



Capacities and technologies linked to Industry 4.0 in Catalonia

April 2021

Technology snapshot

Capacities and technologies linked to Industry 4.0 in Catalonia: Technological Report

ACCIÓ

Regional Government of Catalonia (Generalitat de Catalunya)



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Execution

ACCIÓ Strategic and Competitive Intelligence Unit
IDOM

Collaboration

ACCIÓ Business Innovation Unit

Barcelona, April 2021

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1. Industry 4.0



Definition of the Industry 4.0 concept

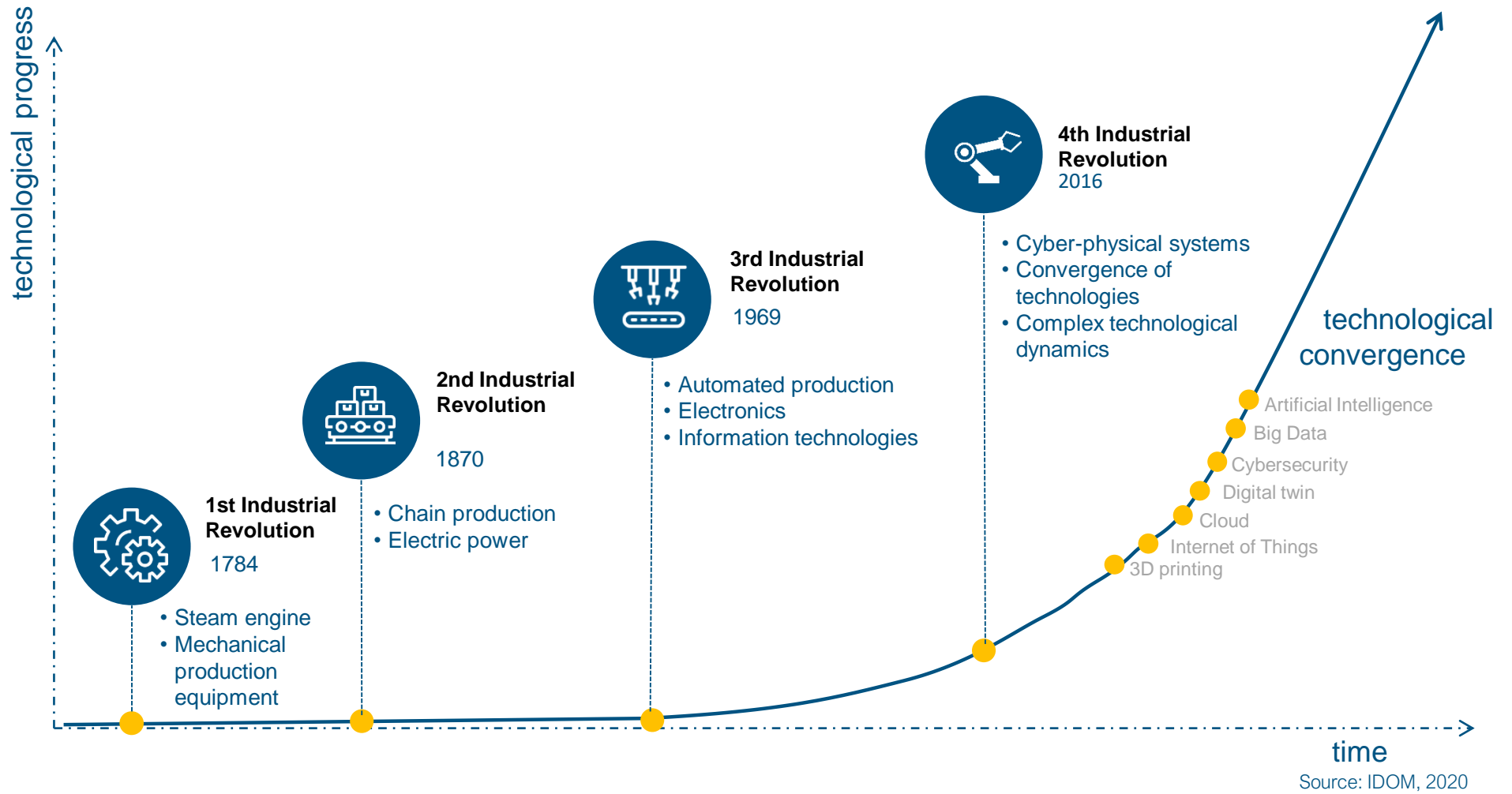
The Industry 4.0 concept represents a paradigm shift in the way things are developed, designed and produced. It is a **convergence of technological trends, such as digitisation, autonomous robots, cloud computing and artificial intelligence**, that contribute to transforming production processes.

I4.0 represents a new approach to **control production processes**, providing **integration and synchronisation** of entities and workflows within the value chain in real time, automating and highlighting the **importance of data**, increasing **flexibility**, enabling **unit and customised manufacturing** of products and optimising production **times and resources**.

Since its introduction at the Hannover Messe in 2011, the I4.0 concept has undergone an evolution over the years, with an increasingly broad and general approach that **goes beyond conventional industrial production, interacting across the entire value chain** and with other megatrends, hence inspiring numerous neologisms, such as logistics 4.0, marketing 4.0 or education 4.0, among others.



From the 1st to the 4th Industrial Revolution



Advanced Manufacturing vs Industry 4.0

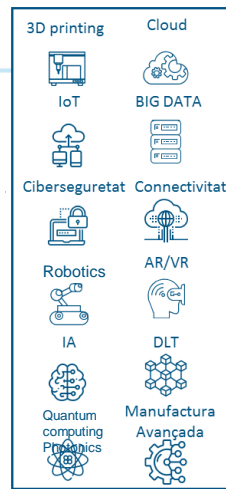
Industry 4.0, understood as the application of digital tools in the industrial value chain generating impact on business ¹, has evolved and boosted the concept of Advanced Manufacturing, making its implementation at any stage of the chain as easy as possible.

Advanced Manufacturing

Advanced Manufacturing encompasses the set of **I4.0 technologies and others** developed in industrial environments to make manufacturing more agile and efficient. To this end, it uses applications of advanced digital technologies in the industrial environment.

It acts along the manufacturing value chain and ends with the **production of a good**

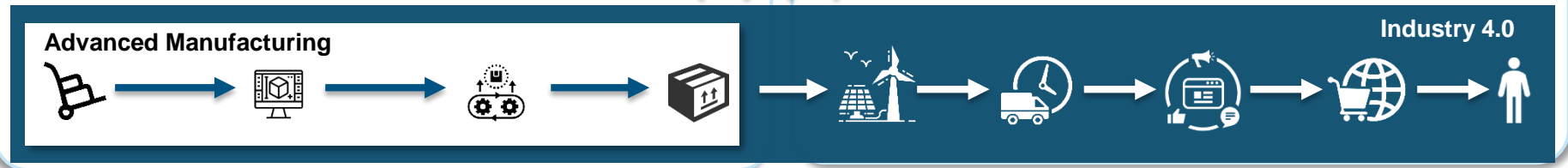
Industry 4.0 Technologies



Industry 4.0

Industry 4.0 is **the application of digital tools across the industry value chain** to profoundly transform its operations and business models.

It acts across industries (**including the production of goods, ecosystems and related services**)



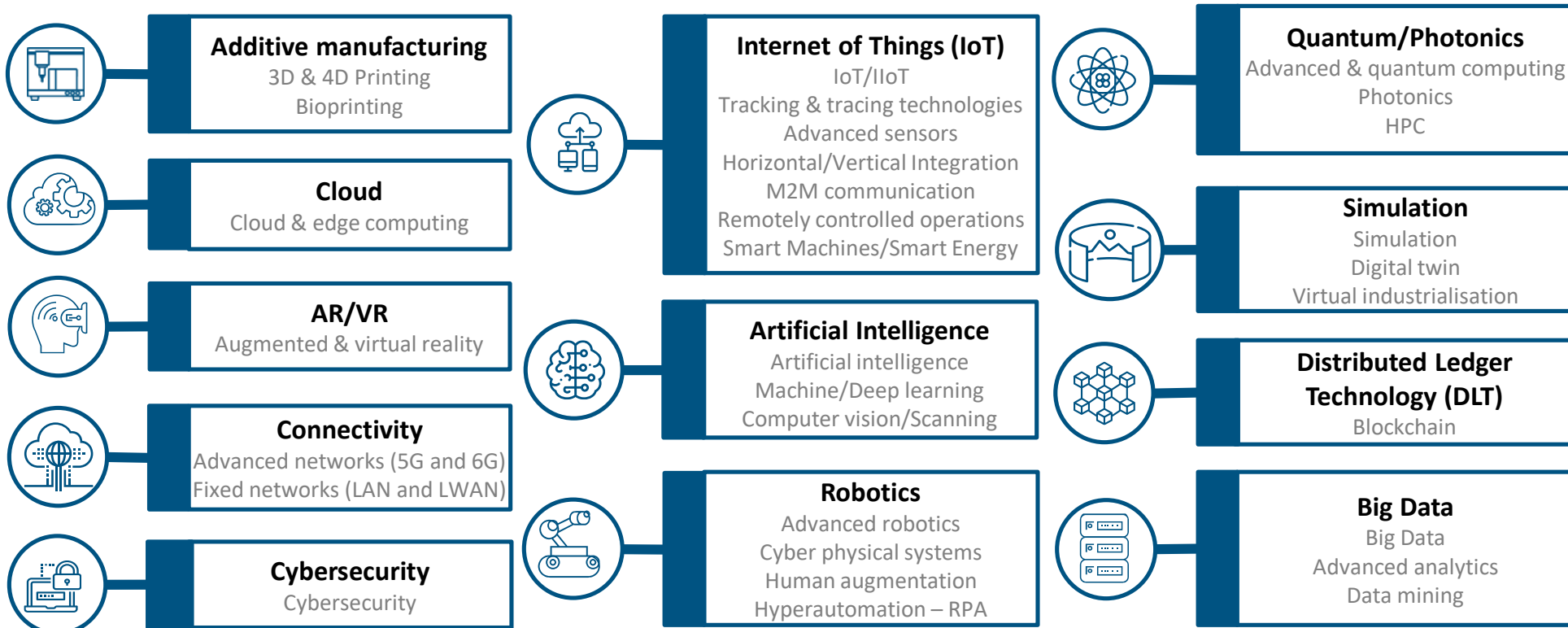
Source: 1. "Advanced Manufacturing Beyond Industry 4.0", MINSAIT 2020

2. Industry 4.0 on a global scale



Technologies included in the Industry 4.0 concept

The technologies considered within the framework of this study are as follows:



Additive manufacturing

Technological components linked to additive manufacturing

- Sensors/actuators
- Advanced robotics
- New materials
- Intelligent computer-aided design

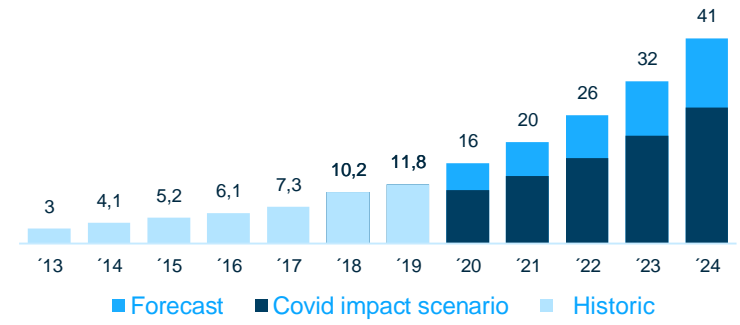
Main current capacities

- VAT photopolymerisation
- Powder bed fusion
- Material extrusion
- Direct energy deposition
- Material jetting
- Foil lamination
- Binder release

Additive manufacturing technology was already expanding before the **COVID-19** pandemic and is likely to continue to expand afterwards.

The growth of additive manufacturing after COVID-19 will depend significantly on the technology's practical applications. In the meantime, new ones have been developed in the **care and health sector**.

