

Barcelona Treball

Smart Cities

Sector report 2013

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The 10 keys to understanding the sector

The political and economic weight of the cities has increased in recent years, which poses challenges in sustainability, infrastructure management and energy, mobility and service to citizens, among others. Cities willing to respond to these challenges need to be smart (Smart Cities).

The sector

Smart City defines the new city model which integrates initiatives to improve environmental and economic sustainability and the efficient management of their services, with the aim of improving people's quality of life and permitting a reduction in public spending. To do this, Smart City innovates, for example, in materials, resources and models used, looking for the maximum integration and connection between infrastructure and city services. Therefore, it uses technology in an intensive manner. The fact that Smart Cities projects affect to the development of a city's infrastructure and services, makes it become a cross-cutting sector that encompasses such diverse activities as energy, water, transport, urban planning, waste collection, teaching or health, in addition to ICT, among others.

Main areas of activity

The Smart Cities sector consists of the following areas of activity: urban mobility; environmental sustainability and infrastructure management; citizenship, governance and economics; and health and social services. Urban mobility encompasses accessibility, safety and efficiency in transportation systems. Environmental sustainability and infrastructure management includes saving services in energy resources based on innovative designs, efficient energy management systems in buildings,

smart applications or the improvement of electric and water grids. The field of citizenship, governance and economics concerns services associated with city government and its relationship with citizenry, support to the economic activity and public safety. Finally, the area of health and social services incorporate new models of production and management of health and social services, many of them based on ICT applications, such as telemedicine or telecare.

Trends

There are some common trends in smart cities related to: the need to store and manage high amounts of data and information (the Open Data and Big Data); energy efficiency and the change in the pattern of production and energy management (Smart Grid and smart grids); the application of ICT to medicine and changes in the provision of medical services (personalized medicine); the new management of public services (e-government); and the necessary combination between construction and technology to face the required infrastructures of a Smart City (the infrastructure sector reinvents itself).

Economic importance

The Smart Cities transversal character makes that there is no specific data available about the industry in Catalonia and Spain, and, therefore, the exposed data relate to its main areas of activity. However, all sources agree that it is a booming sector. So, Ferrovial estimates a turnover of 10 billion Euros for the next 10 years¹. However, it will be necessary a big investment effort from the public sector. Indra considers that large cities will have to invest between 100 and 200 million Euros in the next 3 years to be developed as Smart Cities². Furthermore, according to A. Rodriguez Brey, CEO of Urbiotica, improvements in service efficiency can reach more than 20%.

Employment

Smart Cities projects require and offer employment opportunities to professionals from different backgrounds and fields. Again, the transversal character of the industry means that there is no specific data on employment available, neither at regional level nor at state level. Therefore, it is necessary to take data and trends from some close areas of activity as a referent, such as computing and telecommunications. However, although not all Smart Cities projects are technological, the industry is characterized by an intensive use of technology. For this reason, it is expected that the sector will impact, particularly, in profiles related to this industries, who will be able to participate in different kind of projects, such as those related to the environment or energy, for example.

¹ <http://infraestructurasinteligentes.com/>

² "In search for the future 'Smart' citizen". Expansión, 15 november 2012.

Professional profiles most in demand

The Smart Cities require university-trained professionals, mainly in information and communication technologies (ICT), and sustainability. So, the most demanded professional profiles are computer scientists, engineers (mainly in telecommunications and industrial branches), and professionals trained in subjects linked to sustainability, such as graduates in environmental sciences. Computer and telecommunications engineers are demanded because the sector is intensive in the use of technology. Industrial engineers and environmental graduates are demanded because there are many Smart Cities projects related to energy, air conditioning (heating/conditioning), water and pollution. However, the industry also provides opportunities for less qualified professional profiles performing tasks of installation and maintenance, such as electricians, mechanical, electronic or refrigeration operator.

Occupations most in demand

Most are knowledge-intensive and are related to the development of ICT projects, urban mobility, energy efficiency, environmental sustainability, infrastructure management, and new models of production, management and provision of goods and services. Some of the occupations that may be most demanded are, for example, the expert in transmission and distribution networks, the consultant on urban mobility, the expert on e-Commerce and payment systems, the expert on Big Data or the consultant on e-Health. Among the most demanded and less qualified occupations there is, for example, the energy efficiency service agent.

Future scenarios

The future industry projection goes through the consolidation of some of its areas of activity, and more specifically, the development of production systems, management and provision of efficient and sustainable resources both economically and environmentally, which are based, in many cases, but not necessarily, in ICT solutions. In Barcelona there are some examples of these systems: the automatic system of waste collection that will be implemented in the 22 @ and will save 15% of energy in the collection process; the Open-DAI project, which assesses the potential and effectiveness of open data (Open data) of some authorities to create new services and applications for citizens, businesses and administrations. In addition, Barcelona leads the City Protocol Society, the first alliance of cities, companies and organizations to define future cities' quality standards and share solutions to address their problems and support their transformation.

