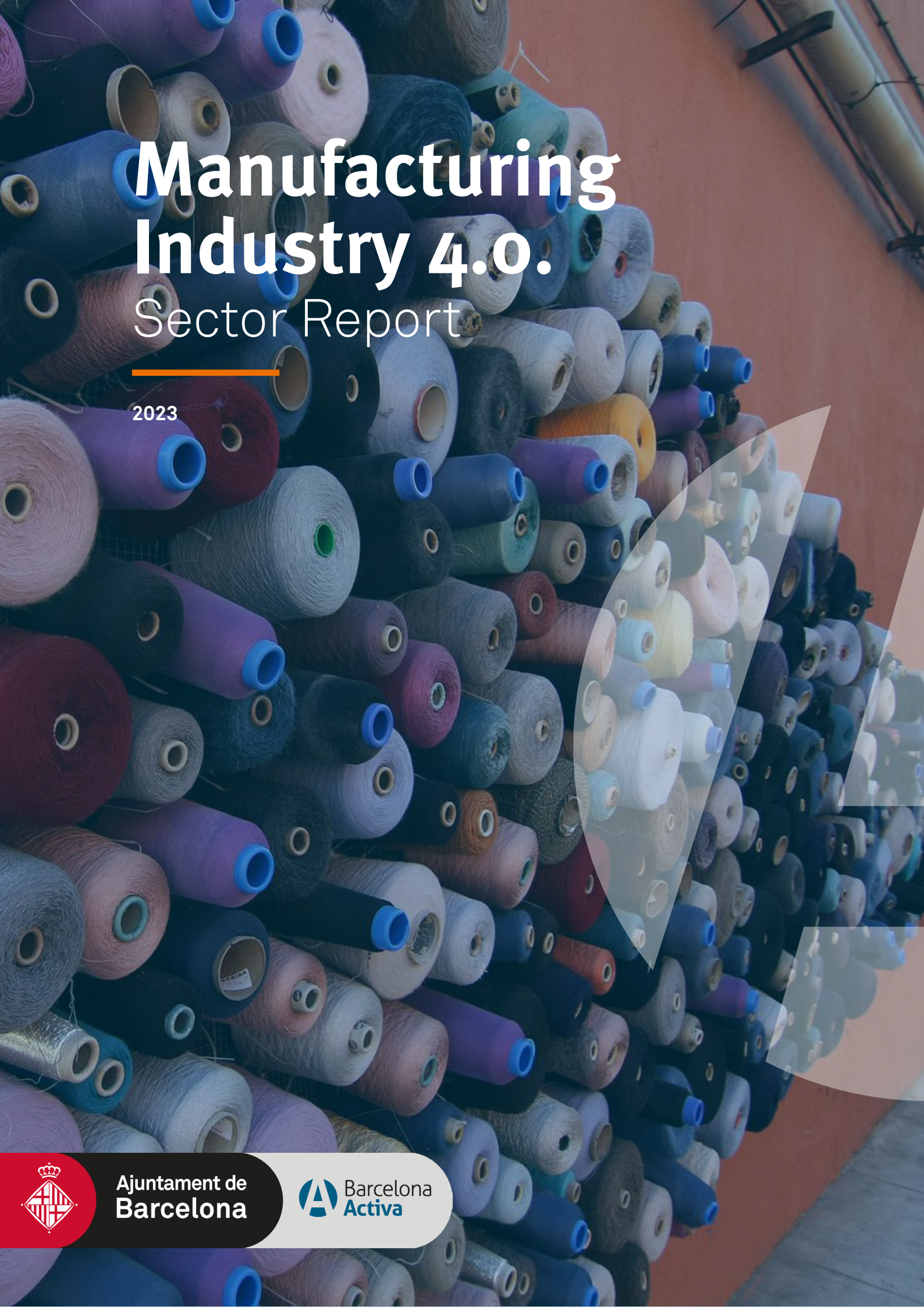


Manufacturing Industry 4.0.

Sector Report

2023

Ajuntament de Barcelona

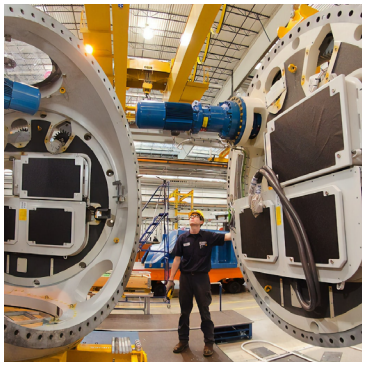
Barcelona Activa

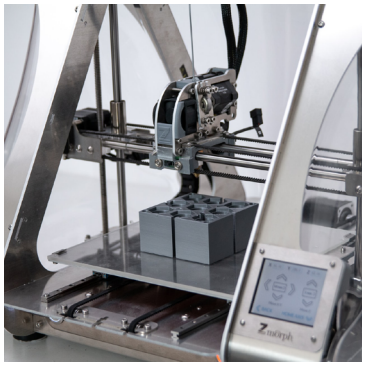
Abstract

Manufacturing Industry 4.0.

After years of expansion of the services sector, the outbreak of the **Fourth Industrial Revolution** (or **Industry 4.0**) has helped renew interest in the Manufacturing Industry as a strategic economic sector. The mainstay of this industrial transformation is the **digitisation of the production process** through the introduction of new technologies, such as the Internet of Things, Big Data, 3D printing and advanced robotics, among others.

As far as employment is concerned, the digital transformation generates opposite effects: on the one hand, its implementation requires high investments from companies and threatens jobs that have a significant manual and systematic component; on the other hand, it opens the door to more sustainable industrial activity that respects the environment and people, and **creates jobs of higher quality and added value.**





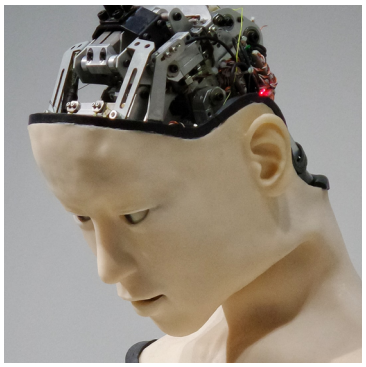


Table of contents

Get to know **the sector**

Introduction to the sector

The Manufacturing Industry covers all those activities aimed at the **processing of raw materials into consumer goods**, ready to be commercialised and distributed to end consumers. In this sense, activities that are traditionally classified as industrial activities are excluded from this categorisation, as they do not consist of manufacturing consumer goods. This applies to industries dedicated to the generation and collection of energy; those collecting, supplying and treating water, as well as activities related to mining and hydrocarbon exploration.