Size and forecast of the global 3D printing market (billions of dollars)¹



Leading countries²

- | | |
|-------------------|---------------------|
| 1 USA | 6 Japan |
| 2 United Kingdom | 7 Mexico |
| 3 Germany | 8 Switzerland |
| 4 France | 9 Italy |
| 5 China | 10 The Netherlands |

Main application sectors³

- Machinery and capital goods
- Electronics and electricity
- Other consumer goods
- Health and medical equipment
- Other services
- Car and motorbike
- Other transport industries
- Digital and audiovisual content

Advanced robotics

Technological components linked to advanced robotics



Sensors/actuators



Artificial vision



IIoT/M2M Communication



Edge/Cloud Services



Connectivity networks

Current main categories



(Domestic, medical and entertainment) service robots



Drones



Industrial and collaborative robots



Autonomous Guided Vehicles (AGVs)



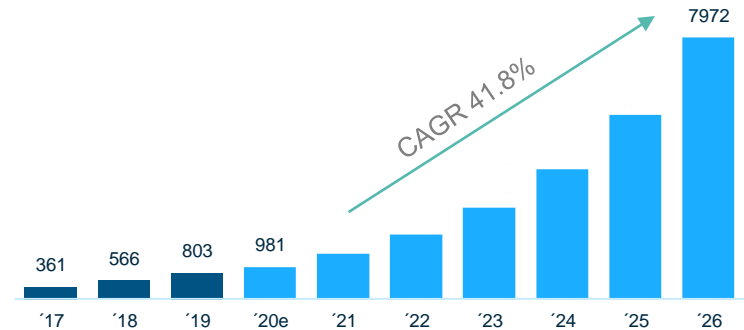
Robotic Process Automation (RPA)



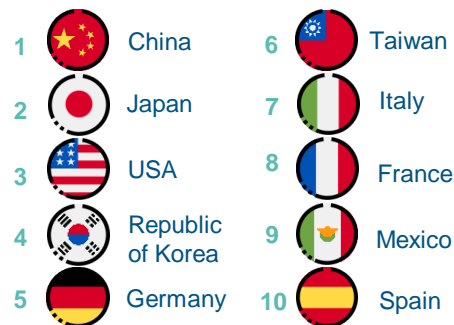
Cyber Physical Systems (CPS)

What began as a simple design to help humans lift and carry **heavy equipment** has evolved into an advanced machine, capable of thinking, learning and performing countless activities without the help or guidance of any human being. **Robots** are slowly becoming a crucial part of our daily lives

Collaborative robots market (billions of dollars)¹



Leading countries²



Main application sectors³



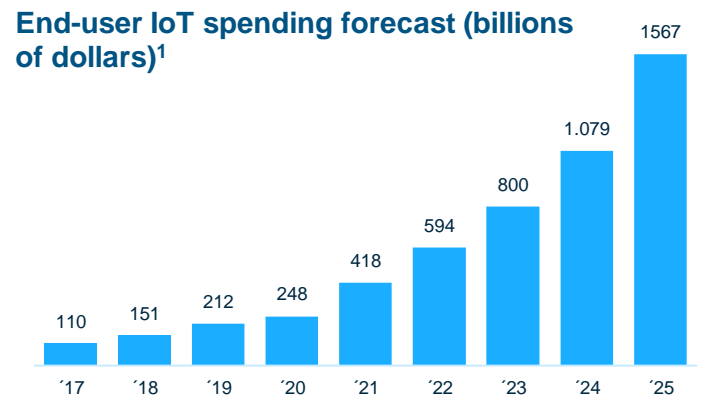
Internet of Things (IoT/IIoT)



Main current capacities

- Identification (QR code icon)
- Traceable objects (tag icon)
- Location (location pin icon)
- Data objects (hand pointing to target icon)
- Signals (heart rate icon)
- Interactive objects (hand pointing to screen icon)
- Processing (brain icon)
- Smart objects (tag with data icon)

It is estimated that by the end of 2020 there were **9.9 trillion connected IoT devices**. By 2022 this number is expected to grow to 21.5 trillion.



Leading countries²

- | | |
|----------------|--------------|
| 1 Sweden | 6 Denmark |
| 2 New Zealand | 7 USA |
| 3 Norway | 8 Ireland |
| 4 Finland | 9 Belgium |
| 5 France | 10 Bulgaria |

Main application sectors³



Artificial Intelligence

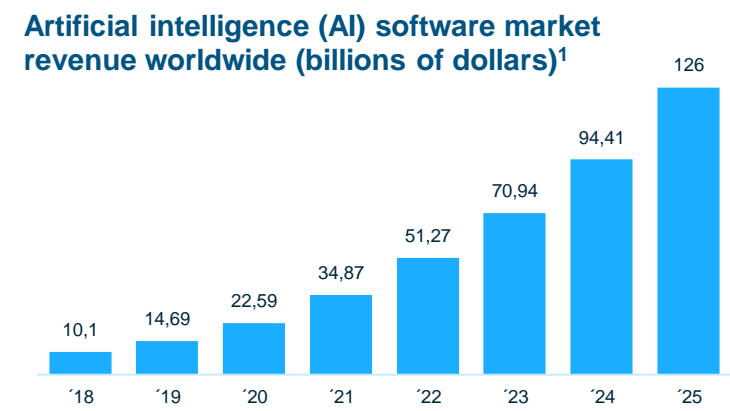
Technological components linked to the Artificial Intelligence

- Sensors, chips and processors
- Advanced computing
- Cloud services (Edge)
- Big data
- Software framework

Type of artificial intelligence

- Weak artificial intelligence
 - Deep learning
 - Machine learning
 - Neural networks
 - ...
- Strong artificial intelligence
 - Human level AI
- Artificial superintelligence
 - Smarter than human

Artificial intelligence was invented decades ago and was mainly used in **robots**, but advances in this technology and its democratisation are expanding its boundaries into new sectors and applications that are getting closer to our daily lives.



Leading countries²

- | | |
|-------------------|------------|
| 1 China | 6 Germany |
| 2 USA | 7 Norway |
| 3 United Kingdom | 8 Sweden |
| 4 Canada | 9 France |
| 5 Russia | 10 India |

Main application sectors³



DLT – Blockchain

Technological components linked to the DLT – Blockchain



On chain code/Smart contracts



Cryptography



The cloud/p2p connectivity



Distributed Ledger ...

Types of DLT technology

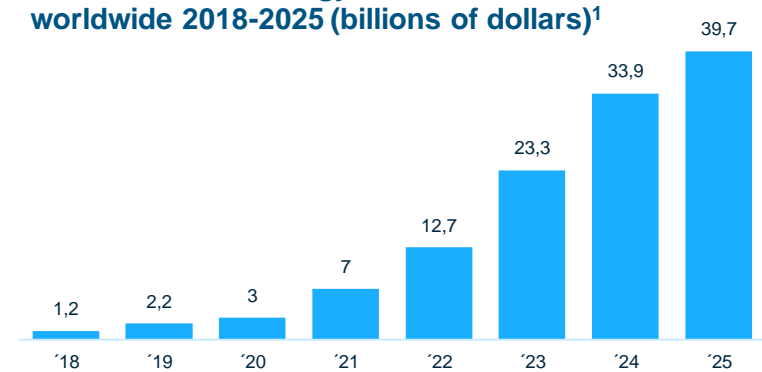
- Public
- Private
- Consortium
- Hybrid

Main applications

- Digital currencies
- Smart contracts
- Titles
- Record keeping

According to Gartner (2020), **blockchain**, along with **artificial intelligence** and machine learning, will be the most transformative technologies of the times to come. **Blockchain** has found application in almost every industry.

Blockchain technology market size worldwide 2018-2025 (billions of dollars)¹



Leading countries²

- | | | | | | |
|---|--|-----------|----|--|------------------------------|
| 1 | | USA | 6 | | United Kingdom |
| 2 | | China | 7 | | United Arab Emirates (Dubai) |
| 3 | | Australia | 8 | | Switzerland |
| 4 | | Japan | 9 | | Singapore |
| 5 | | Estonia | 10 | | Malta |

Main application sectors³



Cloud

Technological components linked to Cloud/Edge Computing



Virtualisation



Network



Storage



Web services

Type of cloud computing services

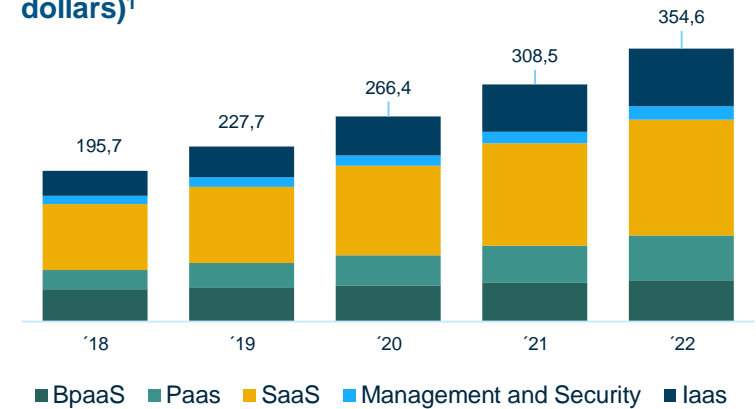
- Infrastructure as a Service (IaaS)
- Platform as a Service (PaaS)
- Software as a Service (SaaS)

Type of cloud computing

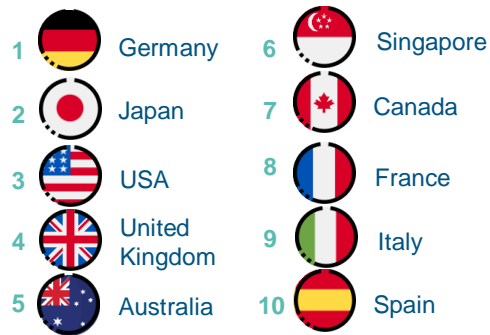
- Private Cloud
- Public Cloud
- Hybrid Cloud
- Edge

Cloud computing is firmly established as the new normal for business IT. Across all industries, the cloud remains one of the **fastest growing** segments of IT spending and one of the key cross-cutting technologies in **Industry 4.0**

Global public cloud revenue (billions of dollars)¹



Leading countries²



Main application sectors³



Augmented and Virtual Reality

Technological components linked to the Augmented and Virtual Reality



Sensors



Artificial vision



Wireless interfaces



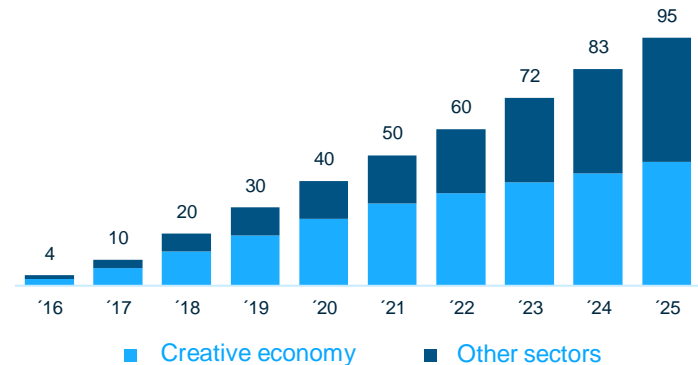
Intelligent design of 3D environments

Current virtual and augmented reality capacities

- Fully artificial environment
- Virtual objects superimposed on the real world environment
- Virtual environment combined with the real world
- Full immersion in a virtual environment
- The real world enhanced with digital objects
- Interaction with the real world and the virtual environment

2020 has been a year of growth for augmented and virtual reality. From entertainment to business applications, these immersive technologies have made their way into every aspect of life. The outbreak of **COVID-19** has significantly increased the adoption of these technologies, as companies have implemented home or remote working.

Projected virtual and augmented reality market growth (\$ billions)¹



Leading countries²



Main application sectors³



Big Data

Technological components linked to Big Data



Data collection



Connectivity networks



Storage



Algorithm/mining platform



Visualisation



HPC

Current Big Data capacities



- Storage and management



- Database



- Processing



- Data integration

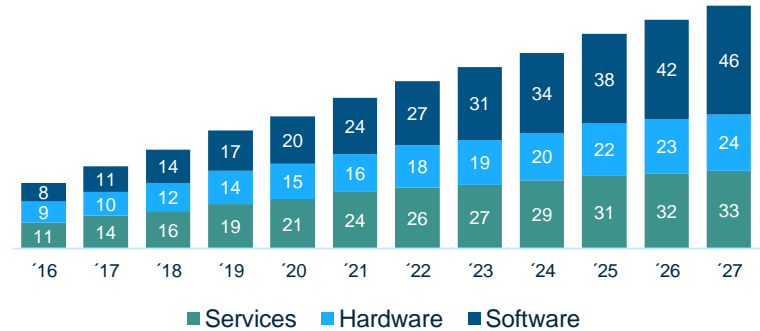


- Statistical analysis

Big data analysis is changing the landscape of business management. Thanks to new **cloud** enhancements and **additional technologies**, the scope and use of **big data** is growing rapidly.