Weaknesses

The implementation and development of Smart Cities projects is complex, and requires a cross-cutting and integrated view, as well as the transformation of many infrastructure and city services and its management models. In addition, public and private collaboration are often affected by the difficulty to get the return on private investment, or by the high public investment needed, taking into account the

current economic climate. Moreover, the exponential development of ICT often complicates the integration between existing and new technology, as well as the adaptation and new uses that people, businesses and governments can make of it. This is accentuated by the fact that the sector uses technology intensively and, often, some projects tend to focus almost exclusively on technological development, without considering other variables such as the management model of urban services or the city model itself.

Opportunities

Barcelona is in eighth position in the European ranking of smart cities, after Copenhagen, Stockholm, Amsterdam, Vienna, Paris, Berlin and London. It is the first of Spanish cities, followed, in this order, by Santander, Madrid, Malaga and Bilbao. Therefore, the city is in a good position to continue developing as a Smart City. It is expected that, in the coming years, it will create jobs and business opportunities in different sectors and areas such as energy, mobility, urbanism, trade, health, education, infrastructure, information technology, electronics, mechanical or environmental. On the other hand, Barcelona has the leadership of City Protocol Society, the first alliance of cities, companies and organizations involving 33 cities. Furthermore, the fact that Barcelona organizes, in 2013, a third edition of "Smart City Expo & World Congress" during the "World Sustainable Mobility Week" and coinciding with the most important exhibition of electric vehicles and the fourth edition of the international exhibition of the rail industry, the BcnRail, will help position the city. Finally, in general, the increasing concentration of population in cities, and the need to manage it efficiently and sustainably, will impact on all traditional sectors, which will probably have growth and employment opportunities related to Smart City projects and models, both locally, nationally and internationally.

01 Introduction to the sector

Cities have become poles of attraction of population as they have acquired a role in the country's socioeconomic development. The concentration of people in cities around the world has increased exponentially in recent years. In fact, in July 2007, the urban world population exceeded that of the rural area, and projections suggest that it will reach nearly 70% by 2050. This gives the city a major economic and political weight. In contrast, this situation has made cities turn into large consumers of resources: it is estimated that cities consume 75% of the global energy and generate 70%³ of the overall greenhouse gases. This situation has promoted the launch (by the public administration, in collaboration with the private sector and the citizenry) of actions designed to turn cities into sustainable spaces committed to their environment, endowed with infrastructure and technologically advanced services. Similarly, the economic crisis requires a more efficient management of cities to maintain the standard of living associated with the welfare state.

Thus, a Smart City develops initiatives to make it more environmentally and economically sustainable, and provides an efficient management of services and infrastructure to improve citizens' quality of life. To do this, a Smart City innovates in materials, resources and models, looking for the maximum integration and connection between the infrastructure and the city services. Therefore, a Smart City uses technology intensively both as a facilitator tool and as an efficiency mechanism. Recent technology has allowed for innovation in urban services, such as spaces where street lighting is activated according to the daylight and the passengers who walk around, automatic watering activation depending on ambient humidity, or signaling of free parking spaces using sensors and Smartphone. But the development of a Smart City goes beyond the use of information and communication technology (ICT).

Thus, the implementation of a Smart City requires, in addition to ICT-based solutions, changes in:

- The models of urban services management, which have to be provided in a more transversal manner and involve municipalities, businesses and entrepreneurs.
- The models of energy production and distribution, which should combine ICT with energy, making it possible, for example, for each building to produce energy, use it and share it through the power grid (known as Smart Grid).
- The usage habits of resources and services, for example, by reducing consumption, providing sustainable transport; or sharing resources through car sharing, for one.

³ "Smart cities: a first step towards the Internet of things". Fundación Telefónica, 2011.

- The city model, which should engage citizens in decision-making and management of the city. This means moving towards the co-city or collaborative city, which requires citizens to be involved in the development of a Smart City and be prepared to use ICT, i.e. "smart people" (concept created simultaneously to the Smart City conception)⁴.

Therefore, the Smart Cities projects can affect many of the services provided in a city: mobility, production and distribution of services (energy, water, waste management, etc.), education, health, safety, care for people, etc. However, there is no single model of Smart City, there are countless initiatives worldwide, and multiple approaches depending on the specific needs and circumstances of each city, its environment and its resources.

On the other hand, the size of Smart Cities projects are of such magnitude that they can only be approached successfully if there is a strong commitment from public institutions and private companies capable of designing models for production, management and provision of services, and technological solutions that ensure their performance.

Barcelona leads the creation of the first protocol of smart cities around the world (the City Protocol) and the world Smart Cities meeting (the Smart City Expo & World Congress), of which there have already two editions, the first in 2011 and the second in 2012. Actually, Barcelona is in eighth position of the European smart cities ranking, after Copenhagen, Stockholm, Paris, London or Berlin. Statewide, Barcelona is in first place, followed by Santander, Madrid, Malaga and Bilbao.

Currently many Smart Cities projects are being developed, for example, the TMB project to expand clean buses or the orthogonal bus line, opened in October 2012, which connects the city rectilinearly with an orthogonal grid to ease citizens' use of it. Moreover, the TAP and GO project, in collaboration with La Caixa, Telefónica and Indra, drives the mass deployment in the city of NFC: contactless payment via mobile phone.

