



Printing in three dimensions (3D printing) is the **process of joining materials to make objects from a digital model**, usually putting one layer on top of another, as opposed to subtractive methodologies such as traditional manufacturing machining. It is about **making solid three-dimensional structures in volume**.

A 3D printer is a machine capable of "printing" of 3D designs, creating **pieces or volumetric models** from a design made by computer.

ORIGIN OF THE INVESTMENT OPPORTUNITY



This methodology arises primarily from the **needs of adaptability to changes in the design of parts** that manufacturing companies face. By drastically reducing costs and **accelerating time to market for both prototypes and tools**, 3D printing solves specific unmet needs in some production lines.

The automotive sector is one of the pioneers in the adoption of 3D printing technology and the largest buyer of 3D printers, capturing a market **share of 40% of the market**. Virtually all major global carmakers and many parts manufacturers have purchased one or more 3D printers. The **medical sector** accounts for around **15% market share of 3D printers**, and generally considered one of the largest markets in the manufacture of final pieces. ⁽¹⁾ All this is possible thanks to **technology** that has led to the evolution of the printer that applies ink to paper, to another that creates layers of resin or other materials to form a volume.

LOCATION OF THE INVESTMENT OPPORTUNITY IN THE SECTOR VALUE CHAIN



The opportunity is located in the **manufacturing link**, that is to say, in the manufacture of 3D printers. Advanced 3D printing technologies allow for the **manufacture product prototypes and even finished products**, through processes of reading dimensional coordinates that until recently only the most advanced design centres of chemical companies, machinery and automobile could do.

DIFFERENTIATING FACTORS OF THE INVESTMENT OPPORTUNITY

CONSUMER/USER	COMPANY/INNOVATION	SOCIETY
<ul style="list-style-type: none"> ● ● ● Innovation ● ○ ○ Price ● ● ○ Quality 	<ul style="list-style-type: none"> ○ ○ ○ Operations ○ ○ ○ Supplies ● ● ● New business lines 	<ul style="list-style-type: none"> ● ● ○ Environment ● ● ○ Well-being ○ ○ ○ Safety
<ul style="list-style-type: none"> In manufacturing companies this technology represents a reduction of costs and a significant improvement in functionality as certain types of complex tools cannot be manufactured using traditional methods. It enables rapid prototyping of an industrial idea, the efficient use of resources, production in small batches, streamlined production, reverse engineering (CAD creation and reconstruction of 3D models from physical objects, parts, moulding or physical scanning). 	<ul style="list-style-type: none"> The low barriers to entry to this production system created the conditions for anyone to design and print what they wanted, which offers great opportunities for entrepreneurs and businesses. It means that there is a multitude of opportunities ranging from the manufacture of plastic casts with windows for greater patient comfort and to allow for the insertion of an ultrasound system, robotic arms, musical instruments, engineering parts to toys, clothing or jewellery. 	<ul style="list-style-type: none"> By producing objects to measure, it reduce the environmental impact related to the large-scale production. It means advances in key sectors for the welfare of citizens, such is the nature of medicine, including the possibility of printing organs.

INVESTMENT OPPORTUNITY LIFE CYCLE

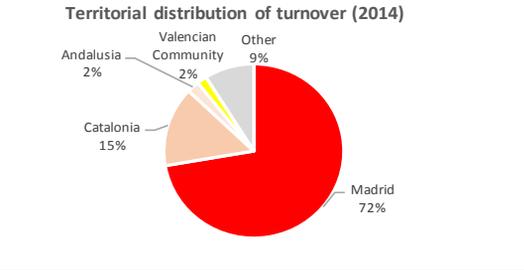
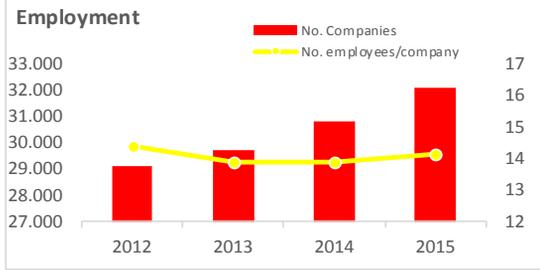
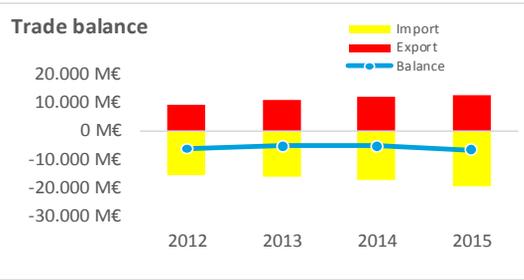
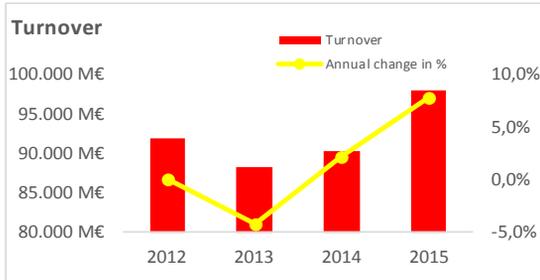