In turn, within the Manufacturing Industry there are two main areas of activity or **subsectors** of economic activity:

Production process

In a general sense, the production process begins with obtaining raw materials from the natural environment (agriculture, livestock, mining, etc.) and concludes with the distribution and marketing of final goods and services (logistics and commercial activities). The manufacturing industry intervenes in the **intermediate phases** of this process, i.e. in all those activities necessary to **transform resources or productive factors into intermediate and finished goods**, with the aim of satisfying the demand of companies and final consumers.

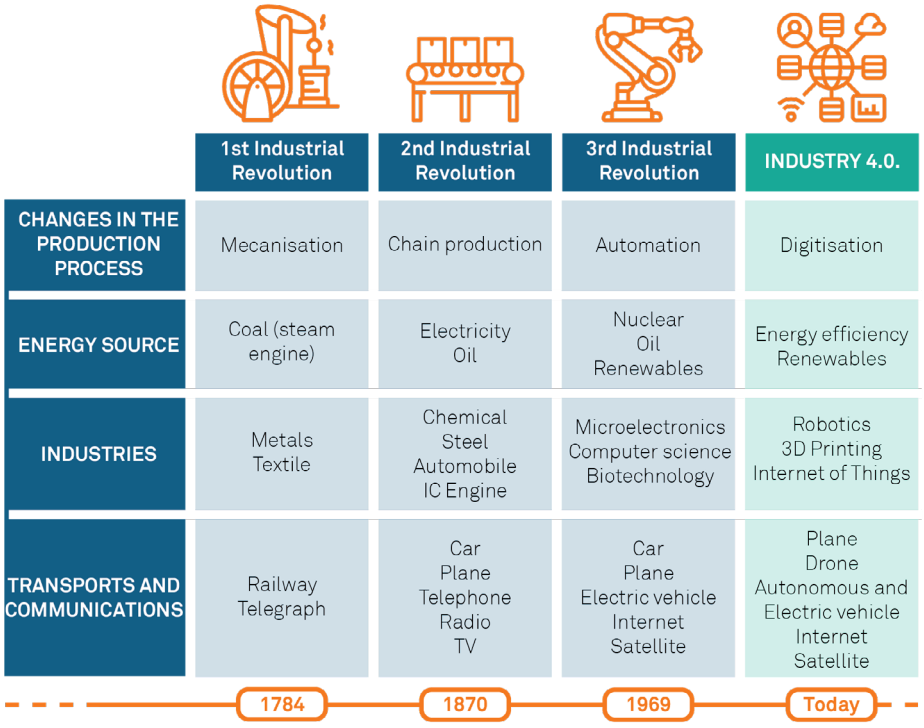
Industrial RDI

Research, development and industrial innovation are the activities by which **knowledge is transformed into new products and services** - or improvements to existing production processes - which respond to market demand and other social needs. In the context of modern economies, called "Knowledge-based Economies", technology is more quickly obsolete. That is why it is the most resilient industrial sectors that are committed to the continued incorporation of new know-how and have highly qualified human resources.

In recent years, the weight of the manufacturing Industry in the economy as a whole has been reduced as the **services sector** has increasingly grown. Therefore, the population employed in the service sector has become larger than that in industry. While the tertiarisation of the economy can be positive in some ways, it also entails a risk of deindustrialisation that many developed countries are striving to avoid. The value of having a powerful manufacturing industry lies in its **traction potential** and its ability to **generate a large amount of high-quality jobs**. Furthermore, the Manufacturing Industry is both a producer and a consumer of technological innovations, making the sector an essential productivity engine to improve competitiveness and maintain sustainable economic growth.

While the economic and productive potential of the manufacturing industry is enormous, so are the changes that currently affect the sector. As a general rule, technological evolution is progressive, but there are three historical moments or industrial revolutions that are characterised by a **radical transformation at the technological level**. Recently, the widespread use of the Internet has been equated to the triggers of previous industrial revolutions, so the digitisation process in which the industry is immersed has now begun to be called "**Fourth Industrial Revolution**" or "**Industry 4.0"**.

Figure 1. Characterisation of the four industrial revolutions



Source: Prepared by the authors

Although there is no single definition of the Industry 4.0, this term is generally understood as an industry transformation process based on the combination of **digitally based production methods and advanced information technologies**. The possibility of having large volumes of information in real time makes the manufacturing process more flexible and adaptive, and encourages the integration of all entities into the value chain. For this reason, the impact of Industry 4.0 goes beyond production centres and affects the same businesses, jobs and end consumers. In terms of employment, digitisation leads to an increase in the demand for **hybrid profiles**, who are familiar both with the production process and with information and communication technologies (ICT). At the same time, an **automation process takes place for the most manual and systematic tasks**, which transforms, and also partly contributes to ousting some professional profiles.

Industry 4.0 in Barcelona

Barcelona and the whole of the Metropolitan Area constitute a significant hub of industrial activity. In total, **182 areas of economic activity** have been identified in the Barcelona Metropolitan Area, with an employability rate of 70% in Baix Llobregat and 86% in Barcelonès, while in the Vallès Occidental AMB municipalities it is 75.2%, and in the only AMB municipality located in Maresme, Montgat, employability is 60%. Despite all this, all the counties in the AMB's area of influence are home to approximately **16,000 companies** that generate a significant part of the wealth and employment in their territories.

Today, there is a **willingness to transform the productive infrastructure** to adapt the Metropolitan Area industrial parks to the new challenges and needs posed by Industry 4.0. Thus, the aim is to condition spaces and prepare them to accommodate the most innovative and competitive industry, with advanced services and processes of specialisation, association and collaboration. This new generation of Economic Activity Areas is designed to encourage **synergies between companies** and encourage **industrial RDI.** It also incorporates **energy sustainability** criteria to reduce the environmental impact of industrial activity.

