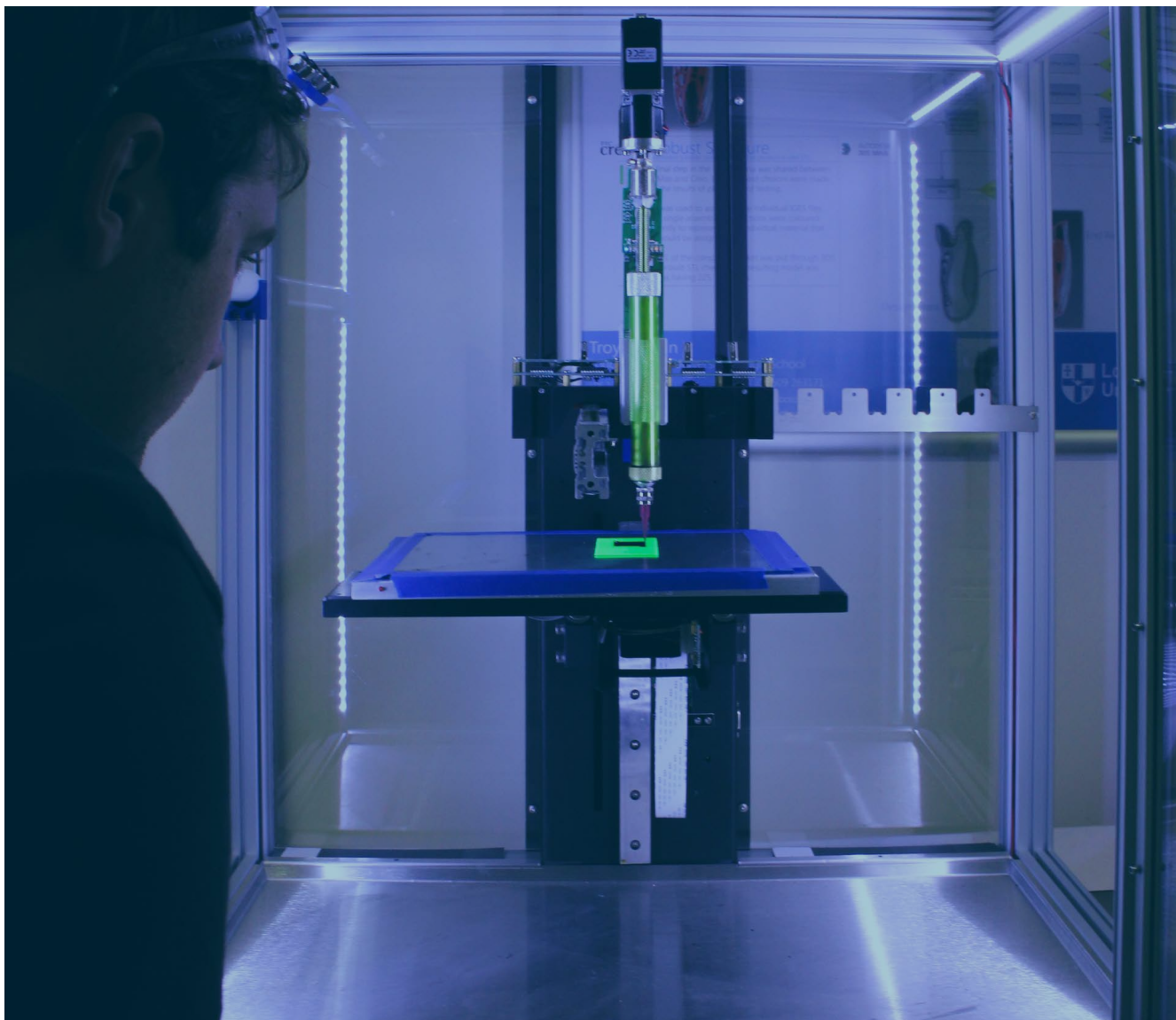


**MANUFACTURING INDUSTRY 4.0**

*Sector focus*



# Additive manufacturing

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2022

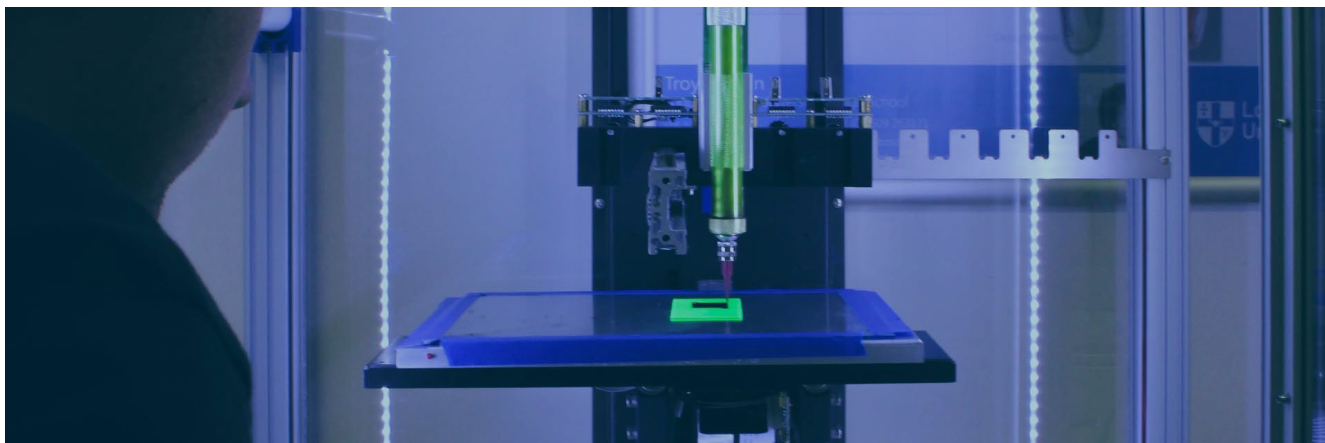


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# Table of contents



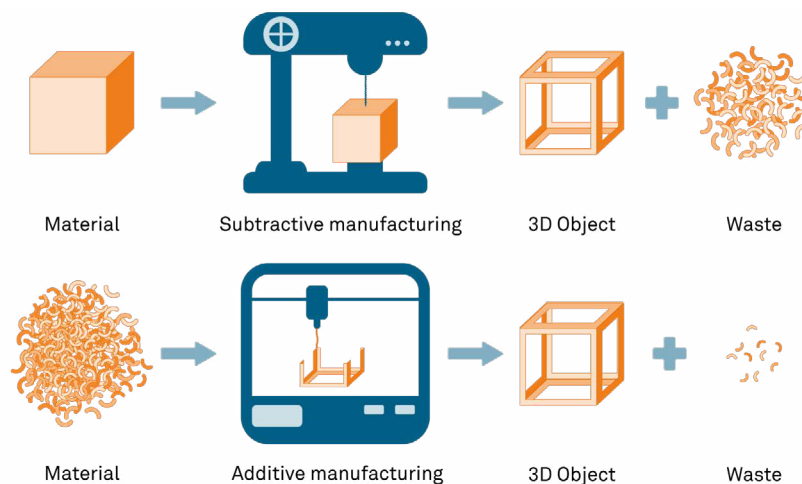
MANUFACTURING FOR THE FUTURE .....	3
IMPLICATIONS OF 3D PRINTING FOR THE PRODUCTION PROCESS .....	5
IMPACT OF ADDITIVE MANUFACTURING ON PROFESSIONAL PROFILES.....	7
ADDITIVE MANUFACTURING, IN FOCUS .....	9
SOURCES CONSULTED .....	10
ADDITIONAL WEBLIOGRAPHY .....	10

# Manufacturing for the future

Additive manufacturing, also known as **3D printing**, refers to the set of technologies that allow the creation of 3D objects from digital models. This kind of manufacturing process is called “**additive**” because it implies sequentially layering a material such as plastic, metal and biological tissue. This process differs from traditional **subtractive** methods, in which the material is removed from a solid block until the final piece is achieved.