Nowadays, the introduction of **artificial intelligence**, **machine learning**, **IoT** and other technologies has increased the quality of data-driven solutions.

Big Data revenue worldwide 2016-2027 (billions of dollars)¹



Leading countries²

- | | | | |
|---|----------------|----|--------------------|
| 1 | United States | 6 | Republic of Korea |
| 2 | Canada | 7 | Russia |
| 3 | Japan | 8 | India |
| 4 | China | 9 | Middle East Region |
| 5 | United Kingdom | 10 | South Africa |

Main application sectors³



Cybersecurity

Technological components linked to cybersecurity

- On chain code/Smart contracts
- Cryptography
- The cloud/p2p connectivity
- Distributed Ledger ...

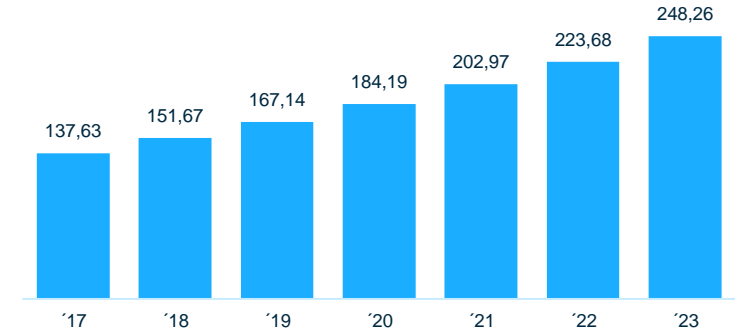
Core capacities of cybersecurity, according to ESCO

- Identify
- Protect
- Detect
- Respond
- Recover

Cybersecurity has become a priority for many companies, as the world becomes more connected: the introduction of **5G** and the rise of cloud computing are some of the flagships.

A **Threat Horizon** report reveals that, in the coming years, organisations will face cyber threats under three key themes: **disruption, distortion and impairment.**

Global cybersecurity market (billions of dollars)¹



Leading countries²



Main application sectors³



Quantum/Photonics

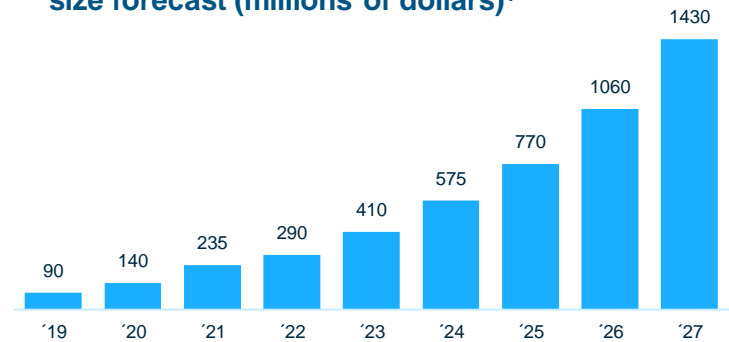


Type	Applications
<ul style="list-style-type: none"> Quantum annealing 	<ul style="list-style-type: none"> Optimisation issues
<ul style="list-style-type: none"> Quantum analogue 	<ul style="list-style-type: none"> Quantum chemistry Materials science Optimisation issues Sampling Quantum dynamics
<ul style="list-style-type: none"> Quantum universal 	<ul style="list-style-type: none"> Secure computing Machine learning Cryptography Quantum Chemistry Searching
<ul style="list-style-type: none"> Photonics 	
<ul style="list-style-type: none"> HPC 	

While **quantum computing** may not become a reality overnight, it is worth considering, for it **will change the world** in the near future.

Companies such as **Atom Computing**, which leverages neutral atoms for wireless qubit control, **Honeywell's** trapped ion approach and **Google's** superconducting metals have shown early results.

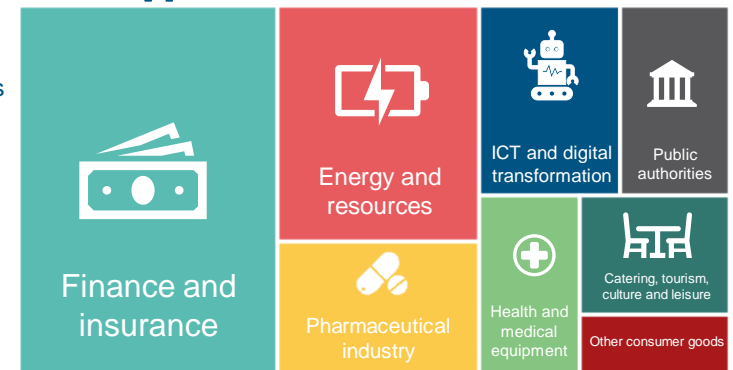
Worldwide quantum computing market size forecast (millions of dollars)¹



Leading countries²



Main application sectors³



Connectivity

Technological components of connectivity

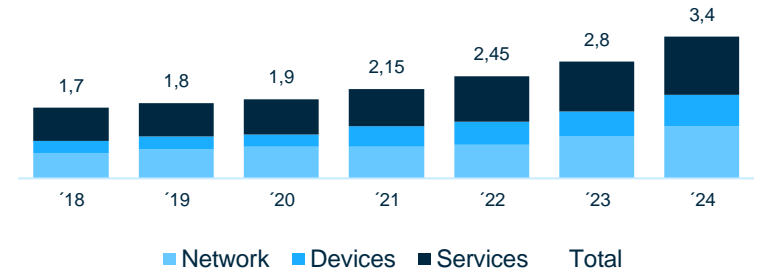
- Ultra-low latency communication
- Massive MIMO
- Millimetre wave
- Network management
- Heterogeneous network

Type of connectivity technologies

- Cellular
 - WI-FI
 - 5G
 - 4G
 - 3G
 - 2G
 - GSM
 - GPRS
 - ...
- Long-range
 - LPWAN
 - SigFox
 - LoRaWAN
 - NB-IoT
 - Cat-M1
 - ...
- Short-range
 - Bluetooth
 - BLE
 - ZigBee
 - NFC/RFID
 - ...

The future of the **connected** world is not just about new frontier technologies like 5G broadband and low-orbit satellite constellations. Much of it will be defined by the **expansion and evolution of existing advanced connectivity technologies**, such as fibre, **low-to-mid-bandwidth 5G, Wi-Fi 6** and other long- and short-range solutions.

Global 5G and private LTE market (billions of dollars)¹



Leading countries²

- | | |
|-------------------------|-----------------------|
| 1 USA | 6 Italy |
| 2 China | 7 Spain |
| 3 Sweden | 8 United Kingdom |
| 4 Australia | 9 Switzerland |
| 5 United Arab Emirates | 10 Republic of Korea |

Main application sectors³

Simulation

Technological components of simulation



Advanced computing



Big data



Virtualisation



Algorithm design



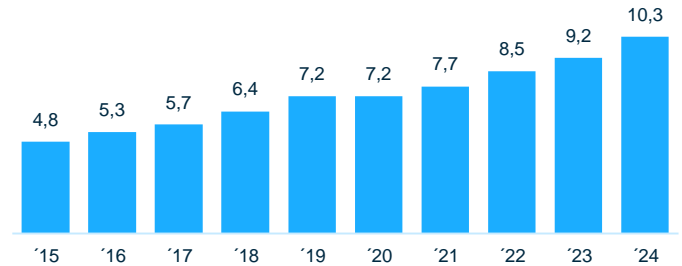
Machine learning and AI

Main current capacities

- Prediction of machine operation
- Stock prediction
- Simulation of real environments for worker training
- Product development
- Error detection in a production plant
- *Digital twin* (digital replication) of assets, processes, people, places, systems and devices

According to **Gartner**, simulation is the use of a **mathematical** or computer representation of a physical system, with the aim of **studying** the effects of constraint.

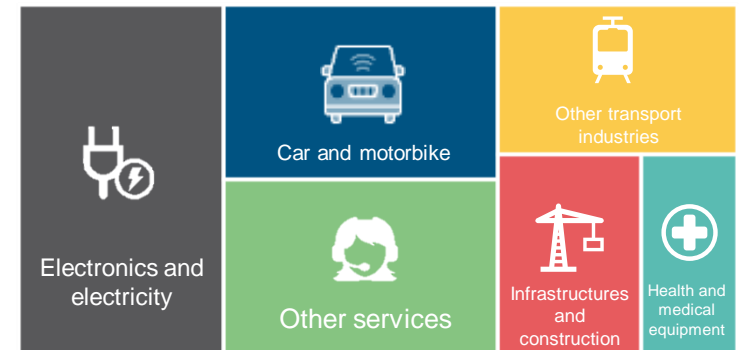
Global market simulation (billions of dollars)¹



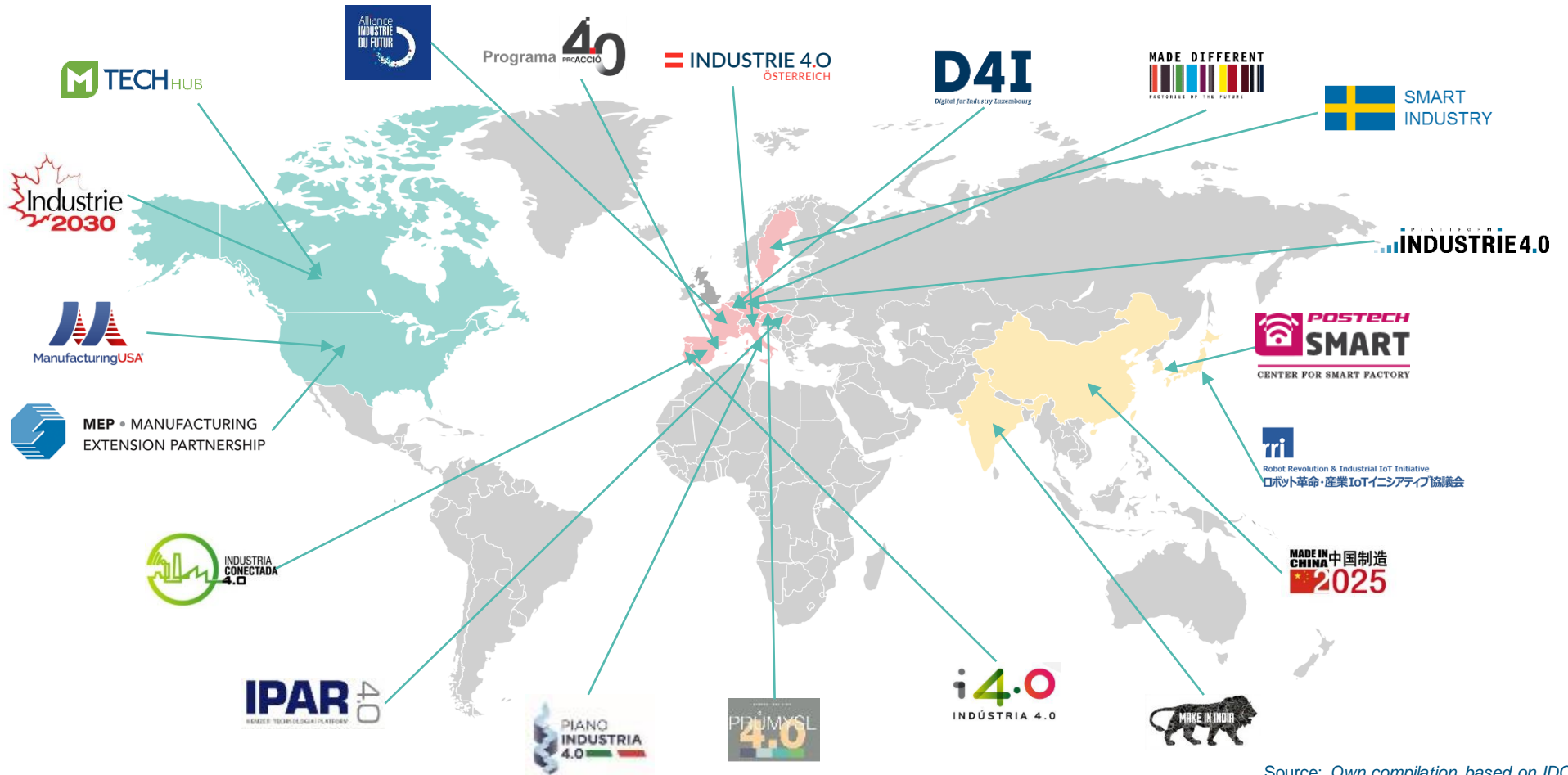
Leading countries²

- | | |
|-----------|-------------------|
| 1 USA | 6 Germany |
| 2 China | 7 France |
| 3 Japan | 8 United Kingdom |
| 4 India | 9 Canada |
| 5 Brazil | 10 Mexico |

Main application sectors³



Key strategies and hubs of relevance in terms of Industry 4.0



Source: Own compilation based on IDC.