Furthermore, the productive system will increasingly tend to integrate into cities, as has already happened with the innovative district of 22@, located in the Poblenou district of Barcelona. **Urban planning based on compatible uses** brings companies and workers closer together, encourages talent loyalty and facilitates a balance of work and family life thanks to the proximity between the home and the workplace. Economic Activity Areas reflect the commitment to talent made by the manufacturing Industry in the context of the fourth Industrial Revolution.

Fields of activity

Within the manufacturing industry, **two major areas of activity** can be distinguished. The first corresponds to all those processes related to the factory activity, necessary to transform raw materials into finished products. The second area includes activities aimed at improving the efficiency of the production process or the characteristics of finished products, and is of particular relevance in the context of the Industry 4.0.

Production process

The EAE Business School describes the production process as a set of activities aimed at **transforming productive resources** or factors into **goods and services** with the aim of meeting the demand of intermediate industrial customers and consumers. This process begins with obtaining raw materials and preparing them to be used in the process of producing consumer goods; then these materials are transformed into final products and finally marketed.

Due to the variety of activities that compose it and its complexity, the production process **involves multiple economic sectors** beyond the Manufacturing Industry. For example, obtaining raw materials corresponds to primary sector activities such as agriculture, livestock, forestry or mining, and the distribution and marketing of end-products falls within logistics and trade. In this sense, the phases of the production process that correspond more directly to the manufacturing Industry and industry 4.0 are those required for the transformation of raw materials into final products.

Broadly speaking, the intervention of the Manufacturing Industry and Industry 4.0 in the production process is summarised in the following areas:

- **Facilities and factory assembly**: these are the processes needed to prepare the spaces where productive activity is performed, such as assembling the machinery and checking its proper functioning.
- **Projecting and planning**: organisational work aimed at ensuring the coordination of the various activities that integrate the production process, compliance with the deadlines and adaptation of the quantities produced to demand, following criteria of efficiency and cost optimisation.
- **Supply chain**: it encompasses all activities directly linked to the process of transforming raw materials into finished products.

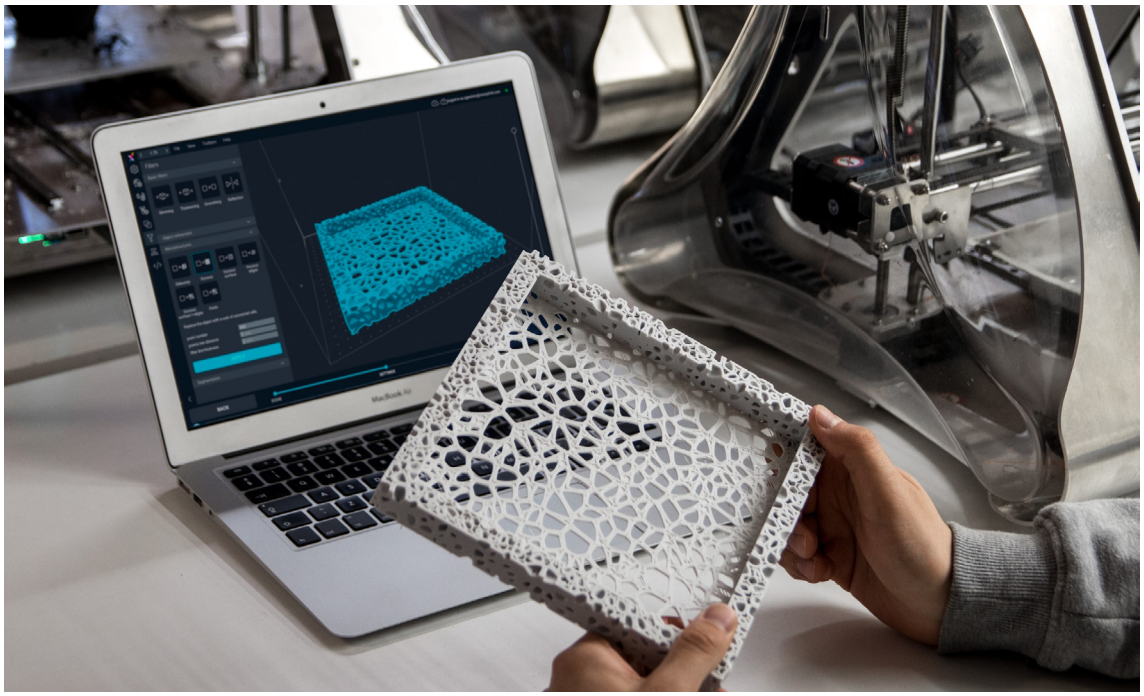
- **Production line management**: control and supervision of the production chain for the detection and resolution of incidents.
- **Quality control**: it is another type of control task, which focuses exclusively on guaranteeing the quality of the product and processes according to the standards defined by the company and also official regulations.
- **Industrial maintenance**: it consists of the resolution of mechanical breakdowns and the conduction of regular reviews in order to favour the proper functioning and conservation of machinery and industrial equipment in optimal conditions.

Industrial RDI

Research, development and **innovation** are essential for the survival of companies in the industrial sector. In a globalised world, manufacturing companies act in a context that is **highly competitive** in a wide variety of dimensions: production technologies, products, materials, legislation, prices and business models, among others. In this environment, companies that do not make sufficient use of the opportunities offered by innovation risk falling behind in terms of competitiveness and losing market share. Instead, **leading companies in innovation**, which invest in research and take risks, can achieve a **competitive advantage** through increases in productivity, flexibility or agility of the production process.

It is common for an industrial RDI process to involve multiple actors, departments and professionals from various fields. Despite this cross-cutting and cooperative nature of innovation, it is possible to define four main areas within industrial RDI:

- **Industrial research and innovation**: It entails creating new production processes or introducing improvements within the existing industrial process. It is often an interactive, multidimensional process that arises from the contact between heterogeneous activities such as research, engineering, financial planning or the study of markets and users.
- **Product development**: It is the process of creating new products —or improving existing products— that are adapted to market requirements and offer a greater economic return to the company. This process is divided into three phases:
  - **Ideation**: First of all, ideas are generated and evaluated for new products. The most promising ideas are refined and become product concepts that move on to the next phase.
  - **Development**: Starting from the concepts obtained during the ideation phase, prototypes are developed, which are used to test the technical and design features of the product. Information is also collected on the prospects for market acceptance of the new product or service. In this way, the initial concept is perfected until the final version of the product is obtained and ready for commercialisation.



