



Rejuvenating Barcelona with digital technologies





Rejuvenating Barcelona with digital technologies

Barcelona already experienced a significant transformation in the early 90's, when the city hosted the Olympic Games. However, the recent growth in connected devices and advanced manufacturing is challenging the city's development once more. In order to turn its challenges into opportunities, Barcelona has embraced the emergence of new technologies. With a local network of five Fab Labs, the city is becoming a playground for testing, prototyping and shaping tomorrow's industry. This is helping Barcelona to reinforce its leading role in the field of innovation.

1

Problem statement

Barcelona has developed a strong innovation ecosystem

Throughout the years, the City of Barcelona has developed a set of policies and reforms that facilitated its efforts to become a Smart and Digital City.

Starting with the Olympics in 1992, the city proved that it has the capacity to fundamentally transform itself¹. This has fostered close collaboration between politicians, companies, academic institutions and residents. Ultimately, Barcelona's powerful innovation ecosystem has drastically improved the city's competitiveness.

Barcelona's Smart and Digital knowledge

Barcelona's Smart and Digital knowledge was developed on the basis of a strong industrial network and competitive clusters that enabled the creation of strong relationships and social networks between companies, institutions, city officials and citizens.

In addition to Barcelona's industrial network and clusters, the presence of relevant academic institutions is an essential asset. With their accumulated know-how, they enable constant improvements of the city's innovation ecosystem and the development of the "smart city" vision (i.e. the Barcelona Smart City Strategy)².

A strategy based on the triple helix model

The major components of the Strategy are based on the triple helix concept, constituted of interactive companies, faculties and citizens. The components include smart districts, living lab initiatives, infrastructures, new services for citizens as well as open data and open innovation platforms.

To support the Strategy, Barcelona uses existing and new digital and non-infrastructures: the 22@ Barcelona innovation district; corporate fiber-optic networks; wireless mesh networks; sensor networks and Public Wi-Fi networks.

Living labs are key drivers of innovation

The process of digitalisation in Barcelona started in the mid '90s and affected mobility and education. Living labs are used as tools and the basis for cooperative processes leading to the creation of user innovation in a real life environment.

Within Barcelona's strategy, Living Lab initiatives are of particular importance³. They inspire companies to test and develop innovative product or service solutions in any field, ranging from sensorisation to urban planning.

Living Labs are employed for learning, conducting tests as well as for research about the implementation of new technologies and services in a large-scale real-life environment.

Barcelona's innovation agenda gets international recognition

Owing to Barcelona's outstanding performance in the fields of innovation and digitalization, the city is now recognized as an International Innovation Hub.

In fact, it was acknowledged internationally at the Innovation Convention 2014, when the city received the "European Capital of Innovation (iCapital) award" from the European Commission for "introducing the use of new technologies to bring the city closer to citizens"⁴.

"Barcelona is a deserving winner of the first iCapital award, for its dedication to using new technologies for the benefits of its inhabitants." – Máire Geoghegan-Quinn, European Commissioner for Research, Innovation and Science⁵

2

The award is a result of the positive outcome of the “Barcelona as a people city” project in which the city introduced new technologies to foster economic growth and the welfare of its citizens through⁶:

- open data initiatives;
- sustainable city growth initiatives on smart lighting;
- mobility and residual energy;
- social innovation;
- promotion of alliances between research centres, universities, private and public partners and the provision of smart services.

2

Realised benefits and new opportunities

Barcelona's smart city strategy creates jobs and cheaper housing

A detailed assessment of the benefits and costs stemming from the digital transformation in Barcelona is difficult to make. However, some insights can be derived when narrowing down the analysis and focusing on the Barcelona Smart City Strategy.

The Fireball4smartcities project estimates that the strategy created more than 4,000 units of new housing with rental prices that are 25% lower and 55,000 jobs at over 1,500 new companies. Also, the strategy has led to the creation of new institutions, mainly in information and communication technologies as well as media industries⁷.