In 1984, Charles Hull invented the method of stereolithography (SLA), a **printing process oriented at models for testing prototypes** before moving to the manufacturing line. That same year he created 3DSystems, a market leading company that allowed the use at industrial level of this process. Years later, between 1989 and 1990, S. Scott Crump developed the technique of Fused Deposition Modelling (FDM), which consisted of **creating three-dimensional objects by superimposing layers of molten material** that subsequently solidified into the desired shape. During the nineties many of these technologies were refined industrially. But it was not until **2012** when the **revolution** started by lowering the cost of 3D printers and the jump to the consumer market. In addition, it is also becoming more important due the expiry of patents protecting some additive manufacturing technologies

Sources: (1) Deloitte 2015 TMT Predictions.



CHARACTERISTICS OF THE ICT SECTOR (2)



SUPPLY

TOP 5 COMPETITORS

#	Company	Net sales	Last available data
1	Hewlett-Packard Company (HP)	€336.47 M	2013
2	LEON3D*	N. avai.	-
3	BQ*	N. avai.	-
4	3D Systems*	N. avai.	-
5	EntresD*	N. avai.	-

* Data not available in the queried database. SABI.

DEMAND

GROWTH

- It was estimated that in 2015 nearly 220,000 3D printers were sold worldwide, reaching a value of 1.6 billion dollars, representing a growth in the number of sales of 100% and about 80% in dollar value compared to 2014 (3).
- In 2017, 70% of the units sold will go to homes, and it is likely that consumer devices will be mainstream, although it will be small units with relatively limited ability to "print" functional pieces in almost every case (1).

SUCCESS STORIES



HP set up their 3D global business centre in Sant Cugat. Trusting the firm at its centre in Catalonia has earned it the **Award for Best Business Initiative 2014**.

The company has been in Catalonia for 30 years and the Sant Cugat facilities, inaugurated in 1990, have become a **world leader in research and development** in areas such as large-format printing. It is HP's biggest R+D centre outside of the US.

After detecting the potential of 3D printing, the American company decided to focus its innovation efforts in this sector in Sant Cugat, where a specific team works **to find future technology and materials which reduce by up to 10 times the time of printing 3D**. As well as investing **50 million in the new centre of 3D printing**, it will consolidate and create new jobs.



The company ClearCorrect expanded the production capacity for orthodontic aligners by 30% thanks to 3D printers by Stratasys. These aligners result in a significant improvement over metallic devices traditionally used for orthodontic treatment. They are completely transparent and allow the patient to remove the aligners and eat foods that are a problem with traditional braces.

ClearCorrect began using Stratasys 3D printing technology with some printers. Upon observing the excellent results, it decided that the entire production of their dental models would be done by 3D printing.



Ford is a pioneer in the use of 3D printers for the production of prototype parts. By using this technique, it is able to reduce development time of components used in all vehicles, such as heads rests, intake manifolds and air intakes. Thus, Ford managed to print **500,000 pieces that it uses to create new prototypes**. Thus, Ford optimizes investment during new product development. 3D printing avoids the use of special tools or moulds for specific parts prone to change. In addition, with this technology engineers can experiment with radical design innovations economic and fast.



POSITIVE FACTORS FOR INVESTING IN SPAIN

Favourable factors in Spain for the development of the opportunity

Associations driving 3D printing

Addimat, the Spanish Association of Additive and 3D Manufacturing Technologies, brings together companies related to the manufacture and marketing of equipment and materials for additive manufacturing and 3D printing and responds to the specific demands of additive and 3D aspects in the world of manufacturing. Addimat aims to bring together all stakeholders with interests in the development and promotion of additive manufacturing and 3D and improve their situation in Spain.