- **Implementation**: The last phase is related to the launch of the product and includes both training tasks within the company, as well as consumer care and market data analysis (sales evolution and reaction from competitors, among others).

- **Industrial design**: It is the professional practice of designing products, devices, widgets and services. It focuses, above all, on the physical appearance, functionality and manufacture of products and, ultimately, aims to improve the experience of end users. Thus, the tasks of industrial designers are closely related to prototyping, although they can also intervene in other phases of the process of developing new products.

- **Materials**: The research for new materials is aimed at improving the durability of products or reducing production costs. Recently, however, this area of research also incorporates an important environmental perspective, since the materials that have traditionally been used in the production of consumer goods have a significant negative impact on the environment. Consequently, in order to guarantee a widespread transition to manufacturing with sustainable materials, new generation materials must be developed that can compete with polluting materials in price and performance.

Trends

The following trends —established and emerging— are transforming the Manufacturing Industry sector and Industry 4.0, and will influence the type of professional profiles and jobs demanded by the sector.

Established Trends

- **Servitisation**: At present, the high competitiveness of the market forces manufacturers to offer higher quality at a lower cost. In many cases, productivity has been optimised to the point that the price-quality ratio of competing products is the same. Manufacturing companies have therefore begun to rely on "servitisation of production", i.e. to offer additional services as a mechanism to **differentiate their products** from others. Examples of servitisation include the extension of warranty periods, customisation of production (through 3D printing, for example) or the popularisation of leasing. All of this contributes to the ability of professionals from different stages of the value chain to become increasingly interlinked, so **teamwork** and **cross-sectional skills** gain importance.

Figure 2. Services offered by companies

TYPE OF SERVICES		
Complementary		Substitute
Facilitating	Adaptation	
Services that improve the sale or use of a product without significatively altering its functionality	These services amplify the functionality of a product or help consumers to develop new uses	Services that substitute the purchase of a product
Examples Technical support Insurances Financing	**Examples** Customisation Integrated solutions	**Examples** Carpooling mobile apps

Source: Prepared by the authors, based on data of the report "La industria en España: propuestas para su desarrollo" (Consejo Económico y Social)

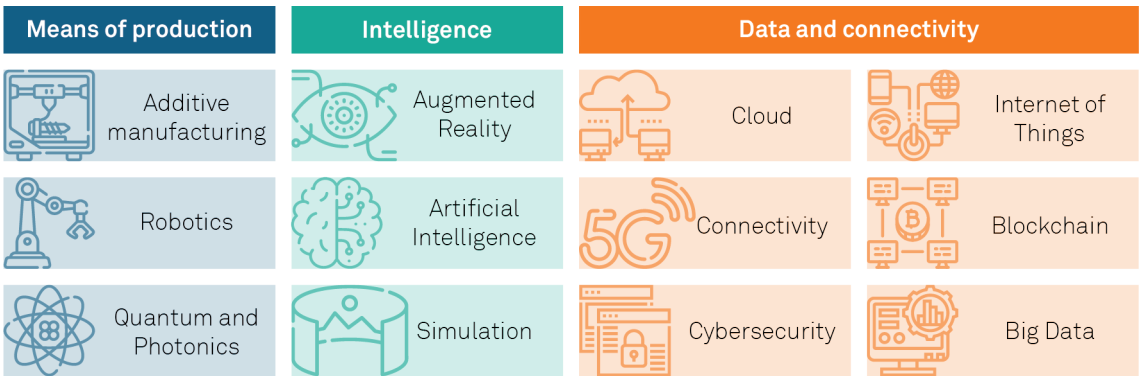
- **Customer-based models**: The democratisation of Internet access facilitates the comparison between products and fosters the emergence of better-informed and more demanding customers. At the same time, the popularisation of social networks, online purchases and intelligent products provide companies with a great deal of information about consumers. All this puts the needs of the customer at the centre of the business, and consequently makes the study of market trends and the analysis of consumer behaviour central to the product development process.
- **Data and connectivity**: One of the main features of Industry 4.0. is decision-making based on data analysis. In this way, there is an increase in the demand for professionals specialised in Information and Communication Technologies (computer scientists, programmers, data analysts...) within the Manufacturing Industry sector.

Emerging Trends

- **New production processes**: Economic instability and evolution toward business models that are focused on customer needs make the adaptability and flexibility of production a priority above productivity. Some examples of more resilient production processes are as follows:
  - **Manufacture on demand**: Its main advantages are the reduction of the risk of over-stock and the obtaining of constant data on demand, which facilitate operability in uncertain environments.
  - **Additive manufacturing**: It is the manufacturing process based on 3D printing. Today it is mostly applied in prototyping, but its use is expected to be rapidly extended to other stages of the production process.
  - **Digital twins**: A digital twin is a representation of something physical —such as a product or an entire productive environment— that allows simulating the performance of a product without performing any physical action.

  The importance of innovative activity to maintain competitiveness levels anticipates an **expansion of RDI departments** in the manufacturing industry and industry 4.0. Consequently, it will also increase the demand for **research-oriented professionals**.

Figure 3. Technologies characteristic of Industry 4.0.



Source: Prepared by the authors, based on data from the report "Capacitats i tecnologies vinculades a la indústria 4.0. a Catalunya". (ACCIÓ)

- **Manufacturing relocation**: The relocation of production to third countries in search of lower production costs has played an important role in reducing the weight of the industrial sector in many developed countries. Recently, however, a number of factors favour the relocation of production closer to the markets that generate demand, encouraging the creation of new local jobs in the Manufacturing Industry sector:
  - **The increase in production costs** in developing countries reduces the advantages of relocation.
  - The surge in the **geographical concentration** of manufacturers, suppliers, clients and research institutions allows for greater specialisation and accelerates innovation.

- There is a rising awareness of **proximity products** as a symbol for quality.
- Nearby production will **reduce risk exposure** to complex geopolitical situations.