Industry 5.0: The road to the new industry

The **European Union**'s recovery becomes an opportunity for accelerating the **Green** and **Digital** transitions. Industry is a key driver in building a society based on a more **sustainable** and **resilient** economy. The **report** prepared by the EU Commission goes beyond the goals of economic growth and jobs, turning the industry a provider of **prosperity**, care for **the environment** and protection of **worker welfare**.

The key **features** of **Industry 5.0** are:



Upgrading technology: Industry must become a solution provider for society. Attracting future talent is necessary and technological upgrading is key to position itself as an attractive option to develop professional life.



Digitisation of Industry 5.0: Digitisation must offer unprecedented opportunities. Artificial intelligence and robotics are seen as elements that interact with people rather than replacing them. Digitisation is therefore seen as empowering.



Green economy: The "Green Deal" will be successful with industry taking the lead. New technologies must rethink production processes, taking into account environmental impacts. Industry must lead the green transition by example.

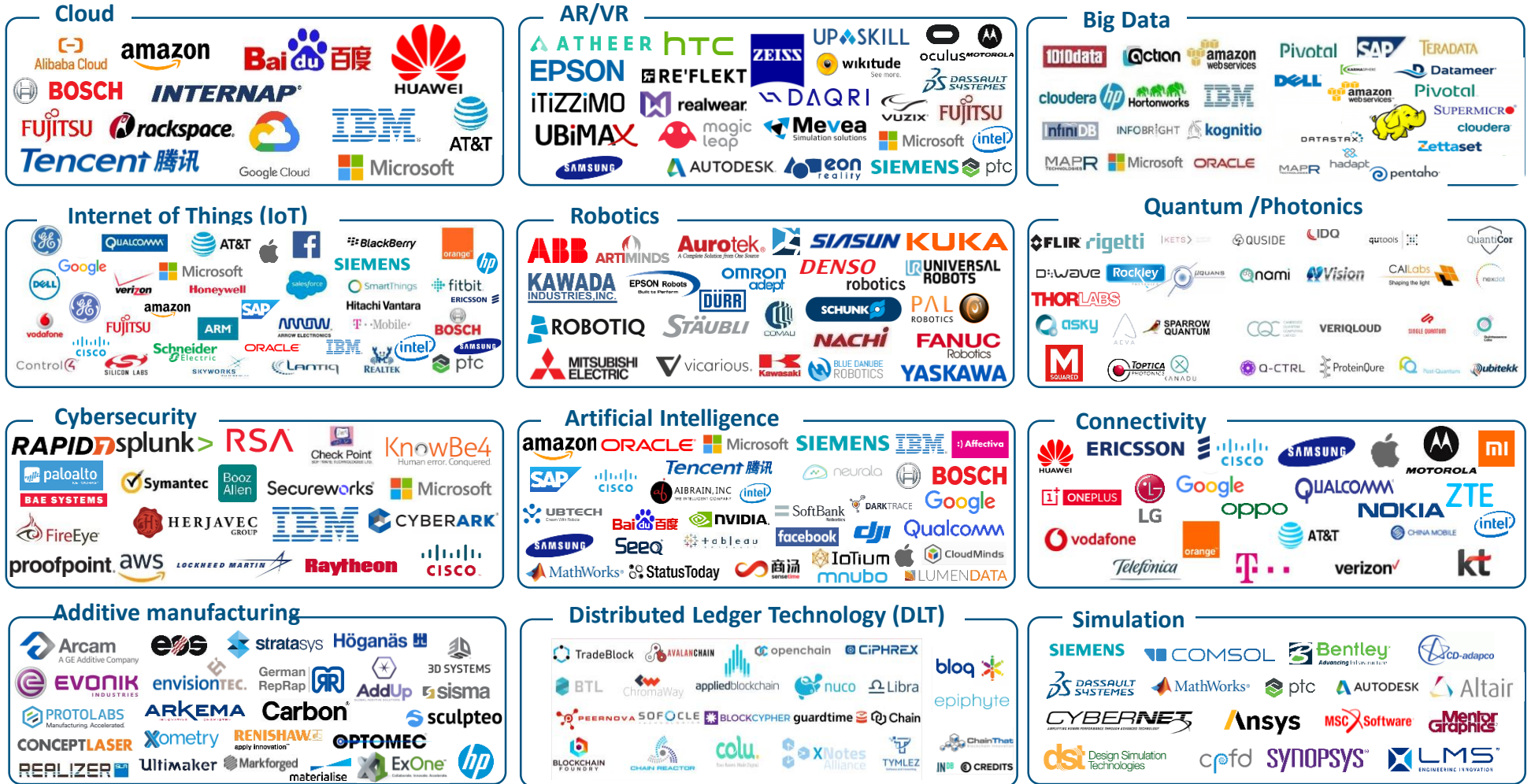


Workers at the centre: The impact on society is a key part of Industry 5.0. Workers are at the centre of the industry, and they must be prepared for the new stage. Role changes can take centre stage, and their skills must be constantly evolving. The new industry demands new skills and adaptation to constant change.



Source: European Union, Industry 5.0

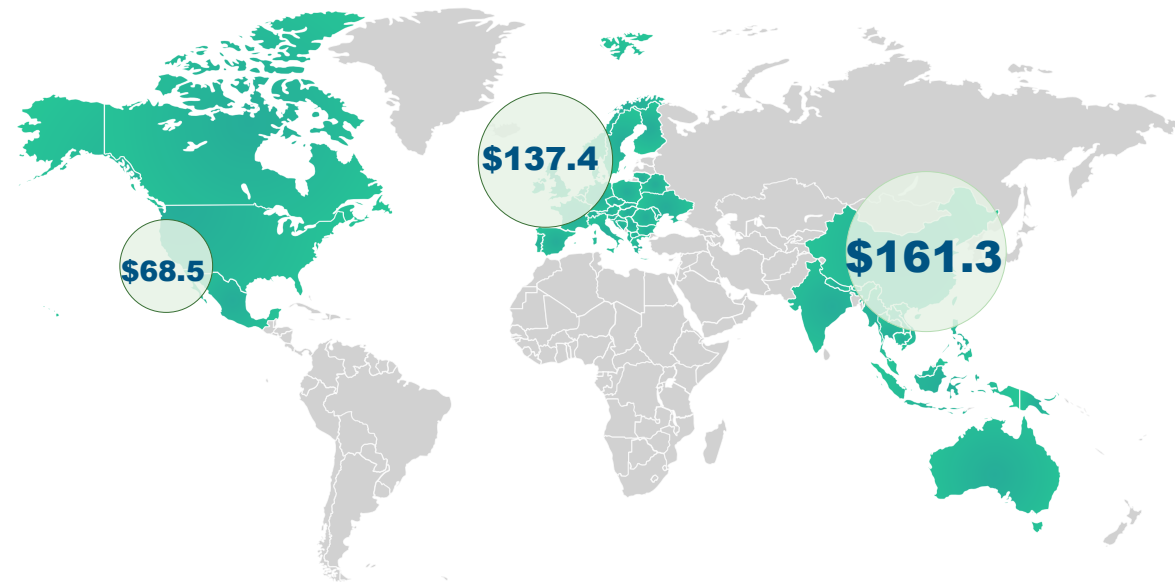
The top companies worldwide in Industry 4.0



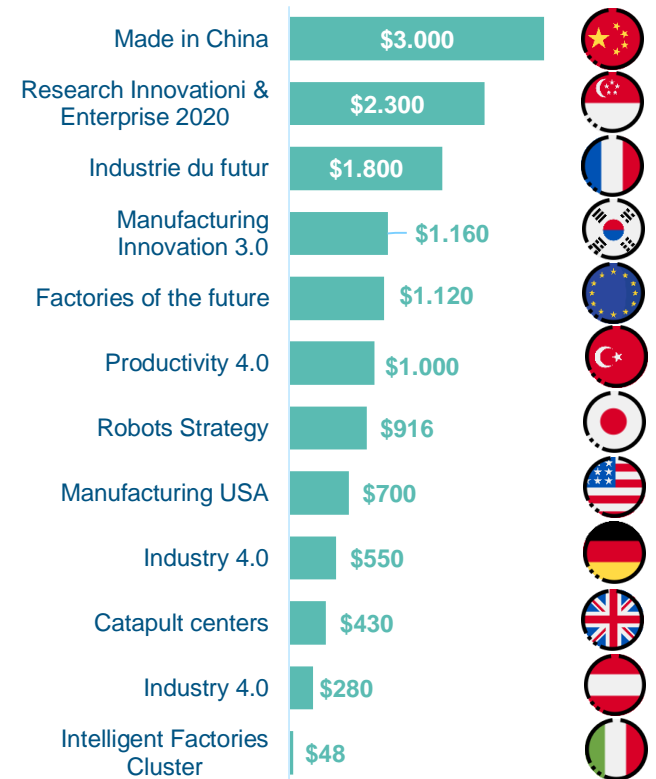
Main global investors

Over the next five years, advanced implementation of Industry 4.0 will become a “qualifier to compete” and is also likely to be seen by investors as a “qualifier for funding”.

Estimated investment required to implement a *Smart Factory* between 2020 and 2024
(billions of dollars)



Investment in selected I4.0 initiatives
(millions of dollars)



Source: 1. Industry 4.0: Rising to the Challenge, Siemens Financial Services (SFS), 2020
2. Roland Berger, 2018

3. Trends in Industry 4.0 and impact on the SDGs



Trends in Industry 4.0

Biological Technologies



Human-centred design



Smart automation on the rise



100% remote



Advanced materials



Sustainability

Trends in Industry 4.0 (I)

Beyond the current technologies analysed, new technological developments are foreseen that will change many paradigms in the industry and will be transferred to society in general. With these advances, an exponential technological leap is expected to drive the society of the future.

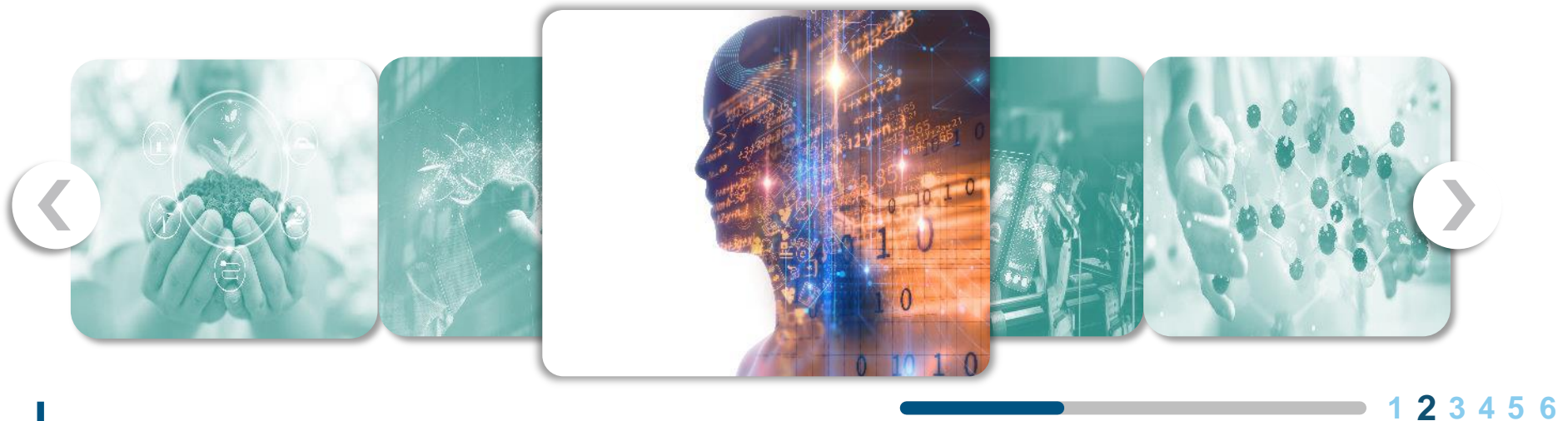


Biological Technologies

In 20 years, synthetic biology could change the manufacture of biological products. Along with advances in genomics, proteomics, systems biology and genetic engineering, synthetic biology will provide a toolbox of standardised genetic parts that can be used in the design and production of a new system. The catalyst for new products will increase understanding of cellular functions and disease models.