In terms of sustainability, efficient Islands project in collaboration with Schneider Electric and GD Suez, begins to enable buildings to generate the energy they consume through the collection and processing of photovoltaics, wind and geothermal. And for companies to test their Smart initiatives, the Urban Lab project allows them to have a space in the 22 @ district to test innovative products that are in pre-commercialization phase. Another project is the Open-DAI, which assesses the potential and effectiveness of different open data (Open Data) of various authorities to create new services and applications for citizens, businesses and administrations. Today, however, the vast majority of Smart Cities projects in Barcelona are related to energy efficiency and sustainability.

⁴ Dossier "The intelligent revolution". "Smart cities and the challenges of the XXI century". Diario de Tarragona, 7 november 2012.

02

Main areas of activity

As we explained in the previous section, there is no single approach or definition of the Smart City concept. However, in order to create taxonomy to analyze the sector and its initiatives, it is subdivided in the following main areas of activity:

Urban Mobility

It includes projects and initiatives related to sustainability, accessibility, safety and efficiency in transport systems, such as real-time traffic management, new transport systems, fleet management and car park, electric vehicles, etc.

One of the main problems in cities is traffic congestion, which has a negative impact on people's lives because of its harmful effects on air quality, noise pollution or decreased productivity. Each year, the Spaniards waste 420 million hours in traffic jams, especially in Barcelona and Madrid, two of the 20 most congested cities in Europe, representing an expenditure of about \$ 1,000 per capita per year⁵.

Urban mobility projects in Smart Cities are intended to decrease the effects of traffic congestion through solutions based on real time traffic management that provide information about congestion, roadwork, traffic lights timing, etc. One of the highlights of Barcelona as a Smart City is to be smart in urban mobility. In this area, Barcelona city has been developed, among other projects, mobile access using Google Maps (m.google.es/maps/transitbarcelona) to control traffic flow and images captured by traffic cameras located in the districts. This application is also available through <http://maps.google.es/transitbarcelona>. In this area, it also has launched, in October 2012, the TMB orthogonal line bus which consists of five new bus routes connecting the city through orthogonal and rectilinear lines, and makes it easier for citizens to use bus lines.

Urban mobility projects in a Smart City can also be about the resizing of public transport networks, the provision of information about transport network (information boards, mobile applications, etc.) in real time, the urban reorganization to design efficient routes in order to reduce travel times, the development of intelligent indicating parking space availability in real time, or the management of the public transport system in cycling, such as Bicing project of the City of Barcelona.

⁵ Report from European Commission's Joint Research Centre: Institute for Prospective Technological Studies (JRC-IPTS).

Environmental sustainability and infrastructure management

This area includes services of savings in energy resources based on innovative designs, efficient management of energy systems in buildings (heating, air conditioning, etc.), intelligent applications (home automation), or improved water and electric grids.

Cities generate most of the CO₂ emissions, require more energy, and 50% of consumed energy by buildings is not efficient⁶. The rising price of energy, its increasing demand and the need to reduce emissions is forcing consumption optimization. Indeed, in 2009 400 cities worldwide were pledged to deeply cut CO₂ emissions⁷, and provide safe and sustainable energy. This means making more efficient use of energy and, at the same time, increasing renewable energy consumption (photovoltaic, wind, biomass, geothermal, etc.) while ensuring continuous service provision, without falls or cuts. In this field, Barcelona is developing the smart Islands project in order to ensure that buildings generate their own energy by capturing and processing photovoltaic, wind and geothermal energy, and also, in the future, maritime energy. Live project (Logistics for the Implementation of the Electric Vehicle) is being implemented in this same line: it is a public-private⁸ partnership platform aimed at supporting and incentivizing the development of electric mobility in Barcelona and its metropolitan area which, among other activities, promotes the deployment of public and private charging networks for electric vehicles. In addition, bylaws are being developed to regulate issues such as the use of solar energy in public and private buildings, and the city wants to invest 550,000 Euros to equip two kilometers of Paseo de Gracia with an intelligent “layer” that should allow, in the future, the deployment of projects such as measured irrigation, lighting control or calculation of traffic flows⁹.

Smart Cities projects about environmental sustainability and infrastructure management are geared to the development of smart grid distribution and management to integrate renewable energy into the existing network (Smart Grid), the introduction of automatic systems (building automation), or to provide general information tools. Some examples of projects that are currently under development: efficient lighting in streets and inside the buildings, use of LED technology in traffic lights; automatic irrigation systems in parks and gardens with sensors and timers that allow for measuring the level of ambient humidity and turning the system on at the optimal moment; mechanisms for measuring the quality of air, water and temperature in real time; lamps with motion sensors, temperature or noise that collect information in real time via Wi-Fi technology (sensors for urban services); or systems for emptying containers and improved management of urban waste.

⁶ <http://www.telenorconnexion.com/>

⁷ Burger, A. “Mayors’ pledge to make ‘drastic’ CO₂ emissions cuts highlight of EU Sustainable Energy Week”. International Institute for Sustainable Development. February 12th. 2009.

