the advantages of this type of floor with those of a raised floor. It consists of separate panels that are removable without disrupting operation, something until now nonexistent in the market. This system allows adaptation in spaces that need to be heated efficiently and economically, whether external (terraces) or internal (public buildings, exhibition centres, offices, etc..), with no impact on the original floor.
	Public lighting	StreetLights A platform for to control the city lights, so that they can be switched on, off and adjusted remotely and automatically. It has power, humidity and light sensors that can reduce power consumption and make a smart and efficient use of energy possible. (Fundetec, 2014)
Government	**E-government**	Sharepoint Sharepoint is a bulletin board that interconnects judges, prosecutors, clerks of a court. Through a web application the staff of the Administration of Justice in the same Juridical Department can access all administrative information in an agile, efficient and controlled manner. Documents, rules, schedules guards and training events are available as well publishing and sharing announcements affecting the juridical department are possible, anytime, anywhere with an internet connection.
		Consulta de Asuntos por el Ciudadano' or 'Consultation of Citizen Affairs' This tool secures access to information issues, resources, legal aid as part of juridical proceedings and allows citizens to check the status of their case. The consultation happens through the ‘Justice Portal’ with an electric identity card or any other electronic certificate recognized by the city. The main advantage of this service is the ability to check anything any time of the day, avoiding travel and unnecessary calls to the court and reducing the time spent by justice officials to provide information.
		Carpeta del Ciudano' or 'Citizen Folder' Via a password and a username citizens of Madrid can have access to the ‘citizen folder’. This service allows people who to see their data and make steps and procedures on the municipal website safely. With the service information can be provided and fully customized, online registrations, voter registration, taxes and municipal taxes, fines and cases handled by the city as can be performed as well as various procedures electronically. The tool is also available for mobile devices.
	Participation	Mejora tu ciudad It is the first collaborative and social smart city platform where citizens and council can interact in real time. The citizen becomes an active sensor in the management, maintenance and improvement of the city.Through a mobile application useful information, preferences, concerns and valuations can be sent. Meanwhile, the council can consult statistics or control the activities of subcontractors through the platform.

	Transparency	OpenData portal This portal ensures a structured and easily access of all the information related to the use of public resources and the planning and management of city activities. It makes valuable data available to citizens and companies that can be used for various market studies. Data such as air quality, real-time traffic information from the EMT, data about parking vehicles in the city, municipal contracting data, data about day centres, sports facilities, cultural facilities, markets and flea markets, museums, municipal health centres, etc. are all available. Detailed budget information is also placed in the portal. All these data sets are presented for free using open standards or market standards and without any restrictions to use it, whether for commercial or non-commercial uses.
Living	**Culture & Entertainment**	Mad4Sports Mad4Sports is an initiative that aims to strengthen the citizen participation in urban sports. People are asked where and how to play sports in Madrid. With this information a database will be build that allows to organize a kind urban contest. The best sports sites can be identified and for example, posters can include QR bar codes, to guide and encourage athletes. A mobile phone application will be developed to help illustrate the routes of sport fans in Madrid and a Timpik application that allows to form groups to play games, organize events and compare brands.
	Healthcare	Telemedicina' or 'Telecare' The strategical plan for Telecare includes various initiatives such as tele-home care to monitor patients in their home and tele-consultation. Nearly a dozen of the hospitals have a tele-surgery service to broadcast surgical procedures and/or train in surgical techniques among specialists.
	Smartphone applications & WiFi	The city has several areas and spaces of free Internet via wireless network such as the public libraries, metro stations, a lot of squares throughout the city and the EMT ('Empresa Municipal de Transportes de Madrid' or 'Municipal Transport Company of Madrid') buses.
		Smartphone applications Different applications for Madrid were developed: ‘Safe to school way’: tool to support schools and families to provide the ability to guide children from their house to school at all times. The location can be seen on a map so that parents and children can walk with other children on specific routes. On these routes are also ‘childhood friends’ people who participate in the project can be seen. The application is only accessible to schools and parents who are participating in the ‘Madrid walk, safe way to school’ project, through an identification code that is provided through the school.

		‘RECICLA.TE’ A tool whose main aim is to help people, and more specifically young people to properly recycle any type of product that has bar code or, if not based on its components. It also offers a game to learn the recycling concepts through questions. ‘RECICLA.ME’ Very similar to the ‘RECICLA.TE’ application. This app is part of the instructional and educational applications that parents can download to raise awareness and educate children between 8 and 12 years old in separating the household waste properly. The app also works with reading barcodes and has several sections with tips, tricks and trivia. ‘Routes for Retiro’: Application that offers the possibility of a self-guided tour through attractions spread in certain locations of the ‘Jardines del Buen Retiro’ park in Madrid. The app provides information about the different types of landscaping in the park with photographs and audio. In turn, you can add information about the gardens and curiosities of various historical periods. ‘Environmental Resource Map’: Application that provides information related to multiple municipal services and resources in the city. Included services and resources are grouped into six categories: parks, parking (for cars, motorbikes and bicycles), trash points (fixed, mobile and containers for clothes), supply points (green fuels: ethanol, CNG, LPG and electric), bike paths (including cycle lanes and safe streets) and areas with residential priority. Data of car parks are not yet available. ‘Habitat Madrid’: Is a project that aims to inform the public of the environmental program of free activities organized by the city council in parks and green areas in the city such as walking, cycling courses and workshops, visits to environmental facilities, exhibitions, storytelling, workshops etc. With this application activities can be booked and confirmed. AccityMaps': They call it ‘the Google Maps of the Disabled’. It is a route planner for a smartphone, tablet or PC which calculates routes accessible for people with disabilities, the elderly or parents with pushchairs. This helps municipalities with removing physical barriers, encourages the use of ICTs among these groups and helps creating ‘cities for everybody’. RiderState': It's a social game for fans of cycling. Using a free mobile app, cyclists are situated in a geolocated adventure where you have to conquer the world on your bicycle. Thus, while sustainable transport and healthy living are promoted the city gets an overview of behavioural patterns of this user community which can play a role in decision making. The ‘Empresa Muncipal de Transportes’ (EMT) or ‘Municipal Transport Company’ has since 2008 an application for mobile phones that automatically collects the user's location and provides information about nearby stops, lines, routes and waiting times. The app allows users to exchange comments, indicate incidents, evaluate or criticize aspects of services, etc.

	Social inclusion and welfare	Provision of general guidance information through multimodal interfaces allowing visually impaired users and the general public to understand by themselves the layout, points of interest and different routing options within an indoor space. The information will be available both from fixed smart points within the public space and from users' mobile personal devices
	Tourism	Madrid Precious Time 'Madrid Precious Time' gives visitors through mobile devices a new perspective of the city with personalized, convenient and instant information based on the location. The program is a collaboration between the WTO, the ministry of industry, energy and tourism of Spain and the city of Madrid. Also 31 companies and private institutions participate.
Mobility	**City logistics**	Implemenatation of a free service installed at bus stops which offers both information on bus routes and tourist information. In order to improve the information systems, bus stops have also been equipped with Wi-Fi. Passengers don'tlose connection to the internet between waiting at the bus stop and boarding the bus, which also has Wi-Fi.
		Smart Parking Meters With the smart parking meters factors as emissions from the vehicles and the occupancy of the parking areas are used to set the price. Vehicles with lower emissions of nitrogen oxides can park cheaper and the most polluting vehicles need to pay more, according to the principle of 'the polluter pays'. Similarly, it will be cheaper to park in a neighbourhood with more space available for parking, while you'll pay more if you choose to leave your car in an area where the parking space is more saturated. The new meters are equipped with a full alphanumeric keyboard. After entering the license plate a screen will guide you and the steps you must follow to obtain the ticket. The meters communicate an operation platform to obtain data of each car (how it's classified according to the emissions) and occupation of the relevant quarter. Payment in cash, credit card, debit card, prepaid card or contact via mobile phone is possible with the new meters. A new feature for those who choose the cash payment option is that if you do not have the exact amount, the change will accumulate in a virtual wallet that can be used the next time. Furthermore new parking regulations are implemented including the pollution and area as explained above but they also take causes such as car-sharing into account.
	Info-mobility	Centro de Gestión de la Movilidad (CGM) 'Centre for Mobility Management' The Center for Mobility Management is dedicated to all the traffic information about mobility that may be of interest for both the driver and the pedestrian through the internet. This information can be divided into three sections: before, during and after the trip. There is a section with visual information. The traffic condition is indicated by colours which determine the circulation intensity or number of vehicles transiting. Green indicates traffic flow; yellow slow traffic, withholding orange, red indicates congested traffic and black indicates a path cut completely to traffic.

		The information includes also daily data of interest about mobility from the location of the taxi stops at service stations and points of interest for people with specific accessibility needs. Information circulatory status of the city in real time is updated every fifteen minutes during rush hour and every thirty minutes in peak hours and every time a remarkable incidence affects the movement of traffic on the main roads. The system has also access to the camera centre. The 177 cameras whose images are updated every two minutes can be viewed by districts, paths or all as a whole. The possibility of observing the main streets of the city in real time on this site is one of the most visited options. In the system important events hosted by the city such as demonstrations are implemented to offer detours. The goal is always to anticipate incidents and inform the driver to avoid conflicted zones and chose alternative routes or as an ideal solution, public transport.
	People mobility	Web platform allowing potential users with similar origin/destination and schedules to get in touch with the final goal of sharing their journeys by the vehicle of one of the users. It is addressed to both public and private users. It includes energy savings tool for user's awareness raising. Including web tools for: reservations, management (creation, modification, cancellation), historical record consultation, billing monitoring, monitoring battery of electric vehicles etc.
		BiciMad Bicycle renting system with multiple bicycle parkings where bicycles can be picked up and returned. The availability of each station can checked at the stations and with mobile devices. There are two modes are available to access the service: occasional or annual subscriber.
		Promoting cleaner or electric vehicles To promote this kind of vehicles multiple measures are taken such as letting electric vehicles use the bus lanes, reserving special parking places for less polluting vehicles in the metropolitan area, airport and train and metro stations, installation of at least one charging point over 20 000 inhabitants for electric vehicles, etc. The renewal of the taxi sector with less polluting vehicles, so that within seven years the entire fleet will be composed and replacing vehicles of the public fleet by models that use cleaner fuels or technologies, including the intercity bus fleet are also part of this.
		Train2Car This pilot project allows to charge an electric vehicle with the energy of braking trains on the suburban network. When a train brakes and thus reduces speed, kinetic energy is converted into other forms of energy. Batteries play a key role in the system, allowing the storage of braking energy and charging the cars at the right time.
People	**Education**	Smart Lab Smart Lab is a centre specialized in incubation and shared workspaces linked to smart cities. The aim is to create a shared environment that encourages the exchange of ideas and the generation of entrepreneurial projects.

	Training	In the context of the STARS (Sustainable Travel Accreditation and Recognition for Schools) project organizing training workshops, exhibitions, workshops for teachers and students, seminars with experts in childhood and mobility, blogs …
		Every week courses are held in the Innovation Center Alvarado and the Technology Classrooms Madrid Puerta Bonita that citizens can attend.

4.11 Málaga

Table 22: Málaga (INE & IGN, 2012)

City	Málaga
Autonomous community	Andalucía
Area (km²)	395,13
Population (habitants)	567 433
Density (hab/km²)	1 436,05

Figure 15: Málaga (source: http://en.wikipedia.org/wiki/M%C3%A1laga)

Málaga is a city and a municipality, capital of the Province of Málaga, in the Autonomous Community of Andalusia, Spain. It is the second most populous city of Andalusia and the sixth largest in Spain. Málaga states that open data, sustainable mobility and an optimal waste management are their priorities. In 2013 the city hosted the 'Greencities' exhibition.

Table 23 lists the projects of Málaga.

Table 23: Málaga

Málaga	Characteristic	Project
Economy	**ICT-enabled manufacturing and services**	Tests and implementation of smart grids and V2G (vehicle to grid) technology, that not only allows the electric car to receive energy from the network but also to store it and make it available to the grid when necessary. (Dirección General de Distribución de Endesa, 2013)
	Innovative and digital business and entrepreneurship	Momopocket System that allows payment with mobile phone in shops in the city and municipal services. (Ramón Orense Tejada, 2013)
		MálagaValley MalagaValley is a technological hub located in the metropolitan area of the city of Malaga in southern Spain, in the area of greatest technological excellence in Europe, an 'European Silicon Valley'. This area has become a center of ideas and innovation generation, able to attract companies from around the world, investments in R & D and talent. It specializes in the High-Speed Rail and Smart Cities industries, with special attention to energy efficiency and sustainability. (MálagaValley, 2014)

Environment	**Natural resources, green, renewable, energy**	E+ project E+ is an European project and the main objective is to develop a control system for energy management at neighborhood level and its associated new business and operation models. In the context of this program 500 square meters of thermal panels will be monitored (and/or installed), street lighting will be monitored and remotely controlled and 8 public buildings will be monitored. The data hereby provided will be used to implement energy optimization strategies. By running simulations the platform will compare the real situation with optimal scenarios. (Eplusproject, 2011)
		The city has numerous roof-mounted photovoltaic installations spread throughout the city, a cogeneration facility, wind turbines and generation systems integrated in street lighting. All these generation systems, combined with two battery-based storage facilities, are used to manage consumption more efficiently. (García Inglán, 2014)
		Over 17 000 smart energy meters have been installed in municipal facilities and houses. A sample of 50 of these users have energy efficiency solutions for the home. Over 10 SMEs and emblematic buildings in the area have energy efficiency solutions installed which enable them to monitor consumption and control some of their charging. The users can view from their computer or mobile phone how much electricity they are consuming at that moment. On top of that, they can disconnect each device on the network or program when it needs to switch off, from their phone or computer. (García Inglán, 2014)
	Public lighting	Nearly 200 street lights have been replaced with new lights featuring energy-efficient technologies (including LED and halogen lighting) and are remotely and automatically managed. (Dirección General de Distribución de Endesa, 2013)
Government	**E-government**	Digitalization of the administration Website with online procedures, citizen folder, participation portal, etc. (Ayuntamiento de Málaga, 2014a)
	Transparency	Implementation of an open data portal which should lead to more transparency, collaboration and participation. (Ayuntamiento de Málaga, 2014b)
	Urban planning	Mi Ciudad AC2 This is an European project and the general objective of Mi Ciudad AC2 is to strengthen the role of local government partners in climate change adaptation and mitigation, through the development of innovative criteria for urban planning applicable both to the development of new urban areas and to the regeneration of those that already exist. In the context of this project Málaga implements various measures on the campus 'Campus El Ejido' such as implementation of telemanagement systems and low energy lighting for public lighting, reordering parking (parking priority for residents) and implementation of charging points for electric vehicles. (Mi Ciudad AC2, 2013)

Living	**Social inclusion and welfare**	Communication systems for blind and/or deaf people Communication system for deaf and blind people that converts text messages into audio messages or audio messages into sign language. ICT's are also used in the movies to support the blind and deaf. A free mobile phone application 'WhatsCine' provides a detailed commentary of what is happening in the movie through the headphone for blind people and for deaf people there are two options. Or locate your smartphone or tablet into a transparent lectern so they can read subtitles or employ glasses that recreate the sign language. (Masa, 2010) & (Pascual, 2013)
Mobility	**City logistics**	Project Victoria This project aims to double the range of electric buses without affecting operating times. To do so ground-breaking triple technology: conventional static, static wireless and dynamic wireless charging is used. The project is executed on a specific bus route in Malaga, the first project of this kind in Spain on an urban public transport system. The project is trialed on an electric bus which operates on the city's number 16 bus route. One of the city's e-buses is adapted with triple charging technology whereby it can be charged by the conventional method when parked at the bus depot at night (using charging points), it can also be partially charged at a static inductive or wireless charging station as well as when travelling along a bus lane equipped with a dynamic inductive (wireless) charging system. (Endesa, 2013)
		Traffic management system Implementation of a traffic management system in 'el Barrio de la Misericordia'. This system works fully automatically and optimizes the traffic flows. This is achieved by using data obtained through sensors combined with a mathematical model that determines the state of semaphores to optimize the traffic flows. (Saiz Peguero, 2011)
	Info-mobility	Intelligent parking system System with sensor, panels and a mobile phone application to detect and indicate available parking spots. (Gutiérrez Colomina, 2012)
	People mobility	Urban M An intelligent electric bicycle that incorporates motor assistance to ensure rapid, convenient and effortless transport. It is foldable and easily transportable, so it can be easily placed at home, on the bus and in the office. It has an urban design that makes it quick, light and efficient to absorb bumps and steps. The two front wheels make it comfortable, stable and suitable for all ages and physical conditions. It also recognizes and processes its own data such as distance, speed, calories burned, location, etc. which can be checked through a smartphone. (Olucha, 2013)
		Zem2all (Zero Emissions Mobility To All) Replacing the municipal fleet with electric vehicles and implementing charging stations in the city. (Zem2all, 2014)
		Bicycle loan system Málaga installed 20 stations with 400 bikes that can be borrowed with the same card bus Municipal Transport Company. (Esmartcity, 2013)

4.12 Móstoles

Table 24: Móstoles (INE & IGN, 2012)

City	Móstoles
Autonomous community	Madrid
Area (km²)	45,36
Population (habitants)	206 031
Density (hab/km²)	4 542,12

Figure 16: Móstoles (source: http://en.wikipedia.org/wiki/M%C3%B3stoles)

Móstoles is the second-largest city in population belonging to the autonomous community of Madrid. It's a member of the RECI since April 2013 and also part of the INNPULSO network ('Red de Ciudades de la Ciencia y la Innovación' or 'Network of Cities of Science and Innovation') and 'Comité de Normalización de Ciudades Inteligentes' or 'Standardization Committee of Smart Cities'. In 2013 Móstoles participated for the first time in the Smart City Expo World Congress in Barelona. Móstoles organizes a two day forum to bring companies and institutions together leading to new contacts and collaborations.

Table 25 gives an overview of the projects in Móstoles, all projects have (Ayuntamiento de Móstoles,2013) as source, unless otherwise stated.

Table 25: Móstoles

Móstoles	**Characteristic**	**Project**
Economy	**ICT-enabled manufacturing and services**	Installation of a fiber optic network in the municipality that reaches more than 50 000 homes, shops and companies. The network will modernize the telecommunications network of Móstoles and replace the existing copper network. This initiative will improve the reliability of the Internet connection, allow higher and more stable speeds, access to new services such as streaming in HD, and is a quantum leap for professionals who work from home or from office. The installation of this network will also create direct and indirect jobs.
		Implementation of digital public information screens in the city and digital kiosks to facilitate the completion of administrative formalities electronically in municipal buildings.
	Innovative and digital business and entrepreneurship	Business incubator 'Móstoles Mirror Stage' where companies can find technical or administrative support, management advice, etc.