Commitment by the Spanish Government on 3D printing

The government is launching PPP projects to promote R+D in new technologies and materials to create a new faster, cheaper and higher quality 3D printers. One example is the aid package of 21.25 million euros to Hewlett-Packard Spain. Moreover, in this case the Ministry of Industry grants aid to HP of 5.31 million as a grant and 15.94 million as a loan.

Automotive sector - strategic sector

The automotive sector is a strategic sector in Spain and has 17 production plants among the most automated in Europe. In addition, recent data places Spain as the 2nd largest producer of vehicles in Europe and the 9th in the world, while wanting production to reach 3 million cars in 2017 (4).

Social factors and habits

Spain is a leader in the development and use of innovative technology in different innovation sectors. Spain and its companies today are prominent in the application of new information and communications technology (ICT), ranking 5th in Europe in terms of turnover. It has first class infrastructure, research centres and leading companies in the implementation of ICT tools in sectors as diverse as environmental technologies, health, marine, space and automotive.

Favourable factors for the sector in Spain

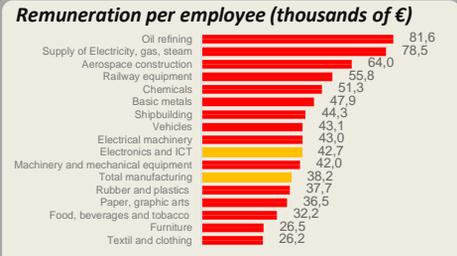
Macroeconomic situation

The Added Value of the information technology and communications sector in 2015 was 45,296 million euros, representing 4.9% of the added value of the Spanish economy.

Sector exports totalled 13,032 million euros. (2)

Labour market

The average productivity per employee in the ICT sector is 52,100 euros per year. Their average individual remuneration is 42,700 euros per year. The Unit Labour Cost accounts for 81.8% of the ratio between the remuneration per employee and the individual productivity (productivity defined as value added per employee). (7)



Graph created using data from the Sectoral Presentation: Electronics and ICT.

Incentives

The Ministry of Energy, Tourism and Digital Agenda allocated 80 million euros to R&D in the ICT sector in 2016 to promote high value technologies in industries of the future (Components and Systems, Internet of the future, High Performance Computing (supercomputing), robots and autonomous systems, Internet of Things, cloud computing solutions for mass data processing...), Cybersecurity and digital trust, agrifood and environmental management, energy efficiency, transport and logistics, and digital content.

I+D+i

There are 15,736 innovative companies and the percentage of innovative companies is roughly 28.5%, spending a total of 13,6747 million euros on innovation.(6)

Talent

Installs in Spain Google Campus to the world's largest entrepreneurs, ahead of London, Seoul and Tel Aviv, demonstrating confidence in the creativity and talent in the country by leading companies the sector. These facilities provide work areas and technical advice for the implementation of new projects. TechHub is involved in this project which manages a global community of digital entrepreneurs.

Geographic location

Spain is within reach of three main regions: the European region, the Mediterranean region and the Atlantic region. Spain is considered to be the gateway between North Africa and Europe, and a key link to Latin America, not only because of its geographical location but also because of its strong historical and cultural ties with the region. In Spain the Canary Islands play a key role with regards to maritime traffic with West Africa.

Technological and research infrastructure

Spain has a very advanced technological infrastructure as shown in areas such as: the presence of 84 technology parks that house more than 5,000 technology companies and a broadband coverage of 96.5%, one of the few OECD countries that has had included in its legislation since 2012 the universal obligation of 100 Mbps broadband supply. In the business arena, broadband penetration exceeds that achieved in the European Union. In 2016 99% of companies in Spain that access the Internet do so by broadband (7).



Graph created using data from Spanish Foundation for Science and Technology.

Transport infrastructure and logistics networks

There are 250 airlines operating in Spain in its 47 airports; its high-speed rail network is the 2nd best in the world and the best in Europe; it is ranked 1st in the EU for its motorway network; and it has excellent sea connections to its 46 ports distributed along the Atlantic and Mediterranean coasts.

Sources: (4) Plan 3 million from the National Association of Automobile and Truck Manufacturers (ANFAC). (5) Electronics and ICT Sectoral Presentation. April 2015. MINETAD (6) Innovation in companies Survey 2016 (7) ONTSI.