Industry 4.0 would then mutate into **cyber-physical-biological models**, further blurring the line between the biological and the digital. For now, some experimental areas in this field are neurotechnology, genetic decoding from artificial intelligence and biosensors.

Trends in Industry 4.0 (II)



Human-centred design

Despite the exponential evolution that industry has undergone in each of its "revolutions", especially the one we are currently immersed in, there is one thing that has remained constant, as a common factor in each and every one of them. This is precisely the human factor.

The success of companies will lie in the fact that, within this **context of social and technological development**, they will be able to adapt and enhance that which will never be replaced, that which brings human rationality and emotionality to the processes, products and business models, i.e. the Human Factor.

Trends in Industry 4.0 (III)



Smart automation on the rise

Smart automation has become a key element to consider for business investments. According to the Smart Industry 4.0 study, prepared by Everis and Advanced Factories, 73% of companies already consider it as such and have opted to integrate it into their organisations. These figures represent an increase of 15% over the previous year. The most pronounced growth can be found in Robots, Machine Learning, NLP and BPM solutions. In addition, the COVID-19 crisis has led **33% of companies** to push automation **to meet the new challenges of the pandemic**.

Process robotics (RPA) remains the most widely used technology. **Optical and intelligent character recognition** and **business process management** follow in second and third place.

Trends in Industry 4.0 (IV)



100% remote

The COVID-19 pandemic has highlighted the need for technologies that allow us to **carry out** more and more of our daily **activities remotely**.

This paradigm shift is expected to continue beyond the current pandemic, impacting sectors such as education, teleworking and manufacturing, among others. Technologies such as the digital twin, augmented and virtual reality, process robotisation, among others, will begin to be part of our everyday reality.

Trends in Industry 4.0 (V)



1 2 3 4 5 6

Advanced materials

We can identify companies and startups that are developing **sustainable, smart and responsive materials**, which in turn offer improved physical properties. For example, biodegradable plastics, thermally adaptable fabrics or flexible screens. New formulations, including nanomaterials and biomaterials, add new functions to existing materials, while expanding the scope of innovation. Additive manufacturing, advanced compounds and 2D materials also lead to the development of various lightweight materials. Along with computing and materials management, surface engineering impacts a variety of industries, from energy, automotive and construction to biotechnology, healthcare and textiles.

Trends in Industry 4.0 (VI)



1 2 3 4 5 6

Sustainability

Some sectors, such as the automotive industry, are beginning to coin the concept of "Industry 4.0s" (Industry 4.0 with an added "s" for sustainable). According to the Spanish Association of Automotive Suppliers, this means moving towards **digital leadership** and **climate neutrality**, while putting in place fair transition mechanisms that leave no one out.

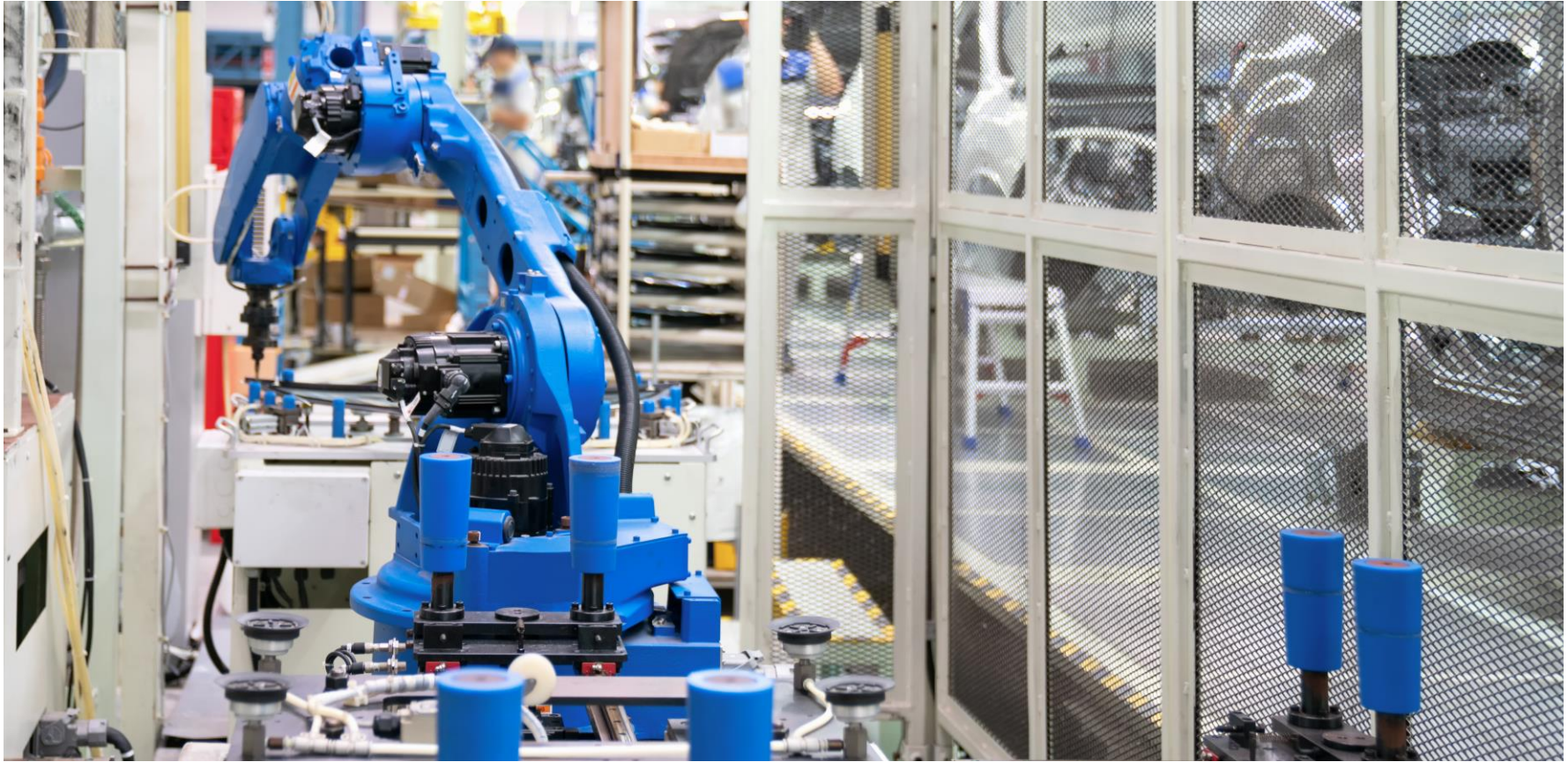
Among the areas to be impacted through the incorporation of Industry 4.0 are Zero Emission, Zero Waste, Zero Accidents and Fair Transition. This trend extends to other relevant sectors with a high environmental and social impact, such as textiles – fashion, energy and food.

Impact on the SUSTAINABLE DEVELOPMENT GOALS

SUSTAINABLE DEVELOPMENT GOALS

<p>3 GOOD HEALTH AND WELL-BEING</p>  <p>e-Health, health monitoring, age-tech, early detection of diseases Customised prosthesis printing Tissue bioprinting</p>	<p>4 QUALITY EDUCATION</p>  <p>Connectivity to support online education. Application of virtual and augmented reality and additive manufacturing to education.</p>	<p>5 GENDER EQUALITY</p>  <p>Ease of teleworking and, thus, work-life balance. Reduction of gender bias in selection processes. Detection of sexist language/attitudes.</p>	<p>1 NO POVERTY</p>  <p>Improving education through devices. Identification of poverty pockets through artificial intelligence.</p>	<p>2 ZERO HUNGER</p>  <p>Optimisation of food production (primary and secondary sectors) and distribution. 3D food printing</p>
<p>8 DECENT WORK AND ECONOMIC GROWTH</p>  <p>Transformation of low value-added jobs in the industry into skilled jobs Generation of economic activity around data</p>	<p>9 INDUSTRY, INNOVATION AND INFRASTRUCTURE</p>  <p>Intelligent management of infrastructures, their use and maintenance Improvement and automation of production processes</p>	<p>10 REDUCED INEQUALITIES</p>  <p>Accessible environments for people with disabilities Extension of broadband connection around the world, promoting social inclusion</p>	<p>6 CLEAN WATER AND SANITATION</p>  <p>Smart water, smart water management infrastructures, leak detection, optimisation of wastewater treatment and processing.</p>	<p>7 AFFORDABLE AND CLEAN ENERGY</p>  <p>Industrial IoT to optimise energy consumption Optimisation of power distribution networks</p>
<p>13 CLIMATE ACTION</p>  <p>Selective recycling through AI and computer vision Reducing waste and greenhouse gas emissions in production</p>	<p>14 LIFE BELOW WATER</p>  <p>Detection of algae blooms through AI Sensors to measure the level of pollution</p>	<p>15 LIFE ON LAND</p>  <p>Measuring air pollution, better management of land ecosystem preservation tasks.</p>	<p>11 SUSTAINABLE CITIES AND COMMUNITIES</p>  <p>Management and optimisation of municipal services Improvement of urban planning and infrastructure management Sustainable construction through 3D printing</p>	<p>12 RESPONSIBLE CONSUMPTION AND PRODUCTION</p>  <p>Flexible production allows you to manufacture only what is needed Optimising of demand forecasting</p>
			<p>16 PEACE, JUSTICE AND STRONG INSTITUTIONS</p>  <p>AI software for participatory processes Detection of illegal activities through computer vision</p>	<p>17 PARTNERSHIPS FOR THE GOALS</p>  <p>Facial recognition at borders AI for tax fraud detection</p>