⁸ “No trace of Madrid”. La Vanguardia, November 14th, 2012.

⁹ “Companies bet on the smart city”. El País, November 11th, 2012.

Citizenship, governance and economy

It includes services related with city government and its relationship with citizens (e-administration, e-Participation); public safety (video surveillance, prevention and civil protection); participation in the management and construction of educational services through new learning and working systems (e-learning and telecommuting); support to economic activity; and promotion of social cohesion.

This area is concerned with improving transparency in governance, promoting citizen participation in decision-making, encouraging the use of ICT in education, improving public safety systems, spreading culture, and providing companies with new management and working tools.

There are projects related to Education, e-Government, e-Participation or Public safety. In the education field, ICT systems are developed to implement e-Learning or blended methodologies. In the e-Government field, services are available on-line to facilitate the relationship with citizenship (access to information, digital signature, transactions by means of mobile applications, payment of taxes and fees, etc.), and to optimize the tasks and processes of public sector workers (workflows). In the field of e-Participation, projects are devoted to promote transparency and community participation, for example, on-line surveys and voting, or analysis of network-generated opinion flows. In the public safety field, projects are carried out to improve the coordination of resources and agents, and emergency systems and civil protection. For example, the 112, which is designed under a multiservice approach, integrates all agencies involved in emergency situations; the deployment of video surveillance cameras to control specific areas; or the generation of fire sensors.

In Barcelona, the Urban Lab project is underway, which allows for companies to have tests spaces to prove innovative products that are in pre-market phase; the TAP and GO project promotes the massive deployment of NFC technology in the city (contactless payment via mobile phone); or iCity project, that is being developed and led by the Municipal Institute of Informatics (IMI) and the Barcelona City Council recently approved by the European Commission, which allows for opening the municipal infrastructure (Wi-Fi and corporate fiber), the reuse of public information and the provision of tools to companies, research centers and universities to develop applications.

Health and social services

It is the application of technology to health and care for people services, such as telemedicine, telecare, shared electronic medical record, electronic prescribing systems or adapted display systems. Thus, the technology applied to health and social services can improve the services by enabling people receive care and assistance at home.

In general, Smart Cities projects in this area are aimed at progressing in the real-time diagnosis, monitoring of the patients' health status at home (telecare and telemedicine), and developing

applications to share medical information (shared electronic medical record or electronic prescriptions).

Barcelona is developing a telecare project that offers home care 24 hours a day every day of the year in order to give an immediate answer to help requests of elderly or disabled. The service is based on a device installed in the user's home and connected by landline or mobile phone to a central station. The user can communicate an emergency by pressing a button. Currently, there are over 50,000 households in Barcelona that have this device, most users being people beyond 75 years and some people with disabilities.

03

Sector trends

The key to the development of a Smart City is the ability to obtain data in real-time and to manage the information generated smartly and immediately. This process can provide greater integration and efficiency to the services offered to citizens.

The Smart City model can be applied to any field of city management and is related to the future vision about it. Therefore, trends in the field of Smart Cities are closely related to each city Smart strategy and specific projects to be developed. However, the following common trends can be identified:

Open Data: accessible data

The Open Data provides data under the state open license (Open Government License), so that data on public services can be accessible to everyone. This will develop many applications to provide information, for example, weather forecasting, traffic incidents or guard services.

Barcelona is developing the Open-DAI project, which tests the potential and effectiveness of open data (Open Data) from different authorities designed to create new services and applications for citizens, businesses and administrations. These applications will cover industries such as transport and the environment, geolocation and touristic services, and new relationships between government and citizens.

Big Data, the power of information

It is estimated that the volume of generated data by the information society from different sources (publications, e-government, e-commerce, social networks and mobile devices) reaches $2.5 \cdot 10^{30}$ bytes per day.

¹⁰ Four Vendor Views on Big Data and Big Data Analytics_ IBM Hurwitz & Associates, Fern Halper, January 2012.

One of the challenges for Smart Cities is to manage and interpret this volume of data. To manage the data, technological solutions have been developed with a high capacity storage, analysis and processing of information, and will be further developed in the future. It is what is called Big Data. This technology offers many possibilities to Smart Cities because it brings intelligence, foresight, facilitates decision-making and promotes collaboration between public services, for example, the traffic service with the environmental control service, health service with the emergency services. An example of the Big Data application to Smart Cities is an integrated analysis of data from digital sensors that can measure and report the location, movement, vibration, temperature, humidity and chemical changes in the air, with applications in the pollution control or parks irrigation.

The Smart Grid

This trend marks a change in the pattern of energy production and distribution; a Smart Grid is a Smart City in which the distribution of electricity is done using digital technology to save energy, reduce costs and achieve an efficient, safe and sustainable power distribution.