Environment	**Natural resources, green, renewable, energy**	Energy efficiency audit The results of this energy efficiency audit will reveal where there is space for imrpovement and z ill help to optimize the performance of facilities and reduce electricity consumption.
		Móstoles District Heating Project based on a network for distributing heating and hot water generated by biomass up to 5 698 households. This decreases costs and helps to reduce CO2 emissions and the dependence on foreign energy.
	Public lighting	Intelligent lighting system Implementation of the LumiMotion Philips system in order to reduce costs without compromising on the security of citizens. The sysem adjusts intensity levels according to the presence or absence of persons in the given area. Optical sensors detect motion in real time (without saving any images) ,increasing the power of lighting in a smooth and gradual when someone approaches to avoid the feeling of being watched caused by an ignition instantaneous lamp. In addition, the citizen does not perceive the drop in intensity before and after his passage and lighting is always 100% where he is. The lights are also replaced by LED lamps. This model illuminates the street for the people, but does not intrude the houses of the surrounding buildings, improving the welfare of the residents during the night.
Government	**E-government**	Website with online services and information for consultation and online procedures and inform the citizens through the ConectaMÓSTOLES webpage.
		Sharepoint Sharepoint is a bulletin board that interconnects judges, prosecutors, clerks of a court. Through a web application the staff of the Administration of Justice in the same Juridical Department can access all administrative information in an agile, efficient and controlled manner. Documents, rules, schedules guards and training events are available as well publishing and sharing announcements affecting the juridical department are possible, anytime, anywhere with an internet connection.
	Transparency	Transparency portal Online portal with information about muncipal corporation, the relationship of the city with citizens and society, economy and financial affairs and recruitment services. (Ayuntamiento de Móstoles, 2014b)

	Urban planning	Use of advanced GIS-technology With this technology it is possible to collect data through sensors, mobile devices and the citizens themselves, to obtain the base data in order to optimize the services offered by the city. The technology allows a continue workflow allowing real-time processing the incoming data and the possibility of online analysis. Once loaded on the platform the possibilities are endless. For example management of watering municipal parks, sewers and sanitary water, cartographic restitution from photogrammetric flights, update maps (new urbanized areas), etc. The technology is a handy tool to support urban management (planning, licenses, etc.), management of parks and gardens (irrigation networks, parkland inventory, etc.) and management of the municipal companies for street cleaning and waste management (lines of collection, waste collection points) and municipal developments (housing, parking).
Living	**Smartphone applications & WiFi**	Wi-Fi access in public buildings and public transport
		Alerta SMS Free information service, any citizen of the City of Móstoles can subscribe and will receive information on various topics that happen in the city on his mobile phone. Ayuntamiento de Móstoles (2014a)
Mobility	**City logistics**	Implementation of 'Area 20' and 'Area 30' The ‘Area 20 residential priority’ is the historical district where the pedestrians and bicycles have priority over other vehicles using public roads. It is an area specially designed for pedestrians and bicycles. The maximum speed of traffic is 20 km/h. Area 30: Area surrounding area 20, where the coexistence of traffic (private car, public transportation) with the pedestrians and bicycles arises. The speed limit is 30 km/h. Those initiatives are part of the 'Plan de Movilidad Urbana Sostenible' or 'Sustainable Urban Mobility Plan'.
	People mobility	Promoting cleaner vehicles The city signed an agreement with 'Asociación de Jóvenes Empresarios' (AJE) or 'Young Entrepreneurs Association' in order to develop and promote the use of electric vehicles in the city. The city also implements a tax bonus for electric or less polluting vehicles and replaces step by step the muncipal fleet with electric vehicles. Charging point for electric vehicles are also provided.
		Promote non-motorized transport modes Promoting transport modes for example walking with implementing safe way to schools, pedestrian priority areas, bicycle parkings, road safety plans, etc.
People	**Training**	Organizing a workshop about 'Energy Management in Smart Grids'with sessions about energy efficiency and sustainability applied to various fields: 'Active Management of Electric Networks', 'Intelligent Building Microgrids', 'Demonstration of Energy Management' and 'Implementation and Technologies'.

4.13 Sabadell

Table 26: Sabadell (INE & IGN, 2012)

City	Sabadell
Autonomous community	Cataluña
Area (km²)	37,53
Population (habitants)	207 938
Density (hab/km²)	5 540,84

Figure 17: Sabadell (source: http://en.wikipedia.org/wiki/Sabadell)

Sabadell is a city in Catalonia, 20 km north of Barcelona. In 2013 it organized 'Fira Sabadell' an international conference of smart cities. The city participates in the European project Civitas to share knowledge and experiences related to sustainable mobility.

Table 27: Sabadell

Sabadell	**Characteristic**	**Project**
Economy	**ICT-enabled manufacturing and services**	Sabadell 3D Visit building in 3D and watch full resolution 360 degrees photographs of Casa Duran, Teatro Principal, Museo de Arte, Campanario San Félix, Museo de Historia, Archivo Histórico and Vapor Buxeda. Virtual tours of museums are also possible. (Ayuntament de Sabadell, 2014a)
		Archaeological Map of Sabadell With a Geographic Information System (GIS) an archaeological map o Sabadell is presented. With the tool you can learn about, promote and preserve the prehistoric and historic features of Sabadell. The map includes an inventory of all archaeological sites and is reviewed and updated automatically. Therefore, it is a living document that should be expanded as new archaeological discoveries occur. Also the tool makes it possible to analyze the archaeological reality according to different objectives: heritage, research or dissemination. (Carlús et al., 2009)
		In collaboration with Banc Sabadell the city implements payment 'contactless' payment by mobile in shops in the city, including the commercial area of Sant Pau de Riu Sec. (Ayuntament de Sabadell, 2014a)
	Innovative and digital business and entrepreneurship	Center for Business Promotion This center offes space for coworking between companies. This ability to share an equipped space is possible at lower costs than traditional office and the development of multidisciplinary collaboration and business is encouraged with the networking center. (Ayuntament de Sabadell, 2014a)

		L'Estruch In the context of an artistic creation center (L'Estruch), laboratory research, development and technological innovation are also implemented. The center offers space for projects and companies in the area of new technologies. The center features a laboratory, a testing room to test prototypes and a living business scene to function as an incubator for technological entrepreneurship. (Ayuntament de Sabadell, 2014a)
Environment	**Natural resources, green, renewable energy**	Installation of smart energy meters in municipal and public housing facilities, along with a platform to manage the data collected by the meters. The meters lead to a reduction in electricity consumption and thus also of greenhouse gas emission. (Ayuntament de Sabadell, 2009a) & (Ayuntament de Sabadell, 2013b)
		Equiping muncipal facilities with a remote HVAC (Heating, Ventilation, and Air Conditioning) system. (Ayuntament de Sabadell, 2014a) & (Ayuntament de Sabadell, a)
		59 muncipal buildings have a thermal solar installation good for in total 1972,89 m2. (Ayuntament de Sabadell, a)
		5 facilities have a geothermal energy installation with a total capacity of 2087,2 kW and there are plans for biomass installations. (Ayuntament de Sabadell, a)
		Wind turbine of 10 kWp in Parc Central del Vallès. (Ayuntament de Sabadell, a)
		Solarweb system, a network to analyse and monitor continuously the consumption and electrical parameters and the production of the 9 solar installations in public buildings, with a total power of 138,9 kWh. (Ayuntament de Sabadell, a)
	Public lighting	Pilot project of the implementation of LED lighting and telemanagement of the lighting in a city school (La Rómanica) and an administrative building (Can Marcet) resulting in over 50% energy savings. (Ayuntament de Sabadell, 2013b)
	Waste management	Implement new technologies for traceability of waste, for example, the installation of sensors in containers to indicate whether they are full or not and waste collection trucks with GPS-systems, to optimize the routes and the management of the service . (Ayuntament de Sabadell, 2013b)
		Pneumatic waste collection 13% of the population of Sabadell has access to the pneumatic waste collection system. This system saves money and reduces noise and CO2 emission by avoiding travel of truck collectors. (Ayuntament de Sabadell, 2012)
	Water management	Up to 90% of the city parks and gardens have a remote irrigation system monitored with humidity sensors that stop watering if there is rain or too much wind. The objective is to implement the system for all the green areas in the city and to only use recycled water. To clean the streets also only recycled water is used. (Ayuntament de Sabadell, 2009b) & (Ayuntament de Sabadell, 2009c)

		Telemanagement of the drainage stations of the underpasses for vehicles in Gran Vía. (Ayuntament de Sabadell, 2014a)
Government	**E-government**	New municipal website with integration of social networks such as twitter, facebook, youtube or flickr, and it offers the ability to subscribe to various information sources (RSS) for city news, cultural events, new job offers, download applications, etc. With the new website more than 100 procedures can performed online and citizens can check the status in real-time and report incidents or requests. (Ayuntament de Sabadell, 2014a)
		Implementation of new software to monitor administrative records at all stages of processing. (Ayuntament de Sabadell, 2014a)
	Participation	Competition of creating mobile applications (apps), with a price of 1 500 euros for the best application. (Ayuntament de Sabadell, 2013b)
	Transparency	Open Data Portal This open data portal needs to promot open data and the use and reuse information of analysis and evaluations of public management. The city council is committed to make the data that are within their power available, thus all public data that is not restricted because of privacy, safety or property reasons. These data are delivered in a standard format so that third parties can create services derived thereof, provided that they follow the appropriate conditions. (Ajuntament de Sabadell, b)
Living	**Culture & Entertainment**	Sabadell Cultura Internet portal that allows to purchase tickets online and provides information about the cultural agenda of the city and connects cultural centers with each others and improve cooperation. (Ayuntament de Sabadell, 2014a)
		Implemented automatic loan system that the citizens can use theirselves in the libraries. (Ayuntament de Sabadell, 2014a)
	Healthcare	Tele-assistance Tele-assistance is a service with a professional care center 24 hours, 365 days a year. It is a preventive health service to support the elderly. QR Codes are introduced in the homes of patients which show the history of the specific patient to facilitate attendance. (Ayuntament de Sabadell, 2014a)
	Smartphone applications & WiFi	Internet portal to combine all the applications related to the city. The portal makes a distinction between applications of the city council itself and third-party applicatons and people can also propose their self-made app. Most significant applications are: 'Ubicat': This application combines multiple municipal services and, therefore, can provide information about health, trade, tourism, transport, culture, ... in a single application. The app is created using Open Data sources. 'On Fan' application to recommended and share on social networks dishes served in restaurants in the city.

		'Appark & Go': This application allows to reserve an underground parking space offering a lower price than in the blue area. (Ayuntament de Sabadell, 2013a) & (Ajuntament de Sabadell, c)
		Installation of 4G infrastructure to cover the city area and 16 public Internet spaces and 15 Wi-Fi access points throughout the city. (Ayuntament de Sabadell, 2014a) & (Telesabadell, 2012)
Mobility	**City logistics**	Active management of public transport The bus stops are equiped with a system using panels that inform about the arrival time of vehicles monitoring in real-time. (Ayuntament de Sabadell, 2014a)
		Active Traffic Management Active traffic management with centralization and synchronization of traffic lights and meters to gather information about routes, traffic coordination with information of public works, information of routes with less traffic to generatee routes for emergency services (ambulance, fire brigade), increasing the number of cameras in busy points (entrances to the city, Gran Via Axis Macia) and a smart phone application to inform the people in real-time about the traffic conditions. The traffic management is coordinated from the central muncipal office and is also able to an automatic prioritization of traffic lights for delayed buses and manage the signalisation. (Ayuntament de Sabadell, 2014a) & (Ayuntament de Sabadell, b)
	Info-mobility	Active parking management Information system about the occupancy, the location and the price/time schedules of 5 public parking centers and making this information also available with an mobile phone application. (Ayuntament de Sabadell, 2014a)
	People mobility	Implementing electric vehicles. The muncipal fleet consists of 11 electric vehicles (5 cars, 1 van, 3 motorcycles and 2 bicycles). There are three charging points in Sabadell (Eix Macià, Vapor Turull and Ikea Sa). The city promotes electric vehicles with a flexible tax system related to CO2 emission and with the implementation of power load stations. THere is also a renewal of the bus fleet incorporating alternative energy vehicles. (Ayuntament de Sabadell, 2014c)
People	**Training**	Vapor Llonch, the economic service of Sabadell, offers more than 100 courses in various business sectors (environment, health ...). Specialized tutors give the courses and doubts can always be reported by email. (Vapor Llonch)

4.14 Santander

Figure 18: Santander (source: http://en.wikipedia.org/wiki/Santander,_Spain)

Table 28: Santander (INE & IGN, 2012)

City	Santander
Autonomous community	Cantabria
Area (km²)	34,76
Population (habitants)	178 465
Density (hab/km²)	5 134,25

The port city of Santander is the capital of the autonomous community and historical region of Cantabria situated on the north coast of Spain. Santander implemented thousands of sensors through the city and is therefore internationally well known.

Table 29 shows the projects of Santander. All projects have (RECI, b) as source, unless otherwise stated.

Table 29: Santander

Santander	Characteristic	Project
Economy	**ICT-enabled manufacturing and services**	Cloud City Center The brain' of the smart city, which not only controls all public services in the city but that makes relations to administer and manage this information in a coordinated manner. This center processes all the incoming data of sensors and communication systems. This center processes all the data of the different sensors that form the 'internet of things' and can detect irregularities or problems. This center combined with the smart sensors is the core for a lot of (future) projects and thus of the Santander smart city.
		SmartSensors Sensors are implemented everywhere. Fastened to building walls, street lamps, inserted in the pavement … They measure light, noise levels, traffic conditions, occupancy of pavements … Taxis, police cars and buses are also equipped with sensors and transmit measurements from their surroundings and track their location.
		Implementation of new payment methods Contactless card payment and mobile phone payment (NFC system). Implementation of these systems of payment in trade, hotels, taxis and city buses. The city intends to continue extending these payment systems to the different services that are offered in many areas of municipal management, such as reservation of sports facilities, municipal taxes, in the municipal libraries, etc.

		Santander innovation map Map which shows all actors in the R + D + i sector of the city, its resources and activities to promote synergies between and the development of research opportunities and business.
		Live! Santander A dynamic platform for displaying the city in real time.
	Innovative and digital business and entrepreneurship	Demonstration and business center The establishment of this center will allow the city to attract both new technology projects and companies that can invest in the development of the ideas that emerge from the center itself. The center has a 'demonstration center' which will be the demonstration area for new projects and an entrepreneurship center which will be laboratory of ideas, from which entrepreneurs submit their proposals for new projects in the field of innovation. The participation of companies will be promoted, so that entrepreneurs have greater strength when they start developing their project. There is also an Innovation Forum. These facilities function as a 'think tank', as a forum for discussion and participation of experts and expertise and customization of developments towards different social groups.
Environment	**Public lighting**	Intelligent lighting system Intelligent lighting system with remote management and automatically modulating light intensity depending on the presence or absence of pedestrians. About 2 500 light points have been subjected to an energy efficiency audit. (Santander Ayuntamiento, 2013a)
	Waste management	Smart waste collections system with sensors.
	Water management	Smart irrigation system
Government	**E-government**	Electronic Administration, virtual office Allowing citizens to obtain digitally and without moving duplicate receipts of road taxes, police services (for example technical report of accident), request action of the city council regarding traffic lights, parks and gardens, street cleaning, … It's planned to launch online possibility for the payment of taxes, applying for licenses to open shops and bill management.
	Participation	www.santandercitybrain.com This portal is presented as an online platform to share proposals, suggestions and projects that contribute to the development of Santander as smart city. (Santander Ayuntamiento, 2013b)
	Transparency	Open Data Making relevant information available to the developers of technology products. Information that is collected in the through different innovation programs, access to traffic cameras, creation of tourist routes …

Living	**Smartphone applications & WiFi**	There are various smartphone applications related to the city of Santander. The city implemented about 2 000 quick response (QR) codes at points of interest, shops and public places around Santander. There is 'SmartsantanderRA' offering information about tourism, cultural activities, businesses, public transportation, beaches, sights and attractions, etc. Anyone who walks into town can focus his smartphone on a certain street and know what points of interest are in the area, both cultural and tourist trade, the bus stops, the time it takes to reach the next station and the exact distance. There is an application to report incidents and thanks to the open data the possibilities te develop new applications are endless. (Newcombe, 2014)
		Extending the WiFi-network in the city over 150 access points.
Mobility	**Info-mobility**	Intelligent parking system Information about parking is displayed on special panels located at major intersections in the city, so anyone who is heading downtown will have an idea of how many spaces are currently available and where they are located.
		Smarter travel In order to make full use of the existing sensors that create an 'Internet of Things' (IoT) his application intends to allow users to reach their destinations in an efficient way, reducing the time spent driving through the streets and avoiding, as much as possible, congestion and occasional incidents on the streets. The sensors will be used to reliably estimate the real-time traffic flows throughout the city, and keep drivers informed in real time of the traffic situation. This will be achieved by setting up a data base to store historical and real-time records from the sensors and by developing a system of models including a flow estimation model and a traffic assignment models. Web and mobile applications will also be developed to facilitate comfortable and effective reporting on the real-time traffic situation in the city. (SmartSantander, 2013)
People	**Education**	Centro de Investigación inteligentes de Santander' (CICIS) or 'Investigation Center Smart Cities of Santander' This center is a collaboration with the Massachusetts Institute of Technology (MIT), the University of Cantabria and the city of Santander. It will convert to Santander in a laboratory of ideas and develop innovative projects from its embryonic stage to its implementation, focusing on the management of cities, both nationally and internationally.

4.15 Sevilla

Table 30: Sevilla (INE & IGN, 2012)

City	Sevilla
Autonomous community	Andalucía
Area (km²)	141,31
Population (habitants)	702 355
Density (hab/km²)	4 970,41

Figure 19: Sevilla (source: http://en.wikipedia.org/wiki/Seville)

Sevilla is the capital and largest city of the autonomous community of Andalusia and the province of Sevilla, Spain. The city indicates economy, environment, mobility and government as priorities. The city is member of the RECI since January 2013.

All projects have (Ayuntamiento de Sevilla, 2014) as source, unless otherwise stated.

Table 31: Sevilla

Sevilla	**Characteristic**	**Project**
Economy	**ICT-enabled manufacturing and services**	Inauguration of the FI-Lab (Future Internet – Lab) The FI-Lab is a data center where innovative developers can experiment with FI-WARE technologies and where entrepreneurs can get in touch with potential investors and clients. FI-Lab also allows cities, administrations, companies and other organizations to upload open data that may help entrepreneurs to develop innovative applications. This way, third parties can develop applications based on FI-WARE that enable a more efficient management of municipal services or bring innovative services to the citizens. The data center will also be part of a red of data centers through Spain and Europe, creating a powerful network of datacenters. It is as center for data processing and backup of all business applications and municipal services. It includes the control and coordination of communications, 'Big Data' and 'Open Data' services of the city. (FI-WARE, 2014) & (Ayuntamiento de Sevilla, 2014)
		Plataforma M2M The M2M Platform interacts with different entities such as field devices (sensors) or smart phones integrating those diversity of formats, protocols and technologies into a single standard. The platform is responsible for processing the data received from the field, modeling and managing the installation of field elements and manage the interaction with devices.

	Innovative and digital business and entrepreneurship	'Instituto Tecnológico del Ayuntamiento de Sevilla' or 'Technological Institute of the City of Sevilla' Technological Institute of the City of Sevilla is an institution responsible for the design and implementation of new technologies, to promote coordination between the different parties and companies and to enable the development and execution of innovative projects.
	Public private partnerships	Acelera Sevilla The project aims to promote and strengthen competitiveness and I+D+i (Investigation, Development and innovation) projects. In the project multiple SME's (Small and Medium Enterprises) will carry out different acitivites and develop various products in various businesses such as telecommunications, food industry, aerospace and aviation … This project will bring together key players in innovative sectors, thereby attracting talent, and at the same time, allowing the development of companies with high growth potential. (Universidad Pablo de Olavide, 2014)
Environment	**Natural resources, green, renewable energy**	Dareed Dareed is an European project with a technology platform to manage energy in the historic center of Sevilla. It has a control center to monitor consumption and power generation in an area or city as a whole. The system includes sensors and smart meters to provide data and information about consumption and generation. In addition the system is able to perform simulations of possible cost-saving measures in buildings and public facilities and to make recommendations to users and check the evolution of consumption and savings. The citizen becomes an active subject with more information about his consumption pattern and is thus better able to decide and implement measures to reduce the electric bill. The platform has tools for intelligent networks that include renewable energy sources and is able to incorporate elements such as lighting and HVAC (Heat, Ventilation and Air Conditioning). This platform will convert to corporations, consumers and governments to be active participants make decisions to make sustainable use of energy, for which they will get information about their consumption and recommendations. Information to the trading of energy and energy services companies, so that they can attract new customers deals will also be provided. Dareed also opens the door to new business models. It can create a market where the consumer can do a voluntary test and choose the improvements that he is willing to do and he will get offers from different companies that are specialized in energy efficiency. (Ayuntamiento de Sevilla, 2013)
		Construction of a solar photovoltaic plant of 1 880 KW in the bus parking garages of TUSSAM as well as installations good for 1 MW on other TUSSAM buildings. The city also starts with the implementation of photovoltaic energy installations in municipal buildings (Sevilla Ciudad Solar).
		Recovery and use of biogas at the garbage dumping site.