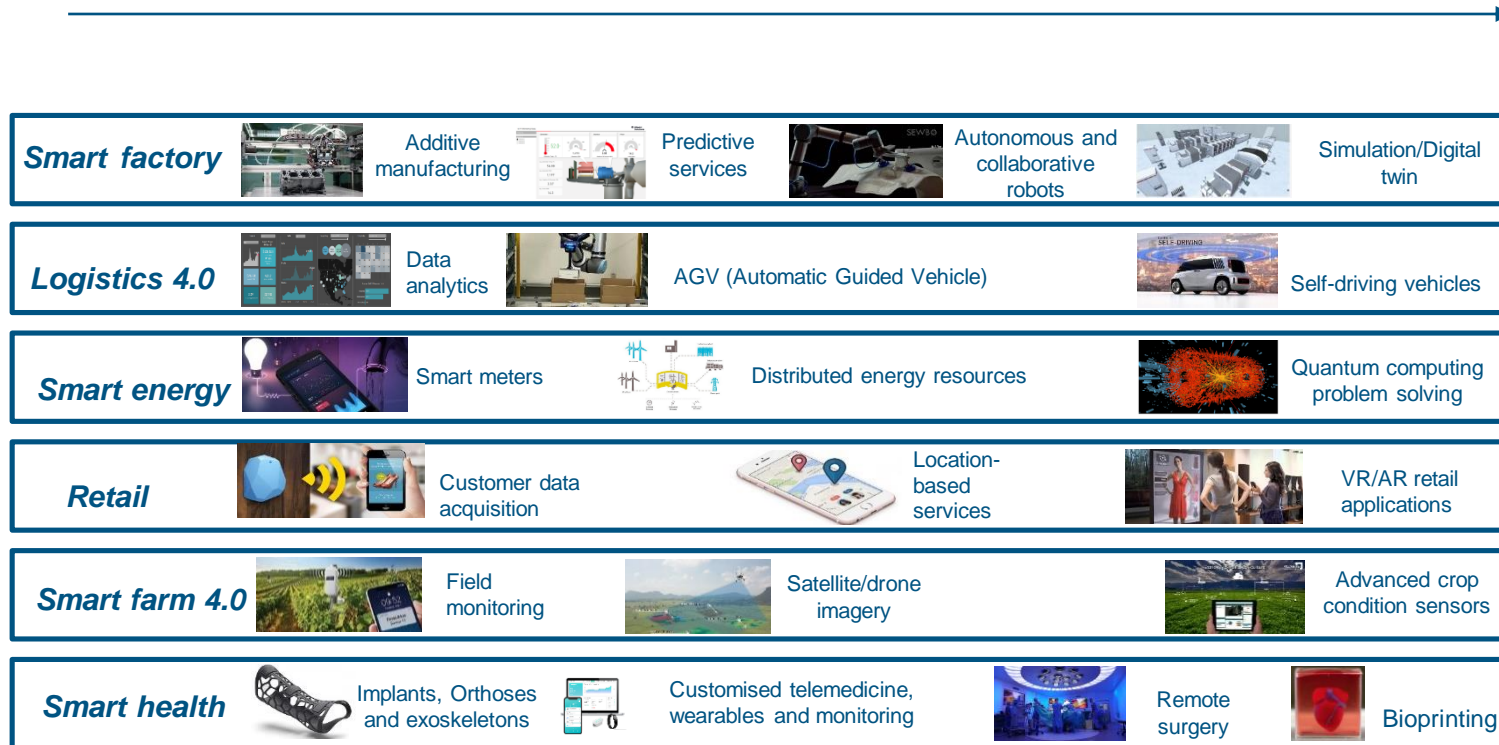
4. Prospective applications by demand sector



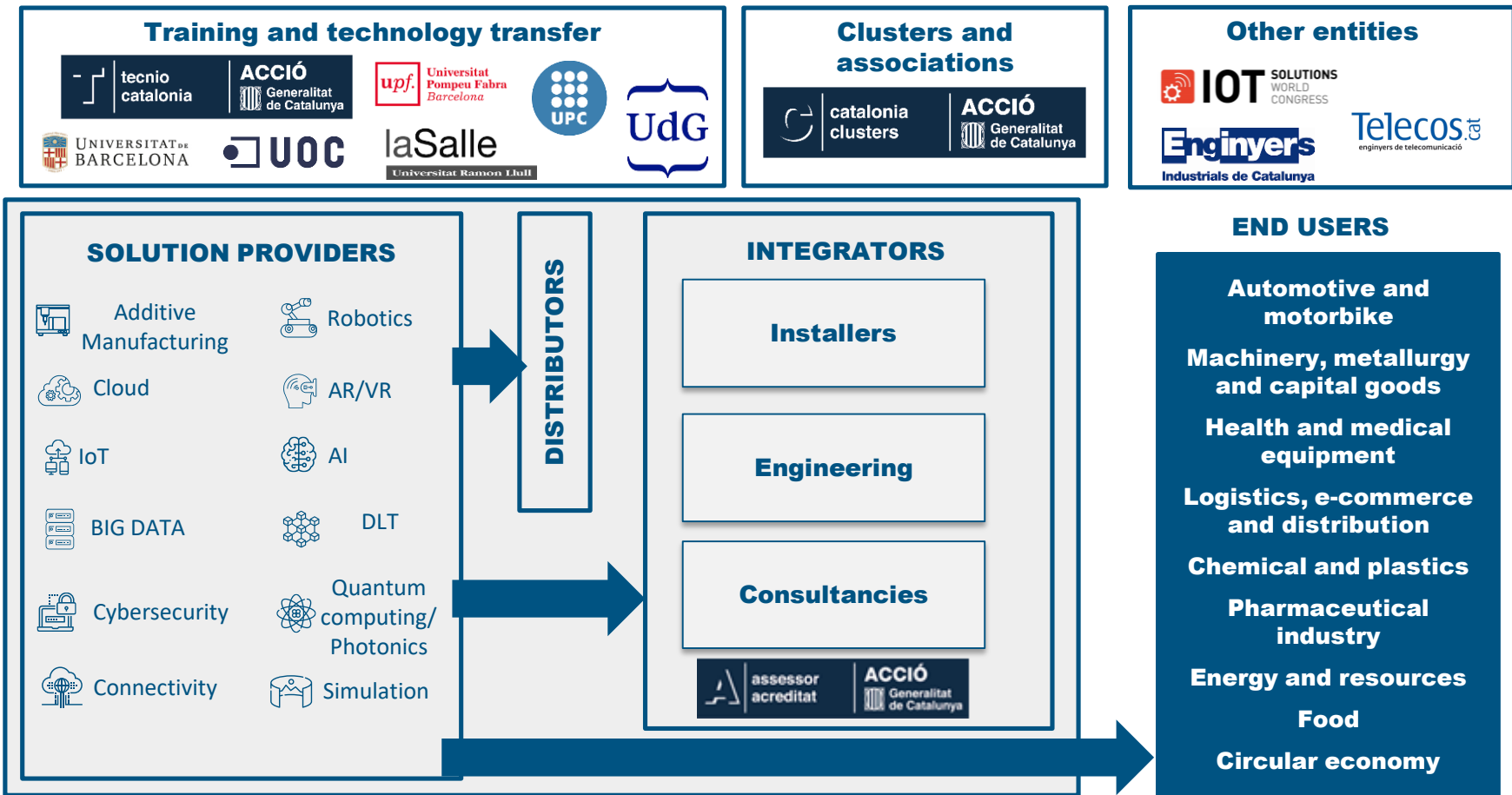
Industry 4.0 applications by sector

Current Applications

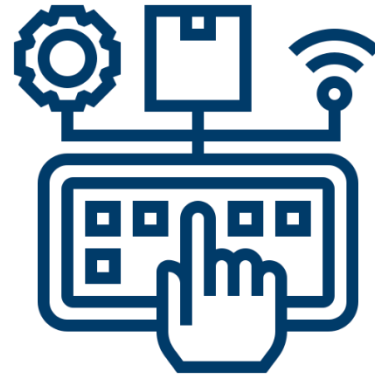
Future Applications



Value chain, ecosystem and map of Industry 4.0 agents in Catalonia



Industry 4.0 in Catalonia: main mapping conclusions





 1,111 companies  €5,564 million

The **1,111** companies represent a **x3** growth compared to 2017

 **26,394** jobs **90.1%** of the total are **SMEs**

 **42.6%** of the companies have a turnover of **more than one million euros** and **15.6%** have a turnover of **more than ten million euros**

 **45.5%** of the companies are less than ten years old  **28.5%** of companies are startups

Degree of internationalisation:  **31.3%** of the companies are exporters

Location  **55.1%** of companies are located in Barcelona













The technology with most companies detected is **cybersecurity**, but the companies with the highest turnover are those focused on **artificial intelligence** and the **Internet of Things (IoT)**

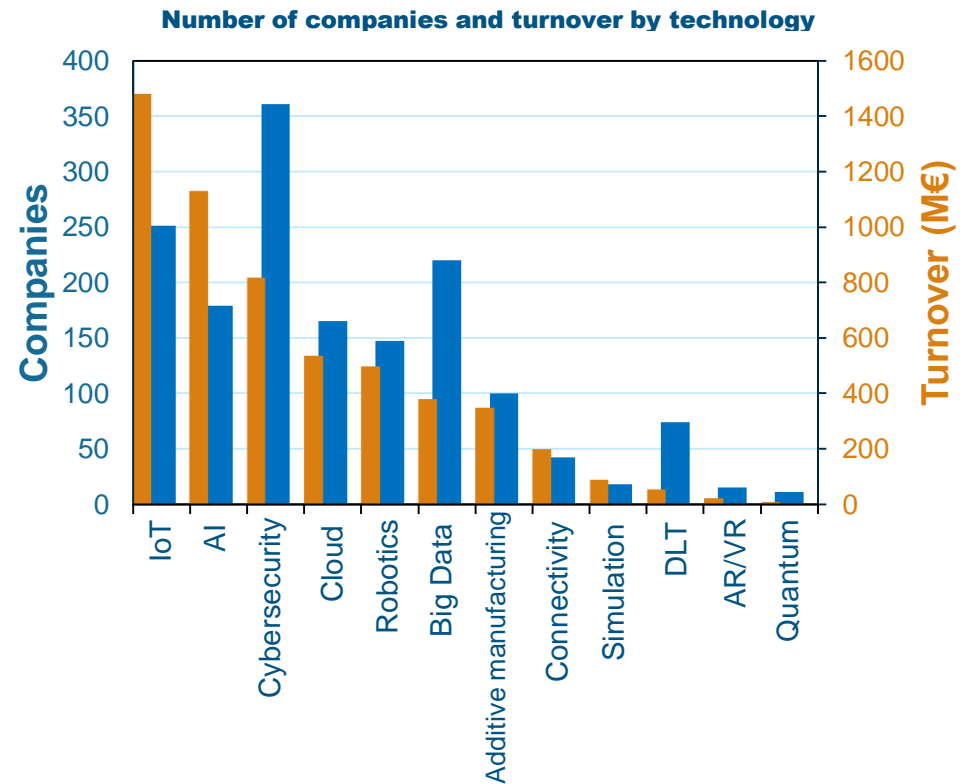
Source: ACCIÓ
Latest available data on turnover and workers, mainly from 2019

Impact of Industry 4.0 technologies in Catalonia

Number of companies, workers and turnover of I4.0 by technology

Cybersecurity is the technology that provides the largest number of companies, but those focused on the Internet of Things (IoT) and artificial intelligence have the highest turnover.

	Number of companies offering technology-related products/services
 Cybersecurity	361
 IoT	251
 Big Data	220
 AI	179
 Cloud	165
 Robotics	147
 Additive Manufacturing	100
 DLT	74
 Connectivity	42
 Simulation	18
 AR/VR	15
 Quantum computing	11