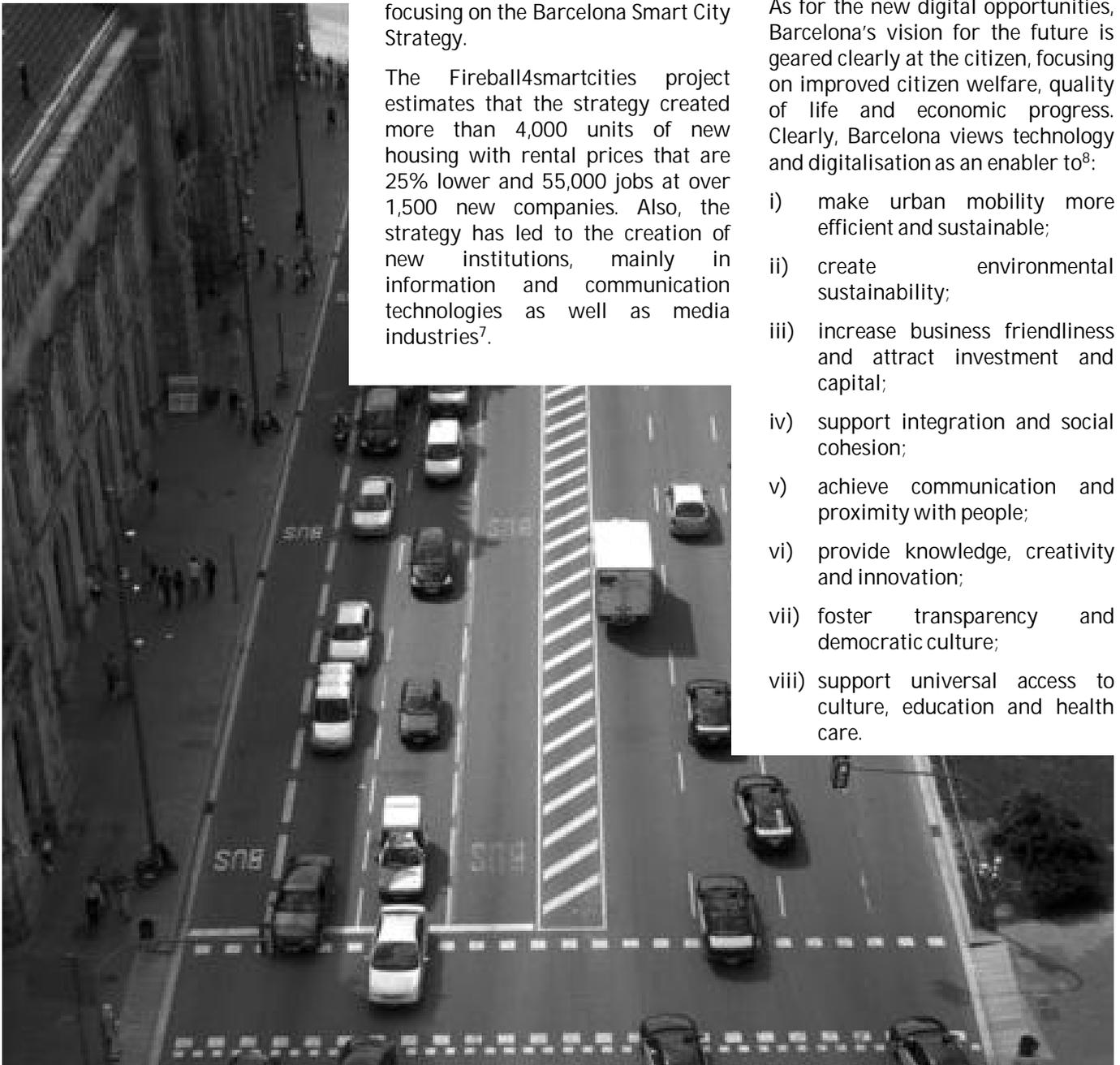
Private sector benefits from improved framework conditions

Owing to a higher density of collaboration and networking, also private organisations gain from the use of leading-edge infrastructures. For instance, through a particular type of living Lab (the 22@Urban Lab) new products and patents are generated from commercial products that have been tested and validated at least in one city. This assures the viability of their solutions in a real environment while fostering innovation.

Barcelona's innovative initiatives will enable fundamental changes

As for the new digital opportunities, Barcelona's vision for the future is geared clearly at the citizen, focusing on improved citizen welfare, quality of life and economic progress. Clearly, Barcelona views technology and digitalisation as an enabler to⁸:

- i) make urban mobility more efficient and sustainable;
- ii) create environmental sustainability;
- iii) increase business friendliness and attract investment and capital;
- iv) support integration and social cohesion;
- v) achieve communication and proximity with people;
- vi) provide knowledge, creativity and innovation;
- vii) foster transparency and democratic culture;
- viii) support universal access to culture, education and health care.