	Public lighting	Intelligent lighting system The system allows monitoring and controlling operating hours, voltage per phase, phase currents, total power, energy consumption, overall power failures of the city lights. The system is able to detect failures in real-time or/and give warnings for preventive maintenance rather than repair and can provide on-demand energy audits.
	Waste management	Separate collection of used oil and Biodiesel to make fuel used by the LIPASAM (' Empresa de Limpieza Pública del Ayuntamiento de Sevilla' or Public Cleaning Company of the City of Sevilla') fleet.
		Implementation of sensor to measure the 'filling level' of containers.
		Implementing GPS-systems and onboard computers on the waste collection trucks to control each vehicle and conduct and plan optimal routes.
		Separated waste collection of glass and paper containers.
		Central pneumatic waste collection in San Diego.
	Water management	Centralized control system to automatically manage irrigation of gardens and parks in the city. The systems increases the use of recycled water and is equiped with sensors to measure the humidity, temperature …
Government	**E-government**	Unifying E-government The unification of electronic procedures makes more automation possible thus increasing the volume of electronic services and procedures provided to citizens and businesses. The unifying and the implementation of an electronic signature should lead to an electronic document management. The city is also starting a system to make the contract and billing procedures completely electronic.
		Hispalnet A single platform to support all municipal services, allowing immediate access for the citizens to information controlled by the different municipal entities. This accessibility is the basis for the development of common systems that unify and facilitate the relationship between citizens and municipal services.
		Tarjeta Ciudadana' or 'Citizen Card' One card that can be used for all the municipal services such as sports and entertainment centersn libraries …
	Participation	Implementation of e-democracy platform 'Participa Sevilla' allowing the active participation of citizens in public life and decision-making of the city.
	Transparency	Implementation of a municipal transparency portal for fulfilling the obligations of national, regional and international public information transparency laws.

	Urban planning	Infraestructura de Datos Espaciales para la Gestión del Espacio Urbano' (IDEGU) or 'Spatial Data Infrastructure for the Management of Urban Space' The IDEGU project is a tool that allows to create, share and manage data, maps and applications containing information and services for the entire city council. Introducing this tool should allow to manage the full cycle of processing spatial data, including publication, within the city of Sevilla.
Living	**Smartphone applications & WiFi**	Sevilla has various applications. The most significant ones are: AppTussam Application providing in a simple and comfortable way all information about the TUSSAM services. The app can find stations near a certain direction, explore the stations of each line, show start and end times of the service or the location of the stations on a map and show the waiting times. It can also how to get from one point to another using the bus network indicating bus lines and the estimated travel time and provides real-time information about the waiting times, incidents, etc. It also has a feature for people with visual disabilities, a VoiceOver system plays multiple voice messages. The latest addition has been a warning for arrival times, where the user can select the line, the station, the time he wants to catch the bus and how long in advance he will be alerted. (Torreglosa, 2014) Application to reservate or request a taxi.
	Tourism	Touristic Internet Portal Introducing a website to promote tourism through providing information about touristic services, restaurants, cultural events, shops, etc. and make this information available through various digital formats and in various languages. The website is easy to use by third-parties and has space for user experiences.
		Smartport Project to provide all cruise passengers in the port of all information and services of the city.
Mobility	**City logistics**	TUSSAM management system TUSSAM ('Transportes Urbanos de Sevilla, Sociedad Anónima Municipal' or 'Urban Transport of Sevilla, SA Municipal') implemented a management system that lets them control their fleet in real time. Each bus is constantly located via GPS, and sends its position to the control center every 25 seconds. The real-time information makes it possible to take the necessary measures to keep the schedules as they are planned despite the impact of all possible incidents that might come along every day, such as traffic problems. On the other hand, knowledge of the positions of the vehicles makes it possible to estimate the arrival times, so that customers can find this information in real-time on the internet, their mobile phone as well as through panels installed on the 100 most important stops of the line network. (Torreglosa, 2014)

		Comprehensive Mobility System Mobility system that that integrates information from different administrations in the city and provides advanced services to citizens, such as real-time traffic conditions or guiding to free parking spaces. Sharing this information in real-time between all involved parties can help managers to make the right decisions and take the right measures in case of for example incidents or events. The information can be checked through multiple channels such as web and mobile applications by the customer who can thus for example anticipate possible incidents. The system also assists the emergency services by transferring information or direct assistance by radio or telephone to drivers in emergency situations in real-time.
		Movele The Movele project involves the installation of a safe and efficient network of 75 charging points for electric vehicles, which gives the city of Sevilla a boost of electric mobility. (Sevilla tiene su punto, 2010)
		Intelligent parking system Intelligent parking system with sensors and a web portal to indicate free parking spots and show information. The portal is available on mobile devices and allows payment, searching parking spots, etc.
	People mobility	Bicycle loan system System to loan bikes with multiple bicycle parkings through the city. The system includes an application that enables citizens to identify from their mobile devices and check georeferenced information about bicycle parkings, occupation, distance to the station, etc.

4.16 Valencia

Table 32: Valencia (INE & IGN, 2012)

City	Valencia
Autonomous community	Comunidad Valenciana
Area (km²)	134,63
Population (habitants)	797 028
Density (hab/km²)	5 920,22

Figure 20: Valencia (source: http://en.wikipedia.org/wiki/Valencia)

Valencia is the capital of the autonomous community of Valencia and the third largest city in Spain after Madrid and Barcelona. On July 8, 2014 Valencia will organize the next general assembly of the RECI.

All projects have (RECI, c) as source, unless otherwise stated.

Table 33: Valencia

Valencia	Characteristic	Project
Economy	**ICT-enabled manufacturing and services**	Smart City Platform The platform will bring together all city's service through 350 connected sensors. It is a PPP with the Telefonica company an uses FI-Ware technology. Thanks to the smart platform, city managers will be able to monitor everything happening in the city and act in real-time improving the quality of various sectors such us transport, energy efficiency, environmental services. (European Commission, 2014)
		The Geographic Information System (GIS) with more than 230 layers of information of many types, allows a more efficient management of resources and can serve as a decision making tool.
		My Pick Box Project to collect online placed orders in the metro of Valencia. This delivering service offers greater time flexibility, speed and privacy for its users. (Esmartcity, 2014b)
		Installation of sensors in the 'Parque Natural de L'Albufera' for early detection of forest fires.
Environment	**Buildings**	Creating green roofs and vertical gardens in municipal buildings.
	Natural resources, green, renewable energy	Installation of photovoltaic installations on roofs of municipal buildings.
		Equiping street elements such as lampposts with solar panels and batteries.

	Public lighting	Complete replacement of mercury vapor lamps by high pressure sodium vapor lamps.
	Water management	Smart irrigation system for green areas in the city that saves up to 35% water.
		Sistema de Información de la Red de Alcantarillado' (SIRA) or 'Information System of the Sewage System' System to control and manage the sewage system with a central control room.
Government	**E-government**	The city strives to a paperless administration and makes it possible to check the status of cases and provide documentation,, pay taxes without resorting to bank offices, request certificates, etc. 240 of the 330 administrative procedures of the city can already be performed online.
Living	**Healthcare**	Valencia has developed a website related to pollen, including a pollen map and alerts service for allergy sufferers.
		Video-assisted thoracic surgery in the 'Hospital Genera' of Valencia. This type of surgery allows minimally invasive operations with greater comfort and safety for the patient. (Esmartcity, 2014a)
	Smartphone applications & WiFi	Valencia has various smartphone applications such as: Realidad Augmentada' or 'Augmented Reality' Application which allows real-time reporting on existing facilities and services (for example municipal resources, tourist and cultural information points) available in the city. (Ayuntament de València, 2014) Application that functions as a guide for museums.
		Multiple points for WiFi access through the city.
Mobility	**City logistics**	Traffic Control Room of the City of Valencia is one of the best equipped in Spain and has many features. There is also the possibility to check the status of traffic in Valencia by checking the cameras through a Mobile App (iCAM).
		Testing with electric taxis in order to verify and test the possibilities of using such vehicles as taxis in the city. (Esmartcity, 2014d)
	People mobility	EcoDriving Project The project provides vehicles with a ‘black box’ and sensors (pollutants and noise information on real time). With this box drivers have access to their ‘electronic driving CV’, with recommendations to improve efficiency. The municipal fleet and the EMT buses are equipped with boxes as well as the vehicles of participating citizens. With the information drivers can be continuously trained on efficient driving. The data of the boxes and sensors can be studied and analyzed and the results of the project are Open Data. (Orrico)

		Bicycle system Bike loan system with bicycle parkings in the whole city, over 103 000 users and with different possibilities to obtain real-time information about parkings, occupancy, … on a web platform or a smartphone.
People	**Training**	Digital training to reduce the 'digital gap'.

5. PROJECT INDEX

For every city the project index, mentioned in chapter 2.2 Project Index, is calculated. The calculations files of the specific cities can be found in the appendices.

Based on those indexes two rankings can be made. A ranking based on the Project Index (PI), thus on how many valuable projects a city has, and a ranking based on the ratio of the PI and the population, number of habitants, of the city (PI/hab) (in the ranking the ratio of the project index and the population is multiplied by 1 000 000 to achieve more common numbers).

Table 34 shows the rankings based on the Project Index and the ratio of the Project Index and the population and below the project indexes are displayed in graph form.

Table 34: Ranking PI and PI/hab

Ranking	City	PI
1	Barcelona	348
2	Madrid	289
3	Sevilla	224
4	Santander	212
5	Sabadell	195
6	Málaga	188
7	Valencia	131
8	Gijón	93
9	Alcorcón	70
10	Móstoles	64
11	A Coruña	59
12	Castellón de la Plana	54
13	Alcalá de Henares	46
14	Las Palmas de Gran Canaria	45
15	Alicante	40

Ranking	City	PI/hab
1	Santander	1188
2	Sabadell	938
3	Alcorcón	412
4	Gijón	335
5	Málaga	331
6	Sevilla	319
7	Móstoles	311
8	Castellón de la Plana	300
9	A Coruña	240
10	Alcalá de Henares	226
11	Barcelona	215
12	Valencia	164
13	Alicante	120
14	Las Palmas de Gran Canaria	118
15	Madrid	89

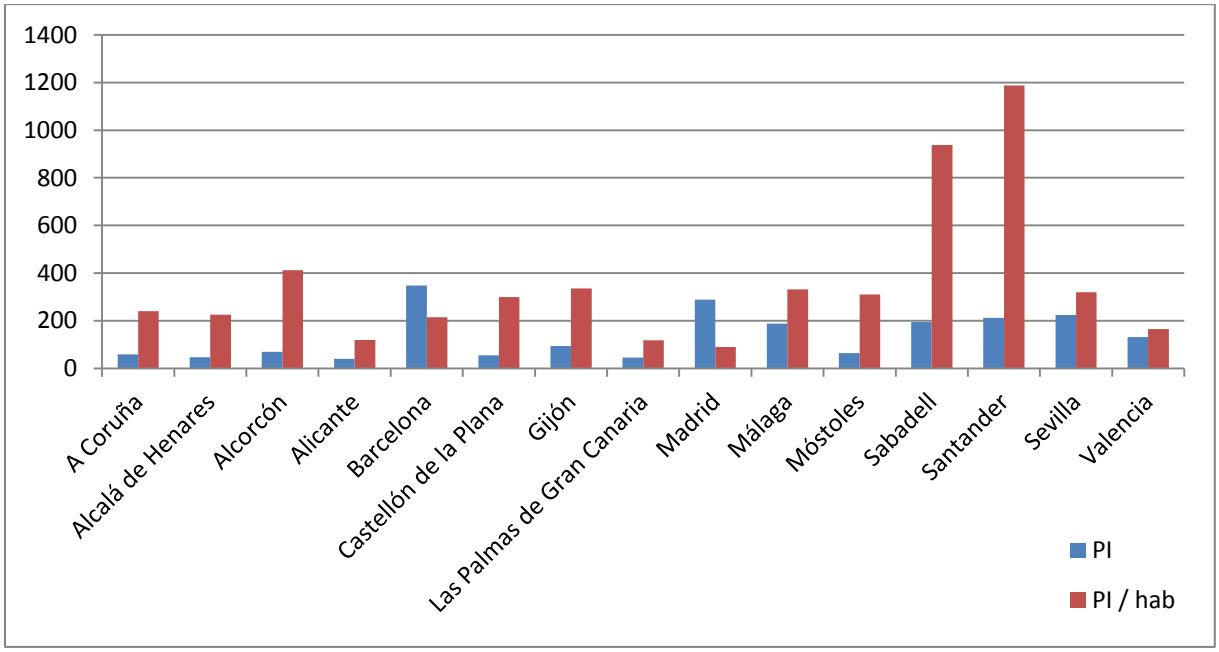

Figure 21: PI and PI/hab

Table 35 shows the number of habitants of each city to clarify the ratio of the Project Index and the population.

Table 35: Habitants

	City	Habitants
1	Madrid	3 233 527
2	Barcelona	1 620 943
3	Valencia	797 028
4	Sevilla	702 355
5	Málaga	567 433
6	Las Palmas de Gran Canaria	382 296
7	Alicante	334 678
8	Gijón	277 733
9	A Coruña	246 146
10	Sabadell	207 938
11	Móstoles	206 031
12	Alcalá de Henares	203 924
13	Castellón de la Plana	180 204
14	Santander	178 465
15	Alcorcón	169 773

6. FINDINGS AND DISCUSSION

For each of the six smart city characteristics (economy, environment, government, living, mobility and people) the PI and the PI/hab are discussed and illustrated in graphics for each city.

6.1 Project Index and Project Index per habitant

There is a big difference between the ranking based on the PI and the ranking based on PI per habitant. In the first ranking the bigger cities dominate because they have the most and the biggest projects. However when we look at the second ranking we notice that some smaller cities significantly rise and some bigger cities like Madrid and Barcelona fall back while a cities like Sevilla and Málaga are able to maintain.

6.2 Economy

In the economical dimension not a lot projects are aimed specifically at improving or establishing PPPs but a lot of the listed projects are implemented thanks to a PPP. Companies like 'Telefónica' and 'Endesa' are involved in multiple projects.

Cities as Madrid and Santander have the biggest project index because they have data and business centers. Other common projects are modernizing communication infrastructure and using GIS (Geographic Information System) technology for city services.

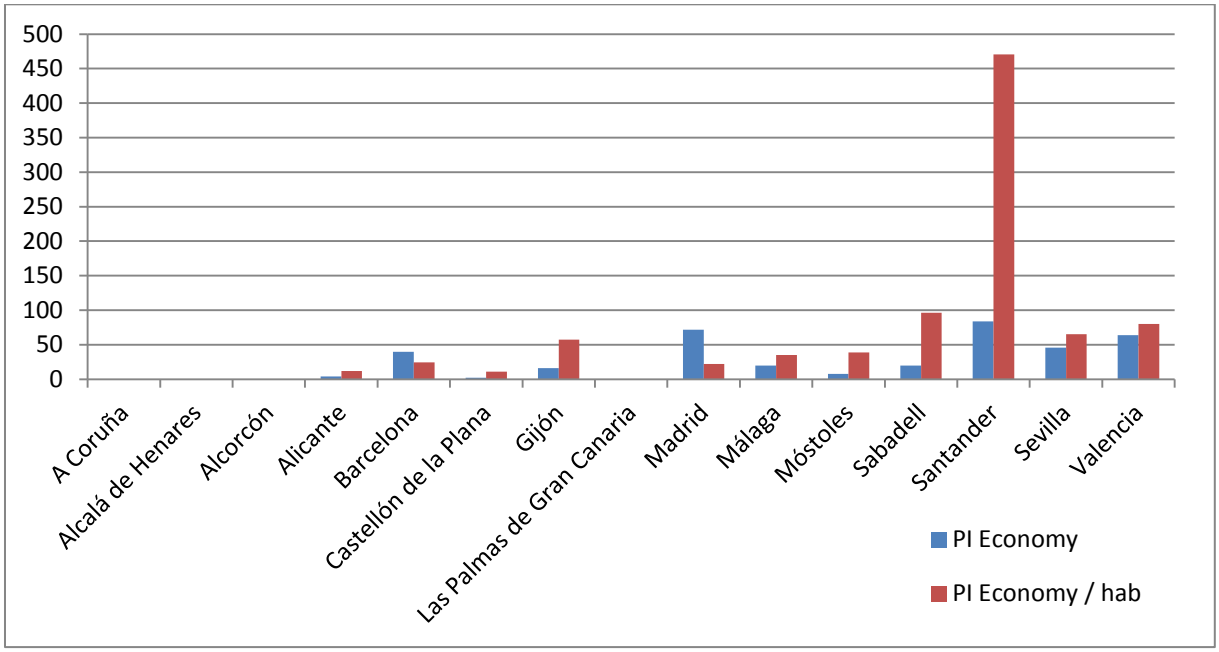

Figure 22: PI Economy

6.3 Environment

Except Las Palmas de Gran Canaría, every city has smart city projects related to the environment. Barcelona and Sabadell score really well because they have numerous projects.

The bigger cities almost all have an automatic irrigation system and an intelligent lighting system while the more innovative cities also have a system for pneumatic waste collection.

Most of the cities also try to implement renewable energy and modify their muncipal buildings to reduce energy consumption.

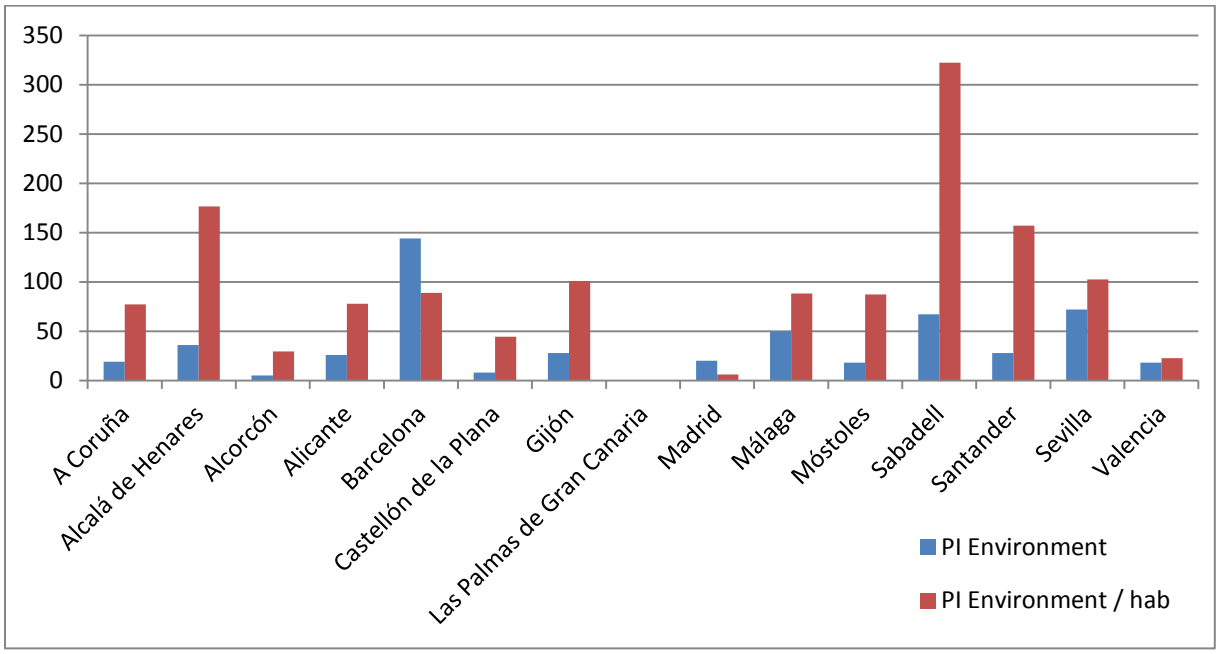

Figure 23: PI Environment

6.4 Government

In the governmental dimension it's clear that most cities strive for a 100% paperless administration but there are big differences in the state of development and implemementation of this objective.

