

OUTPUT 1

Research on innovative skills and best practices to enhance HE students' employability, flexibility and transversal capabilities and develop effective digital work-based approaches

Case of Spain

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Digital Transformation, Industry 4.0 and Human Resources Management: Innovative skills to enhance HE students' employability, flexibility and transversal capabilities



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INTRODUCTION

This report provides an overview of the present state of Industry 4.0 awareness and development in Spain. It encompasses analysis of statistical and economic indicators reflecting the level of digitalization, examination of national strategic planning documents, policies and laws, and a review of relevant educational events and projects within the context of Industry 4.0. Additionally, the report offers insights into companies and their best practices regarding digital transformation and the implementation of the Industry 4.0 concept. Furthermore, it outlines key knowledge and skills that should be deliberately cultivated to facilitate the successful integration of Industry 4.0 into Spain's economic landscape and industrial competitiveness.

The primary content of the report is divided into eight sections below. These sections encapsulate conclusions drawn from information gathered through various sources and systematically organized in the appendices of this report.

1. SPANISH SOFT SKILLS – DIGITAL SKILLS NEED FOR LIFE AND WORK

The European institutions have made a significant effort to establish a reference framework of digital competences that allows all member countries to develop their strategies for the acquisition and development of these skills in a systematic way. In this sense, the Joint Research Center (JRC) of the European Commission launched at the end of 2010 the project “Digital Competence: Identification and European-wide validation of its key components for all levels of learners” (DIGCOMP), which determines a reference framework for digital competences for the citizenship, aligned with the guidelines of the European Digital Agenda, and identifies the components key to digital competencies in terms of knowledge, skills and attitudes.

Since then, the common framework of reference in digital skills has been updated until integrating, in its most recent version, five dimensions and twenty-one competencies structured into eight skill levels as shown in the following figure:



Figure 1. Digital competence framework. Source: DIGICOMP.

As shown in previous figure, the Digital Competence Framework includes the following areas:

- 1) Problem Solving
- 2) Safety

- 3) Digital Content Creation
- 4) Communication and Collaboration
- 5) Information and Data Literacy

Taking these areas in consideration, Spain has embedded a **National Plan for Digital Skills** aimed to provide a roadmap in order to identify the measures needed (on a national, regional and local level) to ensure that all citizens have access to relevant resources so they can acquire and develop digital skills. The rapidly advancing technology requires a general mind-set for continuous improvement and lifelong learning. It is no longer just about what one knows, but increasingly about one's ability to adapt to continuously changing circumstances and to constantly advance one's knowledge and skills. Focusing on technical skills only is thus not enough.

In the National Plan for Digital Skills, Spain addresses a variety of challenges related to digital inclusion, access to technology, and lifelong learning for all. Some of its objectives to be address are:

- Ensuring no Spanish citizen is left behind and promoting inclusion in the digital world.
- Bridging the gender digital divide, through actions aimed at increasing the number of women studying, graduating and working in the information and communication technology (ICT) field.
- Supporting the acquisition of adequate digital skills for education, among teachers and students, and at all levels of the education system.
- Fostering the development of more advanced digital skills amongst the working population.
- Ensuring that Spanish companies in general, and specifically small and medium sized enterprises (SMEs), have sufficient digital skills and access to a skilled talent pool of qualified workforce, in order to manage the impact of the digital transformation.

Therefore, the National Plan for Digital Skills will include soft skills for life and for work as shown below:

a. Guarantee digital inclusion. Digital training of citizens (with emphasis on groups at risk of exclusion digital)

This seeks to train citizens in the digital age by universalizing skills digital basics (as defined in the Spanish Digital Agenda 2026) so that all people can communicate, buy, carry out transactions, interact with the administrations using digital technologies with autonomy and sufficiency.

To this end, special emphasis should be placed on those groups that find it more difficult to acquire these skills today, such as older people, people with low levels income, non-urban areas or with low educational level. In addition, there will be part of these groups that due to their age range are considered active population, for this reason this line intends to be oriented towards that 8% of the Spanish population that has never connected to the internet and almost 20 million that have not possessed basic digital skills.

b. Ensure the digitization of education and the acquisition of skills education for teachers and students at all levels of the system educational

The goal is to guarantee that all students in the educational system acquire the digital skills necessary for their full social integration and professional development future that will be determined by advanced use of technology and the ability to keep them permanently updated.