The origins of additive manufacturing date back to 1981, when researcher Hideo Kosama, from the Nagoya Municipal Industrial Research Institute (Japan), invented two methods to print plastic objects. Initially, these technologies were used exclusively to print prototypes and their potential business uses were limited. In recent years, however, the cost of additive manufacturing has continuously decreased. At the same time, its possibilities expanded. Due to the combination of these two factors, additive manufacturing has become more competitive in regards to traditional manufacturing methods and is now **one of the essential technologies in Industry 4.0**.

**Figure 1.** Difference between traditional manufacturing and additive manufacturing

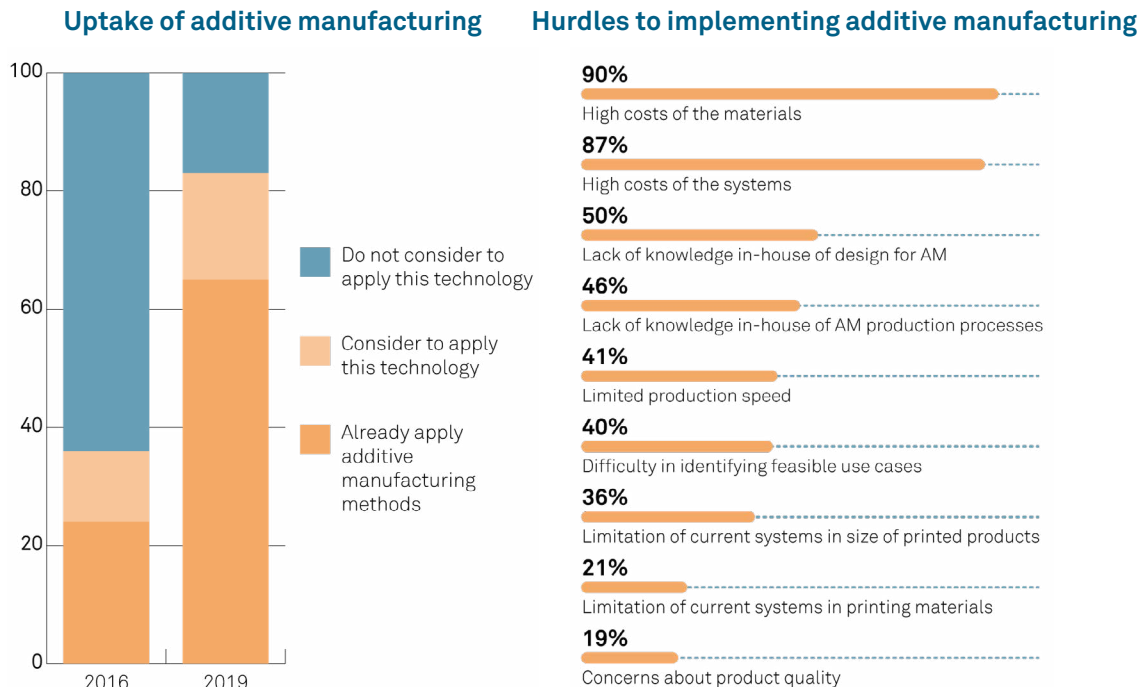


Source: Prepared by the authors, based on Bitfab - What is additive manufacturing? Applications, technologies and advantages

Some of the main advantages of additive manufacturing in regards to traditional manufacturing methods are the following:

- **It reduces the cost of the initial investment** needed to manufacture a new product.
- **It uses the exact amount of material** for each piece, significantly decreasing waste, which makes the manufacturing process more sustainable.
- **The production chain shortens** because it is no longer necessary to have specific tools and machinery for each phase of the manufacturing process.
- **It facilitates on-demand manufacturing**, the production of complex geometric pieces and the personalisation of products and components in short-series manufacturing without added costs.

**Figure 2.** Evolution of the degree of introduction of additive manufacturing technologies and main hurdles to their use



Source: Prepared by the authors, based on Ernst & Young 3D printing: hype or game changer?