Open data access puts citizens at the centre of innovation

Following the initiatives of other cities in Europe, Barcelona has made public data (not subject to any legal restriction) publicly available through the Barcelona Open Data Portal. With currently 326 datasets, 1116 counting historical series and 2585 counting the different formats, this initiative fosters the creation of services by the private sector which are based on public information⁹.

The Barcelona Open Data Portal



provides access to **326** datasets, **1116** counting historical series, and **2585** counting the different formats.

Open innovation creates a dynamic business environment

In connection with the implementation of the 22@UrbanLabCase, Barcelona has been a frontrunner in capturing benefits stemming from technological development. It has increasingly embraced and encouraged innovation from different points of view, including core markets, new markets, entrepreneurs etc.

Today's innovation paradigm includes the creation of a less formal and highly dynamic process. Different stakeholders (e.g. researchers, entrepreneurs, investors and public authorities) jointly work to accelerate and improve the business environment.

Internet of things allows Barcelona to save money and improve its environmental footprint

New digital opportunities could rely also on the Internet of Things concept. According to CISCO, today only 1% of what can be connected, is connected¹⁰.

The Internet of Things allows objects to be sensed and controlled remotely across existing network infrastructures, creating opportunities for more direct integration between the physical world and computer-based systems. This results in improved efficiency, accuracy and economic benefit¹¹.

How Sant Cugat benefited from the Internet of Things

Sant Cugat is a small city close to Barcelona. As part of the @22Barcelona innovation district project, the city has strongly leveraged on the Internet of Things concept.

In fact, Sant Cugat installed electric vehicle charging stations, sensors on trash and recycling bins to minimise costs and the environmental footprint, water sensor in parks to ensure water is used more efficiently, sensors in parking areas to indicate empty spaces and sensors on streetlights that detect movements and adjust the illumination accordingly.

Such initiatives allow the city to save money, to be more efficient and to reduce the environmental footprint. Together, they illustrate the potential opportunities that smart cities can offer.

Fab Labs and digital manufacturing accelerate innovation

Another big opportunity is digital manufacturing and its use outside of the Fab Labs, a concept which is already established in Barcelona. 3D printing is the technology which has the highest growth opportunities as it has, in contrast to many other technologies, not yet reached a high level of market penetration.

3D Printing technology brings a wide range of benefits, including product innovation and personalisation, time-to-market reduction, simplified product distribution, production process innovation and production cost reduction.



© Ovidio Roy/Pexels.com

“When governments and businesses work together in partnership, there is unique opportunity for innovation and growth. Through their 2020 Vision, the City of Barcelona is seizing this opportunity to use technology to drive economic and social transformation and become a model for the world”– Cisco Chairman and CEO, John Chambers¹³

3

Drivers and obstacles

A

Drivers

Barcelona embraced the sharing economy and servitisation trend

A new economic trend is on the rise and rapidly transforming the relationship of businesses with consumers. Businesses are finding creative and innovative ways to promote renting, lending, swapping, bartering, gifting, and sharing products between strangers around the world. In doing so, they have created a trend known as collaborative consumption, a term that describes the shift in today's consumer values from ownership to access¹².

Today's widespread access to the internet and social media is making it possible to match what people own to what people want, allowing sharing and swapping to happen at a phenomenal rate. This enables personalisation (tailoring of services and products to individual customers' needs), process automation and engineering, new product developments and market enlargement.

Sharing economy fostered the community

Many start-ups and small businesses were created in the Barcelona area, creating a surge of co-working spaces. This collaborative spirit helped the city to form a stronger community.

Peer-to-peer platforms (e.g.: trip4real, EatWith, Airbnb) have created a very simple opportunity for people to become micro-entrepreneurs and generate some additional income.

In addition, the Catalan lifestyle attracts many tourists creating endless opportunities for these types of businesses to prosper.

Strong academic institutions attract top talent

Some of the world's top ranked business (IESE, ESADE) and design (IED, BAU) schools are located in Barcelona, resulting in many sharp-minded individuals to gather from all over the world.

For an upcoming tech start-up, this proves to be an exceptional pool of both local and international talent.