Barcelona is one of the most advanced cities in this dimension. It implemented several online procedures, an electronic signature and processing documents happens almost completely electronic.

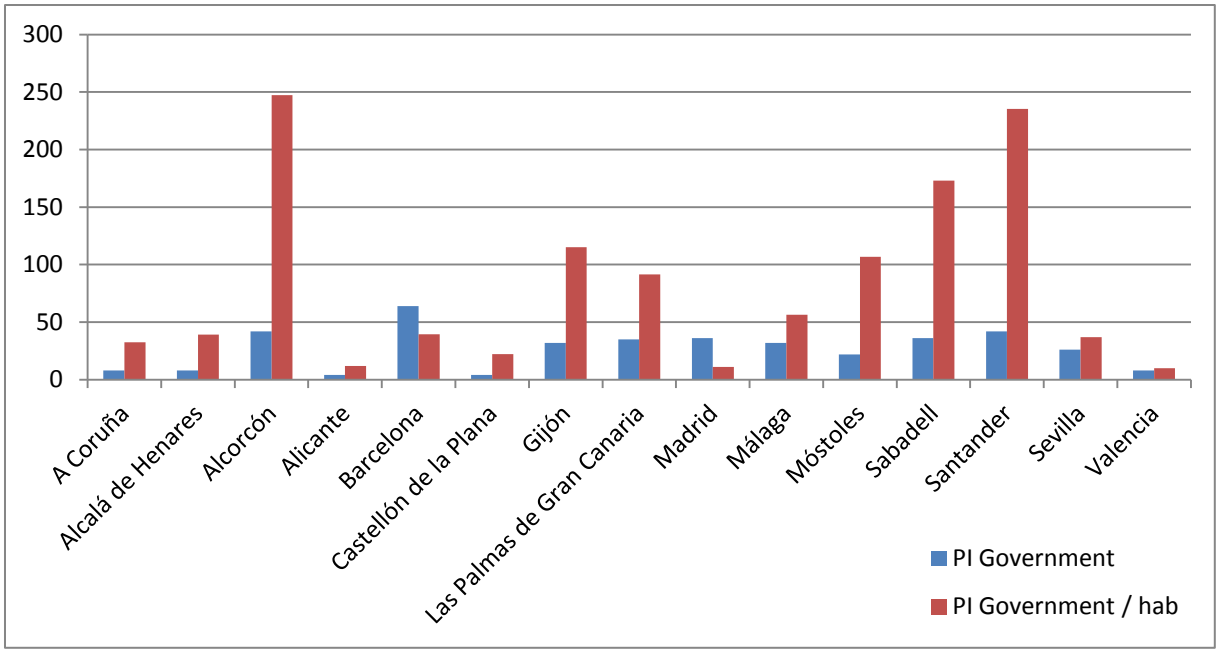

Figure 24: PI Government

6.5 Living

The main part of the projects categorized in the living characteristic are smartphone applications. This is not a big surprise because the possibilities of those applications are endless.

There are applications to support disabled people, with information about the buses or events, to make reservations for sport facilities …

Applications are a very interesting tool because a company can create them and a lot of them are interactive and thus improve the participation of citizens.

Almost every city has applications, Castellón de la Plana is the only exception. Most cities try to provide WiFi-access as well.

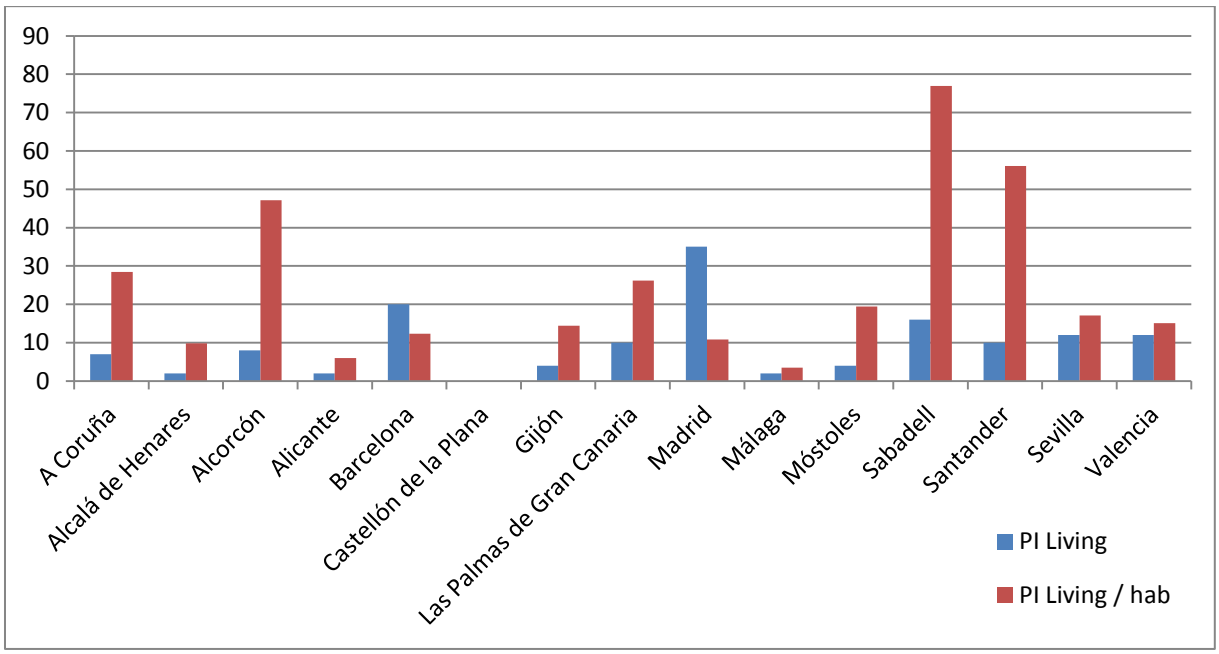

Figure 25: PI Living

6.6 Mobility

The bigger cities try to implement a traffic management system to manage and control their roads. Innovative cities also introduce a smart parking system to find available parking spots in the city.

Next to improving the public transport and providing real-time information, replacing the vehicles of the municipal fleet with electric ones and provide charging station for electric vehicles are also a popular measures. Multiple cities also have a bicycle loan system.

Mobility is together with environment the dimension with the most or biggest projects. Málaga has with 'Victoria' one of the most innovative projects. The project makes it able to charge an electric bus while driving.

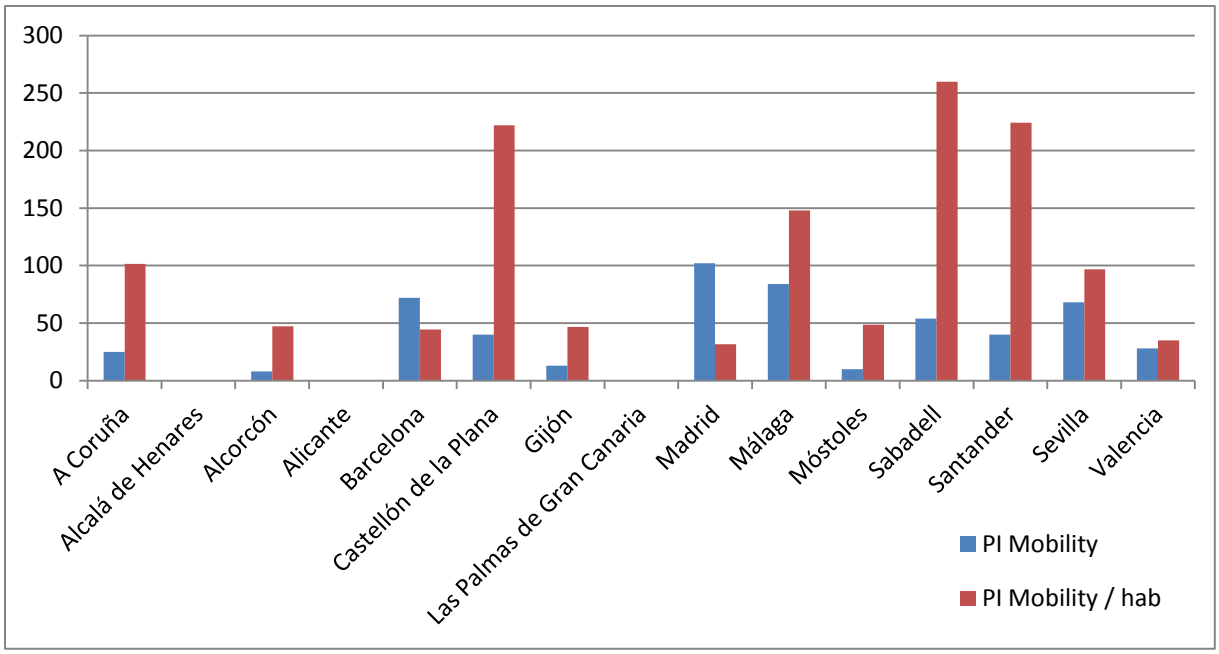

Figure 26: PI Mobility

6.7 People

Various cities organize workshops and trainings but in general the trend is that the people dimension is the one with the least priority. Few cities score well for this characteristic.

Creating an educational center, training people to help them find a job and projects to tackle the digital gap are most common.

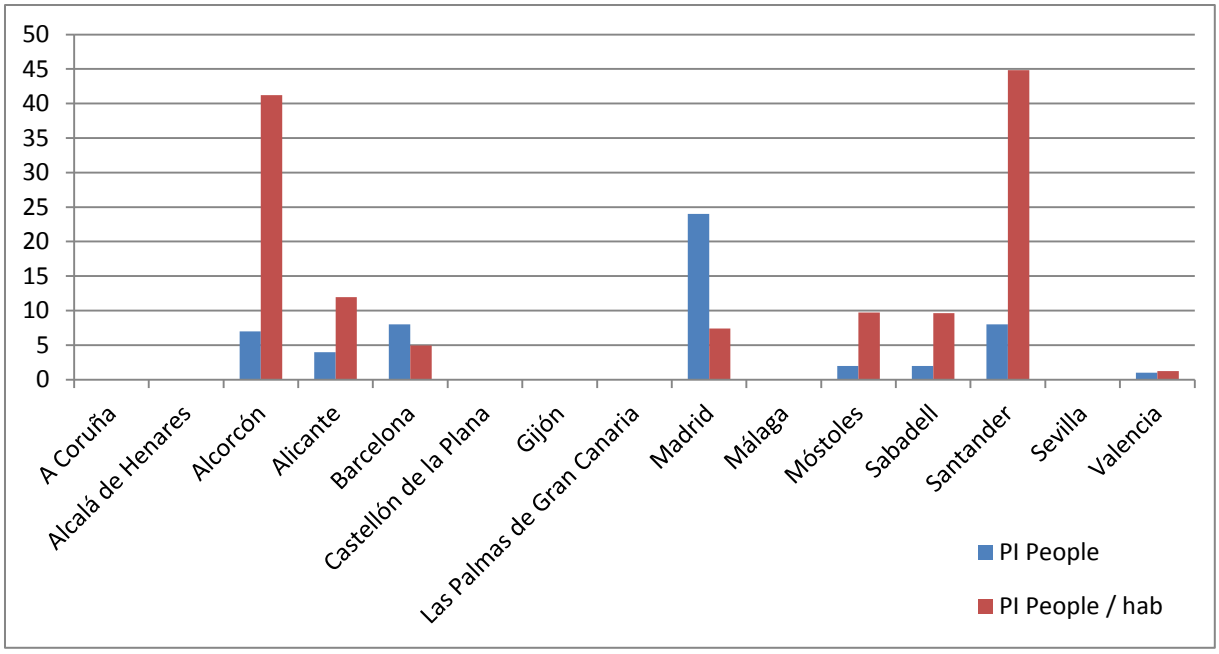

Figure 27: PI People

6.8 Analysis

Analyzing the various projects reveals multiple causes. First of all we need to be vigilant and always stay critical about the quality of the projects. If not smart city projects can be used as a smokescreen to cover up the shortcomings and weaknesses of local urban policies under the seduction of terms such as ‘quality of life’, ‘sustainability’, ‘smart’, etc. .

The projects are part of a marketing strategy and do not always have valuable urban city politics content. We should note that that cites that advertise most and make the most publicity about their projects will probably also have a bigger amount of projects involved in there PI calculation.

So on the one hand cautiousness is required when cities are ‘bragging’ about their projects, on the other hand they need to show and promote their projects to inform the people, let them participate and achieve more transparency.

Therefore the ranking with the Project Index tries to value projects depending on their innovative character and impact. Projects that are not really ‘visible’ for the citizens can alike be of great value for the society. The ranking intents to rank the cities not only on the amount of projects but on the total quality of their projects. One quality project can have a bigger impact that several smaller projects.

It also only includes the actual practical projects. All the cities have strategic plans, and a lot of beautiful words about their way of becoming a smart city but that’s not always accompanied with real projects, actions and/or measures in practice. Because smart cities are still in an early phase hopefully all those plans will result one day in quality projects in practice.

The ranking does not take into account the moment of execution. That’s because most projects are or recently finished, or in progress now or will start soon (at the latest in a few years) and it is not always possible to differentiate projects in of those three categories.

In general environment and mobility are the most popular dimensions. Almost all the cities have multiple projects related to those characteristics. A lot of projects are also indirectly related to environment. For example the paperless administration that cities try to achieve is also beneficial for the environment.

Various analyzed cities collects a lot of data. This ‘big data’, for example collected through sensors or people, can be processed in a data center but there are not always specific applications. Despite this information is very valuable it is not always used optimally. However a city like Santander does useful things with their data. The ‘Cloud City Center’ collects and processes the data of thousands of sensors to detect problems and irregularities. Also because of the open data concept the data is available for companies and civic hackers and they can use it for various purposes.

At last there should also be enough attention for digital safety. The ICT systems should be protected properly to avoid unwanted intruders. This is very important because if not the consequences can be enormous. The whole traffic control could be messed up or the water supply of a whole city could be poisoned.

Sometimes it’s also necessary to lift our eyes from concentrating only on ITC solutions because simple measures can also make a big difference and make city more ‘smart’. In general we should keep in mind that we can only welcome more ITC solutions to achieve more quality of life but that the technologies should be implemented with great care and by skilled people because technology is not unfailing.

7. CONCLUSION

The smart city scene is alive and booming. Every city has its own way and projects to become a smart city but there is a lot of progress and innovation. However we need to stay critical and alert to avoid that governments abduct the smart city concept as a smokescreen to cover up the shortcomings of local urban policies.

In this dissertation a ranking was developed that ranks the cities not on the amount of projects but on the total quality, innovative character and impact of their projects.

The analysis reveals that the bigger cities have a lot of quality projects however when we look at the population smaller cities even score better.

The most popular characteristics are environment and mobility. Most cities have projects affection these characteristics. In the dimension mobility recurrent projects are implementing electric vehicles, a bicycle loan system and improving the public transport. Environmentally projects are mostly related to energy production (renewable energy) or consumption and sustainable use of resources.

On the other hand the people characteristic has the least priority. There are cities that organize trainings and workshops but in general this dimension is ranked lowest.

In the governmental dimension trying to achieve an paperless administration is the main goal of almost every city. However, what holds true for every project in every dimension, there are big differences in the state of development and approach.

The majority of the projects of the living characteristic are smartphone applications. The possibilities of those applications are endless and they are very interesting because they can encourage cooperation between companies and city governments, and can be interactive and thus encourage participation of citizens.

Most of the projects are executed in cooperation with a company and thus are also beneficial for the economy.

However now and then it's also necessary to lift our eyes from concentrating only on ITC solutions because sometimes simple measures can also make a big difference and make city more 'smart'.

In general we should keep in mind that we can only welcome more ITC solutions to achieve more quality of life but that the technologies should be implemented with great care and by skilled people because technology is not unfailing. There are cases enough of failing technology, for example recently with the implementation of the bicycle loan system in Madrid as the article 'Los pedales de la Discordia' in 'El País' illustrates.
(available at: http://ccaa.elpais.com/ccaa/2014/06/27/madrid/1403893905_449839.html)

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APPENDICES

Appendix: Calculation files

A Coruña	Characteristic	Project	Pa (1,2,3)	Pm (1,2,3)	Pi (1,2,3)	Ps (1,2)	PI	PI/hab
Environment	**Energy**	Energy Improvement in ETAP ('Estación de Tratamiento de Agua Potable' or 'Drinking Water Station')	1	1	2	2	4	16,3
		This project includes a detailed analysis of the current operation of the ETAP and an initial audit of its energy consumption. Analyze the information obtained to meet the main needs improvement and ETAP identify actions. This analysis reveals the main needs and specific actions that needs to be taken. Measuring devices and sensors are installed to capture information and improve processes.						
		Monitoring and control of energy efficiency in public buildings.	1	1	2	1	2	8,1
		Remote measuring system of water and gas.	1	1	1	1	1	4,1
	Water management	Intelligent management of urban waste.	2	1	2	1	4	16,3
		Continuous monitoring and quality alert of bathing waters and reservoirs.	2	2	1	1	4	16,3
	Waste management	Remote intelligent irrigation in parks and gardens.	1	2	1	2	4	16,3
Government	**E-government**	Digitalization of the administration including a virtual tax office.	1	1	1	2	2	8,1
	Participation	Organisation of a Smart Weekend where people can participate in workshops and come up with innovating ideas.	1	1	1	2	2	8,1
		Introdcution of a technical platform This platform is associated with technologies such as Big Data, Open Data, 3D advanced visualization and Business Intelligence. It can be used by entrepreneurs or students to improve their research or business.	1	2	2	1	4	16,3

Living	**Healthcare**	Ambulatory Telecare System System for offering remote care of elderly and physically less able people, providing the care and reassurance needed to allow them to remain living in their own homes.	1	2	1	1	2	8,1
		Information system with information about the emergency services.	1	1	1	1	1	4,1
	Public security and safety	Remote control of air quality and noise.	1	1	1	1	1	4,1
	Tourism	Guided system with augmented reality and information services in real time.	1	1	1	2	2	8,1
		Information system about events.	1	1	1	1	1	4,1
Mobility	**Info-mobility**	Traffic optimization system Initiatives of this new system are regulated walking areas and providing information to citizens. To improve mobility and optimize the capabilities of the streets, cameras and detection devices are installed which are connected to the traffic control system. This system collects all the information and details about the traffic situation in real time. This information will be useful for municipal managers who can make decisions in real time in case of a problem on the road and also to the citizens, as they will be informed about the traffic situation and can decide which is the best route to reach their destiny.	3	2	3	1	18	73,1
	People mobility	Intelligent parking system.	2	1	3	1	6	24,4
		Information system about the public services.	1	1	1	1	1	4,1
						TOTAL	59	239,7

Alcalá de Henares	Characteristic	Project	Pa (1,2,3)	Pm (1,2,3)	Pi (1,2,3)	Ps (1,2)	PI	PI/hab
Environment	**Buildings**	Building of a center of 'eco-efficient' data The centre is focused on getting the more efficiently significant reductions in the consumption of water, energy and CO2 emissions compared to conventional data centers. The air conditioning of the rooms of the new data center Telefónica carried out using Free Cooling technology a solution that uses the outside air when the temperature is lower than in the halls, thereby significantly reducing power consumption and reaching one of the best energy efficiency standards. In its new data centre, Telefónica will provide outsourcing services infrastructure, hosting, backup, storage, monitoring, etc. There is also a special focus on the new cloud services.	3	3	2	2	36	176,5
Government	**E-government**	Adjustment of computer equipment and software , through the acquisition of PC 's and high-performance servers and the implementation of high-speed networks to interconnect the Municipal Offices	2	1	1	2	4	19,6
		eGovernment Planning with the creaotion of a municipal website and online procedures	2	2	1	1	4	19,6
Living	**Smartphone applications & wifi**	Creation of WiFi access in cultural and youth centres, libraries and public spaces	1	1	1	2	2	9,8
						TOTAL	46	225,6