Professional profiles

Isolating the effects of the fourth Industrial Revolution on employment is an extremely complex task and, for that reason, there is no consensus on the net labour impact that Industry 4.0 will have in Catalonia. However, a number of changes in the **type of professional profiles demanded** and the **training needs** in the manufacturing industry are already beginning to be noted and will be consolidated soon.

One of the key factors in understanding labour changes brought by the industry 4.0 is **automation**. This concept refers to the fact that, as digitisation progresses, machines take on tasks that were previously reserved for humans. Among the most pessimistic views, this trend has spread concern about the fact that the industry 4.0 will trigger major job losses, particularly in those jobs focused on more **systematic and manual** tasks. In contrast, more optimistic views argue that, although in the short term industry 4.0 will destroy jobs, in the medium term this decline will be offset by the **creation of more skilled jobs** with **more added value**.

Indeed, this change in the type of professional profiles demanded by the Manufacturing Industry sector has been noticeable and quantifiable for years. For example, the analysis of employment contracts between 2011 and 2016 shows that the demand for profiles linked to the industry 4.0 was already growing at that time, while the occupations that decreased most were manual and routine jobs, as well as some intermediate technical occupations.

Contrary to the fears of automation critics, the demand for professionals in the fields of industry 4.0 and STEM (science, technology, engineering, mathematics) **far exceeds the current offer of graduates** in Catalonia. Among the 25 most in-demand jobs in the last five years, some new STEM-related occupations stand out, such as cybersecurity analyst, site reliability engineer, artificial intelligence engineer, or DevOps engineer.

Figura 4. Changes in the dmanufacturing-related occupations

Growing demand for...	Recruitment of new staff is reduced...
Technical engineers	Textile, leather and allied crafts and trades workers
Laminators and die setters	Mechanical machinery fitters
Supervisors in the chemical and pharmaceutical industry	Packaging and labelling machine operators
Process control technicians	
Product and pieces designers	

Source: Prepared by the authors, based on data from the report "L'impacte laboral de la indústria 4.0." (Generalitat de Catalunya)

In terms of vocational training, the training programmes that are most related to industry have experienced in recent years similar levels or a decrease in registration. This, combined with an increased demand for specialists in Industry 4.0, has resulted in a **high degree of job placement in the first year** following the completion of studies of graduates in higher level vocational training programmes in the areas of installation and maintenance (83.28%), food industries (80.88%), mechanical manufacturing (79.47%) and chemistry (77.81%), according to data from 2022.

All this therefore points to the fact that in the short and medium term **jobs** in the Manufacturing Industry sector **will be created.** Although this demand for professionals will revolve around the **technologies of the Industry 4.0**, it will not only benefit those with higher education. Joaquim Minguella, a professor and researcher at the Polytechnic University of Catalonia, notes that less qualified profiles (machinery operators, installers, fitters and industrial labourers, among others) adapt to the digital transformation by taking **complementary training** on the tools and technologies specific to their workplace. Thus, all profiles will be able to benefit from opportunities arising from the industry 4.0.

Below there is a more in-depth explanation of the features and requirements of eight of the professional profiles of the Manufacturing Industry and Industry 4.0 with **better job prospects**, according to the Employment Observatory of March 2021:

Head of technology transfer

Those responsible for technology transfer are in charge of commercialising the knowledge generated in their entity (university, hospital, research centre or business) through licensing or through the creation of technology-based companies. It is a key profile in a context of innovation, as it is responsible for **turning generated knowledge into value**. In addition to having a broad knowledge of the scientific and technological needs and supply of the sector in which they operate, these professionals must have personal, communication and sales skills. They will also be demanded to be flexible, willing to travel, and to have an advanced knowledge of languages —especially English—, as promotional tasks will often require their participation in international fairs and congresses.

On the other side of the knowledge and technology exchange is the **CEO of digital technology** (Chief Digital Officer). This is a new professional profile in the Industry 4.0 sector, which is responsible for implementing technological solutions in the production process.

Electronic Equipment and Automation Systems Repair Mechanic

Due to increased automation, the demand for professionals with **mechanical and electronic knowledge** of the machinery used in the production process is growing. It is an essential professional profile to ensure the proper functioning of production chains, as it detects faulty errors and components and performs the corresponding changes and repairs. Thus, manual skills and also concern for order and quality are valued in this job.

Chemical Laboratory Technician

This professional profile belongs to the field of industrial research and innovation and works on the **design** and **synthesis of compounds**. Its high demand is because it is a role present in different fields related to chemistry, one of the major industrial branches in terms of turnover in Catalonia and the Barcelona Metropolitan Area. For example, chemical laboratory technicians can work in developing drugs, obtaining new materials or in the perfume and cosmetics sector, among others. In addition, it has the advantage of being a job that **can be accessed from various educational paths**, both university and vocational training.

Industrial Labourer

The industrial labourer figure provides support in different **production-related tasks**, such as preparing materials, cleaning and maintaining areas, machines and equipment, and plant work routines. Although the most systematic tasks of these professionals are highly susceptible to automation, it remains one of the most demanded profiles in the labour market. The need for this professional profile is due to two reasons: firstly, automation replaces routine manual tasks (e.g. the packaging process), but not those less systematic or requiring greater cognitive skills (e.g. manipulation in disorganised environments); secondly, the work of this professional is highly adaptable to change through retraining programmes or specific training.

Materials Engineer

Materials engineers perform select and design materials that can be used in industrial processes. Although it is not a new professional profile, research and application of advanced materials has intensified with the Industry 4.0 through several factors. Firstly, innovation in this field **improves the competitiveness of companies** and their market positioning, as it results in products that are more resistant, lighter and/or longer-lasting. Secondly, the use of new materials is **closely linked to the expansion of additive manufacturing** and is a necessary element for extending the possibilities of this technology, which is already applied in fields such as construction and food. Finally, the development of more **sustainable and recyclable materials** that do not increase production costs disproportionately will be key in order to meet the challenges posed by the climate crisis.

Electronics Technician

Electronic technicians work in the **product development** field, designing or developing small, custom-made **cards and simple electronic products**. It is job on the rise in the labour market due to the extensive digitisation process currently going through the Manufacturing Industry sector and Industry 4.0. As it is a job in the field of innovation, some essential requirements are the ability to adapt to change, and being familiar with trends in the sector and the functioning of new technologies. In this lifelong learning process it is useful to have an advanced level of English and to know the technical terminology of the sector.