In a Smart Grid, the energy needed is consumed and the rest is stored. Electricity rates are different depending on demand; the consumer knows this in real time and is able to adapt their consumption to the price. This system requires the installation of smart devices (Smart Meters) that replace the old meters which, together with other computer protocols, report on the price of energy. The aim of this system is to increase the energy consumption during off-peak demand and rationalize it. In addition, in this smart grid, users can be energy suppliers. For example, buildings have clean energy generators that can distribute the surplus through smart grids. Another example of this trend is the vehicle-to-grid, which use the excess energy generated by the electric vehicle to sell it in the charging points.

Personalized medicine, a new service model patient-centered health

The e-Health concept, referring to ICT use in the health field affects one of the areas in which Smart Cities industry is structured, will enable the implementation of a more personalized medicine in which the patient will be at the center of the health system.

Indeed, e-health enables the development of systems and tools that facilitate the diagnosis and individualized treatment through shared information networks, electronic health records, telemedicine services and portable communications systems or health webs, among other tools to support the prevention, diagnosis, treatment, monitoring and management of the lifestyles.

An innovative example of these tools, which are developed by microelectronics engineers and biomedical at the Georgia Institute of Technology, is the generation of biosensors that enable the analysis of many health parameters in real time, which allows for immediate diagnosis and accurate drugs prescription, time saving and improvement in the quality of health care.

The e- Government

The e-Government is one of the rising trends in Smart Cities, and is based on a new procedure for the filing in, processing, receiving and sending documents to the Government, and a new system of relationship between it, the citizens and businesses.

The three pillars of the e-Government are:

- Multi-channel: provision of services through all available channels (web, phone, mobile, DTT, etc.).
- Procedural Simplification: reorganization of internal administrative procedures to make them more simple and efficient.
- Documentary Simplification: to eliminate unnecessary requirements and documents for public purpose which are already available by the Government.

The infrastructure sector is reinvented

A Smart City requires intelligent infrastructures that combine elements of construction, engineering and technology. For this reason, collaboration between construction and technology companies is becoming increasingly common to exploit the potential of Smart Cities, and will remain so in the future. Nowadays, it is not surprising that, for example, the installation tasks are separated from the signaling tasks in rail contracts. The first ones are assumed by construction companies, the second by technology companies.

04 The sector in figures

In Spain there is no specific data on economy and employment in the Smart Cities industry, due to the fact that activities are diluted on those implemented in other industries, as already discussed. Despite of this, data related to the key industries or areas of activity that are more related to the Smart Cities is provided, which justifies its relevance to business and employment generation.

Economic data

- There are several estimates of the business volume generated by Smart Cities industry, and all agree on its being a growing market. CISCO sets this volume at 1.2 trillion dollars over the next 10 years, Spain's International Data Corporation (IDC) estimates it at more than 57 billion Euros in 2014, and Ferrovial calculates that outsourcing of municipal environmental and mobility services in Spain amounts to 10 billion¹¹.
- Europe currently has 35 cities with more than one million inhabitants and China, in 2025, will have 221,600. Cities host a fifth of the world population and generate 60% of global GDP¹².
- Cities occupy 2% of the planet's surface, but consume 75% of global energy and resources. In 40 years, 75% of the world population will live in cities, these figures show the weight of the economic activities generated in cities¹³.
- Cities' growth is related to the development of business activities. An inefficient administrative system could cost up to 6.8% of GDP in some economies. An administrative cost reduction of 25% (simplification of procedures through e-Government) can represent up to 1.5% of GDP savings¹⁴.
- The impact of traffic congestion in cities like Barcelona is between 1.4% and 4% of the city's GDP. Spanish drivers wasted 420 million hours in traffic jams each year, especially in

¹¹ "Roadmap for the Smart City". Technology Centre of Catalonia. Barcelona, February 2012.

¹² "Smart cities: a first step towards the Internet of things". Fundación Telefónica, 2011.

¹³ Garnett, T. (1996). "Farming the city: the potential urban agriculture". The Ecologist, via Factiva.

¹⁴ Measuring administrative costs and reducing administrative burdens in the European Union". European Commission. 2006.; and IBM Global Business reports "Smart Cities".

Barcelona and Madrid, two of the twenty most congested cities in the world, representing a per capita expenditure of \$1,000 per year¹⁵.