Easy access to financial incentives fosters innovative action

A key element of Barcelona's digital strategy is the presence of an easy access to financing based on the participation of both public and private stakeholders.

Barcelona's municipality offers many financial channels. For example, Barcelona Activa¹⁴ which was founded by the city council in 1986 aims at improving the economic growth of the city and promoting SMEs, entrepreneurship and employment through the provision of major incubators for innovative start-ups.

Other government associations include:

- ACC10 (Agency of the Government of Catalonia to promote Business Development, Innovation and Exports);
- INICIA (Online resource and support centers for entrepreneurs in Catalonia)

"[Fab Labs] must generate solutions, projects with impact and educational programs that help to make them durable. The ultimate goal is not the success of fablabs, but the success of the initiatives they impel." – Tomas Diez, Founder and Director of Fab Lab BCN

Incubators and accelerators complement public programmes

With regard to incubators and accelerators, significant examples of financial channels are represented by:

- Seedrocket (a private initiative providing a complete Seed Funding Venture Program for Entrepreneurs that includes funding, training and support which is tailored to the individual needs of new technology start-ups);
- LaSalle Technova (one of Europe's leading incubators for innovative technology start-ups);
- Wayra (Telefonica's incubator program with operations in 14 countries).

Wayra is frequently mentioned as a reference initiative in digital entrepreneurship by the relevant stakeholders. The reason is that Wayra is providing funding, office space, mentoring and access to the Telefonica R&D platform to a wide range of selected start-up companies.

City offers various additional incubator opportunities

Investors who are calling for great opportunities and entrepreneurs who are looking for financial support find a developed playing field in Barcelona.

The city provides extensive access to investment firms (Nauta Capital, Active VP, Highgrowth, Caixa Capital Risc and Inveready).

Also, Business Angel Groups are active in Barcelona (ESADE BAN, IESE BAN, Lanta Digital Ventures, Intellectium, BCN Business Angels).

Other incubation opportunities are available through intermittent Barcelona programmes provided by international organisations. Examples include the Founder Institute, the largest incubator in the world, Seedcamp and many others.

Key stakeholders

The involved stakeholders who act as facilitators and who create a vivid environment for the rise of innovative initiatives in Barcelona include:

- i) Public Stakeholders
 - Ministry of Economics and Competitiveness;
 - Ministry of Industry, Energy and Tourism;
 - Spanish Agency for international Development Cooperation;
 - University of Catalonia.
- ii) Private Stakeholders
 - Institute for Advanced Architecture in Catalonia;
 - Large international firms (e.g. ABB, CISCO, Endesa, Moriz, etc);
 - Museums and artistic places.

Key infrastructures

Both Private and Public organisations foster innovation

Barcelona has developed an ecosystem of both public and private actors that enables great opportunities for new digital transformation. Besides, the great number of start-ups, many other channels such as investment firms, Universities, Research centers, incubators and accelerators are present in the city.

Figure 1: Public and private actors fuelling Barcelona's digital transformation

	Developers	Facilitators
Public	<ul style="list-style-type: none"> - Research centres - Universities 	<ul style="list-style-type: none"> - Technology transfer offices - Incubators - Scientific parks - Development agencies
Private	<ul style="list-style-type: none"> - R&D corporate laboratories - R&D consortia - Technology centres 	<ul style="list-style-type: none"> - Venture Capitalist funds - Consulting companies - Law firms - Certification agencies

Source: PwC Analysis

Barcelona Institute of Science and Technology (BIST)

The BIST was founded through a collaboration of 6 of Catalonia's top research centers:

1. the Centre for Genomic Regulation;
2. the Institute of Chemical Research of Catalonia;
3. the Catalan Institute for Nanoscience and Nanotechnology;
4. the Institute of Photonic Sciences;
5. the High Energy Physics Institute;
6. the Institute for Research in Biomedicine.

This scientific initiative seeks to foster interdisciplinary research in order to leverage its scientific impact and to position itself among the leading European institutions.

The innovation district of 22@Barcelona

22@Barcelona is an innovative and competitive campus that will transform the city into an experimentation and innovation laboratory.

Its center will be the Smart City Campus, a cluster where companies, universities, entrepreneurs and research centers associated with information technology, ecology and urban development can prosper.