Industrial Project Manager

They are the person in charge of **managing development projects** (design, construction and installation) of **products or systems**. It is a very important position within the manufacturing industry that will require new skills, resources and techniques to adapt to changes in the implementation of the Industry 4.0. Mainly, professionals will be required to keep up with the sector's latest technological developments (cybersecurity, data management and sustainability, among others) and to incorporate them into the production process to increase efficiency. It is therefore a professional profile requiring extensive technical knowledge, organisational and management skills and leadership skills.

Automation-robotics Technician

The production of robots and a higher degree of automation in production chains will increase the demand for robotics experts and automation of processes that are capable of **coordinating and configuring robots**. Since advanced robotics allows real-time monitoring of the production process, it will become increasingly important for robotic-related professional profiles to complement their mechanical skills with knowledge about **data analysis and connectivity technologies**. For example, it will be valued that they have specialised training in Machine to Machine integrations, ERP (Enterprise Resource Management) integrations, Machine Learning or Internet of Things.

The sector in figures

Figure 5. The Manufacturing Industry in Catalonia and the Barcelona Metropolitan Area (AMB)

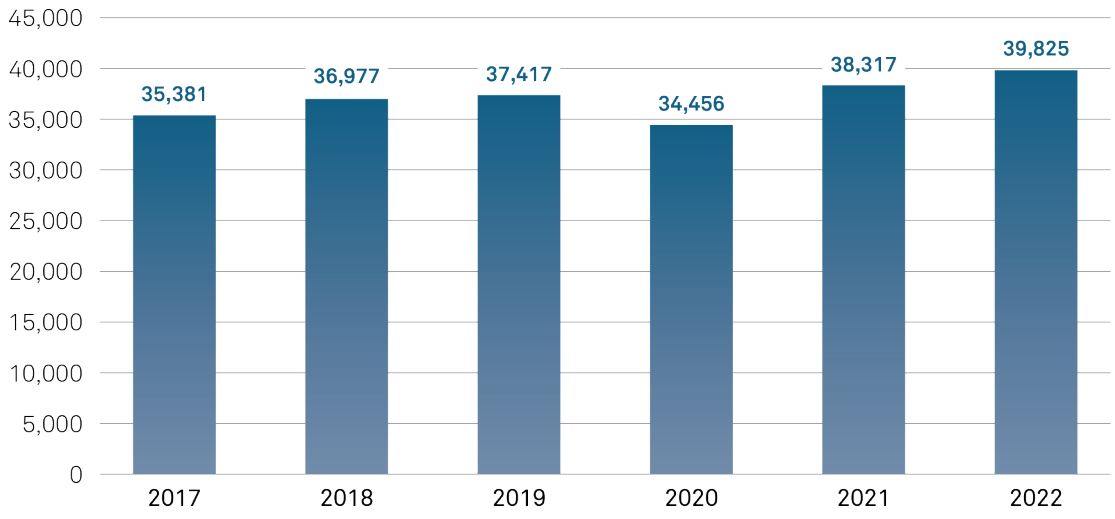
Indicator	Most recent data
Sector's GDP in Catalonia	39.82 B € (2022)
Weight of the sector (% GDP)	15.69 % (2022)
Number of active companies in Catalonia	35,688 (2022)
Number of active companies in the AMB	6,557 (2021 T1)
Employed people in Catalonia	600,700 (2023)
Percentage of female staff	32% (2022)

Source: Prepared by the authors, based on data by Idescat.

Manufacturing Industry

- The contribution of the manufacturing industry to **Catalonia's GDP** has grown in recent years to reach close to **40 billion euros** in 2022. However, it is worth highlighting the shock that the Covid-19 crisis meant for the sector, which mainly affected the 2020 financial year, with a fall of 34,456 million euros. Nonetheless, the recovery of the contribution of the manufacturing industry to the Catalan GDP has been more than remarkable.

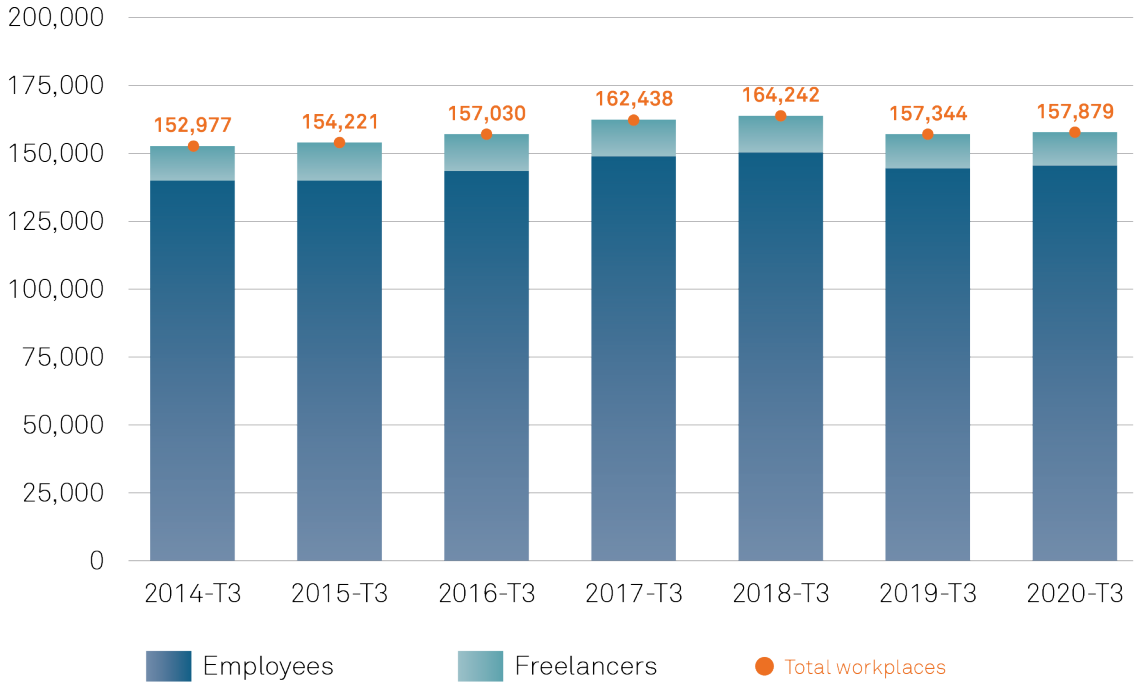
Figure 6. Evolution of the contribution of the manufacturing industry to the Catalan GDP (in millions of euros)



Source: Prepared by the authors, based on data by Idescat .