- Traffic congestion cost 78,000 million dollars to the U.S. economy in 2005, and caused the loss of 4,200 million hours, according to the study of IBM "Smart Cities: towards a new model of efficiency and sustainability". These figures increase by 8% each year. Only in New York, the economic cost of congestion is approaching 4,000 million dollars annually. Various estimates suggest that the cost of congestion in cities amounts to between 1 and 3% of GDP.
- Parking search causes 30% of traffic jams in cities, according to a worldwide study developed by IBM. Intelligent parking systems can considerably reduce this percentage¹⁶.
- The Barcelona city Council wants the city to be, in a 40 years run, the first energetically self-sufficient city in the world through the use renewable energies¹⁷.
- The C40 Cities network, consisting of 58 cities in the world taking measures to promote energy efficiency, have launched more than 4,700 initiatives. These cities foresee nearly 250 million tones cuts in annual emissions by 2020 and 1,000 million in 2030. These cities include Barcelona, Hong Kong, Jakarta, Moscow, Basel, Berlin, Rome, San Francisco and Toronto.
- Barcelona is a testing city for electric vehicles, and installed the first fast charge public electrogas station in Spain, that can fill the tank in 10 minutes. It also has a public-private platform that promotes the use of electric vehicles in the city, owned by the Spanish Government and Catalan, Barcelona City Council, Endesa, Siemens and Seat (Live Barcelona project).
- The Spanish cities over 50,000 inhabitants spend more than 1,600 million Euros in waste collection and treatment, and more than 1,000 in street cleaning.
- The improvements in services' efficiency enable a Smart City to reach more than 20%, according to A. Rodriguez Brey, Urbiotica CEO.
- The use of irrigation applications in municipal parks and gardens can save up to 15% of the water used; and 25% in transport, in garbage collection case¹⁸.
- According to OECD data, the number of users of DSL (Digital Subscriber Line), which are all technologies that provide a digital connection over the telephone network, have grown by 37% in Spain since 2006; cable services by 27%; and fiber by 36%. These data indicate that people are increasingly prepared to live in a Smart City and there is a growing number of "smart citizens."

Employment data

The Smart Cities industry is cross-cutting and requires and offers employment opportunities to professionals with diverse training backgrounds, and although not all projects in Smart Cities are

¹⁵ Institute for Prospective Technological Studies - European Commission's Joint Research Centre (JRC-IPTS).

¹⁶ <http://www-03.ibm.com/press/es/es/pressrelease/35510.wss>

¹⁷ <http://www.redesurbanascaloryfrio.com/images/stories/noticias/121009notaconveniogsuez.895.pdf>

¹⁸ http://www.tic.cat/web/i-digital/coneixement/experiencies/detall/-/asset_publisher/Dcb0/content/entrevista_jordi_sala

technological, the fact is that the industry is characterized by intensive use of technology. For this reason, and due to the absence of specific data on the Smart Cities, the data on employment presented below focuses on the activity in the telecommunications and ICT area, as being two of the most related to Smart City industry.

- The European Union considers that the development of a digital strategy in Europe is an essential tool for economic and social growth. Thus, development of telecommunications networks, particularly those based on optical fibers, are a priority infrastructure. It is expected that by 2013 all European citizens will have access to broadband, and by 2020 these connections should be at 30Mb. This will create jobs in the telecommunications and ICT, programming and consulting areas. In the first quarter of 2012, telecommunications activities employ 0.7% of employed Spanish population; programming and consulting employ 1,3%¹⁹.
- One of the most common trainings among Smart Cities' professionals is computer engineering or telecommunications. Currently, the unemployment rate among engineers of these branches is set at 7.6% compared to 22.6% in Catalonia, according to the 3rd quarter of 2012. 13% of vacancies require these training profiles²⁰. It is expected that the demand of this profiles increase further if Smart Cities' initiatives continue growing.
- According to an ESADE report for Infojobs, from 961.145 jobs vacancies advertised on this website in 2011, 23% (about 250.000) were for the category Telecommunications and ICT. In addition, there were 14 candidates for each job in this category, while the average of candidates for the remaining categories was 62²¹. Similarly, a study published by the Center for Innovation in Vocational Training (CIFO) of Lleida in 2012, points out that 84% of ICT students in this province find work at the end of training, and even before finishing it²². The findings of these two studies highlight the need to encourage students in choosing training on computers and telecommunications to ensure demand coverage for these professionals in coming years.
- In the information and communication technologies area in Catalonia, in the first quarter of 2012, there were 88,500 employed people; this is 4.2% of all persons employed in the service industry²³.
- The U.S. need between 140,000 and 190,000 workers with analytical skills and understanding of databases, and \$ 1.5 million with data management training and management profile, according to 2011 data from the consultancy McKinsey Global Institute.

¹⁹ INE

²⁰ <http://noticias.universia.es/en-portada/noticia/2012/06/19/943781/profesionales-mas-demandan-empresas.html>
<http://www.adecco.es/data/NotasPrensa/pdf/372.pdf>

²¹ <http://blog.uchceu.es/informatica/estudiar-informatica-una-vocacion-con-un-7-de-desempleo/>

²² <http://www.lavanguardia.com/local/lleida/20120629/54317654607/ingenieros-informaticos-esquivan-crisis-paro.html>

²³ INE

05 Professional profiles most in demand

Most highly qualified professional profiles

Training profile

Despite the transversal character of the industry, Smart Cities require professionals trained mainly in information and communication technologies (ICT); sustainability, infrastructure management, and new models of production, management and delivery of goods and services. Thus, the most common regulated training among professionals are computer science, engineering (mainly telecommunications and industrial), and certain education related to sustainability, such as environmental science. The computer and telecommunications engineers are demanded because the industry is intensive in the use of technology. And industrial engineers or graduates in environmental science are demanded because there are many Smart Cities projects related to energy, the HVAC (heating/cooling), water, pollution and intelligent infrastructure construction. To a lesser extent, the industry requires people with backgrounds in economics, business administration, or with economic/law double degree to work on projects related to economic efficiency, and analysts and statisticians to work in the collection and analysis of data.