Led by IMI – Urban Habitat (Barcelona city council), the Barcelona Urban Lab and a multitude of partners (CISCO, UPC, i2cat Foundation, Indra, Tradia, etc.), the 22@Barcelona project transforms 200 hectares of industrial land into a district offering modern spaces for the strategic concentration of intensive knowledge-based activities.

It is the most important urban transformation project in Barcelona of the last years and one of the most ambitious of its kind in Europe. It has a high real estate potential and is funded through EUR 180 million in public investment.

BDigital: Barcelona digital technology centre

BDigital is a private, non-profit organization and serves as a digital centre of technology. Its main aim is to drive business and growth transformation towards the new Digital Society.

The organisation invests in knowledge-intensive and high value-added products and services in order to improve the competitiveness of the economy in Catalonia.

Its main fields of expertise include Health, Security, Mobility, Energy, Food and the Environment. In its efforts, BDigital aims to foster open innovation in the Catalan industry.



B

Obstacles

Despite Barcelona's exemplary efforts to innovate in different areas such as open data, the Internet of Things and Fab Labs, there are some obstacles preventing it from achieving a full digital transformation.

Turning innovative potential into tangible benefits remains a challenge

Barcelona shows strong commitment in terms of research and investigation of digital opportunities. The traditional way of conducting research, however, has completely detached from its economical applications.

This resulted, with few exceptions (e.g. Bdigital), in an insufficient rate of cooperation between universities, research centers and local entrepreneurship as well as a lack of valuable synergies among them.

Individual initiatives need to join forces in collaborative environment

A further challenge within Barcelona's vivid ecosystem of innovation is the need of an overall management of the community and its several initiatives.

It is important to provide the necessary infrastructures, create a collaborative network and effective relationships. This will enable the achievement of real solutions and the ultimate goal of changing the way of interaction with technology.

The above mentioned challenges are strictly related to the urge to change old working habits in order to accelerate the speed in which the transformation of the city is taking place.

General socio-economic conditions in Spain impede innovation

There are still several challenges ahead for the city in order to make its innovation ecosystem more effective. The first one is to cope with the economic situation in Spain, which affects public funding and projects.

In particular, it is important to provide effective governance action in the case of budget restrictions while sustaining urban growth with continuous development.

Other main challenges include that the skilled human capital level is not high enough to satisfy the needs of industry clusters (especially in terms of digital skills); that the levels of local entrepreneurship are low compared to other countries; that the venture capital system is not fully established; that most innovation efforts are led by only a small number of large firms and that the global connectivity remains low.

More generally, there is a problem of connection that makes it more difficult for knowledge gathered at universities and research centres to be transferred to businesses.

Introduce increased collaboration to overcome socio-economic challenges

The collaboration gaps can be addressed by setting up agreements at different levels between citizens, companies, governing bodies and other agents. Only together they can create a shared vision that drive the city forward.

At infrastructure level, the deployment and management of wireless networks will be crucial.

4

Lessons learnt

Citizens must be involved as active agents in the innovation process

A key lesson from Barcelona's case is that cities of the future need to commit to a model in which citizens are not just customers but active agents of change in the urban environment.

In particular, the technological changes that have taken place over the last decades are putting the citizen at the centre of the product and service development process.

Operating model of a city is redefined across multiple dimensions

These changes go far beyond traditional citizen participation. In fact, they substantially redefine the operating models of cities. In addition, this refocus does not only take place in the political realm but also in economic, social, cultural, environmental and geographic terms, ultimately creating the "productive citizen".

Living labs as enablers of citizen participation

In this framework, living labs are of fundamental strategic importance for the innovation process, the reason being that they provide an accurate vision of what citizens need.

Also, they allow to test proposed solutions in real environments by bringing together a wide range of players who need to use technology to develop new and more efficient business models.

5

Key Recommendations

While Barcelona was able to create an excellent setting for research institutions and businesses, innovation largely occurs in isolation. Thus, the existing internal infrastructures should act as a driver to increase the collaboration between different innovation agents.

Only an interdisciplinary approach allows the city to capture its full potential. Therefore, it is essential for Barcelona to introduce platforms and the necessary infrastructure to connect technological services provided by research institutions and the industry.

The society of Catalonia needs an infrastructure that ensures both the provision of a basic service throughout Catalonia as well as the rolling out of high-capacity networks that connect Catalonia with the rest of the world in a way that will guarantee future competitiveness.

