The Internet of Things (IoT) in Catalonia

October 2019

Technological Snapshot

ACCIÓ

Generalitat de Catalunya

The Internet of Things (IoT) in Catalonia: Technological report

ACCIÓ
Regional Government of Catalonia (Generalitat de Catalunya)

Execution
Strategy and Competitive Intelligence Unit of ACCIÓ and
Sowlers Technologies SL

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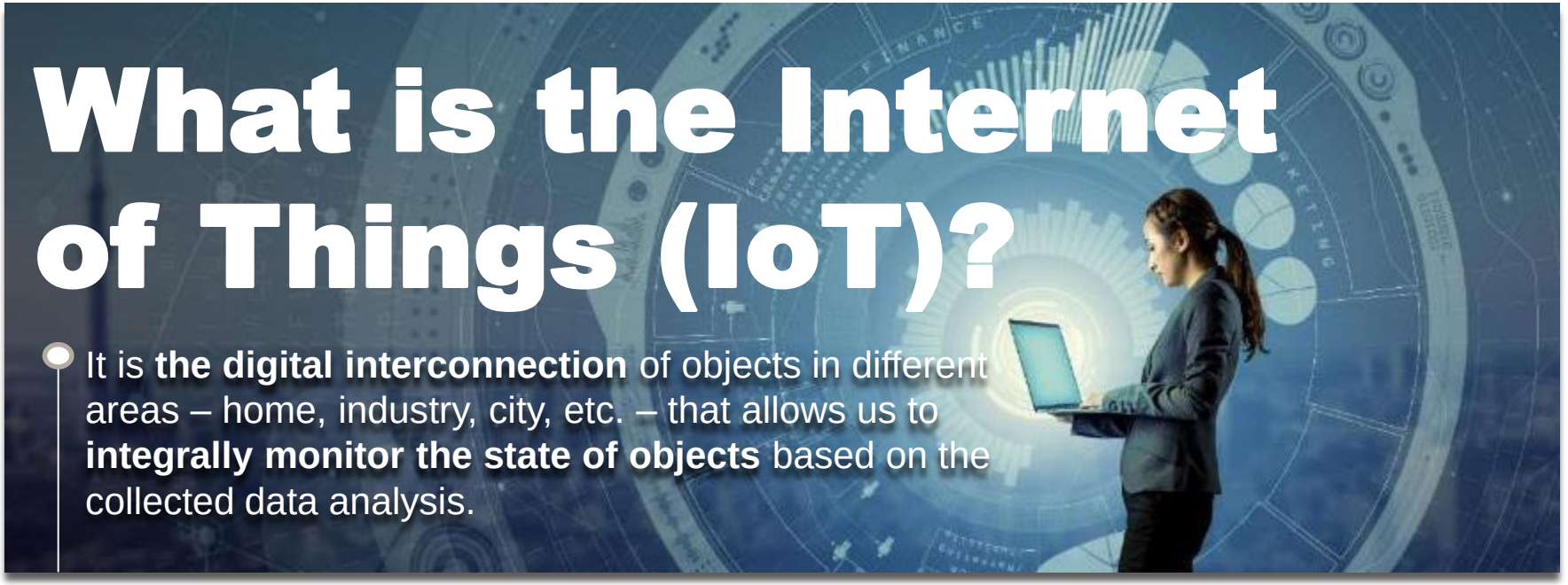
1. The Internet of Things (IoT): definition and importance for industry

What is the Internet of Things (IoT)?



It is **the digital interconnection** of objects in different areas – home, industry, city, etc. – that allows us to **integrally monitor the state of objects** based on the collected data analysis.

It involves **enriching different devices with integrated computing** and connecting them using standard technologies. This allows different devices to **communicate and interact,** both between them and with centralised controllers. **Analysing the data** collected by these objects allows them to make decisions and act or **modulate their behaviour**.

The Internet of Things (IoT) is a **key driver for innovation,** focused on consumers, data-based business opportunities, industrial transformation, new applications and even new business models, as well as revenue flows in all sectors of the digital transformation economy.

The IoT concept, depending on its field of application, may adopt different names: «**smart cities**» in the case of urban applications, «**industrial IoT**» (IIoT) for industrial applications, «**smart homes**» for household applications, «**connected vehicle**» in the case of vehicles, etc.