Alcorcón	Characteristic	Project	Pa (1,2,3)	Pm (1,2,3)	Pi (1,2,3)	Ps (1,2)	PI	PI/hab
Environment	**Buildings**	Installing LED lights in the Municipal Institute of Employment and Economic Development (IMEPE)	1	2	1	2	4	23,6
	Energy	Reduced schedules in the operation of ornamental fountains in the city	1	*2*	1	1	2	11,8
	Public lighting	The use of low energy lighting on public roads	2	*2*	1	2	8	47,1
Government	**E-government**	Within the administrative modernization plan of the city launching a data processing centre in order to improve the quality of municipal services and bring the digital administration to the residents and the implementation of a document management system and an electronic signature	3	3	2	2	36	212,0
		The city has also implemented a virtual office application through which neighbours of Alcorcon can do their paperwork electronically and send their scanned documents to other authorities without physically moving. This makes life easier for the residents of Alcorcón, administration is more effective and also generates immediate savings.	1	2	1	1	2	11,8
	Decision-making	Establishment of an innovative management model through which the proposals, ideas and projects from other cities, universities and research centres, companies and its own staff can be analysed and forward useful information to the management team for decision-making.	2	1	2	1	4	23,6

Living	**Healthcare**	Pediatric service online by which any citizen may rise doubts, make appointments and seek advice	1	1	1	2	2	11,8
	Public security and safety	Creation of PPI ('Planes Previos al Incendio' or 'Previous Plans to Fire') of schools and public buildings Each PPI is composed of a data sheet of the building or facility and, second, a collection of plans and positions of key elements for making decisions in case of emergency: fire hydrants, emergency exits, access through doors and windows, gas and electric facilities, possible fuel or water tanks, etc. PPIs are therefore an essential instrument to support first aid in any disaster, reducing uncertainty and improving the speed and effectiveness of the response of the emergency services. This will not only reduce the damage or injury, but also ensure more safety and security to emergencies.	1	1	1	2	2	11,8
	Smartphone applications & wifi	Incorporation through the smartphone app SafetyGPS, new services for citizen interaction with the city management, reporting incidents, urban maintenance, safety or the location of defibrillators.	1	2	1	2	4	23,6
		Guidance Access System in all municipal buildings: this system facilitates blind people access to city buildings and services provided to them by a mobile application. They can read a series of QR codes. These codes are located in specific areas and provide the necessary information to guide the visually impaired, in particular. Also for those with hearing disabilities or wheelchair users can it be an improvement	1	1	1	2	2	11,8
Mobility	**People mobility**	System of tax credits for alternative fuels (biogas, compressed natural gas, methane, hydrogen or electricity) & 'green taxation' with tax credits to encourage the use of less polluting vehicles	2	2	1	2	8	47,1
People	**Education**	EdCivEmerg Educational school program for assistance in first aid and risk prevention	1	1	1	1	1	5,9
	Integration and plurality	Job Club as a meeting of all those seeking employment	1	1	1	2	2	11,8
	Training	Organizing occupational training and mixed employment programs (employment workshops and student workers)	1	1	1	2	2	11,8
		Career guidance to help people find the right jobs and vice versa	1	1	1	2	2	11,8
						TOTAL	81	477,1

Alicante	Characteristic	Project	Pa (1,2,3)	Pm (1,2,3)	Pi (1,2,3)	Ps (1,2)	PI	PI/hab
Economy	**ICT-enabled manufacturing and services**	Fiber broadband networks throughout the city The optical fiber technology deployment in Alicante will allow direct transmission of high-speed signals. The company 'Telefónica' will grant individual homes and enterprises the access to optical fiber, and will provide faster internet connection.	2	1	1	2	4	12,0
Environment	**Natural resources, green, renewable, energy**	Photovoltaic floor of 20 000m² in Mercalicante The solar plant consists of 5,676 photovoltaic modules covering an area of 20 000 square meters and generates 1 599 400 kWh of energy per year the equivalent of the energy expenditure of 468 homes.	3	2	2	2	24	71,7
	Water and waste management	SCW2: Smart Cities Water & Waste Developing a strategic plan for the water management and renovation works of sanitation infrastructure such as collectors, continuing flood park ' La Marjal', etc.	2	1	1	1	2	6,0
Government	**E-government**	Modernization of municipal structures This includes promoting and disseminate new tools to access the new services and better accessibility of the website of the city, mobile payments of taxes, administrative procedures that can be performed through the internet, etc.	2	2	1	1	4	12,0
Living	**Smartphone applications & WiFi**	Disabledpark It is a website and a free mobile application that facilitates the geolocation of parking spaces for disabled persons.	1	1	1	2	2	6,0
People	**Training**	Promote technological literacy of citizens, businesses and social organizations in order to break the digital divide between administration and citizens	1	1	1	2	2	6,0
		Free monthly forum meeting with high-level training in on-line marketing and social networks.	1	1	1	2	2	6,0
						TOTAL	40	119,5

Barcelona	Characteristic	Project	Pa (1,2,3)	Pm (1,2,3)	Pi (1,2,3)	Ps (1,2)	PI	PI/hab
Economy	**ICT-enabled manufacturing and services**	City OS: 'Sistema Operativo de Ciudad' or 'Operating System of the City' Technology platform of services and solutions able to acquire and process information fast, efficient, reliable and sustainable of different systems (sensors, applications, control centres, ...) scattered throughout the city. This platform will be able to relate, combine, complete, process and store events. You can build and run city processes, generate and send messages to other parts, applications or control centres. There is the ability to predict and anticipate any emergency to help coordinate resources more quickly and efficiently, and to support decision making in real time. This platform will be used to design, model and better manage the urban environment.	3	3	2	1	18	11,1
		The Smartquesina A bus station that features a touch screen with municipal public services, applications, contactless technology ... These new technologies offer the citizen interactive services to improve the user experience. Next to the interactive digital display that allows interactive queries, provides help on routes and destinations and offers a ticket sales service there is also a video casting system on the bus and metro network that provides service information, news and georeferenced advertising. The installation is powered by solar energy and futures also smart advertising panel. A panel with a camera that identifies the number, sex and age of the people standing in front of it. The content displayed varies according to these factors.	2	2	1	2	8	4,9
		Creating a new single telecommunications network that integrates all preexisting vertical networks, including remodeling urban streets/neighborhoods and deploying new sensors	2	2	1	1	4	2,5

		Punt BCN They are 'electronic kiosks' and offer services related to the city administration and are located in the office of citizen services and other facilities such as libraries, community centers, shopping malls and subway stations.	1	1	1	2	2	1,2
		Barcelona 3D Barcelona 3D is an initiative to visualize the city in three dimensions. Tis is useful to unify the spatial information and it improves the understanding of the city through visual art tools. It can be used to make visual trips through the city or simulate new infrastructure projects.	2	1	1	2	4	2,5
	Innovative and digital business and entrepreneurship	Carpeta del Profesional' or 'Professional portfolio' This application for professional use allows telematic management of a wide range of procedures associated with the government. Thus necessary movement of managers and costumers can be reduced.	1	2	1	2	4	2,5
Environment	**Buildings**	Creating self-sufficient blocks Barcelona promotes a new building model based on autonomous production of energy resources with new principles of management, design and financing of urban networks, enabling energy independence and a more sustainable management. The program intends to apply these principles of self-sufficiency in areas of new construction, where items such as solar covers, joint district heating, water recycling and use of electric vehicles will be incorporated. The focus is also on energy generation from renewable sources that approach zero emissions (solar, wind, geothermal, biomass, etc.); the efficient use of natural resources, insulation and shading devices; the introduction of smart management (for example control of the water cycle), promoting green urban presence through micro-gardens or green roofs and selective garbage collection and prepare building adapted to the use of electric vehicles. To this end two blocks are build; Valldaura, which occupies 12,633 square meters in the Nou Barris district, and Cristobal de Moura, which occupies 12,000 square meters in the district of Sant Martí.	2	3	3	2	36	22,2

		MEDIA-TIC Building at the 22@ district The medIa-TIc building is a good example of the new smart and sustainable architecture in Barcelona, which uses the latest technology. The building is shaped by large iron beams covered in a plastic coating of inflatable bubbles. This covering has a functional utility as as way of regulating light and temperature. This 'skin' is activated using pneumatic mechanisms thanks to 'luxometer' sensors that automatically adjust depending on how much solar energy there is. These luxometers are energy independent.	1	3	2	2	12	7,4
		Barcelona Solar Thermal Ordinance The installation of thermal and photovoltaic solar collectors in public and in big new or renovated buildings. The Solar Bylaw makes the installation of solar heating panels compulsory for new or renovated buildings since 2000.	2	2	2	2	16	9,9
	Natural resources, green, renewable, energy	Installing solar panels throughout the city for example the panel by the Forum in Barcelona that produces 550,000 KWh a year, which can generate power to over 160 000 households.	1	2	1	2	4	2,5
	Public lighting	Pla Director d'Il·luminació de Barcelona' or 'Lighting Master Plan' Plan defining accurate luminance criteria for the city(Ajuntament de Barcelona, 2012)This plan defined the lighting for each street in Barcelona. It consists of remotely managed low energy LED luminaires connected directly to the city's communications network, which enables the lighting to be adjusted to the needs of the moment. About fifty streets have already LED lighting. The lighting in the Josep Tarradellas Avenue is also equiped with presence sensors that enhance the power of light when they recognize pedestrians.	2	2	2	2	16	9,9

Pollution control	Environment Smartsensors Sensors connected to the city's WiFi-network report in real-time temperature, noise levels, humidity, gases dust particles, etc. concentrated in a particular environment. These sensors provide real-time information about the air quality in the city.	2	2	1	1	4	2,5
	Create low-emission zones where only vehicles that meet certain standards of pollutant emissions can circulate, and dessiminate information about air quality and its impact on health.	2	2	1	1	4	2,5
Waste management	Smartsensors in waste management Sensors installed inside containers to monitor the fill level. This data is sent in real time to a control centre, which enables optimal management of collection. Also inspectors of waste containers have mobile PDA devices that allow them to visualize the list of inspections performed, inspection schedule and inspection forms and the valuation.	1	2	1	2	4	2,5
	Containers with a subterranean vacuum network through the pipes, sucking up trash below the ground. This automated waste collection system decreases noise pollution made by trash trucks.	2	3	3	2	36	22,2
	Improve waste managemant with reduction, reuse and recycling of waste. Moving towards a zero waste with taxes, packaging reuse and return systems etc. Eliminate food waste by linking food retailers and food collection associations.	2	2	1	2	8	4,9
Water management	Centralized remote management of automated irrigation infrastructure and optimizing the use of rainwater.	2	1	1	2	4	2,5

Government	**E-government**	Developing a paperless administration Barcelona intents to develop a paperless administration with different initiatives such as a eFirma; electronic signature used to sign electronic documents, eContrato; electronic contracting allows to attach all information and documentation records of governement contracts electronically as well the bidding, eDocumento; the generation, storage, access, preservation, and custody of all electronic documents generated by the city and those contributed by citizens and business, e-pagot; electronic payment different means of payment that allow you to pay all taxes, fees, charges and fines the city of Barcelona, eRegistro; allows you to handle municipal procedures or services performed by the city electronically and eNotificació; allows the governemnt to create a notification in electronic format, and store the file securely in the folder of the citizen or company. The city also keeps electronic files about inspections, subsidies and licenses for artworks.	3	3	1	2	18	11,1
		Barcelona Contactless Barcelona contactless provides specific information regarding the precise time and place location of the user when accessing a virtual platform. Depending on the item, you can view information on the equipment/service itself or information from other facilities/services nearby, view the related agenda, download related mobile applications (apps), check events in the city, etc. To access the platform you need to have a device with internet connection and connect via one of the QR (Quick Response) code or NFC (Near field communication) technologies.	1	1	2	2	4	2,5

	Identidad digital móvil' or 'Mobile digital identity' The mobileID system allows citizens to safely remotely identify through a digital identity on your mobile phone. It is based on a record of mobile digital identities to associate a mobile phone number to any citizen who wishes to have this new type of digital accreditation. Any user of a smartphone connected to the internet may request and use the digital identity mobileID through an application.	1	1	1	2	2	1,2
	Mobility services platform on a PDA (Personal Digital Assisstent) for staff By equiping the police, inspectors, social workers, etc. with an PDA or a new smartphone they can report and make decisions in real-time.	1	1	1	2	2	1,2
Participation	Consulta ciudadana Diagonal' or 'Diagonal Public Consultation' With this public consulting people can give their opinion about the transformation of Barcelonas most important street 'La Avenida Diagonal'	1	1	1	2	2	1,2
Transparency	Videorecording of the city council meetings Recording the city council meeting leads to more transparency. The secretary takes notes, signs with his electronic signature and attaches the necessary documents. Storage and creation of overviews of the meetings all happens electronically.	1	1	1	2	2	1,2
	OpenData BCN The OpenData Barcelona project makes data held by the city council available for public use. The data are provided in digital, standard and open formats, following a clear structure that allows automated use and understanding the data.	2	3	2	2	24	14,8
	El Tablón de Edictos Electronic' (TEE) or 'The Electronic Bulletin Board' This bulletin board allows citizens to see so official communications of the City of Barcelona. Citizens can filter content based on their interests, for example art or administration and use the search option.	1	1	1	2	2	1,2
Urban planning	Maintaining and creating green areas and expanding green urbanery. Collserola is one of the great lungs of the city, a unique natural area of great ecological value and it covers an area of 8,300 hectares. Also conservating the costal and marine environments and river systems.	1	2	1	1	2	1,2

		Diagonal Besòs -22@ Campus or Barcelona's innovation district In the 22@ district, Barcelona has consolidated a diverse, balanced, sustainable environment, in which the most innovative companies and universities coexist with housing, facilities and green zones. On one hand, the area features the Smart City Campus-22@, which will be home to companies, universities, entrepreneurs and research centers in ICT, ecology and urban-planning, with the aim of becoming a benchmark technology center for smart cities. On the other, the UPC and administrations are promoting the Diagonal Besòs -22@ Campus in order to create an area of excellence in internationally renowned research in the energy, sustainable mobility, materials technology and biomedical engineering sectors.	1	3	2	1	6	3,7
Living	**Smartphone applications & WiFi**	App4bcn Creation of the website 'http://apps4bcn.cat/esp/' which gives an overview of all the applications that are useful to enjor and/or live in Barcelona. One of the most significant applications is ApparkB. A smartphone app with which to pay for green and blue zone parking, which replaces the traditional parking metre. Payment can be made in real time and for the actual period for which the service was used. The app alerts you when you reach the maximum parking time allowed and identifies the exact location of the vehicle.	2	3	1	2	12	7,4
		Barcelona WiFi Barcelona WiFi is a service that allows you to connect to the Internet via WiFi access points located throughout the city.	1	1	1	2	2	1,2
		Mobile services With a mobile phones arrangements can be made and information received with applications of the city council for smart phones or with SMS or WAP services.	1	1	1	2	2	1,2

	Social inclusion	Bienvenida a Barcelona' or 'Welcome to Barcelona' Welcome to Barcelona is a service package that combines in a single procedure all the claims and common needs of people who are registering new in town or people who move. Before the package you had to make several procedures separately but now they are unified in a single request.	1	1	1	2	2	1,2
		New model of care The new model of care and information systems allow incorporating an integrated social care that fits in the city vision. New technologies are included so all the workers have access to the necessary data and applications.	2	1	1	1	2	1,2
Mobility	**City logistics**	Design of a new bus network The new bus network includes vertical buslines through the city. Also new technologies are used for advanced information systems for users, to provide WiFi access, to decrease travel time and to obtain better sustainability criteria regarding the consumption of resources (for example with hybrid motors).	2	2	2	2	16	9,9
		Boost deterrents to the use of private motor vehicles (cars, motorcycles, vans, etc.): regulate traffic in strategic areas of the city (30 km/h zones, schedules, constraints, etc.), creating peripheral parking spaces, HOV lanes, etc. Promote efficient driving.	2	3	1	2	12	7,4
	Info-mobility	Smart Parking Pilot test to assess sensors installed on streets that enable real-time query via smartphone on availability of parking spaces.	2	2	3	2	24	14,8
	People mobility	Promoting the use of electric vehicles in the city with providing charging stations (already 262 throughout the city) and promoting electric vehicle rental. Barcelona has already a fleet of almost 700 electric vehicles. Implemenation of electric taxis and developing specific electric taxi stops and a preferential queuing system at airports and railway stations.	2	2	1	2	8	4,9
		Bicycle rent system A bicylce rent system with multiple bicycle parkings throughout the city combined with an application that lets you check where the nearest bicycle parkings are and shows in real-time the availability of bikes and parkings through a mobile device. The application can also calculate the fastest and safest route.	2	2	1	2	8	4,9

		Web platform allowing potential users with similar origin/destination and schedules to get in touch with the final goal of sharing their journeys by the vehicle of one of the users. It is addressed to both public and private users. It includes energy savings tool for user's awareness raising.	1	2	1	2	4	2,5
People	**Education**	Fab Lab Barcelona The Fab Lab Barcelona, one of the leading fabrication laboratories in the world, is part of the Institute for Advanced Architecture of Catalonia (IAAC), a cutting edge education and research centre for the development of architecture capable of meeting the challenges of habitability in the early 21st century.	1	3	1	2	6	3,7
	Integration and plurality	Using urban waste collection and recycling as an oppurtunity to provide work and training for people with social-integration and job-placement difficulties	1	2	1	1	2	1,2
						TOTAL	348	214,7

Castellón de la Plana	Characteristic	Project	Pa (1,2,3)	Pm (1,2,3)	Pi (1,2,3)	Ps (1,2)	PI	PI/hab
Economy	**ICT-enabled manufacturing and services**	Application of new technologies in the production of ceramics.	1	2	1	1	2	11,1
Environment	**Public lighting**	Lighting shutdown during dispensable lighting phases and replacing old lights with leds.	2	2	1	2	8	44,4
Government	**E-government**	Improving and transforming the administration by digitizing procedures and interoperability services.	2	2	1	1	4	22,2
Mobility	**City logistics; Info-mobility; People mobility**	Construction of an urban mobility control center and a traffic light installation maintenance service. The platform will enable coordinated management of all of the city's mobility-related systems and will initially focus on the centralized monitoring of traffic infrastructures and traveler information panels. The ICM platform will facilitate the coordinated management of events that have an impact on mobility, such as road construction, incidents, and political, social or sports events. The platform also affords capabilities that include real-time supervision of traffic conditions, analysis of historical evolution, and short-term situation forecasting. As well as the ICM platform, the company will implement a travel-time monitoring system, which will enable the city's authorities to optimize urban planning and mobility resource management. Using Bluetooth and WiFi signals, the system will provide data on: traffic status, vehicle flow, capacity estimation, pattern identification, congestion and incident detection alarms, historical data records and forecasts. The system will have an additional internet platform which will provide the public with information regarding mobility, municipal services and tourism. Through the city's internet portal, users will be able to: calculate routes and travel times in real time traffic conditions and compare different routes and modes of transport.	2	3	2	2	24	133,2

	City logistics	The implementation of electric cars and an efficient public transport with the TRAM (Transporte Metropolitano de la Plana) which is the name of a trolleybus that assures rapid transit flows through the city.	2	2	2	1	8	44,4
		Bicycle hire service(BICICAS) Service consists of a network of bikes that can be automatically parked to make bikes available for public use in the city.	2	2	1	2	8	44,4
						TOTAL	54	299,7