Category	Role of the stakeholder
<p>Local government</p> 	<ul style="list-style-type: none"> • Create co-workerspace and incubators • Open access to public infrastructure for technology and to develop projects • Invest in key infrastructures for a business-friendly environment such as transport infrastructures, business offices, university buildings • Be open and enabling: they should act as facilitators not only administratively, but by deploying real talent • Engage stakeholders in long-term partnerships and build trust relationship between them • Develop open innovation and open data platforms
<p>Universities/ Research centres</p> 	<ul style="list-style-type: none"> • Be proactive in the creation of a digital ecosystem around the university • Strengthen your digital competences (e.g. by seeking support from local tech champions) • Create networks with other universities and local business as well as create university spin-off • Retain and attract digital talents
<p>Businesses</p> 	<ul style="list-style-type: none"> • Innovate, create and apply digital technologies • Collaborate with other stakeholders from the digital ecosystem • Traditional companies should seek support in the application of digital opportunities • Experiment in cooperative environment (e.g. Fab Labs) • Tech companies should support traditional companies in their digitalisation efforts
<p>Incubators</p> 	<ul style="list-style-type: none"> • Connect business with relevant stakeholders to enable their digital transformation • Provide spaces for people to meet and open space for cross-fertilization • Provide inspiration, support and stimulation

References

¹ Business Insider, "How The Olympic Games Changes Barcelona Forever", 2012, available at: <http://www.businessinsider.com/how-the-olympic-games-changed-barcelona-forever-2012-7?IR=T>

² Ajuntament de Barcelona, "Barcelona Smart City", 2013, available at: <http://ibarcelona.bcn.cat/>

³ European Network of Living Labs (EnoLL), "All our Living Labs in Spain", available at: <http://www.openlivinglabs.eu/ourlabs/Spain>

⁴ The European Innovation Partnership on Smart Cities and Communities (EIP-SCC), "Barcelona, awarded with the European Capital of Innovation", 2014, available at: <https://eu-smartcities.eu/content/barcelona-awarded-european-capital-innovation>

⁵ EC, "Barcelona is "iCapital" of Europe", 2014, available at: http://europa.eu/rapid/press-release_IP-14-239_en.htm

⁶ League of European Research Universities, "Barcelona is "iCapital" of Europe", 2014, available at: <http://www.leru.org/index.php/public/news/barcelona-is-icapital-of-europe/>

⁷ Fireball, "Fireball white paper on Smart Cities as Innovation Ecosystems sustained by the Future Internet", 2013, available at: http://www.academia.edu/3021992/FIREBALL_white_paper_on_Smart_Cities_as_Innovation_Ecosystems_sustained_by_the_Future_Internet

⁸ Ajuntament de Barcelona, "Barcelona Smart City", 2013, available at: http://ibarcelona.bcn.cat/sites/default/files/barcelona_smart_city.pdf

⁹ Ajuntament de Barcelona, "Open Data BCN", available at: <http://opendata.bcn.cat/opendata/en>

¹⁰ McKinsey, "Connecting everything: A conversation with Cisco's Padmasree Warrior", 2013, available at: <http://www.mckinsey.com/industries/high-tech/our-insights/connecting-everything-a-conversation-with-ciscos-padmasree-warrior>

¹¹ IoT Symposium, "About IoT", available at: <http://www.iotsymposium.co.in/about-iot/>

¹² Barcinno, "See How Barcelona Is Inspiring New Collaborative Consumption Platforms", 2015, available at: <http://www.barcinno.com/barcelona-inspires-collaborative-consumption-platforms/>

¹³ Cisco, "Barcelona and Cisco Announce Strategic Initiatives to Transform the City into a Global Urban Reference Model", 2012, available at: <https://newsroom.cisco.com/press-release-content?articleId=680179>

¹⁴ Ajuntament de Barcelona, "Barcelona Activa", available at: <http://www.barcelonactiva.cat/barcelonactiva/cat/>

This report was prepared with the support of PwC, CARSA, IDATE and ESN as part of the Digital Entrepreneurship Monitor project for the European Commission, Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs.

Editors: Laurent Probst, Bertrand Pedersen & Olivia-Kelly Lonkeu, Giovanna Galasso, Enrico Gaspari & Fiona Arnone PwC

© - 2016 – European Union. All rights reserved. Certain parts are licensed under conditions to the EU.

This publication is funded under the COSME programme of the European Union.