The IoT is not a technological revolution, but a technology-leveraged **business revolution**. It is about the **services** offered, not the devices themselves.

Source: *IDC, World Bank and our own data.*

How does the Internet of Things (IoT) work?

COMPONENTS

Sensors
The sensors collect data from physical or mechanical systems and transfer it to the cloud using networks and connectivity technologies.

Networks
Connections are established through short-range wireless technologies, such as WPAN (Wireless Personal Area Network), WAN (Wide Area Network), Wi-Fi or mobile technology (5G).

Big data/analytics
Smart analytics are applied to extract useful information.

Actuators
They allow changes to be made to the internal state of the device or use it to perform an external task.

IoT KEYS FOR COMPANIES

Reducing expenses

Increasing productivity while maintaining production times.

Reducing costs.

Reducing waste.

Increasing profits

Better understanding the sales patterns and improving the demand forecast.

Improving user experience while increasing retention.

Achieving a better time-to-market.

Source: *IDC, World Bank and our own data.*

Practical examples of IoT ecosystems

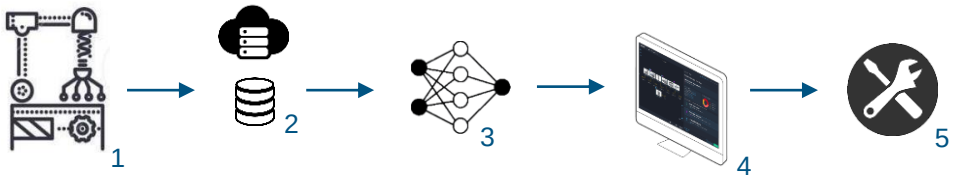
The ecosystem in which the Internet of Things occurs allows the user to remotely connect and control their devices. By using a remote control device (smartphone, tablet) you can access information generated by different sensors or send the order to start a process.

The device processes the received order and executes the action or sends the requested information through the network, for it to be analysed and shown on the remote control device (smartphone, tablet).

- In the example of a connected home, the user monitors the state of the different devices (lighting, temperature, operation) and is able to start or stop it.

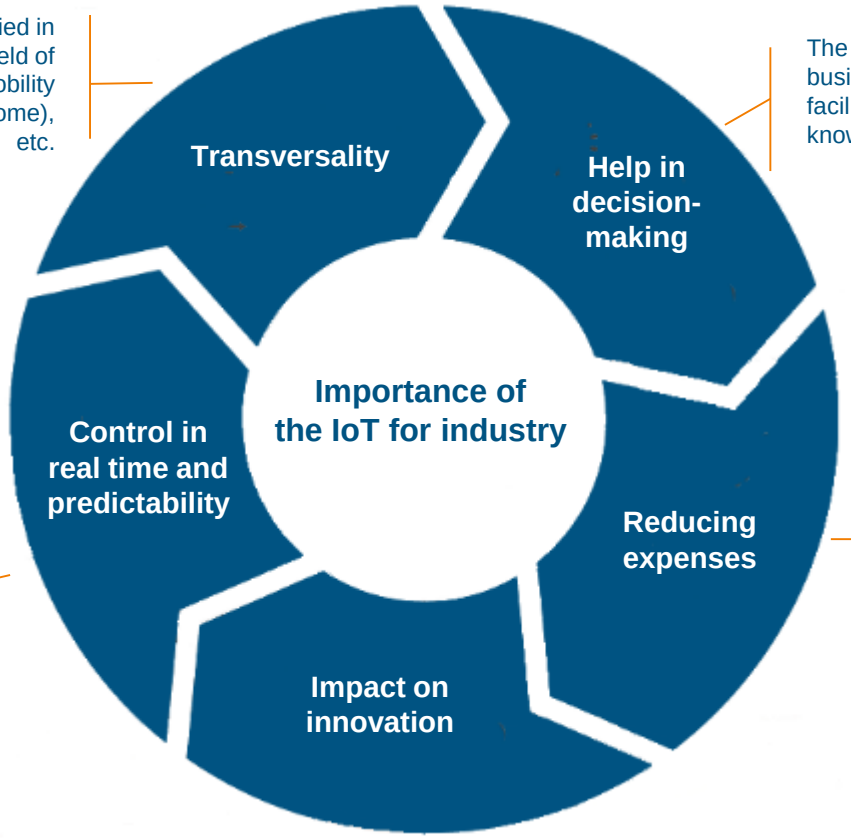
1. Switching on or off the air conditioning.
2. Switching on the lighting.
3. Programming cleaning devices.
4. Switching on or off the TV set and channel control.
5. Monitoring food quantity and state.