- According to the latest data available from the Labour Force Survey, the industrial sector in Catalonia **employs 600,700 people**, 1.03% more than in 2021. This increase comes mainly from the **industry associated with machinery, electrical equipment and transport** (194,100 people employed). Year-on-year, employment in industry fell by 2.7% (16,218 fewer people), while overall employment in Catalonia increased by 3.8%.
- According to the latest available data, the number of **people employed** in the industry sector in the Barcelona Metropolitan Area is **145,959**. The number of **freelancers** is **11,940.** The trend points to a slight increase in the number of salaried employees and a fall in the number of self-employed workers since 2014.

Figure 7. Evolution of industrial jobs in the Barcelona Metropolitan Area



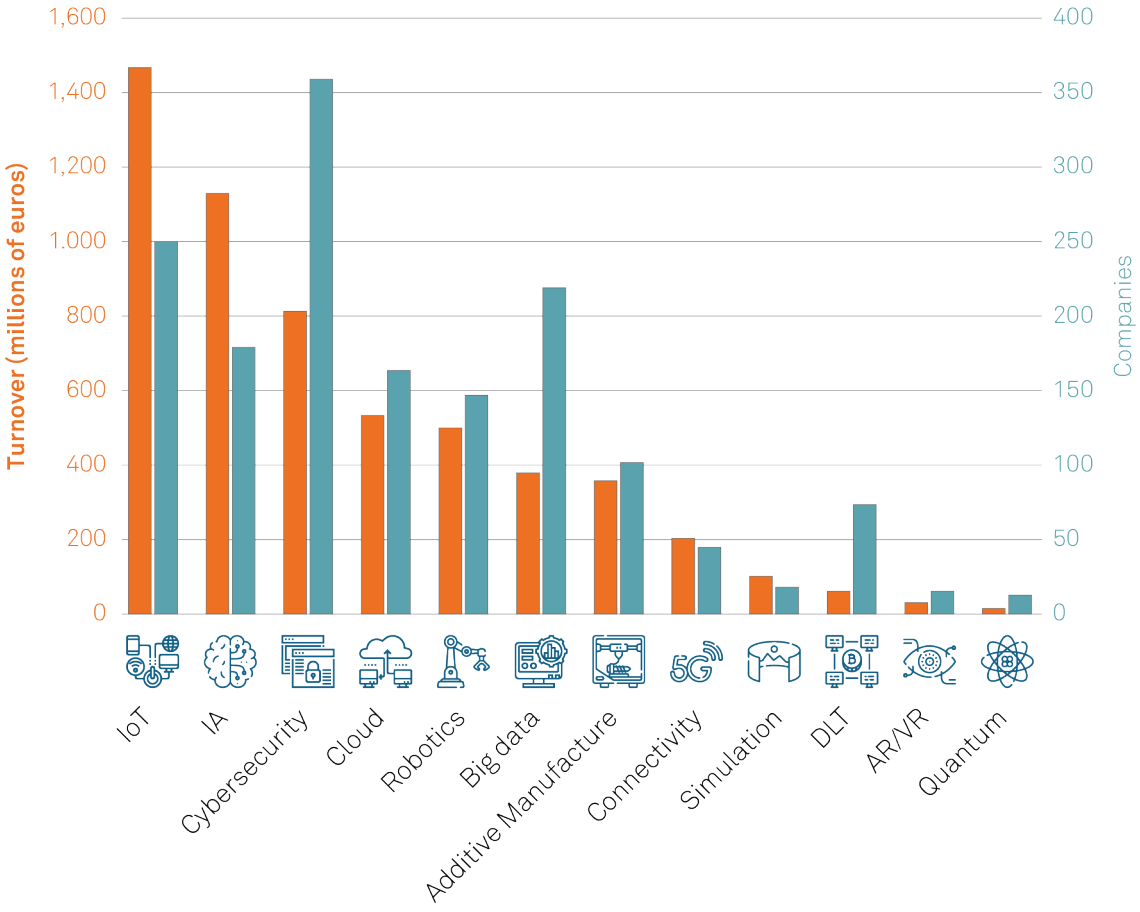
Source: Prepared by the authors, based on data by Idescat

- According to the Innovation Barometer in Catalonia, o**ne in four companies in Catalonia acquires or develops RD**.
- By age, **companies with the highest innovative activity** are the most mature (+50 years) and the most emergent (0-9 years).
- In 2021, there were **6,557 industrial companies** in the Barcelona Metropolitan Area.
- The Catalan industry experienced a strong recovery, with an **increase in GVA of 5.3%** in 2021. The industrial production index (IPI) grew by 8.2% in 2022, the highest increase in the available series in 20 years.
- 87,2**%** of innovative industrial companies **export their products** abroad. For the total companies, this percentage is only 29,5%.
- The largest sector of Catalan industry is **food**, which increased production in 2021 more than Spain and the EU. It is followed by the **chemical industry**, whose employment reached the highest level in the last decade, and the **automotive industry**, according to GVA.

Industry 4.0.

- In Catalonia, the sector with the most demand for solutions of the Industry 4.0 is **metallurgy and metal products** manufacturing, followed by the food and gourmet products sector and logistics, e-commerce and distribution.
- The **Internet of Things** and **artificial intelligence** are the technologies related with the Industry 4.0 that have a higher turnover.
- 55.1% of companies related to Industry 4.0 in Catalonia are located in the city of Barcelona.
- In total, ACCIÓ has detected 1,111 **companies in Industry 4.0** in Catalonia, 90.1% of which are SMEs. Altogether, they have a turnover of 5.56 billion euros per year and a total of 26,394 jobs.

Figure 8. Number of companies and turnover by technology. Catalonia.



Source: Prepared by the authors. Report "Capacitats i tecnologies vinculades a la indústria 4.0. a Catalunya". (ACCIÓ).