A study conducted by Ernst & Young, based on interviews to 900 companies from three different continents, suggests that **additive manufacturing has more than doubled in popularity and use in recent years**. In 2016, one out of four companies used additive manufacturing technologies, and more than 60% did not consider using them. Only three years later, in 2019, 65% of companies used these technologies and only 17% did not consider applying them. This same study shows that the main reasons holding back companies from using additive manufacturing are, in the following order: the high cost of materials and equipment, the lack of knowledge necessary to make 3D designs and operate printing machinery, and the speed limits in production.

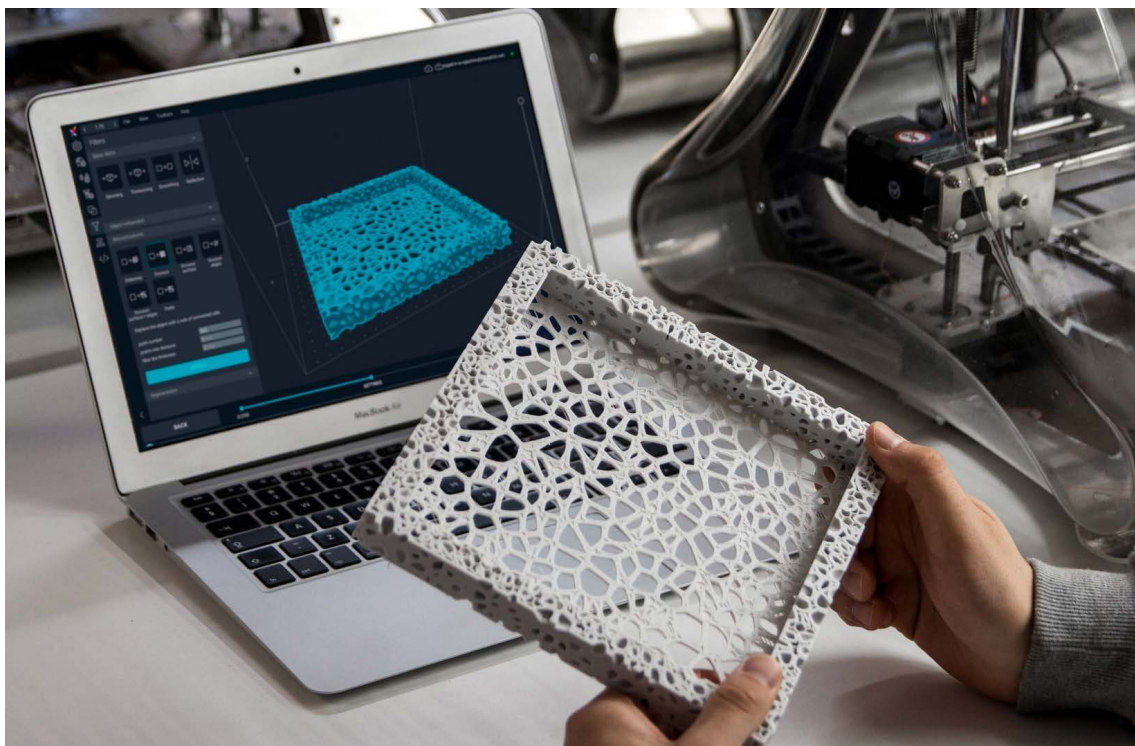


The expansion of additive manufacturing has also arrived in Catalonia. This region aims to position itself as **one of the main hubs of 3D printing development worldwide**. In 2019 there were **118 companies** in Catalonia linked to 3D printing, which employed over **1,300 staff members**. About 25% of these companies had a yearly turnover of over 1 million euros, and the sector's total turnover was roughly 325 million euros. Besides, the city of Barcelona hosts worldwide leading exhibitions and congresses in the sectors of Industry 4.0 and 3D printing, such as Advanced Factories and INDUSTRY: From Needs to Solutions.