- With regard to industry, the IoT allows us to monitor production processes and carry out predictive maintenance by sensorising and monitoring the maintenance needs of robots throughout the chain and prepares repairs before the components are damaged.



1. Sensorised production chain.
2. Operation data is collected and stored for processing.
3. A predictive analysis of future failures is made by means of machine-learning algorithms.
4. Viewing state information and possible alerts on the monitoring and control dashboard.
5. In the case of breakdown forecasts, an automatic maintenance ticket is generated.

IoT importance for industry



It is a technology that is applied in many sectors, either in the field of production (smart factory), mobility (smart cities), housing (smart home), etc.

The fact of featuring real-time data on the business, process and product variables facilitates decision-making based on real knowledge in a faster way.

More efficient processes that are connected on two levels: device-device and device-person. This can be translated into lower costs, since information is available on the use and operation of devices, supply chains, facilities and their relationship between different devices.

The IoT generates innovation opportunities for companies in different fields (products, processes and business models).

It allows people to monitor the state of assets in real time and anticipate future behaviours. Thus, it is possible to identify possible failures before they occur and, therefore, to implement predictive maintenance systems.
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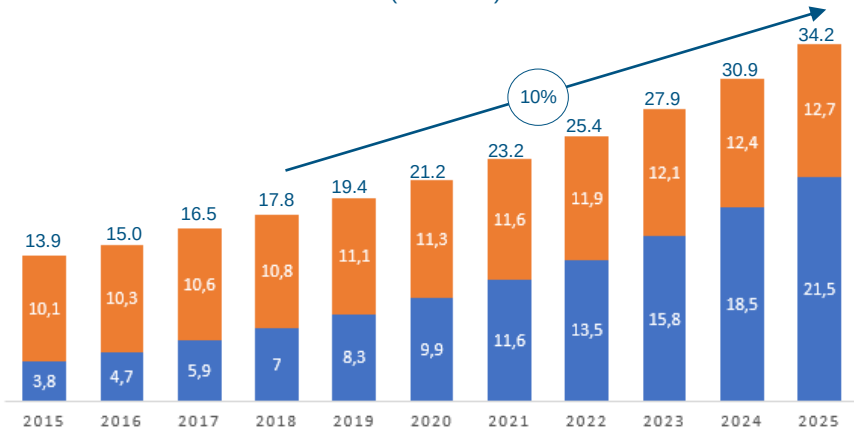
2. Main global figures

Number of connected devices

By 2020, **more than 65% of companies** (at present, 30%) will have adopted IoT products.

- The volume of connected devices worldwide in 2018 exceeds **17** billion.
- The volume of connected devices in 2018, excluding smartphones, tablets and laptops, amounts to **7** billion.
- Growth is expected to place connected devices at **9.95** billion by 2020 and at **21.5** billion by 2025. These values take into account active connections and exclude devices that were previously acquired and are no longer used.
- Regarding the ratio between IoT devices and population, there has been a significant growth in recent years, which is expected to continue. Whereas in 2013 this ratio stood at 0.07 devices per person, it is expected that this figure will reach 2.72 devices per person by 2020 and that it will exceed four devices by the year 2025.

Volume of connected devices worldwide (one billion)



- Smartphones, tablets and laptops
- IoT devices, excluding smartphones, tablets and laptops