Concerning additional training to graduate and masters' level, the expertise required depends on the Smart project to be developed, however, the most common are those related to technology (e.g. ICT and biotechnology), sustainability and the environment.

The most qualified professional profiles often perform works with responsibility, with a highly technical component, manage projects and are responsible for its implementation. Therefore, these professionals should plan tasks, organize their time and take over the management of their business unit or project, so it is convenient to extend their basic training with training in management. A knowledge of more languages than Catalan and Spanish, preferably English, is also required.

Skills profile

The Smart Cities industry is evolving rapidly and constantly, and requires professionals who are able to find new ways and solutions to face industry challenges. They also have to be able to meet the expectations of the companies, which are bound to evolve rapidly and to offer proposals responding to an increasingly demanding requirements from the environment and the citizenry , which need an immediate access to information. Therefore, professionals must be flexible, innovative, capable of anticipating changes (especially in technology), with organizational, planning and analytical skills, and with capabilities in integrating and interrelating concepts.

These professionals also have to manage and coordinate, and be motivated and committed to the goal of the Smart Cities: more efficient, sustainable and habitable cities.

Examples of jobs in the Barcelona Treball website

- ✓ [Expert consultant on urban mobility.](#)
 - ✓ [Expert in transmission and distribution networks](#)
 - ✓ [Consultant on e-Health.](#)
 - ✓ [Expert on e-commerce and payment systems](#)
 - ✓ [Expert on Big Data.](#)
-

Less qualified professional profiles

Training profile

The less skilled training profiles required by the industry correspond to the same specialties as those reported for higher qualification profiles. In this case, the training level required is higher o medium vocational training, or equivalent education. In the ICT case, there are some higher-level vocational training that fit with the requirements for some Smart Cities projects, such as multiplatform application development and web application development (in the field of computing and communications).

Professionals with less qualification carry out installation and maintenance tasks within Smart Cities projects in different areas. Among these professionals are, for example, electricians, mechanics, operators of refrigeration, and solar installers. No specific knowledge related to the sector is required beyond understanding that they are working in more sophisticated and cross-cutting projects than those carried out in traditional sectors where they are used to work.

Skills profile

Less qualified professional profiles of Smart Cities industry need the following skills: manual dexterity, attention focused, neatness and attention to detail, concern for order and quality, and learning and use of knowledge.

Examples of jobs in the Barcelona Treball website

- ✓ [Energy Efficiency Service Agent.](#)
 - ✓ [Road safety officer.](#)
 - ✓ [Municipal environmental management technician.](#)
 - ✓ [ARC Operator.](#)
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06

Future scenarios

Weaknesses

- Some Smart Cities projects tend to focus almost exclusively on technological development, without sufficiently considering the changes required in the model of urban services management (to be provided more transversally and involving municipalities), companies and entrepreneurs, and in the city's own model, which should involve citizenship in decision-making.
- Changes in strategy and development priorities of the Smart City model, to result from the changes in the city government. This is an essential issue because the implementation of a Smart City model is complex and affects virtually all city services and, therefore, requires a cross-cutting and integrated vision and involves changes in urban infrastructure and management models.
- ICT exponential growth sometimes causes the ICTs not to follow specific standards that facilitate the integration of new technologies into existing ones. Thus, the introduction of new and improved technologies is conditioned by the ability to harness the power and knowledge developed by the previous.
- Legal aspects concerning the deployment of a Smart City is in a nascent state of regulation, especially if it is considered that the public sector is one of the main agents involved in this deployment.

Threats

- The number of young people enrolled in technology education has gradually decreased in recent years, which can generate a deficit of professionals with the skills necessary to develop the industry in Catalonia and Spain.
- The high public investment required by the industry may slow down its development and effective implementation, especially in the current economic moment.

- The difficulties to get returns on private investment, as the result of public-private partnerships, and the difficulty to configure this cooperation.
- The effective implementation of the Smart Cities is also related to new uses that people, businesses and governments make of ICT. This is because many Smart Cities projects require using or/and understanding information generated in new devices. In this sense, it must bear in mind that digital gap between Spain and the average EU is increasing. Thus, in the third quarter of 2011, the Information Society Indicator (ISI), prepared by Everis and IESE, fell 0.7% in Europe and 1.3% in Spain. This indicator takes into account variables such as the number of computers or mobile phones per inhabitant, the use of social networks, or online sales.

Strengths

- The Smart City model plays a very important role in energy efficiency, in emissions reductions and in sustainable growth.
- The Smart City model not only helps create more sustainable cities, but it also promotes the competitiveness of the local industry and generates business opportunities.
- Barcelona has training centers with high capacity to educate professionals with the skills required by the industry.
- Barcelona has enough research background to lead Smart Cities' projects that can be implemented in the city and internationalized.
- Barcelona's leadership of the City Protocol Society. This is the first partnership of cities, companies and several organizations, involving 33 cities, diverse private companies, including Schneider Electronic-Telvente or Indra; universities as the London School of Economics and Massachusetts Institute of Technology, and organizations such as the Citizen Housing and Planning Council New York and the Spanish Network for Smart Cities.
- The creation, by the Third Tenure of Barcelona City Council, a department which includes the areas of town planning, environment, technology and urban services to get an integrated approach to boost Smart Cities projects in the city.