Gijón	Characteristic	Project	Pa (1,2,3)	Pm (1,2,3)	Pi (1,2,3)	Ps (1,2)	PI	PI/hab
Economy	**ICT-enabled manufacturing and services**	Communications infrastructure for the internet of things For data transport that connect the sensors installed on public roads, equipment and furniture and buildings. These devices communicate with each other and be instructed. For example it can be used for lighting if someone approaches a street light or natural light is insufficient, irrigation if rain is detected or whether or not a container is full.	2	3	2	1	12	43,2
	Innovative and digital business and entrepreneurship	Oficina Te-CREA CREA is an office to meet the needs of people interested in starting a business in our city. Its aim is to integrate in a single office the procedures and various services that an entrepreneur needs to launch its initiative and also to meet the needs of entrepreneurs as people who already have started a business or economic activity.	1	2	1	2	4	14,4
Environment	**Buildings**	Control instalations for heating of comunity buildings	1	1	1	2	2	7,2
	Natural resources, green, renewable energy	Installation of photovoltaic elements in the main building of the Science and Technology Park	1	2	2	2	8	28,8
		Participation in the CASCADE-project CASCADE is project about networking and peer-to-peer learning on local energy leadership. Multiple cities in Europe learn from each other. It supports cities in delivering the Europe 2020 targets for energy and climate change.	1	2	1	1	2	7,2
	Public lighting	Intelligent management of public lighting Allows control of each individual light point as well monitoring and analyzing their consumption and status	2	1	2	2	8	28,8
	Water management	Project with the Empresa Municipal de Aguas (Municipal Water Company) for an efficient management of leaks in the supply network (In-pipe system)	2	1	2	2	8	28,8

Government	**E-government**	Citizen card It is a multipurpose document that identifies its holder, allowing you to access the various municipal services such as pools and libraries, replacing the old membership cards, pay bills, traveling on public transport or conduct transactions online through the website of Gijón. The citizen card is part of the ASPA (Ayuntamiento sin papelos or City Council without papers) project.	2	2	1	2	8	28,8
	Transparency	Accessibility for any citizen to the Open data generated (in the portal datos.gijon.es there are 187 of them available and upgradeable)	2	3	2	2	24	86,4
Living	**Smartphone appl & WiFi**	WiFi-access in public spaces	1	1	1	2	2	7,2
		Smartphone application so people can make suggestions or report incidents detected on the public road, such as damage to sidewalks and streets, street lamps, furniture, signs, woodlands …	1	1	1	2	2	7,2
	Tourism	Plan de Acción Turismo (Touristic actions plan) Plan with touristic actions including for example a marketing program	1	1	1	1	1	3,6
Mobility	**City logistics**	Participation in the Site (Smart Integrated Ticketing for Europe) project The SITE project establishes a network of local and regional transport authorities representing the 5 member states in the Atlantic Area (Spain, Portugal, France, Ireland and the United Kingdom) to work together on the development of new smart ticketing products and identify barriers to interoperability of smart ticketing across regions of the Atlantic Area. The ultimate goal is to enable residents of one region to purchase a smart ticket that can be used in the transport networks of the other regions of the Atlantic Area thus facilitating the continuity of transport networks, increasing mobility and contributing to transport sustainability.	1	1	1	1	1	3,6

	People mobility	Fleet of electric cars shared by the muncipal staff	1	2	2	2	8	28,8
		LabCityCar LabCityCar is a Living Lab project based on the sustainable mobility of private cars, developed in the city of Gijon. It proposes the fulfilment of a set of actions that begin with the analysis of the impact of the mobility of these vehicles in the different zones of the city and the ideas for improving their impact with benefits for the citizens and therefore for Gijon. In this project, the citizens are the main source of information thanks to their active participation, and in this way each one becomes a “citizen-researcher”. Also the city bus company Bus Gijón and EMTUSA (EMpresa de Transporte Urbano S.A) actively joined the project with their respective vehicles.	1	2	2	1	4	14,4
	Info-mobility	Intelligent Parking application The number and location of parking spaces, free blue zones is displayed and it allows payment.	1	1	1	1	1	3,6
						TOTAL	95	342,1

Las Palmas de Gran Canaria	Characteristic	Project	Pa (1,2,3)	Pm (1,2,3)	Pi (1,2,3)	Ps (1,2)	PI	PI/hab
Government	**E-government**	Comprehensive tax management and generating the electronic signature This system ensures a tax managment without paperwork. It also allows statistical control of waiting times in which every citizen is served, allowing streamlining and improving responses almost immediately.	2	2	1	1	4	10,5
		Online certificates of residence	1	1	1	2	2	5,2
	Participation	The publication of a portal for citizen participation	1	1	1	1	1	2,6
	Transparency	The implementation of a Web TV channel municipal, through which relayed, among other content, the town meetings live.	1	1	1	2	2	5,2
		Implementation of appointments for all administrative procedures This measure reduces waiting times and ensures more efficiency in the administration.	1	1	1	2	2	5,2
		Open data portal This portal allows to present information and data about various municipal services as municipal buses, traffic and accessibility related to the interest areas of other parties	2	3	2	2	24	62,8

Living	**Smartphone applications & WiFi**	Las Palmas de Gran Canaria developed multiple applications. These are the most significant ones: LPA Tip An application allowing to report incidents in public spaces easily and quickly, with the possibility of including georeferencing and image of the reported fault. LPA accessible Application to report architectural barriers and points with difficult accesability of the city. LPA Park Application for quick management of regulated parking which prevents the driver to carry coins, move to the meter to renew the ticket, plus it's possible to check and pay penalties. LPA Avisa Application with information about the city facilities and activities. LPA Visit Application with information about the turistical highlights, opening hours, events, etc.	2	2	1	2	8	20,9
		Providing public WiFi access in rural areas.	1	1	1	2	2	5,2
						TOTAL	45	117,7

Madrid	Characteristic	Project	Pa (1,2,3)	Pm (1,2,3)	Pi (1,2,3)	Ps (1,2)	PI	PI/hab
Economy	**ICT-enabled manufacturing and services**	SmartCity Glass It consists of a system to obtain efficient control of incidents in the city by using the Google Glass and Occipital sensor structure. The city staff can report incidents of a wrong parked vehicle, rough pavement, warning of an accident, etc. through the glasses. The incidents are examined by experts that are located in other places and they can verify the situation and make decisions as if they were in the scene, in less time and at a lower cost.	2	2	2	1	8	2,5
		Integrated 'Centro Integrado de Seguridad y Emergencias' (CISEM) or 'Security and Emergency Centre', which coordinates and organizes interventions of the police or emergency services and achieved response times of less than 8 minutes.	2	1	1	2	4	1,2
		Integrated control system in Madrid Río. The system can perform tasks such as opening and closing gates or measuring water levels.	1	2	1	2	4	1,2
		Launch of a Centre for ICT Services to offer support, communication and infrastructure The establishment of 'Centro de Servicios TIC' (CESETIC) or 'Centre for ICT Services' will serve to provide the infrastructure, communications and support services in the capital and services such as cloud model infrastructure. It will also be responsible for communications with the headquarters of companies and services.	2	3	2	2	24	7,4

	Additionally there is the development of ‘Suite de Sistemas de Información para Madrid Inteligente (Suite MiNT)’ or ‘Suite Information Systems for Intelligent Madrid (MiNT Suite)’, which will combine existing tools with new ones, such as monitoring indicators, inventories of the city, fleet management, billing, quality control, management of specific services, etc. It also brings together the different analysis and monitoring systems of the city and systems for measuring the quality of services, for data analysis and financial management of contracts and billing. The last element is the integration system, monitoring and orchestration. This is the main pillar on which rests the success of this model, which is responsible for information to flow from where it is produced to where it is needed, and also to be the facilitator, through the establishment of standards. These standards will allow connections and interacting between different systems and make it possible to add new initiatives in the future. This system needs to define, design and catalogue the set of protocols available for all concerned units of the city and interested companies.						
Innovative and digital business and entrepreneurship	La Catedral ‘La Catedral’ is a centre bind the innovation and development of new technologies. It’s the headquarters for innovators, technologists, artists and entrepreneurs. The idea is to turn the neighbourhood of Villaverde in the ‘digital neighbourhood’ of the capital. The centre has an exhibition where you can learn more about the latest technologies when it comes to robotics, automation and information technologies and communication. It includes also a convention centre where conferences and workshops and can be held and the ‘Innovation Factory’ the place where innovators and entrepreneurs can find support to create more efficient and profitable business through the use of new technologies.	2	2	2	2	16	4,9

	Public private partnerships	Sistema informático P3PAT' or 'Computer System P3PAT' This computer system promote the processes of public-private partnerships and the revitalization of industry in the city. The new system aims at the comprehensive management of all processes related to the public private partnerships, aligning interests and common goals and benefits for all parties involved: municipality , companies and society. The objective is to promote and develop private participation in projects of the city of Madrid, providing resources for managers. The system provides a comprehensive view of the relationship between Madrid and the company, experiences, contact persons, areas for improvement and an analysis of results. as well as continuous updating of information of all the areas.	2	2	2	2	16	4,9
Environment	**Buildings**	Development of a underfloor heating system that combines the advantages of this type of floor with those of a raised floor. It consists of separate panels that are removable without disrupting operation, something until now nonexistent in the market. This system allows adaptation in spaces that need to be heated efficiently and economically, whether external (terraces) or internal (public buildings, exhibition centres, offices, etc..), with no impact on the original floor.	1	2	3	2	12	3,7
	Public lighting	StreetLights A platform for to control the city lights, so that they can be switched on, off and adjusted remotely and automatically. It has power, humidity and light sensors that can reduce power consumption and make a smart and efficient use of energy possible.	2	1	2	2	8	2,5
Government	**E-government**	Sharepoint Sharepoint is a bulletin board that interconnects judges, prosecutors, clerks of a court. Through a web application the staff of the Administration of Justice in the same Juridical Department can access all administrative information in an agile, efficient and controlled manner. Documents, rules, schedules guards and training events are available as well publishing and sharing announcements affecting the juridical department are possible, anytime, anywhere with an internet connection.	1	2	1	2	4	1,2

		Consulta de Asuntos por el Ciudadano' or 'Consultation of Citizen Affairs' This tool secures access to information issues, resources, legal aid as part of juridical proceedings and allows citizens to check the status of their case. The consultation happens through the 'Justice Portal' with an electric identity card or any other electronic certificate recognized by the city. The main advantage of this service is the ability to check anything any time of the day, avoiding travel and unnecessary calls to the court and reducing the time spent by justice officials to provide information.	1	1	1	2	2	0,6
		Carpeta del Ciudano' or 'Citizen Folder' Via a password and a username citizens of Madrid can have access to the 'citizen folder'. This service allows people who to see their data and make steps and procedures on the municipal website safely. With the service information can be provided and fully customized, online registrations, voter registration, taxes and municipal taxes, fines and cases handled by the city as can be performed as well as various procedures electronically. The tool is also available for mobile devices.	2	1	1	2	4	1,2
	Participation	Mejora tu ciudad It is the first collaborative and social smart city platform where citizens and council can interact in real time. The citizen becomes an active sensor in the management, maintenance and improvement of the city.Through a mobile application useful information, preferences, concerns and valuations can be sent. Meanwhile, the council can consult statistics or control the activities of subcontractors through the platform.	1	1	1	2	2	0,6

	Transparency	OpenData portal This portal ensures a structured and easily access of all the information related to the use of public resources and the planning and management of city activities. It makes valuable data available to citizens and companies that can be used for various market studies. Data such as air quality, real-time traffic information from the EMT, data about parking vehicles in the city, municipal contracting data, data about day centres, sports facilities, cultural facilities, markets and flea markets, museums, municipal health centres, etc. are all available. Detailed budget information is also placed in the portal. All these data sets are presented for free using open standards or market standards and without any restrictions to use it, whether for commercial or non-commercial uses.	2	3	2	2	24	7,4
Living	**Culture & Entertainment**	Mad4Sports Mad4Sports is an initiative that aims to strengthen the citizen participation in urban sports. People are asked where and how to play sports in Madrid. With this information a database will be build that allows to organize a kind urban contest. The best sports sites can be identified and for example, posters can include QR bar codes, to guide and encourage athletes. A mobile phone application will be developed to help illustrate the routes of sport fans in Madrid and a Timpik application that allows to form groups to play games, organize events and compare brands.	1	2	1	2	4	1,2
	Healthcare	Telemedicina' or 'Telecare' The strategical plan for Telecare includes various initiatives such as tele-home care to monitor patients in their home and tele-consultation. Nearly a dozen of the hospitals have a tele-surgery service to broadcast surgical procedures and/or train in surgical techniques among specialists.	1	2	2	2	8	2,5

Smartphone applications & WiFi	The city has several areas and spaces of free Internet via wireless network such as the public libraries, metro stations, a lot of squares throughout the city and the EMT ('Empresa Municipal de Transportes de Madrid' or 'Municipal Transport Company of Madrid') buses.	1	1	1	2	2	0,6
	Smartphone applications Different applications for Madrid were developed: 'Safe to school way': tool to support schools and families to provide the ability to guide children from their house to school at all times. The location can be seen on a map so that parents and children can walk with other children on specific routes. On these routes are also 'childhood friends' people who participate in the project can be seen. The application is only accessible to schools and parents who are participating in the 'Madrid walk, safe way to school' project, through an identification code that is provided through the school. 'RECICLA.TE' A tool whose main aim is to help people, and more specifically young people to properly recycle any type of product that has bar code or, if not based on its components. It also offers a game to learn the recycling concepts through questions. 'RECICLA.ME' Very similar to the 'RECICLA.TE' application. This app is part of the instructional and educational applications that parents can download to raise awareness and educate children between 8 and 12 years old in separating the household waste properly. The app also works with reading barcodes and has several sections with tips, tricks and trivia. 'Routes for Retiro': Application that offers the possibility of a self-guided tour through attractions spread in certain locations of the 'Jardines del Buen Retiro' park in Madrid. The app provides information about the different types of landscaping in the park with photographs and audio. In turn, you can add information about the gardens and curiosities of various historical periods.	2	2	2	2	16	4,9

	‘Environmental Resource Map’: Application that provides information related to multiple municipal services and resources in the city. Included services and resources are grouped into six categories: parks, parking (for cars, motorbikes and bicycles), trash points (fixed, mobile and containers for clothes), supply points (green fuels: ethanol, CNG, LPG and electric), bike paths (including cycle lanes and safe streets) and areas with residential priority. Data of car parks are not yet available. ‘Habitat Madrid’: Is a project that aims to inform the public of the environmental program of free activities organized by the city council in parks and green areas in the city such as walking, cycling courses and workshops, visits to environmental facilities, exhibitions, storytelling, workshops etc. With this application activities can be booked and confirmed. AccityMaps': They call it ‘the Google Maps of the Disabled’. It is a route planner for a smartphone, tablet or PC which calculates routes accessible for people with disabilities, the elderly or parents with pushchairs. This helps municipalities with removing physical barriers, encourages the use of ICTs among these groups and helps creating ‘cities for everybody’. RiderState': It's a social game for fans of cycling. Using a free mobile app, cyclists are situated in a geolocated adventure where you have to conquer the world on your bicycle. Thus, while sustainable transport and healthy living are promoted the city gets an overview of behavioural patterns of this user community which can play a role in decision making. The ‘Empresa Muncipal de Transportes’ (EMT) or ‘Municipal Transport Company’ has since 2008 an application for mobile phones that automatically collects the user's location and provides information about nearby stops, lines, routes and waiting times. The app allows users to exchange comments, indicate incidents, evaluate or criticize aspects of services, etc.						
Social inclusion and welfare	Provision of general guidance information through multimodal interfaces allowing visually impaired users and the general public to understand by themselves the layout, points of interest and different routing options within an indoor space. The information will be available both from fixed smart points within the public space and from users’ mobile personal devices	1	1	1	1	1	0,3

	Tourism	Madrid Precious Time 'Madrid Precious Time' gives visitors through mobile devices a new perspective of the city with personalized, convenient and instant information based on the location. The program is a collaboration between the WTO, the ministry of industry, energy and tourism of Spain and the city of Madrid. Also 31 companies and private institutions participate.	1	2	1	2	4	1,2
Mobility	**City logistics**	Implemenatation of a free service installed at bus stops which offers both information on bus routes and tourist information. In order to improve the information systems, bus stops have also been equipped with Wi-Fi. Passengers don'tlose connection to the internet between waiting at the bus stop and boarding the bus, which also has Wi-Fi.	2	2	1	2	8	2,5
		Smart Parking Meters With the smart parking meters factors as emissions from the vehicles and the occupancy of the parking areas are used to set the price. Vehicles with lower emissions of nitrogen oxides can park cheaper and the most polluting vehicles need to pay more, according to the principle of 'the polluter pays'. Similarly, it will be cheaper to park in a neighbourhood with more space available for parking, while you'll pay more if you choose to leave your car in an area where the parking space is more saturated. The new meters are equipped with a full alphanumeric keyboard. After entering the license plate a screen will guide you and the steps you must follow to obtain the ticket. The meters communicate an operation platform to obtain data of each car (how it's classified according to the emissions) and occupation of the relevant quarter. Payment in cash, credit card, debit card, prepaid card or contact via mobile phone is possible with the new meters. A new feature for those who choose the cash payment option is that if you do not have the exact amount, the change will accumulate in a virtual wallet that can be used the next time. Furthermore new parking regulations are implemented including the pollution and area as explained above but they also take causes such as car-sharing into account.	1	2	2	2	8	2,5

Info-mobility	Centro de Gestión de la Movilidad (CGM) 'Centre for Mobility Management' The Center for Mobility Management is dedicated to all the traffic information about mobility that may be of interest for both the driver and the pedestrian through the internet. This information can be divided into three sections: before, during and after the trip. There is a section with visual information. The traffic condition is indicated by colours which determine the circulation intensity or number of vehicles transiting. Green indicates traffic flow; yellow slow traffic, withholding orange, red indicates congested traffic and black indicates a path cut completely to traffic. The information includes also daily data of interest about mobility from the location of the taxi stops at service stations and points of interest for people with specific accessibility needs. Information circulatory status of the city in real time is updated every fifteen minutes during rush hour and every thirty minutes in peak hours and every time a remarkable incidence affects the movement of traffic on the main roads. The system has also access to the camera centre. The 177 cameras whose images are updated every two minutes can be viewed by districts, paths or all as a whole. The possibility of observing the main streets of the city in real time on this site is one of the most visited options. In the system important events hosted by the city such as demonstrations are implemented to offer detours. The goal is always to anticipate incidents and inform the driver to avoid conflicted zones and chose alternative routes or as an ideal solution, public transport.	3	3	3	2	54	16,7

	People mobility	Web platform allowing potential users with similar origin/destination and schedules to get in touch with the final goal of sharing their journeys by the vehicle of one of the users. It is addressed to both public and private users. It includes energy savings tool for user's awareness raising. Including web tools for: reservations, management (creation, modification, cancellation), historical record consultation, billing monitoring, monitoring battery of electric vehicles etc.	1	2	1	2	4	1,2
		BiciMad Bicycle renting system with multiple bicycle parkings where bicycles can be picked up and returned. The availability of each station can checked at the stations and with mobile devices. There are two modes are available to access the service: occasional or annual subscriber.	2	2	1	2	8	2,5
		Promoting cleaner or electric vehicles To promote this kind of vehicles multiple measures are taken such as letting electric vehicles use the bus lanes, reserving special parking places for less polluting vehicles in the metropolitan area, airport and train and metro stations, installation of at least one charging point over 20 000 inhabitants for electric vehicles, etc. The renewal of the taxi sector with less polluting vehicles, so that within seven years the entire fleet will be composed and replacing vehicles of the public fleet by models that use cleaner fuels or technologies, including the intercity bus fleet are also part of this.	2	2	1	2	8	2,5
		Train2Car This pilot project allows to charge an electric vehicle with the energy of braking trains on the suburban network. When a train brakes and thus reduces speed, kinetic energy is converted into other forms of energy. Batteries play a key role in the system, allowing the storage of braking energy and charging the cars at the right time.	1	2	3	2	12	3,7

People	**Education**	Smart Lab Smart Lab is a centre specialized in incubation and shared workspaces linked to smart cities. The aim is to create a shared environment that encourages the exchange of ideas and the generation of entrepreneurial projects.	1	2	3	2	12	3,7
	Training	In the context of the STARS (Sustainable Travel Accreditation and Recognition for Schools) project organizing training workshops, exhibitions, workshops for teachers and students, seminars with experts in childhood and mobility, blogs …	2	2	1	2	8	2,5
		Every week courses are held in the Innovation Center Alvarado and the Technology Classrooms Madrid Puerta Bonita that citizens can attend.	1	2	1	2	4	1,2
						TOTAL	289	89,4