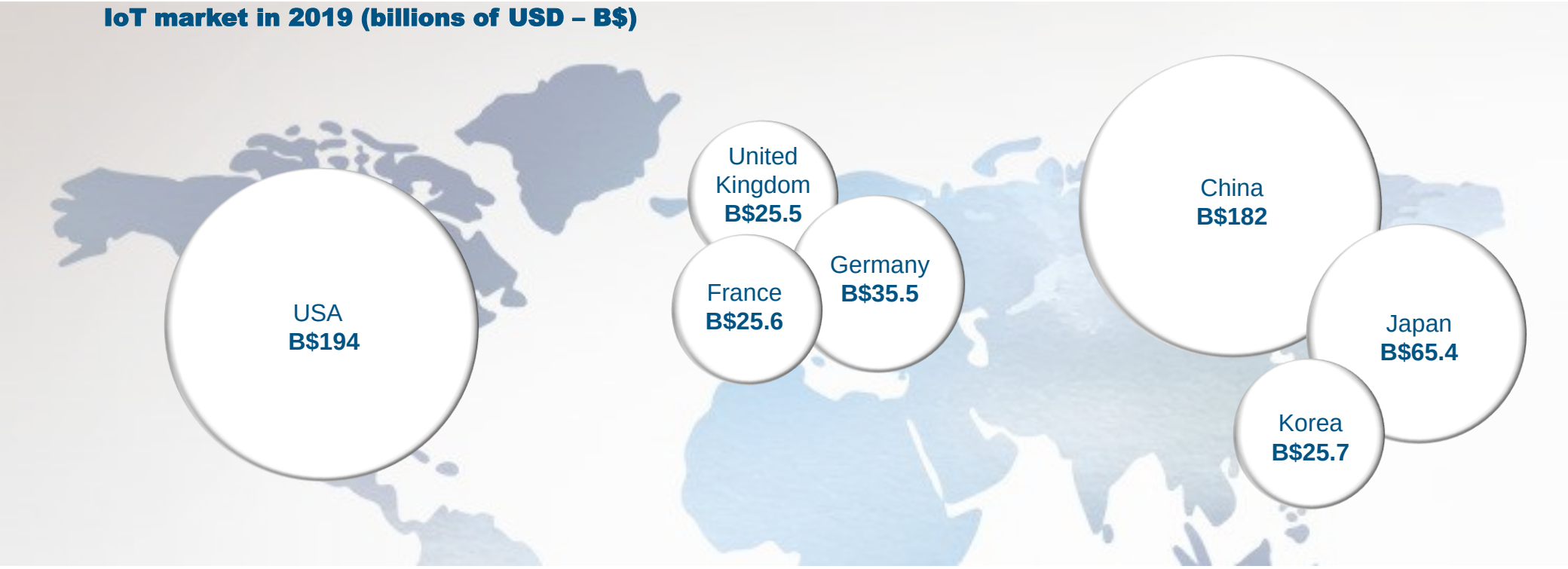
Year	Population	IoT devices	Ratio
2013	7.16	0.5	0.07
2015	7.38	13.9	1.88
2020	7.79	21.2	2.72
2025	8.18	34.2	4.18

Source: *IoT Analytics 2018.*

Main regions and relevant hubs

Worldwide spending on the Internet of Things (IoT) is projected to reach **745 billion** US dollars by the end of 2019. This represents an **increase of 15.4%** over the 646 billion invested in 2018.

IoT market in 2019 (billions of USD – B$)



It is expected that it will maintain the annual two-digit growth during the 2017-2022 period and exceed **the milestone of 1 billion** in 2022.

Source: *IDC 2019.*

World-leading IoT companies

The **top 20 companies** in the IoT field are:

Top 5

Source: *IoT Analytics.*

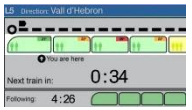
3. Trends and applications

Recent and prospective applications (I)

CURRENT APPLICATIONS → FUTURE APPLICATIONS

Available technology → Underdeveloped technology → Developing technology

SMART CITIES



Occupancy control in public transportation

Real-time parking information

Dynamic road markings

Traffic light and lighting control

Acoustic pollution mapping

Comprehensive traffic and parking management

SMART HOMES

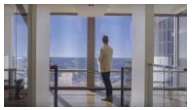
Smart thermostat

Comprehensive home security

Integration of security, power supply and heating systems

Media – audio and video reproduction control

Caring for the elderly and disabled



Smart windows adapted to outdoor conditions

Source: *World Economic Forum, World Bank Group, McKinsey Global Institute, Capgemini Research Institute, Deloitte.*

Recent and prospective applications (II)

CURRENT APPLICATIONS → FUTURE APPLICATIONS

Available technology | Underdeveloped technology | Developing technology

MOBILITY

Navigation aids and route optimisation

Connected vehicle (smart vehicle)

Predictive maintenance of roads, tracks and ports

Information on the state of tracks in real time

Customs queue management system

Fuel monitoring and predictive vehicle and fleet maintenance

INDUSTRIAL IOT (IIOT)