Opportunities

- The fact that Barcelona is in the eighth position in the European ranking of smart cities, after Copenhagen, Stockholm, Amsterdam, Vienna, Paris, Berlin and London²⁴.

²⁴ "Barcelona pushes up in the ranking". "Smart". La Vanguardia, November 14th. 2012.

- Barcelona is in the first position in Smart Spanish cities ranking, before Santander, Madrid, Malaga and Bilbao, in this order²⁵.
- The fact that Barcelona organizes in 2013 a new edition of "Smart City Expo & World Congress" to be held during "World Sustainable Mobility Week", coinciding with the most important exhibition of electric vehicles and the fourth edition of the international exhibition of rail industry, the BcnRail.
- The creation of an excellence Smart City center (the first one) in the 22@, resulting from the collaborative effort between the city of Barcelona and the company Schneider Electric-Telvent, in which it is planned to develop energy, transportation or construction projects, in collaboration with other companies.
- The public collaboration as a mechanism to develop new business models around the growth of Smart Cities. The concentration of population in cities and the need to manage them efficiently and sustainably means that, in one way or another, all traditional sectors have growth and employment opportunities due to the development of Smart City model.
- The concentration of population in urban areas, which gives cities a large political and economic weight. In this sense we must take into account that 75% of the world population will live in cities in the next 40 years, and that Europe has the highest rates of urbanization, which will be close to 80% in 2020.
- Barcelona is a tourist attraction; the first quarter of 2012 3,564,611 tourists visited the city, 1.7% higher than that in the same period last year²⁶. Increasing the value of touristic supply by means of developing technological systems is an opportunity to further develop the field of Smart Cities, and to create jobs not only in tourism but also in ICT.
- The need to reduce the effects of the combination of population growth and climate change through ICT development and renewable energy, which, according to Jeremy Rifkin (adviser of European governments and European Commission), can lead to "third Industrial Revolution or to energy Internet "and promote changes towards the Smart City model.
- The estimated 30,000 million dollars investment in broadband communications systems, health or power distribution networks. This could generate about one million jobs only in the U.S.²⁷.
- The citizenship approach to decision centers through e-Participation applications. This can turn the cities into democratic spaces.

²⁵ "A language called City Protocol". El País, November 11th. 2012.

²⁶ Barcelona City Council.

²⁷ Atkinson, Robert D., Daniel Castro and Stephen J. Ezell. "The Digital road to recovery: A stimulus plan to create jobs, boost productivity and revitalize America". International Technology and Innovation Foundation. 2009. <http://www.itif.org/files/roadtorecovery.pdf>.

- The Smart Cities need to have intelligent citizens (people willing to participate in the city management and able to use the ICT) to promote citizen participation and reduce the digital gap.

07 Useful links

International organisations

City Protocol Society

<http://www.cityprotocol.org/>

European Smart Cities

<http://www.Smart-cities.eu/>

SETIS, Strategic Energy Technologies Information System

<http://setis.ec.europa.eu/about-setis/technology-roadmap/european-initiative-on-Smart-cities>

European Commission. Technology & Innovation. Smart Cities and Communities

http://ec.europa.eu/energy/technology/initiatives/Smart_cities_en.htm

Massachusetts Institute of Technology

<http://cities.media.mit.edu>

World association of the Major Metropolises

<http://www.metropolis.org/>

United cities and local governments

<http://www.cities-localgovernments.org>

Centro Iberoamericano de Desarrollo Estratégico Urbano (CIDEU)

<http://www.cideu.org>

Spanish organisations

Barcelona Ciudad Inteligente

<http://Smartbarcelona.cat/es/>

Ayuntamiento de Barcelona. BarcelonaCrecimiento.

<http://w42.bcn.cat/web/cat/>

Distrito 22@ Barcelona

<http://www.22barcelona.com/>

Red Espanyola de Ciudades Inteligentes (RECI)

<http://www.redciudadesinteligentes.es/>

International events (fairs, conference, etc.)

Smart City event

<http://www.Smartcityevent.com/>

Spanish events (fairs, conference, etc.)

Smart City Expo Barcelona

www.Smartcityexpo.com/

I Congreso Smart Grids

<http://www.eSmartcity.es/eventosDetalle.aspx?id=505&idm=104&pat=104>

National and International themed portals

Smart Cities and communities

<http://eu-Smartcities.eu/>

Live. Enchúfate a Barcelona.

<http://w41.bcn.cat/>

Smart Cities (Idom)

<http://www.Smartcities.es/>

Smart Cities projects around the North Sea

<http://www.Smartcities.info>

Connected Urban Development (CUD). CISCO's initiative.

<http://www.connectedurbandevlopment.org/>

List of publications about cities growth. McKinsey & Company

<http://www.mckinsey.com/>

eSmartcity. Todo sobre ciudades inteligentes

<http://www.eSmartcity.es/>