Málaga	Characteristic	Project	Pa (1,2,3)	Pm (1,2,3)	Pi (1,2,3)	Ps (1,2)	PI	PI/hab
Economy	**ICT-enabled manufacturing and services**	Tests and implementation of smart grids and V2G (vehicle to grid) technology, that not only allows the electric car to receive energy from the network but also to store it and make it available to the grid when necessary.	1	2	3	1	6	10,6
	Innovative and digital business and entrepreneurship	Momopocket System that allows payment with mobile phone in shops in the city and municipal services.	1	1	1	2	2	3,5
		MálagaValley MalagaValley is a technological hub located in the metropolitan area of the city of Malaga in southern Spain, in the area of greatest technological excellence in Europe, an 'European Silicon Valley'. This area has become a center of ideas and innovation generation, able to attract companies from around the world, investments in R & D and talent. It specializes in the High-Speed Rail and Smart Cities industries, with special attention to energy efficiency and sustainability.	1	2	3	2	12	21,1
Environment	**Natural resources, green, renewable, energy**	E+ project E+ is an European project and the main objective is to develop a control system for energy management at neighborhood level and its associated new business and operation models. In the context of this program 500 square meters of thermal panels will be monitored (and/or installed), street lighting will be monitored and remotely controlled and 8 public buildings will be monitored. The data hereby provided will be used to implement energy optimization strategies. By running simulations the platform will compare the real situation with optimal scenarios.	2	2	2	2	16	28,2
		The city has numerous roof-mounted photovoltaic installations spread throughout the city, a cogeneration facility, wind turbines and generation systems integrated in street lighting. All these generation systems, combined with two battery-based storage facilities, are used to manage consumption more efficiently.	1	2	1	1	2	3,5

		Over 17 000 smart energy meters have been installed in municipal facilities and houses. A sample of 50 of these users have energy efficiency solutions for the home. Over 10 SMEs and emblematic buildings in the area have energy efficiency solutions installed which enable them to monitor consumption and control some of their charging. The users can view from their computer or mobile phone how much electricity they are consuming at that moment. On top of that, they can disconnect each device on the network or program when it needs to switch off, from their phone or computer.	2	2	3	2	24	42,3
	Public lighting	Nearly 200 street lights have been replaced with new lights featuring energy-efficient technologies (including LED and halogen lighting) and are remotely and automatically managed.	2	1	2	2	8	14,1
Government	**E-government**	Digitalization of the administration Website with online procedures, citizen folder, participation portal, etc. (Ayuntamiento de Málaga, 2014a)	2	2	1	1	4	7,0
	Transparency	Implementation of an open data portal which should lead to more transparency, collaboration and participation.	2	3	2	2	24	42,3
	Urban planning	Mi Ciudad AC2 This is an European project and the general objective of Mi Ciudad AC2 is to strengthen the role of local government partners in climate change adaptation and mitigation, through the development of innovative criteria for urban planning applicable both to the development of new urban areas and to the regeneration of those that already exist. In the context of this project Málaga implements various measures on the campus 'Campus El Ejido' such as implementation of telemanagement systems and low energy lighting for public lighting, reordering parking (parking priority for residents) and implementation of charging points for electric vehicles.	1	2	2	1	4	7,0

Living	**Social inclusion and welfare**	Communication systems for blind and/or deaf people Communication system for deaf and blind people that converts text messages into audio messages or audio messages into sign language. ICT's are also used in the movies to support the blind and deaf. A free mobile phone application 'WhatsCine' provides a detailed commentary of what is happening in the movie through the headphone for blind people and for deaf people there are two options. Or locate your smartphone or tablet into a transparent lectern so they can read subtitles or employ glasses that recreate the sign language.	1	1	2	1	2	3,5
Mobility	**City logistics**	Project Victoria This project aims to double the range of electric buses without affecting operating times. To do so ground-breaking triple technology: conventional static, static wireless and dynamic wireless charging is used. The project is executed on a specific bus route in Malaga, the first project of this kind in Spain on an urban public transport system. The project is trialed on an electric bus which operates on the city's number 16 bus route. One of the city's e-buses is adapted with triple charging technology whereby it can be charged by the conventional method when parked at the bus depot at night (using charging points), it can also be partially charged at a static inductive or wireless charging station as well as when travelling along a bus lane equipped with a dynamic inductive (wireless) charging system.	1	2	3	2	12	21,1
		Traffic management system Implementation of a traffic management system in 'el Barrio de la Misericordia'. This system works fully automatically and optimizes the traffic flows. This is achieved by using data obtained through sensors combined with a mathematical model that determines the state of semaphores to optimize the traffic flows.	2	2	3	2	24	42,3
	Info-mobility	Intelligent parking system System with sensor, panels and a mobile phone application to detect and indicate available parking spots.	2	2	3	2	24	42,3

	People mobility	Urban M An intelligent electric bicycle that incorporates motor assistance to ensure rapid, convenient and effortless transport. It is foldable and easily transportable, so it can be easily placed at home, on the bus and in the office. It has an urban design that makes it quick, light and efficient to absorb bumps and steps. The two front wheels make it comfortable, stable and suitable for all ages and physical conditions. It also recognizes and processes its own data such as distance, speed, calories burned, location, etc. which can be checked through a smartphone.	1	2	1	2	4	7,0
		Zem2all (Zero Emissions Mobility To All) Replacing the municipal fleet with electric vehicles and implementing charging stations in the city.	2	2	2	2	16	28,2
		Bicycle loan system Málaga installed 20 stations with 400 bikes that can be borrowed with the same card bus Municipal Transport Company.	1	2	1	2	4	7,0
						TOTAL	188	331,3

Móstoles	Characteristic	Project	Pa (1,2,3)	Pm (1,2,3)	Pi (1,2,3)	Ps (1,2)	PI	PI/hab
Economy	**ICT-enabled manufacturing and services**	Installation of a fiber optic network in the municipality that reaches more than 50 000 homes, shops and companies. The network will modernize the telecommunications network of Móstoles and replace the existing copper network. This initiative will improve the reliability of the Internet connection, allow higher and more stable speeds, access to new services such as streaming in HD, and is a quantum leap for professionals who work from home or from office. The installation of this network will also create direct and indirect jobs.	2	1	1	2	4	19,4
		Implementation of digital public information screens in the city and digital kiosks to facilitate the completion of administrative formalities electronically in municipal buildings.	1	1	1	2	2	9,7
	Innovative and digital business and entrepreneurship	Business incubator 'Móstoles Mirror Stage' where companies can find technical or administrative support, management advice, etc.	1	1	1	2	2	9,7
Environment	**Natural resources, green, renewable, energy**	Energy efficiency audit The results of this energy efficiency audit will reveal where there is space for imrpovement and will help to optimize the performance of facilities and reduce electricity consumption.	1	1	1	2	2	9,7
		Móstoles District Heating Project based on a network for distributing heating and hot water generated by biomass up to 5 698 households. This decreases costs and helps to reduce CO2 emissions and the dependence on foreign energy.	2	1	2	2	8	38,8

	Public lighting	Intelligent lighting system Implementation of the LumiMotion Philips system in order to reduce costs without compromising on the security of citizens. The sysem adjusts intensity levels according to the presence or absence of persons in the given area. Optical sensors detect motion in real time (without saving any images) ,increasing the power of lighting in a smooth and gradual when someone approaches to avoid the feeling of being watched caused by an ignition instantaneous lamp. In addition, the citizen does not perceive the drop in intensity before and after his passage and lighting is always 100% where he is. The lights are also replaced by LED lamps. This model illuminates the street for the people, but does not intrude the houses of the surrounding buildings, improving the welfare of the residents during the night.	2	1	2	2	8	38,8
Government	**E-government**	Website with online services and information for consultation and online procedures and inform the citizens through the ConectaMÓSTOLES webpage.	2	1	1	2	4	19,4
		Sharepoint Sharepoint is a bulletin board that interconnects judges, prosecutors, clerks of a court. Through a web application the staff of the Administration of Justice in the same Juridical Department can access all administrative information in an agile, efficient and controlled manner. Documents, rules, schedules guards and training events are available as well publishing and sharing announcements affecting the juridical department are possible, anytime, anywhere with an internet connection.	1	2	1	2	4	19,4
	Transparency	Transparency portal Online portal with information about muncipal corporation, the relationship of the city with citizens and society, economy and financial affairs and recruitment services.	1	1	1	2	2	9,7

	Urban planning	Use of advanced GIS-technology With this technology it is possible to collect data through sensors, mobile devices and the citizens themselves, to obtain the base data in order to optimize the services offered by the city. The technology allows a continue workflow allowing real-time processing the incoming data and the possibility of online analysis. Once loaded on the platform the possibilities are endless. For example management of watering municipal parks, sewers and sanitary water, cartographic restitution from photogrammetric flights, update maps (new urbanized areas), etc. The technology is a handy tool to support urban management (planning, licenses, etc.), management of parks and gardens (irrigation networks, parkland inventory, etc.) and management of the municipal companies for street cleaning and waste management (lines of collection, waste collection points) and municipal developments (housing, parking).	2	3	2	1	12	58,2
Living	**Smartphone applications & WiFi**	Wi-Fi access in public buildings and public transport	1	1	1	2	2	9,7
		Alerta SMS Free information service, any citizen of the City of Móstoles can subscribe and will receive information on various topics that happen in the city on his mobile phone.	1	1	1	2	2	9,7
Mobility	**City logistics**	Implementation of 'Area 20' and 'Area 30' The ‘Area 20 residential priority’ is the historical district where the pedestrians and bicycles have priority over other vehicles using public roads. It is an area specially designed for pedestrians and bicycles. The maximum speed of traffic is 20 km/h. Area 30: Area surrounding area 20, where the coexistence of traffic (private car, public transportation) with the pedestrians and bicycles arises. The speed limit is 30 km/h. Those initiatives are part of the 'Plan de Movilidad Urbana Sostenible' or 'Sustainable Urban Mobility Plan'.	1	2	1	2	4	19,4

	People mobility	Promoting cleaner vehicles The city signed an agreement with 'Asociación de Jóvenes Empresarios' (AJE) or 'Young Entrepreneurs Association' in order to develop and promote the use of electric vehicles in the city. The city also implements a tax bonus for electric or less polluting vehicles and replaces step by step the muncipal fleet with electric vehicles. Charging point for electric vehicles are also provided.	1	2	2	1	4	19,4
		Promote non-motorized transport modes Promoting transport modes for example walking with implementing safe way to schools, pedestrian priority areas, bicycle parkings, road safety plans, etc.	1	2	1	1	2	9,7
People	**Training**	Organizing a workshop about 'Energy Management in Smart Grids'with sessions about energy efficiency and sustainability applied to various fields: 'Active Management of Electric Networks', 'Intelligent Building Microgrids', 'Demonstration of Energy Management' and 'Implementation and Technologies'.	1	1	1	2	2	9,7
						TOTAL	64	310,6

Sabadell	Characteristic	Project	Pa (1,2,3)	Pm (1,2,3)	Pi (1,2,3)	Ps (1,2)	PI	PI/hab
Economy	**ICT-enabled manufacturing and services**	Sabadell 3D Visit building in 3D and watch full resolution 360 degrees photographs of Casa Duran, Teatro Principal, Museo de Arte, Campanario San Félix, Museo de Historia, Archivo Histórico and Vapor Buxeda. Virtual tours of museums are also possible. (Ayuntament de Sabadell, 2014a)	1	2	1	2	4	19,2
		Archaeological Map of Sabadell With a Geographic Information System (GIS) an archaeological map o Sabadell is presented. With the tool you can learn about, promote and preserve the prehistoric and historic features of Sabadell. The map includes an inventory of all archaeological sites and is reviewed and updated automatically. Therefore, it is a living document that should be expanded as new archaeological discoveries occur. Also the tool makes it possible to analyze the archaeological reality according to different objectives: heritage, research or dissemination. (Carlús et al., 2009)	1	2	1	2	4	19,2
		In collaboration with Banc Sabadell the city implements payment 'contactless' payment by mobile in shops in the city, including the commercial area of Sant Pau de Riu Sec. (Ayuntament de Sabadell, 2014a)	1	1	1	2	2	9,6

	Innovative and digital business and entrepreneurship	Center for Business Promotion This center offes space for coworking between companies. This ability to share an equipped space is possible at lower costs than traditional office and the development of multidisciplinary collaboration and business is encouraged with the networking center. (Ayuntament de Sabadell, 2014a)	1	1	1	2	2	9,6
		L'Estruch In the context of an artistic creation center (L'Estruch), laboratory research, development and technological innovation are also implemented. The center offers space for projects and companies in the area of new technologies. The center features a laboratory, a testing room to test prototypes and a living business scene to function as an incubator for technological entrepreneurship. (Ayuntament de Sabadell, 2014a)	1	2	2	2	8	38,5
Environment	**Natural resources, green, renewable energy**	Installation of smart energy meters in municipal and public housing facilities, along with a platform to manage the data collected by the meters. The meters lead to a reduction in electricity consumption and thus also of greenhouse gas emission. (Ayuntament de Sabadell, 2009a) & (Ayuntament de Sabadell, 2013b)	2	1	1	2	4	19,2
		Equiping muncipal facilities with a remote HVAC (Heating, Ventilation, and Air Conditioning) system. (Ayuntament de Sabadell, 2014a) & (Ayuntament de Sabadell, a)	1	1	1	2	2	9,6
		59 muncipal buildings have a thermal solar installation good for in total 1972,89 m2. (Ayuntament de Sabadell, a)	1	2	2	2	8	38,5
		5 facilities have a geothermal energy installation with a total capacity of 2087,2 kW and there are plans for biomass installations. (Ayuntament de Sabadell, a)	1	2	2	2	8	38,5
		Wind turbine of 10 kWp in Parc Central del Vallès. (Ayuntament de Sabadell, a)	1	1	1	2	2	9,6
		Solarweb system, a network to analyse and monitor continuously the consumption and electrical parameters and the production of the 9 solar installations in public buildings, with a total power of 138,9 kWh. (Ayuntament de Sabadell, a)	1	1	2	2	4	19,2
	Public lighting	Pilot project of the implementation of LED lighting and telemanagement of the lighting in a city school (La Rómanica) and an administrative building (Can Marcet) resulting in over 50% energy savings. (Ayuntament de Sabadell, 2013b)	2	1	2	2	8	38,5

	Waste management	Implement new technologies for traceability of waste, for example, the installation of sensors in containers to indicate whether they are full or not and waste collection trucks with GPS-systems, to optimize the routes and the management of the service . (Ayuntament de Sabadell, 2013b)	1	1	1	1	1	4,8
		Pneumatic waste collection 13% of the population of Sabadell has access to the pneumatic waste collection system. This system saves money and reduces noise and CO2 emission by avoiding travel of truck collectors. (Ayuntament de Sabadell, 2012)	2	2	3	2	24	115,4
	Water management	Up to 90% of the city parks and gardens have a remote irrigation system monitored with humidity sensors that stop watering if there is rain or too much wind. The objective is to implement the system for all the green areas in the city and to only use recycled water. To clean the streets also only recycled water is used. (Ayuntament de Sabadell, 2009b) & (Ayuntament de Sabadell, 2009c)	2	1	1	2	4	19,2
		Telemanagement of the drainage stations of the underpasses for vehicles in Gran Vía. (Ayuntament de Sabadell, 2014a)	1	1	1	2	2	9,6
Government	**E-government**	New municipal website with integration of social networks such as twitter, facebook, youtube or flickr, and it offers the ability to subscribe to various information sources (RSS) for city news, cultural events, new job offers, download applications, etc. With the new website more than 100 procedures can performed online and citizens can check the status in real-time and report incidents or requests. (Ayuntament de Sabadell, 2014a)	1	2	1	2	4	19,2
		Implementation of new software to monitor administrative records at all stages of processing. (Ayuntament de Sabadell, 2014a)	2	2	1	1	4	19,2
	Participation	Competition of creating mobile applications (apps), with a price of 1 500 euros for the best application. (Ayuntament de Sabadell, 2013b)	1	2	1	2	4	19,2

	Transparency	Open Data Portal This open data portal needs to promot open data and the use and reuse information of analysis and evaluations of public management. The city council is committed to make the data that are within their power available, thus all public data that is not restricted because of privacy, safety or property reasons. These data are delivered in a standard format so that third parties can create services derived thereof, provided that they follow the appropriate conditions. (Ajuntament de Sabadell, b)	2	3	2	2	24	115,4
Living	**Culture & Entertainment**	Sabadell Cultura Internet portal that allows to purchase tickets online and provides information about the cultural agenda of the city and connects cultural centers with each others and improve cooperation. (Ayuntament de Sabadell, 2014a)	1	1	1	2	2	9,6
		Implemented automatic loan system that the citizens can use theirselves in the libraries. (Ayuntament de Sabadell, 2014a)	1	1	1	2	2	9,6
	Healthcare	Tele-assistance Tele-assistance is a service with a professional care center 24 hours, 365 days a year. It is a preventive health service to support the elderly. QR Codes are introduced in the homes of patients which show the history of the specific patient to facilitate attendance. (Ayuntament de Sabadell, 2014a)	1	1	1	2	2	9,6
	Smartphone applications & WiFi	Internet portal to combine all the applications related to the city. The portal makes a distinction between applications of the city council itself and third-party applicatons and people can also propose their self-made app. Most significant applications are: 'Ubicat': This application combines multiple municipal services and, therefore, can provide information about health, trade, tourism, transport, culture, ... in a single application. The app is created using Open Data sources. 'On Fan' application to recommended and share on social networks dishes served in restaurants in the city. 'Appark & Go': This application allows to reserve an underground parking space offering a lower price than in the blue area. (Ayuntament de Sabadell, 2013a) & (Ajuntament de Sabadell, c)	2	2	1	2	8	38,5

		Installation of 4G infrastructure to cover the city area and 16 public Internet spaces and 15 Wi-Fi access points throughout the city. (Ayuntament de Sabadell, 2014a) & (Telesabadell, 2012)	1	1	1	2	2	9,6
Mobility	**City logistics**	Active management of public transport The bus stops are equiped with a system using panels that inform about the arrival time of vehicles monitoring in real-time. (Ayuntament de Sabadell, 2014a)	1	1	1	2	2	9,6
		Active Traffic Management Active traffic management with centralization and synchronization of traffic lights and meters to gather information about routes, traffic coordination with information of public works, information of routes with less traffic to generatee routes for emergency services (ambulance, fire brigade), increasing the number of cameras in busy points (entrances to the city, Gran Via Axis Macia) and a smart phone application to inform the people in real-time about the traffic conditions. The traffic management is coordinated from the central muncipal office and is also able to an automatic prioritization of traffic lights for delayed buses and manage the signalisation. (Ayuntament de Sabadell, 2014a) & (Ayuntament de Sabadell, b)	3	3	2	2	36	173,1
	Info-mobility	Active parking management Information system about the occupancy, the location and the price/time schedules of 5 public parking centers and making this information also available with an mobile phone application. (Ayuntament de Sabadell, 2014a)	1	2	2	2	8	38,5
	People mobility	Implementing electric vehicles. The muncipal fleet consists of 11 electric vehicles (5 cars, 1 van, 3 motorcycles and 2 bicycles). There are three charging points in Sabadell (Eix Macià, Vapor Turull and Ikea Sa). The city promotes electric vehicles with a flexible tax system related to CO2 emission and with the implementation of power load stations. THere is also a renewal of the bus fleet incorporating alternative energy vehicles. (Ayuntament de Sabadell, 2014c)	1	2	2	2	8	38,5