Projection and future scenarios

The following outline presents a summary of trends that will mark the future scenarios of the Manufacturing Industry and 4.0 sector:

Weaknesses

- The popularisation of industry 4.0 among Catalan companies it is **still emerging**; it is estimated that only one in six companies has started taking actions in this field.
- There is **a lack of qualified professionals** to meet the demand for technological profiles, as the annual number of graduates in this field is lower than the number of jobs created.
- The high initial investment required is a **barrier to the adoption of new technologies** by SMEs.

Threats

- The high **dependency on the Internet** of 4.0 technologies can result in extensive damage from small connection disruptions or computer attacks.
- There will be a decline in recruiting for jobs with **high a probability of automation**.
- The effects of the implementation of the industry 4.0 will benefit most **big business** and **highly qualified workers**.

Strengths

- Industry 4.0. makes manufacturing activity more **agile, flexible and adaptable to change** thanks to the processing of large volumes of real-time data.
- **STEM jobs are more resilient** to economic transformation, as they are associated with higher levels of productivity and generation of added value.
- Barcelona has a **powerful ICT sector**, consisting of more than 12,000 companies, and is capable of accompanying the Manufacturing Industry in the process of digital transformation.

Opportunities

- The trend to **relocate production** will contribute to the creation of new industrial jobs due to the opening of new local production centres.
- The tendency to bring productive activity closer to the city favours **recruitment and talent retention** and facilitates a **work and family life balance** for workers.
- Innovation is growing thanks to the **increase in collaborative initiatives** between companies, research centres, technological centres and universities.

The impact of Industry 4.0 in the manufacturing sector is substantial. Digital processing not only revolutionises the way in which we produce and do business, but also results in a significant **increase in the demand for qualified and multidisciplinary professionals**, particularly in the fields of ICT and STEM. However, despite the fact that adopting 4.0 technologies has the potential to increase productivity levels and create thousands of new skilled jobs, it can also **widen inequalities between small and large companies**, and between workers of different training levels. Similarly, the high investments required can be a barrier for SMEs to adopt the latest technologies, although automation threatens the most manual and systematic jobs, often linked to less qualified professional profiles. Due to this asymmetric impact of digital transformation, the process must be accompanied by **redistribution policies** as well as educational strategies aimed at **updating the skills** of workers.

Sources consulted

The sources used for this report were the following:

- Acció (2017). Mapeig i anàlisi de la Indústria 4.0. a Catalunya.
- Acció (2019). Baròmetre de la Innovació a Catalunya 2019.
- Acció (2021). Capacitats i tecnologies vinculades a la indústria 4.0. a Catalunya.
- Acció (2022). Baròmetre de la Innovació i la transformació digital i verda a Catalunya 2022.
- AMB (2021). Mapping del teixit associatiu dels PAE. Radiografia de l'estat de les associacions empresarials metropolitans.
- Aristidis Mamasioulas, Dimitris Mourtzis & George Chryssolouris (2020) A manufacturing innovation overview: concepts, models and metrics, International Journal of Computer Integrated Manufacturing, 33:8, 769-791, DOI: 10.1080/0951192X.2020.1780317.
- CES (2019). La industria en España: Propuestas para su desarrollo.
- Deloitte (2017). Forces of change: Industry 4.0.
- Deloitte (2021). 2021 Manufacturing Industry Outlook.
- EAE Business School. Proceso de producción: en qué consiste y cómo se desarrolla.
- Ernst, H., Hoyer, W.D., & Rubsaamen, C. (2010). Sales, Marketing, and Research-and-Development Cooperation Across New Product Development Stages: Implications for Success. Journal of Marketing, 74, 80-92.
- Generalitat de Catalunya (2017). Què és la servitització?
- Generalitat de Catalunya (2022). Informe anual sobre la indústria a Catalunya 2021.
- Generalitat de Catalunya - Departament d'Empresa i Coneixement (2018). L'impacte laboral de la Indústria 4.0. a Catalunya.
- Generalitat de Catalunya i Consell General de Cambres de Catalunya (2022). Inserció Laboral dels Ensenyaments Professionals 2022.
- Görmüs, Ayhan. (2019). Future of Work with the Industry 4.0.
- Idescat. 2461 – Enginyers industrials i de producció.
- Industrial Designers Society of America. What is Industrial Design?
- Material Innovation Initiative.
- Sancho, R. (2007). Innovación industrial. Revista Española de Documentación Científica, 30, 553-568.
- SEPE (2021). Observatorio de las ocupaciones – Marzo de 2021.

Webliography

For further information on the sector, please consult the following list of resources:

- Cámara de Comercio de España. Mapa del sector industrial español: claves y retos.
- Deloitte (2015). El futuro de la manufactura: Fabricando cosas en un mundo cambiante.
- Publications office of the European Union (2020). The 2020 EU industrial R&D scoreboard.
- Observatorio de las Ocupaciones (2020). Los perfiles de la oferta de empleo 2020.
- Eurecat Academy. Guía de perfiles prodesionales de la industria 4.0.

Image credits

VICENTE ZAMBRANO / CC. Can Batlló factory. Cover image.
GREG ROSENKE. Sparking drill bit. Abstract.
MARKUS SPISKE. Screen with code. Abstract.
POSSESSED PHOTOGRAPHY. Robot. Abstract.
SCIENCE IN HD. Aircraft assembly. Abstract.
THE CREATIVE EXCHANGE. Food industry workers. Abstract.
ZMORPH. 3D printer. Abstract.
CARLOS ARANDA. Production process. Pg. 4.
THIS IS ENGINEERING. Industrial RDI. Pg. 4.
VICENTE ZAMBRANO. Pg. 6.
ARNO SENONER. Pg. 7.
THIS IS ENGINEERING. Pg. 8.
ZMORPH. Pg. 9.
ROMAIN DANCRE. Pg. 10.
LARS KUCZYNSKI. Pg. 12.
PTTI EDU. Pg. 13.
THIS IS ENGINEERING. Engineer at her workplace. Pg. 14.
LAUREL AND MICHAEL EVANS. Industrial Operators. Pg. 14.
THIS IS ENGINEERING. Metal material. Pg. 14.
MECH MIND. Pg. 15.

This report has been prepared by **Utrans.**