# Implications of 3D printing for the production process

The current state of development of additive manufacturing suggests that these technologies will not replace traditional manufacturing methods in the short term. However, **3D printing will continue to quickly gain ground in the steps of the production process in which it offers obvious advantages in regards to traditional manufacturing.** These steps include the creation of prototypes, patterns, moulds and stencils; the manufacture of complex pieces and structures; small production runs; and manufacturing processes that demand high levels of flexibility or customisation.



Companies banking on incorporating 3D printing will have to assume a substantial initial investment, make organisational changes, add new specialised professional profiles or train their staff in this new technology. In return, they will obtain important benefits:

- **3D printing streamlines the processes of product design and development.** Together with the fact that this technology does not require producing in large amounts to reduce costs, this offers the possibility to continuously innovate the products, improving the company's competitiveness and market positioning.
- Another benefit is that **3D designs may be shared online and printed anywhere** in the world, which reduces the need to import parts and finished products. This entails savings in transport and logistics expenses for industrial companies, as well as a reduced environmental impact.

Lastly, additive manufacturing is a cross-cutting technology, meaning it stands out for its wide range of potential applications in different areas. Some of its applications are listed below:



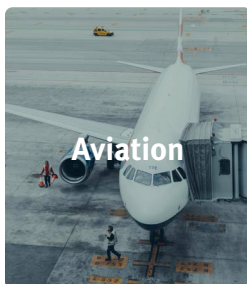
Project Nutrialth, promoted by Althaia Foundation, uses 3D printing to cook meals in mousse, purée and cream textures, respecting their original flavours. Their goal is that people with swallowing difficulties can enjoy tasty, healthy and safe meals.



Technological company Icon, non-profit New Story and design studio Fuseproject have united to build affordable housing made with 3D printing in Latin America. This project aims to build houses adapted to the environmental conditions and the culture of the communities that will live in them.



CIM UPC Foundation has created the line 3D Printing for Health, which researches the applications of 3D printing in health. They print prostheses and build presurgical models for surgeons to practice on before high risk operations, amongst other services.



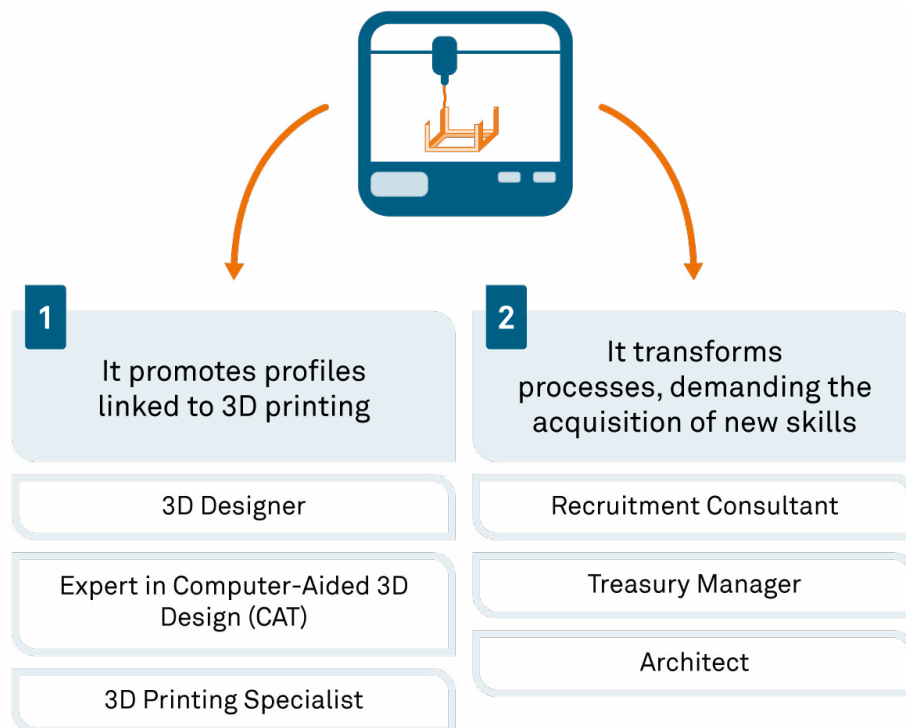
Aircraft building is one of the sectors with a higher demand for additive manufacturing solutions. In the context of an unstoppable rise of air traffic, 3D printing accelerates production processes. At the same time, it makes it possible to manufacture lighter structures that reduce fuel consumption and the environmental impact of flights.