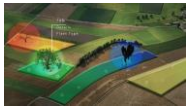
Temperature control to maintain quality

Control of usage capacity and equipment loading management

Satellite network for wildlife monitoring

Process control and stock monitoring

Logistics in the cold chain



Agricultural sensorisation analytics

Source: *World Economic Forum, World Bank Group, McKinsey Global Institute, Capgemini Research Institute, Deloitte.*

Recent and prospective applications (III)

CURRENT APPLICATIONS → FUTURE APPLICATIONS

Available technology → Underdeveloped technology → Developing technology

MASS MARKET/ RETAIL

Sensorisation of biodegradable and biocompatible **food**

Retail
Individual information in real time

Retail
Integration of sales services into tourism – e.g. shopping day trips

Prevention of bicycle thefts

Reducing paper forms through the use of mobile devices + sensors + QR codes + cloud services

Retail
Smart shelves

HEALTH

Smart watch

Monitoring disease risk

Remote health monitoring and treatment of chronic diseases

Smart scales

Providing updated and real-time information to the nearest clinic

Smart beds at hospitals

Source: *World Economic Forum, World Bank Group, McKinsey Global Institute, Capgemini Research Institute, Deloitte.*

Recent and prospective applications (IV)

CURRENT APPLICATIONS → **FUTURE APPLICATIONS**

Available technology → Underdeveloped technology → Developing technology

SUPPLIES

Communication hubs with solar power

Light, water, gas – predicting congestion and drop in supply networks

Comprehensive management of facility inspections by technicians through RFID

Energy management

Automatic adaptation to different supply sources according to dynamic demand

Smart meters

Source: *World Economic Forum, World Bank Group, McKinsey Global Institute, Capgemini Research Institute, Deloitte.*

The Internet of Things and the OBJECTIUS DE DESENVOLUPAMENT SOSTENIBLE

Health
Sensors to diagnose patient health with more precision and monitor disease risk.
Interconnected medical devices sharing patient information.
Remote health monitoring and treatment of chronic diseases
Providing updated and real-time patient information to the clinic.

Responsible production and consumption
Optimising the cost of resources.
Reducing production costs, more sustainable production thanks to control and monitoring.

Sustainable energy
Communication hubs with solar power.
Control of consumption with automatic adaptation to different supply sources.

Sustainable cities
Optimising energy expenditure in buildings and infrastructure.
Interconnected devices to collect big data in the IoT.
Integrating security, power supply and heating systems for a sustainable use.

Infrastructures and industry
Optimising industrial processes and logistics thanks to the IoT.
Improvement and automation of productive processes.
Control of usage capacity and loading management.
Sensorisation analytics.

Source: *World Economic Forum, SmartCity Expo World Congress, ITU, CISCO, ERICSSON.*

4. The Internet of Things in Catalonia

Main mapping conclusions

251 companies have been detected in Catalonia that are dedicated to offering IoT solutions for businesses

A turnover of M€519.9 directly linked to the Internet of Things

3,188 employees linked to the Internet of Things

Types of companies considered:
- Platforms and software (31.3%)
- Integration (30.5%)
- Consulting and services (24.1%)
- Sensors (10%)
- Network (4%)

The Internet of Things in Catalonia

An ecosystem formed by both start-ups and mature businesses with a business line in the IoT

63.8% of companies are less than ten years old

92.4% of companies are SMEs

32.5% of companies with a turnover of more than one million euros

Highly internationalised sector:

38.6% of companies are exporters

10% of companies have branches abroad

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Source: *EIC (DGI-ACCIÓ) based on Orbis, ACCIÓ and Barcelona & Catalonia Startup Hub directories. For turnover and employee data (2017), estimates were made based on the business lines of companies.*

The IoT ecosystem in Catalonia (I)

Within the IoT market in Catalonia, we can identify the following types of companies in the value chain:

Sensors and automation

A company that develops components and IoT-enabling sensors

Network and cloud

A company that manages and offers IoT network and infrastructure

Platforms and software

A company that develops management platforms, software and IoT applications

Integration

A company that integrates sensors and components into devices to provide them with IoT and market them