People	**Training**	Vapor Llonch, the economic service of Sabadell, offers more than 100 courses in various business sectors (environment, health ...). Specialized tutors give the courses and doubts can always be reported by email. (Vapor Llonch)	1	1	1	2	2	9,6
						TOTAL	195	937,8

Santander	Characteristic	Project	Pa (1,2,3)	Pm (1,2,3)	Pi (1,2,3)	Ps (1,2)	PI	PI/hab
Economy	**ICT-enabled manufacturing and services**	Cloud City Center The brain' of the smart city, which not only controls all public services in the city but that makes relations to administer and manage this information in a coordinated manner. This center processes all the incoming data of sensors and communication systems. This center processes all the data of the different sensors that form the 'internet of things' and can detect irregularities or problems. This center combined with the smart sensors is the core for a lot of (future) projects and thus of the Santander smart city.	2	3	3	2	36	201,7
		SmartSensors Sensors are implemented everywhere. Fastened to building walls, street lamps, inserted in the pavement … They measure light, noise levels, traffic conditions, occupancy of pavements … Taxis, police cars and buses are also equipped with sensors and transmit measurements from their surroundings and track their location.	2	3	3	2	36	201,7
		Implementation of new payment methods Contactless card payment and mobile phone payment (NFC system). Implementation of these systems of payment in trade, hotels, taxis and city buses. The city intends to continue extending these payment systems to the different services that are offered in many areas of municipal management, such as reservation of sports facilities, municipal taxes, in the municipal libraries, etc.	1	1	2	2	4	22,4
		Santander innovation map Map which shows all actors in the R + D + i sector of the city, its resources and activities to promote synergies between and the development of research opportunities and business.	1	1	1	2	2	11,2
		Live! Santander A dynamic platform for displaying the city in real time.	1	1	1	2	2	11,2

	Innovative and digital business and entrepreneurship	Demonstration and business center The establishment of this center will allow the city to attract both new technology projects and companies that can invest in the development of the ideas that emerge from the center itself. The center has a 'demonstration center' which will be the demonstration area for new projects and an entrepreneurship center which will be laboratory of ideas, from which entrepreneurs submit their proposals for new projects in the field of innovation. The participation of companies will be promoted, so that entrepreneurs have greater strength when they start developing their project. There is also an Innovation Forum. These facilities function as a 'think tank', as a forum for discussion and participation of experts and expertise and customization of developments towards different social groups.	1	2	1	2	4	22,4
Environment	**Public lighting**	Intelligent lighting system Intelligent lighting system with remote management and automatically modulating light intensity depending on the presence or absence of pedestrians. About 2 500 light points have been subjected to an energy efficiency audit.	2	1	2	2	8	44,8
	Waste management	Smart waste collections system with sensors.	2	2	2	2	16	89,7
	Water management	Smart irrigation system	2	1	1	2	4	22,4
Government	**E-government**	Electronic Administration, virtual office Allowing citizens to obtain digitally and without moving duplicate receipts of road taxes, police services (for example technical report of accident), request action of the city council regarding traffic lights, parks and gardens, street cleaning, … It's planned to launch online possibility for the payment of taxes, applying for licenses to open shops and bill management.	2	2	1	1	4	22,4
	Participation	www.santandercitybrain.com This portal is presented as an online platform to share proposals, suggestions and projects that contribute to the development of Santander as smart city.	1	1	1	2	2	11,2

	Transparency	Open Data Making relevant information available to the developers of technology products. Information that is collected in the through different innovation programs, access to traffic cameras, creation of tourist routes …	3	3	2	2	36	201,7
Living	**Smartphone applications & WiFi**	There are various smartphone applications related to the city of Santander. The city implemented about 2 000 quick response (QR) codes at points of interest, shops and public places around Santander. There is 'SmartsantanderRA' offering information about tourism, cultural activities, businesses, public transportation, beaches, sights and attractions, etc. Anyone who walks into town can focus his smartphone on a certain street and know what points of interest are in the area, both cultural and tourist trade, the bus stops, the time it takes to reach the next station and the exact distance. There is an application to report incidents and thanks to the open data the possibilities to develop new applications are endless.	2	2	1	2	8	44,8
		Extending the WiFi-network in the city over 150 access points.	1	1	1	2	2	11,2

Mobility	**Info-mobility**	Intelligent parking system Information about parking is displayed on special panels located at major intersections in the city, so anyone who is heading downtown will have an idea of how many spaces are currently available and where they are located.	2	2	2	2	16	89,7
		Smarter travel In order to make full use of the existing sensors that create an 'Internet of Things' (IoT) his application intends to allow users to reach their destinations in an efficient way, reducing the time spent driving through the streets and avoiding, as much as possible, congestion and occasional incidents on the streets. The sensors will be used to reliably estimate the real-time traffic flows throughout the city, and keep drivers informed in real time of the traffic situation. This will be achieved by setting up a data base to store historical and real-time records from the sensors and by developing a system of models including a flow estimation model and a traffic assignment models. Web and mobile applications will also be developed to facilitate comfortable and effective reporting on the real-time traffic situation in the city.	2	2	3	2	24	134,5
People	**Education**	Centro de Investigación inteligentes de Santander' (CICIS) or 'Investigation Center Smart Cities of Santander' This center is a collaboration with the Massachusetts Institute of Technology (MIT), the University of Cantabria and the city of Santander. It will convert to Santander in a laboratory of ideas and develop innovative projects from its embryonic stage to its implementation, focusing on the management of cities, both nationally and internationally.	1	2	2	2	8	44,8
						TOTAL	212	1187,9

Sevilla	Characteristic	Project	Pa (1,2,3)	Pm (1,2,3)	Pi (1,2,3)	Ps (1,2)	PI	PI/hab
Economy	**ICT-enabled manufacturing and services**	Inauguration of the FI-Lab (Future Internet – Lab) The FI-Lab is a data center where innovative developers can experiment with FI-WARE technologies and where entrepreneurs can get in touch with potential investors and clients. FI-Lab also allows cities, administrations, companies and other organizations to upload open data that may help entrepreneurs to develop innovative applications. This way, third parties can develop applications based on FI-WARE that enable a more efficient management of municipal services or bring innovative services to the citizens. The data center will also be part of a red of data centers through Spain and Europe, creating a powerful network of datacenters. It is as center for data processing and backup of all business applications and municipal services. It includes the control and coordination of communications, 'Big Data' and 'Open Data' services of the city. (FI-WARE, 2014) & (Ayuntamiento de Sevilla, 2014)	2	2	3	2	24	34,2
		Plataforma M2M The M2M Platform interacts with different entities such as field devices (sensors) or smart phones integrating those diversity of formats, protocols and technologies into a single standard. The platform is responsible for processing the data received from the field, modeling and managing the installation of field elements and manage the interaction with devices. (Ayuntamiento de Sevilla, 2014)	2	2	2	1	8	11,4
	Innovative and digital business and entrepreneurship	'Instituto Tecnológico del Ayuntamiento de Sevilla' or 'Technological Institute of the City of Sevilla' Technological Institute of the City of Sevilla is an institution responsible for the design and implementation of new technologies, to promote coordination between the different parties and companies and to enable the development and execution of innovative projects. (Ayuntamiento de Sevilla, 2014)	1	2	2	2	8	11,4

	Public private partnerships	Acelera Sevilla The project aims to promote and strengthen competitiveness and I+D+i (Investigation, Development and innovation) projects. In the project multiple SME's (Small and Medium Enterprises) will carry out different acitivites and develop various products in various businesses such as telecommunications, food industry, aerospace and aviation … This project will bring together key players in innovative sectors, thereby attracting talent, and at the same time, allowing the development of companies with high growth potential. (Universidad Pablo de Olavide, 2014)	1	2	3	1	6	8,5
Environment	**Natural resources, green, renewable energy**	Dareed Dareed is an European project with a technology platform to manage energy in the historic center of Sevilla. It has a control center to monitor consumption and power generation in an area or city as a whole. The system includes sensors and smart meters to provide data and information about consumption and generation. In addition the system is able to perform simulations of possible cost-saving measures in buildings and public facilities and to make recommendations to users and check the evolution of consumption and savings. The citizen becomes an active subject with more information about his consumption pattern and is thus better able to decide and implement measures to reduce the electric bill. The platform has tools for intelligent networks that include renewable energy sources and is able to incorporate elements such as lighting and HVAC (Heat, Ventilation and Air Conditioning). This platform will convert to corporations, consumers and governments to be active participants make decisions to make sustainable use of energy, for which they will get information about their consumption and recommendations. Information to the trading of energy and energy services companies, so that they can attract new customers deals will also be provided. Dareed also opens the door to new business models. It can create a market where the consumer can do a voluntary test and choose the improvements that he is willing to do and he will get offers from different companies that are specialized in energy efficiency. (Ayuntamiento de Sevilla, 2013)	2	2	2	2	16	22,8

		Construction of a solar photovoltaic plant of 1 880 KW in the bus parking garages of TUSSAM as well as installations good for 1 MW on other TUSSAM buildings. The city also starts with the implementation of photovoltaic energy installations in municipal buildings (Sevilla Ciudad Solar). (Ayuntamiento de Sevilla, 2014)	2	2	2	2	16	22,8
		Recovery and use of biogas at the garbage dumping site. (Ayuntamiento de Sevilla, 2014)	1	1	3	2	6	8,5
	Public lighting	Intelligent lighting system The system allows monitoring and controlling operating hours, voltage per phase, phase currents, total power, energy consumption, overall power failures of the city lights. The system is able to detect failures in real-time or/and give warnings for preventive maintenance rather than repair and can provide on-demand energy audits. (Ayuntamiento de Sevilla, 2014)	2	1	2	2	8	11,4
	Waste management	Separate collection of used oil and Biodiesel to transformate to fuel used by the LIPASAM (' Empresa de Limpieza Pública del Ayuntamiento de Sevilla' or Public Cleaning Company of the City of Sevilla') fleet. (Ayuntamiento de Sevilla, 2014)	1	2	1	2	4	5,7
		Implementaion of sensor to measure the 'filling level' of containers. (Ayuntamiento de Sevilla, 2014)	1	1	1	2	2	2,8
		Implementing GPS-systems and onboard computers on the waste collection trucks to control each vehicle and conduct and plan optimal routes. (Ayuntamiento de Sevilla, 2014)	1	1	1	2	2	2,8
		Separated waste collection of glass and paper containers. (Ayuntamiento de Sevilla, 2014)	1	1	1	2	2	2,8
		Central pneumatic waste collection in San Diego. (Ayuntamiento de Sevilla, 2014)	1	2	3	2	12	17,1
	Water management	Centralized control system to automatically manage irrigation of gardens and parks in the city. The systems increases the use of recycled water and is equiped with sensors to measure the humidity, temperature … (Ayuntamiento de Sevilla, 2014)	2	1	1	2	4	5,7

Government	**E-government**	Unifying E-government The unification of electronic procedures makes more automation possible thus increasing the volume of electronic services and procedures provided to citizens and businesses. The unifying and the implementation of an electronic signature should lead to an electronic document management. The city is also starting a system to make the contract and billing procedures completely electronic. (Ayuntamiento de Sevilla, 2014)	2	2	1	1	4	5,7
		Hispalnet A single platform to support all municipal services, allowing immediate access for the citizens to information controlled by the different municipal entities. This accessibility is the basis for the development of common systems that unify and facilitate the relationship between citizens and municipal services. (Ayuntamiento de Sevilla, 2014)	2	2	1	1	4	5,7
		Tarjeta Ciudadana' or 'Citizen Card' One card that can be used for all the muncipal services such as sports and entertainment centersn libraries … (Ayuntamiento de Sevilla, 2014)	2	2	1	1	4	5,7
	Participation	Implementation of e-democracy platform 'Participa Sevilla' allowing the active participation of citizens in public life and decision-making of the city. (Ayuntamiento de Sevilla, 2014)	1	2	1	2	4	5,7
	Transparency	Implementation of a municipal transparency portal for fulfilling the obligations of national, regional and international public information transparency laws. (Ayuntamiento de Sevilla, 2014)	1	1	1	2	2	2,8
	Urban planning	Infraestructura de Datos Espaciales para la Gestión del Espacio Urbano' (IDEGU) or 'Spatial Data Infrastructure for the Management of Urban Space' The IDEGU project is a tool that allows to create, share and manage data, maps and applications containing information and services for the entire city council. Introducing this tool should allow to manage the full cycle of processing spatial data, including publication, within the city of Sevilla. (Ayuntamiento de Sevilla, 2014)	1	2	2	2	8	11,4

Living	**Smartphone applications & WiFi**	Sevilla has various applications. The most significant ones are: AppTussam Application providing in a simple and comfortable way all information about the TUSSAM services. The app can find stations near a certain direction, explore the stations of each line, show start and end times of the service or the location of the stations on a map and show the waiting times. It can also how to get from one point to another using the bus network indicating bus lines and the estimated travel time and provides real-time information about the waiting times, incidents, etc. It also has a feature for people with visual disabilities, a VoiceOver system plays multiple voice messages. The latest addition has been a warning for arrival times, where the user can select the line, the station, the time he wants to catch the bus and how long in advance he will be alerted. (Torreglosa, 2014) Application to reservate or request a taxi. (Ayuntamiento de Sevilla, 2014)	2	2	1	2	8	11,4
	Tourism	Touristic Internet Portal Introducing a website to promote tourism through providing information about touristic services, restaurants, cultural events, shops, etc. and make this information available through various digital formats and in various languages. The website is easy to use by third-parties and has space for user experiences. (Ayuntamiento de Sevilla, 2014)	1	1	1	2	2	2,8
		Smartport Project to provide all cruise passengers in the port of all information and services of the city. (Ayuntamiento de Sevilla, 2014)	1	1	1	2	2	2,8

Mobility	**City logistics**	TUSSAM management system TUSSAM ('Transportes Urbanos de Sevilla, Sociedad Anónima Municipal' or 'Urban Transport of Sevilla, SA Municipal') implemented a management system that lets them control their fleet in real time. Each bus is constantly located via GPS, and sends its position to the control center every 25 seconds. The real-time information makes it possible to take the necessary measures to keep the schedules as they are planned despite the impact of all possible incidents that might come along every day, such as traffic problems. On the other hand, knowledge of the positions of the vehicles makes it possible to estimate the arrival times, so that customers can find this information in real-time on the internet, their mobile phone as well as through panels installed on the 100 most important stops of the line network. (Torreglosa, 2014)	2	2	2	2	16	22,8
		Comprehensive Mobility System Mobility system that that integrates information from different administrations in the city and provides advanced services to citizens, such as real-time traffic conditions or guiding to free parking spaces. Sharing this information in real-time between all involved parties can help managers to make the right decisions and take the right measures in case of for example incidents or events. The information can be checked through multiple channels such as web and mobile applications by the customer who can thus for example anticipate possible incidents. The system also assists the emergency services by transferring information or direct assistance by radio or telephone to drivers in emergency situations in real-time. (Ayuntamiento de Sevilla, 2014)	2	3	2	2	24	34,2
		Movele The Movele project involves the installation of a safe and efficient network of 75 charging points for electric vehicles, which gives the city of Sevilla a boost of electric mobility. (Sevilla tiene su punto, 2010)	1	1	2	2	4	5,7

		Intelligent parking system Intelligent parking system with sensors and a web portal to indicate free parking spots and show information. The portal is available on mobile devices and allows payment, searching parking spots, etc. (Ayuntamiento de Sevilla, 2014)	2	2	2	2	16	22,8
	People mobility	Bicycle loan system System to loan bikes with miultiple bicycle parkings through the city. The system includes an application that enables citizens to identify from their mobile devices and check georeferenced information about bicycle parkings, occupation, distance to the station, etc. (Ayuntamiento de Sevilla, 2014)	2	2	1	2	8	11,4
						TOTAL	224	318,9

Valencia	Characteristic	Project	Pa (1,2,3)	Pm (1,2,3)	Pi (1,2,3)	Ps (1,2)	PI	PI/hab
Economy	**ICT-enabled manufacturing and services**	Smart City Platform The platform will bring together all city's service throught 350 connected sensors. It is a PPP with the Telefonica company an uses FI-Ware technology. Thanks to the smart platform, city managers will be able to monitor everything happening in the city and act in real-time improving the quality of various sectors such us transport, energy efficiency, environmental services. (European Commission, 2014)	2	3	3	2	36	45,2
		The Geographic Information System (GIS) with more than 230 layers of information of many types, allows a more efficient management of resources and can serve as a decision making tool. (RECI, 2014)	2	3	2	2	24	30,1
		My Pick Box Project to collect online placed orders in the metro of Valencia. This delivering service offers greater time flexibility, speed and privacy for its users. (Esmartcity, 2014b)	1	1	1	2	2	2,5
		Installation of sensors in the 'Parque Natural de L'Albufera' for early detection of forest fires. (RECI, 2014)	1	1	1	2	2	2,5
Environment	**Buildings**	Creating green roofs and vertical gardens in municipal buildings. (RECI, 2014)	1	1	1	2	2	2,5
	Natural resources, green, renewable energy	Installation of photovoltaic installations on roofs of muncipal buildings. (RECI, 2014)	1	2	1	2	4	5,0
		Equiping street elements such as lampposts with solar panels and batteries. (RECI, 2014)	1	1	1	2	2	2,5
	Public lighting	Complete replacement of mercury vapor lamps by high pressure sodium vapor lamps. (RECI, 2014)	1	1	1	2	2	2,5
	Water management	Smart irrigation system for green areas in the city that saves up to 35% water. (RECI, 2014)	2	1	1	2	4	5,0
		Sistema de Información de la Red de Alcantarillado' (SIRA) or 'Information System of the Sewage System' System to control and manage the sewage system with a central control room. (RECI, 2014)	2	1	1	2	4	5,0

Government	**E-government**	The city strives to a paperless administration and makes it possible to check the status of cases and provide documentation,, pay taxes without resorting to bank offices, request certificates, etc. 240 of the 330 administrative procedures of the city can already be performed online. (RECI, 2014)	2	2	1	2	8	10,0
Living	**Healthcare**	Valencia has developed a website related to pollen, including a pollen map and alerts service for allergy sufferers. (RECI, 2014)	1	1	1	2	2	2,5
		Video-assisted thoracic surgery in the 'Hospital Genera' of Valencia. This type of surgery allows minimally invasive operations with greater comfort and safety for the patient. (Esmartcity, 2014a)	1	1	3	2	6	7,5
	Smartphone applications & WiFi	Valencia has various smartphone applications such as: Realidad Augmentada' or 'Augmented Reality' Application which allows real-time reporting on existing facilities and services (for example municipal resources, tourist and cultural information points) available in the city. (Ayuntament de València, 2014) Application that functions as a guide for museums. (RECI, 2014)	1	1	1	2	2	2,5
		Multiple points for WiFi access through the city. (RECI, 2014)	1	1	1	2	2	2,5
Mobility	**City logistics**	Traffic Control Room of the City of Valencia is one of the best equipped in Spain and has many features. There is also the possibility to check the status of traffic in Valencia by checking the cameras through a Mobile App (iCAM). (RECI, 2014)	2	2	2	2	16	20,1
		Testing with electric taxis in order to verify and test the possibilities of using such vehicles as taxis in the city. (Esmartcity, 2014c)	1	1	1	2	2	2,5

	People mobility	EcoDriving Project The project provides vehicles with a 'black box' and sensors (pollutants and noise information on real time). With this box drivers have access to their 'electronic driving CV', with recommendations to improve efficiency. The municipal fleet and the EMT buses are equipped with boxes as well as the vehicles of participating citizens. With the information drivers can be continuously trained on efficient driving. The data of the boxes and sensors can be studied and analyzed and the results of the project are Open Data. (Orrico)	1	1	1	2	2	2,5
		Bicycle system Bike loan system with bicycle parkings in the whole city, over 103 000 users and with different possibilities to obtain real-time information about parkings, occupancy, … on a web platform or a smartphone. (RECI, 2014)	2	2	1	2	8	10,0
People	**Training**	Digital training to reduce the 'digital gap'. (RECI, 2014)	1	1	1	1	1	1,3
						TOTAL	131	164,4