Companies providing Industry 4.0 solutions in Catalonia

Additive Manufacturing

Robotics

Cloud

AR/VR

IoT

AI

Big Data

DLT

Cybersecurity

Quantum/Photonics

Connectivity

Simulation

Nota: Imatge il·lustrativa parcial

Industry 4.0 support ecosystem in Catalonia

CLUSTERS OF THE CATALONIA CLUSTER PROGRAMME



PROFESSIONAL ASSOCIATIONS



BUSINESS ASSOCIATIONS



TRADE FAIRS AND EVENTS



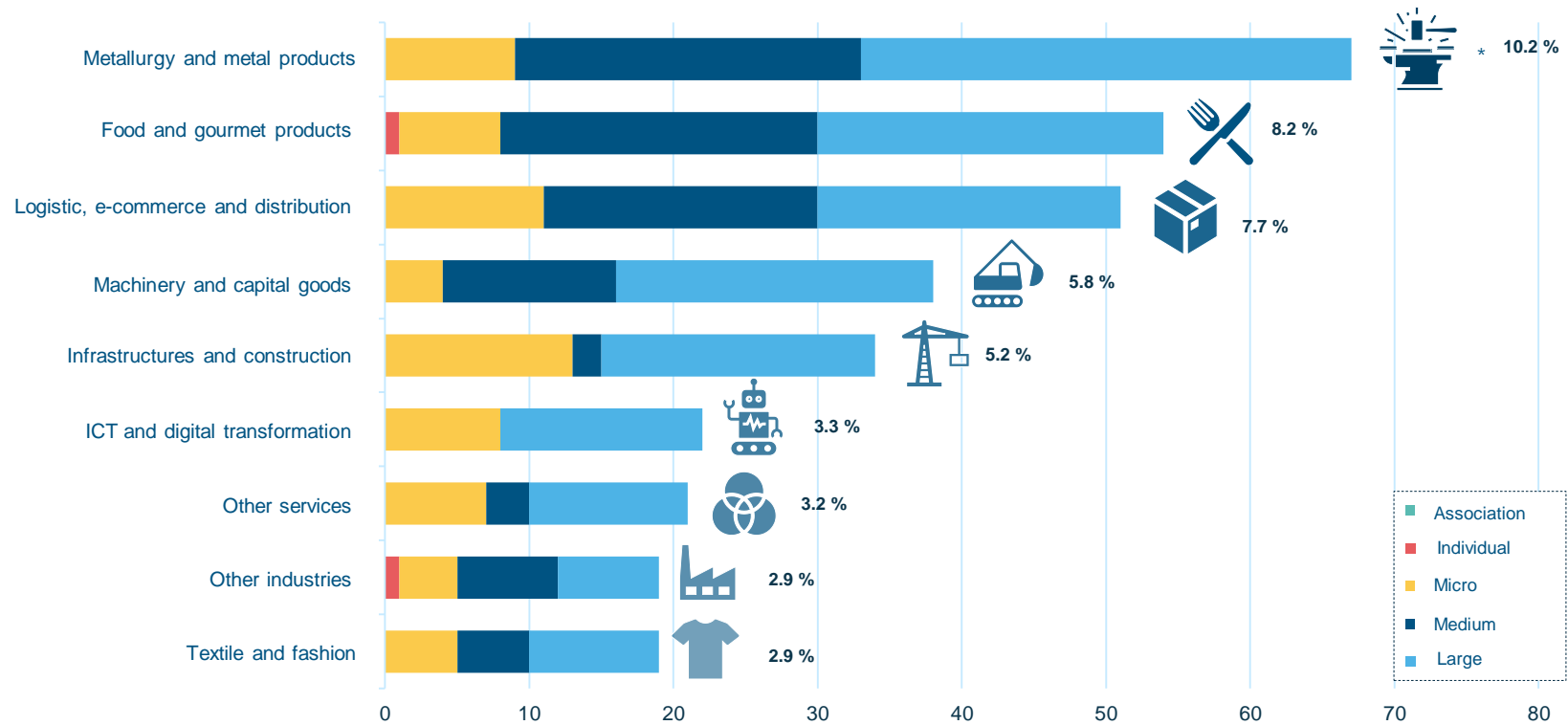
Note: Partial illustrative image

TECNIO centres specialising in Industry 4.0 in Catalonia

The image displays 12 panels, each representing a different Industry 4.0 technology area. Each panel contains logos of various research and technology centers in Catalonia, such as eurecat, inLab FIB, IREC, and others, along with the specific technology name.

- IOT:** CTTC, CD6, UPC, CITCEA, UBCEMIC, CIMNE, caUech, eurecat, LEITAT, GCEM, IBEC, CIEFMA, inLab FIB, IREC, IRTA, laSalle, MCIA, SARTI.
- SIMULATION:** laSalle, R&D Research & Development, eurecat, inLab FIB, exiIT, GCEM, UBCEMIC, LEITAT, VICOROB, ROBOTICS.
- PHOTONICS:** CD6, UPC, UBCEMIC, CTTC, CVC 25, eurecat, IRTA.
- ADDITIVE MANUFACTURING:** IBEC, LEITAT, CIEFMA, IREC, CTTC, eurecat.
- AR/AV:** laSalle, R&D Research & Development, CVC 25, Graphics & Imaging Laboratory.
- CONNECTIVITY:** i2cat, CTTC.
- CYBERSECURITY:** eurecat, laSalle, i2cat, inLab FIB, CVC 25.
- CLOUD:** eurecat, laSalle, D S.
- BIG DATA:** inLab FIB, eurecat, MCIA, i2cat, S, exiIT, upf, Universitat Pompeu Fabra Barcelona, GTI, Grup de Tecnologies Interactives, IREC, IRIA, Institut d'Investigació en Intel·ligència Artificial, VICOROB, AI.

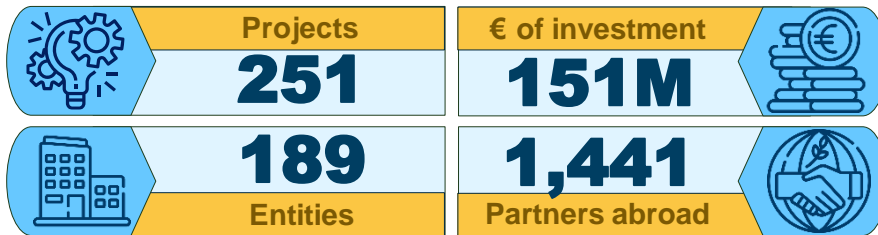
Sectors mostly demanding Industry 4.0 solutions in Catalonia



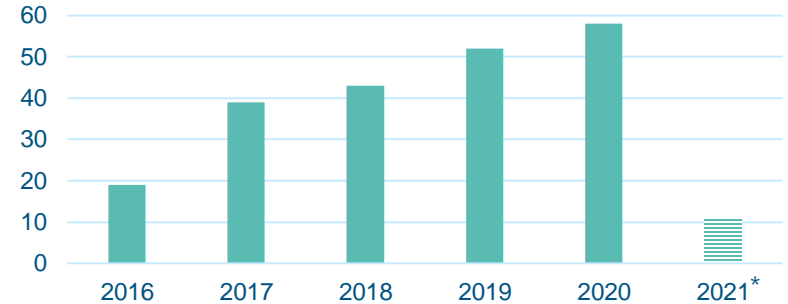
The **metallurgy and metal products** sector is the most demanding in the Business Competitiveness Coupons aid programme (Industry 4.0 Coupons), followed by the **food and gourmet products** and the **logistics, e-commerce and distribution** sectors.

Catalan participation in R&D projects

Main research data



Evolution of the number of European projects in I4.0



(*) Projects planned as of November 2020

Project keyword cloud



In Catalonia, **251** Industry 4.0 projects (2014 – 2021) have been started on a European level.

There has been a **considerable increase** in this type of project **over the last five years**. In 2016, 19 I4.0 projects were started, while, in 2020, 58 I4.0 projects were implemented.

Digital Innovation Hub of Catalonia

<https://dih4cat.cat/en/>




DIH4CAT is Catalonia's connected network of assets, infrastructures and knowledge to boost the digital transformation of Catalan industry.

DIH4CAT is set up following the model of Digital Innovation Hubs established by the European Commission and is configured as a networked service community, through which **industry** and **public administrations** can access a set of services, infrastructures, capacities and technological and non-technological solutions to boost their digital and technological transformation, acting, in turn, as an advanced connector between supply and demand in Catalonia as a whole.

DIH4CAT **offers services** through infrastructure as well as advanced digital and technological capacities

 Information

 Technological and digital maturity diagnoses

 Infrastructures for testing and experimenting

 Training

Digital and technological infrastructures

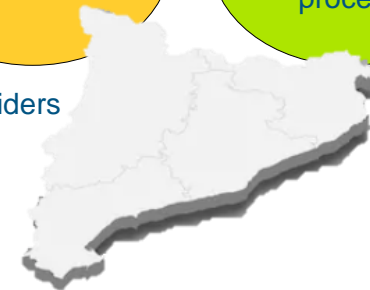
Solutions marketplace

Support in the digitisation process

 Search for technology partners and providers

 Search for funding







 Best practices and case studies



ProACCIÓ 4.0 programme

ProACCIÓ 4.0 is ACCIÓ's 4.0 aid and services programme aimed at SMEs. It acts as a one-stop shop in Catalonia to raise awareness, support and advise Catalan companies, especially SMEs, to tackle the 4.0 technological transformation

ProACCIÓ 4.0 Services

 <p>Industry 4.0 Coupons Industry 4.0 Coupons involve aid for outsourcing to identify opportunities for the integration of industry 4.0 technologies for implementation into products, services or processes.</p>	 <p>Guidance, training and advise ProACCIÓ 4.0 provides guidance and advise on tackling the major challenges of digitization. Through the program, you can also take part in specialist training or in a digital immersion course for directors of SMEs, in collaboration with the EOI Foundation. Do you have any queries? Contact us!</p>
 <p>Aid for promoting R&D projects in Industry 4.0 Access R&D projects to take the leap. ACCIÓ offers services such as the INNOTEC aid or Business R&D cores, a chance to make the R&D projects you've always dreamed about come true.</p>	 <p>Lines of funding We provide guidance on funding your digital transformation projects through lines of funding. This is the case of the loans for industrial businesses from the Catalan Finance Institute or the ACTIVA Funding initiative by the Ministry of Industry, Trade and Tourism. Want to know more? Contact us!</p>
 <p>The ecosystem of suppliers and enabling agents ACCIÓ provides the most suitable technology for your company through the TECNIO Developers and the Agents specializing in industry 4.0, as well as the experts and supporting infrastructure for digital transformation associated to the Digital Innovation Hub of Catalonia. Want to know more? Drop us a line!</p>	 <p>Activa Industry 4.0 program ACCIÓ plays an active role in this specialist advisory program to guide businesses in their digital transformation process. An initiative by the Ministry of Industry, Trade and Tourism, through the EOI Foundation. Find out more!</p>



[More information about the programme](#)

Collaborators of the ProACCIÓ 4.0 programme:



6. Industry 4.0 opportunities



Innovation opportunities (I)



Additive manufacturing



Cloud



IoT



Big Data



AI



Cybersecurity

Industrial systems

Optimisation of parts
Toolmaking

Knowledge of the manufacturing process/Process optimisation

Diagnosis and forecasting of process anomalies

Servitisation

Predictive/preventive maintenance

Production optimisation

Avoid process interruptions due to external causes

Food industries

Food printing

Quality control
Field and crop control

Monitoring of livestock fattening

Avoid information leaks

Health, well-being and life sciences

Customisation
Surgical guides
Bioprinting

Traceability/Monitoring of chronic and disabled patients/eHealth

Diagnosis/Prevention/Drug design

Sustainable mobility and smart city

Prototyping Production process optimisation

Prediction of traffic conditions

Autonomous vehicle

Avoid service interruptions due to external causes

Customisation

Identification of pollution peaks

Crowd management

Flow, traffic prediction

Chemistry, energy, resources and circular economy

Development of printing materials

Manufacturing process control/Identification of leaks and faults
Smart grid/Prediction of consumption and peaks
Waste management/Symbiosis

Design industries

Prototyping

Customisation

Intelligent product design
Home automation
Customer knowledge/Virtual assistants
Stock management

Avoid process/service interruptions due to external causes

Cultural and experience-based industries

Replication and conservation of cultural heritage

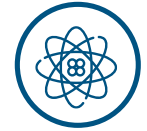
Fab Labs

Customer knowledge/Virtual assistants

Network culture/Online leisure and entertainment/Distance learning

Digital marketing

Innovation opportunities (II)