Consulting and services

A company that offers consulting and other services around the IoT

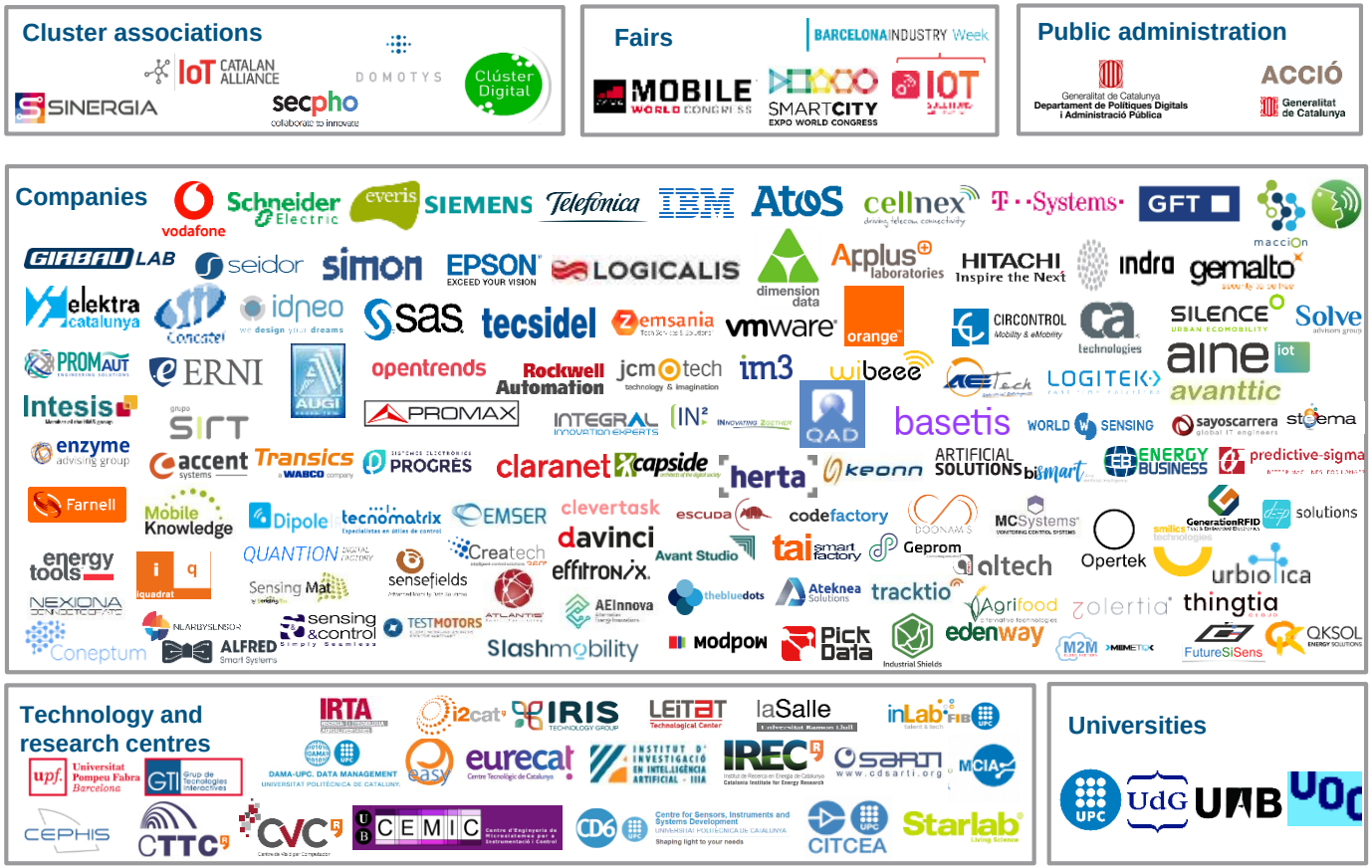
Application sectors

- Smart cities
- Smart homes
- Mobility
- Industrial IoT (IIoT)
- Mass consumer sector/retail
- Health
- Supplies

Source: *DGI (EIC-ACCIÓ).*

The IoT ecosystem in Catalonia (II)

Partially illustrative



Application sectors

- Smart cities
- Smart homes
- Mobility
- Industrial IoT (IIoT)
- Mass consumer sector/retail
- Health
- Supplies

Source: *EIC (DGI-ACCIÓ) from various sources, among which the companies directory of the IoT Catalan Alliance.*

ACCIÓ

Passeig de Gràcia, 129
08008 Barcelona
www.accio.gencat.cat
www.catalonia.com
@accio_cat
@catalonia_ti

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