# Impact of additive manufacturing on professional profiles

Since the first Industrial Revolution, technological progresses favouring production process automation have been perceived as a threat for employment. While it is true that certain tasks and jobs may become obsolete due to the introduction of new technologies, the net result of technological evolution has been positive historically. In other words, new technologies create more jobs than they destroy. Future predictions point that the transition towards Industry 4.0 will not be an exception. Specifically, **the expansion in additive manufacture technologies will create employment as well as transform existing job roles.**

The impact of 3D printing on employment may be summarised in two points. Firstly, there will be **new 3D printing job roles**, in which professionals will be in charge of applying this technology. Secondly, additive manufacturing will replace or transform some industrial processes. Therefore, some **professionals will not work directly with this technology, but will need specific knowledge on the matter** in order to do their job correctly. For instance, an industrial recruitment consultant should have basic knowledge of 3D printing in order to properly evaluate candidates to job roles linked to this technology.

Figure 3. Impact of additive manufacturing on employment



Source: Prepared by the authors

Some of the most in-demand professional profiles resulting from the implementation of additive manufacture technologies are listed below:



**3D Designer:** A person who transforms a product idea into a design with suitable format and specifications for 3D printing manufacture. This activity is closely linked to the **experts in Computer-aided 3D Design (CAD)**, who transform the product design into a digital model for 3D printers.



**3D Printing Specialist:** Besides having the knowledge necessary to operate 3D printers, these experts must have notions of 3D design to advise customers and make product drafts that meet their needs. They are also in charge of reviewing the final designs and suggesting changes when necessary.



**R&D&I Engineer:** Additive manufacturing has been applied in technological and scientific industries for decades. By contrast, the implementation of this technology in the fields of art and consumer goods manufacturing (such as fashion and home decor products) is in its beginnings. In the context of democratisation of technology, companies of all sectors will need engineers and designers dedicated to researching new ways to apply 3D printing to the production process, with the aim to optimise costs and improve the output of the final product.



**Architect:** This one of the many job roles that will need to acquire specific 3D technology skills although they don't work with them directly. In the field of construction, printing of 3D mock-ups allows to accurately portray structures and to view architecture projects in a simple and intuitive way. Therefore, 3D prototypes will complement 2D blueprints that are currently used and perhaps will completely replace them in the future.

Additive manufacture will also have an impact on **education** and **legal services**. Regarding education, schools and training centres are developing 3D printing programmes to meet the increasing demand of professionals specialised in this technology. Concerning legal services, the popularisation of 3D printing has led to an actualisation of legal frameworks, especially those regulating patents and intellectual property rights.