AR/VR

Connectivity

DLT

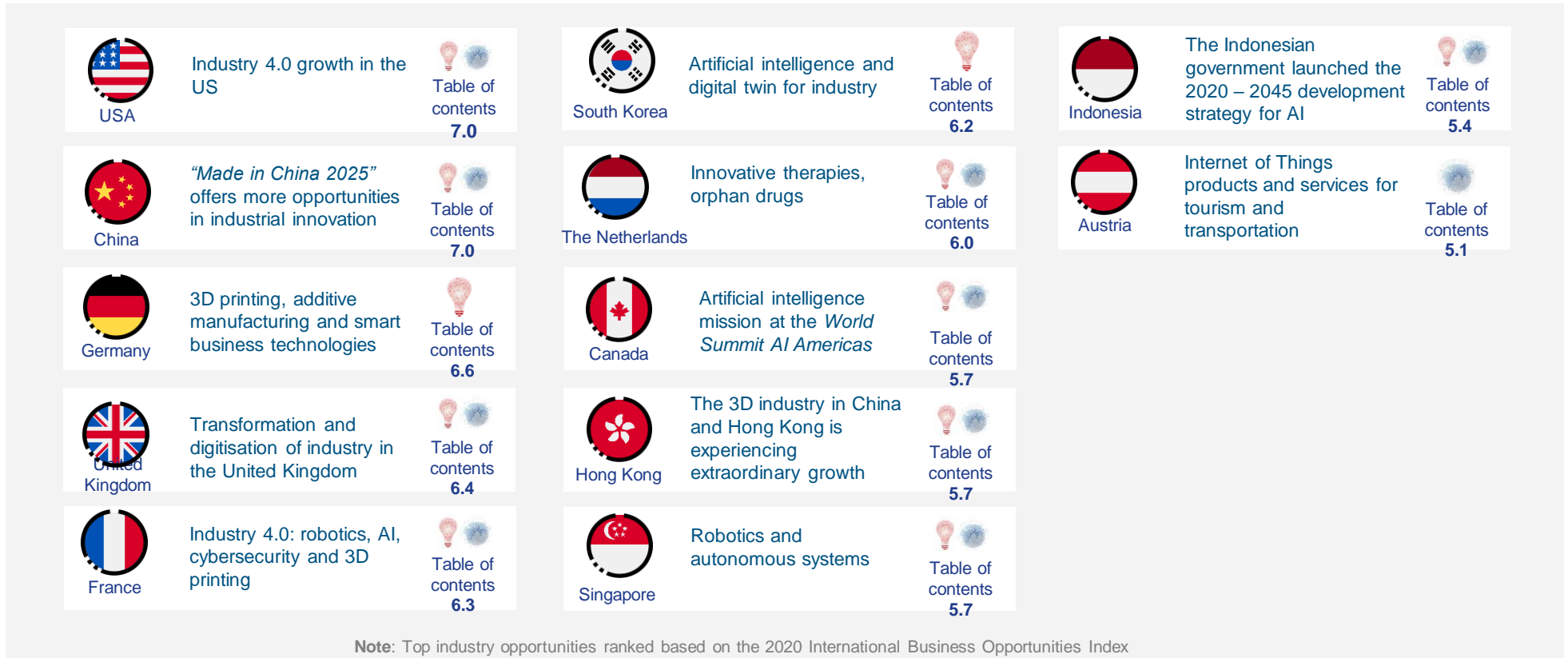
Simulation

Robotics

Quantum computing/Photonics

	AR/VR	Connectivity	DLT	Simulation	Robotics	Quantum computing/Photonics
Industrial systems	Instruction manual Training Maintenance	Remote control and manufacturing	Supplier control <i>Smart contract</i>	Design and control of manufacturing processes (digital twins)	Exoskeletons Application to non-ergonomic activities	Inspection Sensors Manufacturing tool
Food industries	Maintenance support Training Sorting	Mobile private networks	Guarantee of origin		Picking/Manufacturing	Sensors Inspection Cybersecurity
Health, well-being and life sciences	Simulation Training	Variable monitoring eHealth Surgery and remote care	Traceability Research Identity/Personal health record	Digital twins of healthcare infrastructure Surgical simulation	Exoskeletons Social robots	Inspection Medical imaging Medical laser
Sustainable mobility and smart city	Training Picking, location	Mobile private networks Connected vehicle	Supply chain control	Flow simulation	Picking Autonomous mobility	Cryptography
Chemistry, energy, resources and circular economy	Maintenance support Training	Remote control and manufacturing Mobile private networks	Professional certification Research Traceability and supplier management	Design and control of manufacturing processes, infrastructures (digital twins)	Hazardous maintenance activities	Energy
Design industries	Smart testers Showrooms	e-commerce Omnichannel	Loyalty programmes	Physical space projection	Warehouse and stock management Marketing Customer interaction Protocol robots	Inspection Sensors Manufacturing tool
Cultural and experience-based industries	Marketing Shows Virtual heritage	Smart Tourism	Traceability of works of art	Games and serious games Hospitality		Sensors

International business opportunities in the Industry 4.0 and 3D printing sector



Innovation opportunity



Internationalisation opportunity



Mixed opportunity

Source: ACCIÓ. World map of international business opportunities, 2020



Attraction of foreign direct investment (I)

INVESTMENT IN I4.0 IN CATALONIA BY COUNTRY OF ORIGIN (2018 – 2019)



Country	Capital investment (M€)
United States	128.11
Germany	42.46
Argentina	25.53
Switzerland	16.52
Japan	6.63
Bulgaria	3.85
France	3.83
Ireland	2.6
United Kingdom	1.52
China	0.6
Italy	0.39
Denmark	0.3
The Netherlands	0.1

Source: Own compilation based on data by fDi Markets

Attraction of foreign direct investment (II)

MOST RELEVANT INVESTMENTS



vmware[®]
€90.85M

VMWARE, which specialises in the development of corporate software and cloud infrastructure, has created up to 250 jobs in Barcelona as a result of its growth strategy to promote technology talent in Europe, the Middle East and Africa (EMEA) at its new centre in the Catalan capital.



SATELLOGIC[®]
€19M

Satellogic, a leader in high-resolution microsatellite imaging technology, has recently opened its headquarters in Barcelona. The Catalan capital was chosen mainly because of the excellent supply of talent in computer science and artificial intelligence.



ABB
€16.52M

ABB, which focuses mainly on industrial automation, has opened its first customer innovation centre in Europe dedicated to robotics in Sant Quirze de Vallès, which will develop digital and automation technologies for companies.



BA BILSING AUTOMATION[®]
SET THE PACE!
€13.88M

Bilsing Automation, a leading provider of automated tool solutions for the automotive sector, has opened a new facility in Sabadell, dedicated to the marketing, after-sales, design, pre-assembly, storage and implementation of different technological solutions.



Mitek
€10.3M

Mitek, which specializes in computer vision technology, has created 48 new jobs in recent years at its headquarters in Cerdanyola del Vallès. Mitek technology specialises in the use of computer vision, artificial intelligence, deep learning and biometric tools to check digital identities.

7. Industry 4.0 business cases in Catalonia



Business cases in Catalonia (I)



AIS has developed a software called Winbox based on artificial intelligence for optimising the production of corrugated cardboard boxes. It works with Tabu Search models, which have proven to be effective in the Industry 4.0 challenge of making decisions based on information from multiple sensors and the large volume of data collected.

Cardboard factories work with large cardboard reels. One of their main challenges is to optimise order planning with regard to the stock and availability of these reels and minimise material losses. Winbox not only responds to this challenge, but also optimises the overall manufacturing of the entire production, ordering pending production orders in such a way that all machines are running without bottlenecks, or machines that are stopped or saturated. In addition, it takes into account the delivery times of each order and even applies intelligence to the planning of truck loads that bring the production of boxes to different customers.

Winbox is currently installed in more than 60 factories in 9 countries, including Cartonajes Vallés Gasset S.A. in Catalonia.



Applus IDIADA has relied on Orange for the development of a Mobile Private Network at its facilities in L'Arbonar (Tarragona) to test connected and autonomous vehicles in a controlled, safe and sustainable environment.

Any entity linked to the automotive industry and new technologies will be able to test and develop new and innovative technological solutions and future services linked to connectivity (IoT, 5G and autonomous/connected vehicles). The private connectivity developed by Orange enables proof of concept, certification and approval of the technology and experimenting the operation of services and applications.

Mobile technology will enable many advantages in the automotive world, while being especially important for testing autonomous cars, as, while testing the vehicle, other aspects of the car can be examined (acceleration, braking time, ...), but also all aspects related to connectivity and multimedia applications of vehicles (on-board services, vehicle monitoring and maintenance, payment automation, accident prevention, autonomy reliability, ...).

Business cases in Catalonia (II)



The GO Visió - Grups Operatius project studies how pig feeding affects their fattening process. The project partners are Mafrica, the Manresa slaughterhouse, Catalana i Pinsos, SETNA and the Centre de Visió per Computador. The project is a clear example of the application of artificial intelligence for sustainability and productivity in the agricultural world "Smart Farming": how artificial intelligence and computer vision techniques can help in pig growth control and improvement.

However, weighing pigs with an industrial scale is not a very swift process. Thus, the idea was to replace the scales with a vision system focused on a 3D camera that can estimate the volume and weight of pigs.



To improve the efficiency of its production processes, CELSA Group, in collaboration with IThink UPC and MCIA Research Centre, has identified the need to implement an Industry 4.0 programme, called Data-driven Steel 4.0, which will enable it to:

- Collect and centralise the information generated
- Implement data-based models for real-time diagnosis and forecasting of anomalies in production processes.
- Determine the effects generated by anomalies to facilitate and speed up decision-making by plant supervisors.
- Deploy advanced analytics projects with different objectives and suppliers, within an ongoing improvement process.

Some of the goals achieved through Data-driven Steel 4.0 are as follows:

- The structuring, standardisation and centralisation of information on the production processes of all CELSA Group plants.
- The implementation of industrial analytics projects in a progressive and scalable manner, within an ongoing improvement strategy.
- Improved knowledge of process operation
- Improving and streamlining decision-making thanks to the visualisation of results of analysis algorithms.

Business cases in Catalonia (III)



SOM CARE is the IoT platform developed by Grup Saltó that runs a robot offering support, assistance and surveillance to elderly or disabled people. The robot moves around the house, recognises people, talks to them and asks them questions about their health and well-being, as well as reminding them of daily tasks, such as medication to be taken or medical appointments. In addition, emergency calls can be made via voice, and the system automatically sends alerts to the mobile phone of an assigned family member or caregiver.

The SOM CARE solution is a pioneering project in Spain, which won the “5G Challenge: How to improve the lives of the elderly through technology”, organised by the Mobile World Capital Foundation and the Barcelona City Council, and is currently being tested in the homes of volunteers who live with the robot.

Grup Saltó is a technological services and innovative digital solutions company with more than 25 years of experience in Spain.



Schneider has developed a comprehensive and sustainable solution for Nestlé Waters to reduce the downtime required for an on-site cleaning process. The system also enables improved traceability of cleaning and production operations, in accordance with food safety regulations, as well as improved operational, energy and resource efficiency.

The implemented system, called EcoStruxure, features a flexible architecture that adapts to the limitations of software and automation, and allows you to monitor and diagnose the cleaning process on site.

Thanks to this system, a 20% reduction in production downtime and increased productivity has been achieved. The monitoring and diagnosis of the valves has improved substantially, saving 340 tons of CO₂ used in the water production process.

The success of the solution has encouraged the company to use it in new production lines.

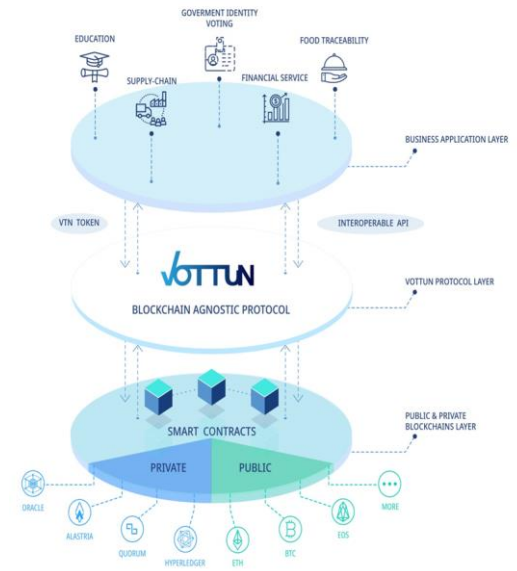
Business cases in Catalonia (IV)



Ous Montsoliu, a pioneering company in the production of organic eggs, wants to demonstrate, through blockchain traceability, that their eggs are organic, providing full transparency and confidence to consumers about the origin and treatment of their eggs.

Through the traceability platform of the company VOTTUN, the data is recorded on the blockchain, which guarantees transparency and confidence for the end consumer: all the steps in the production process are recorded, from the feeding of the hens to the product's delivery to the supermarket. Thus, consumers can see the entire process and verify that the eggs are truly organic by reading a QR code on their smartphone.

Vottun's platform is a pioneer in allowing the use of a public (Ethereum) and private (Hyperledger) blockchain simultaneously. This interoperability guarantees efficiency in data recording by means of a private blockchain and full transparency of the process through a public blockchain. This development facilitates the adoption of this technology and offers the flexibility needed today for blockchain use.



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@catalonia_ti

See the full report here:

<http://catalonia.com/.content/documents/2021/industry40-in-catalonia.pdf>

More information on the sector, news and opportunities:

<http://catalonia.com/industries-in-catalonia/sectors/industrial-systems-smart-industry-and-3d-printing/ICT-and-digital-transformation.jsp>



For the full technological report, please send an e-mail to irodriguez@catalonia.com