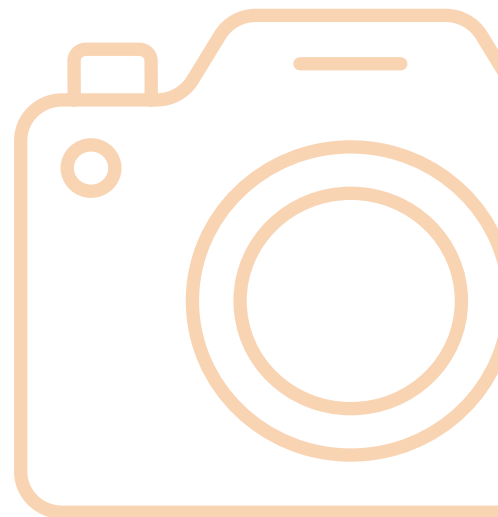
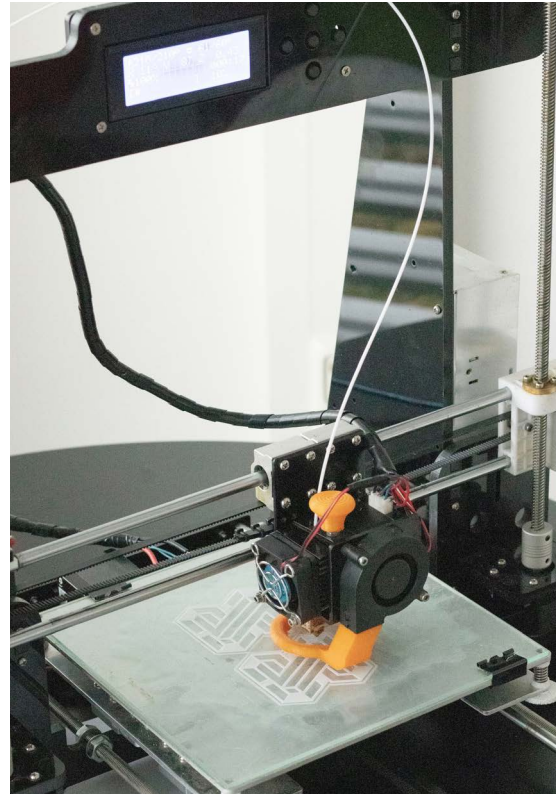


# Additive manufacturing, in focus

Additive manufacturing has become a **prevailing trend** in the context of Industry 4.0 due to its recent development. This is evidenced by the fact that the leading industries in its application, such as aerospace and health sciences industries, are already researching, developing and applying complex 3D printing solutions. At the same time, the industrial sectors that had not used additive manufacturing are starting to show interest in the possibilities of this technology and experiment with them.

3D printing is expanding due to its advantages compared to traditional manufacturing methods. It is an attractive technology for businesses because **it allows to improve product design** in ways that used to be too expensive or technically impossible to carry out. Also, in many cases **it may help reduce costs**. More broadly, the boost in additive manufacturing results in **environmental advantages**, such as less waste derived from the production process and lower levels of pollution linked to freight transport.

The **impact on employment and professional profiles** will be positive as long as companies and employees are willing to bring themselves up-to-date technically and intellectually. As a result, 3D printing will become the field of expertise for some people. For most people, however, it will be enough to **receive specific training** regarding how additive manufacturing will change their job roles.



## Sources consulted

- Dynatec (2020). [La fabricación aditiva clave en la Industria 4.0.](#)
- ACCIÓ (2019). [La impressió 3D a Catalunya i al món.](#)
- EY (2019). [3D Printing: hype or game changer?](#)
- Deloitte University Press (2015). [El futuro de la manufactura: Fabricando cosas en un mundo cambiante](#)
- Harvard Business Review (2015). [The 3-D Printing Revolution.](#)
- La Vanguardia (2021). [Así ayuda la tecnología 3D a las personas con dificultades para deglutir alimentos.](#)
- Fuseproject. [New Story Charity.](#)
- Fundació CIM. [3D Printing for Health.](#)
- Eos. [Industrial 3D Printing for Aviation.](#)
- Business News Daily (2019). [10 3D Printing Jobs On the Rise.](#)
- Universia (2021). [¿En qué consiste el Trabajo de un técnico de impresión 3D?](#)
- Yong Huang et al. (2015). [Additive Manufacturing: Current State, Future Potential, Gaps and Needs, and Recommendations.](#)
- Impresión3D. [Historia de la impresión 3D.](#)
- Bitfab. [¿Qué es la fabricación aditiva? Aplicaciones, tecnologías y ventajas.](#)

## Additional webliography

- World Economic Forum (2020). [Jobs of Tomorrow: Mapping Opportunity in the New Economy.](#)
- World Economic Forum (2020). [A short history of jobs and automation.](#)
- INSIDER (2014). [This Technology Could Have The Biggest Impact On American Jobs Since Offshoring.](#)
- EY (2021). [How the future of 3D Printing is taking shape.](#)
- LEITAT. [Les nostres iniciatives.](#)
- Trimech (2019). [A Brief History of Additive Manufacturing.](#)

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