Therefore, an identified objective is to promote the use of ICT in schools, to promote the creation and sharing of educational digital content, or programs such as Internet in the Classroom, Internet at School, or the most recent Connected Schools and "Educa en Digital" also deserves a special mention the collaboration between educational administrations for the elaboration of the Framework of Reference of the Teaching Digital Competence.

The "Digitalization and Digital Competencies Plan of the Educational System" consists of a set of actions to support the digital transformation of the education system by providing of

devices to schools and students, digital educational resources, the adequacy of digital skills of teachers and actions that involve the application of intelligence artificial to personalized education. It is carried out by combining different strategies and means, which include the collaboration agreement "Educa en Digital" for the development of some of its actions, as a result of a collaboration between the Ministries of Education and Vocational Training, Economic Affairs and Digital Transformation, and the Autonomous Communities.

c. Guarantee the acquisition of advanced digital skills both for unemployed people to improve their employability conditions, and for the employed people

This line aims to intensify the professional training system in digital skills professionals throughout life in collaboration with economic and social agents so that both employed men and women and unemployed people can develop the skills necessary to fully integrate into the digital economy. Administrations should pay special attention to the rebalancing of digital skills among people employed and unemployed women, as well as rebalancing in gender issues.

At Community level, following the publication of the Digital Single Market Strategy, the European Commission launched an initiative known as the Digital Skills and Job Coalition. More than 400 actors have joined this Coalition from both from the public sector and from the private sector with the aim of promoting training digital in the European Union. In this sense, it is also necessary to collaborate actively with the European Commission in order to align public policies to the strategic framework of action of the European Union in this area.

Around 55% of all jobs in the Spain need at least a basic level of digital skills. These dates reflect that there is a mismatch between demand and supply in digital skills, where supply of ICT-related profiles is not enough to meet a growing demand almost four times faster than the offer. In this sense, the demand for professionals from the information and communication technologies has grown by 4% per year over the last ten years, and yet digital

skills are still lacking in Europe at all levels, where 43% of the EU population and 35% of the workforce have insufficient digital skills. In Spain, these figures are 45% and 34%. In addition, 42% of people without digital skills are unemployed, according to the DESI 2020 report.

Furthermore, in relation with soft skills, the Work Economic Forum identified the current skills in Spain in focus on:

c1. Existing reskilling/upskilling programmes, and

c2. Emerging skills

In this context the skills will be shown in priority rank in the following tables.

c1. Existing reskilling/upskilling programmes

Related to current skills in focus of existing reskilling/upskilling programmes, information share of companies surveyed identifying these skills as being in focus across their reskilling or upskilling programs, these current skills are showed in the following table:

Reskilling/Upskilling Skills	
1	<i>Analytical thinking and innovation</i>
2	<i>Active learning and learning strategies</i>
3	<i>Critical thinking and analysis</i>
4	<i>Technology use, monitoring and control</i>
5	<i>Leadership and social influence</i>
6	<i>Complex problem-solving</i>
7	<i>Management of personnel</i>
8	<i>Systems analysis and evaluation</i>
9	<i>Service orientation</i>
10	<i>Quality control and safety awareness</i>

Table 1. Reskilling/Upskilling Skills in Spain. Source: World Economic Forum

Most of these mentioned skills are related with social behaviors of personnel in working environments.

c2. Emerging skills in Spain

The WEF also identified the emerging skills. These skills are identified as being in high demands with their organization in Spain, ordered by frequency and showed in the following table:



Figure 2.- Emerging Skills in Spain. Source: WEF

Most of these mentioned skills are related with problem solving situations in working environments.

2. SPANISH HARD SKILLS – DIGITAL SKILLS AND EDUCATION

The European Union Publication Office (OPEU) announced in their website the skills for industry curriculum guidelines 4.0. This document claims there are four key technological developments that can be distinguished within Industry 4.0 such as:

- 1) digitisation and integration of vertical and horizontal value chains;
- 2) digitisation of product and service offerings;
- 3) digitisation of business processes and way of working, and
- 4) digitisation of business models and customer access

These four key technological developments can be as seen in the following figure:

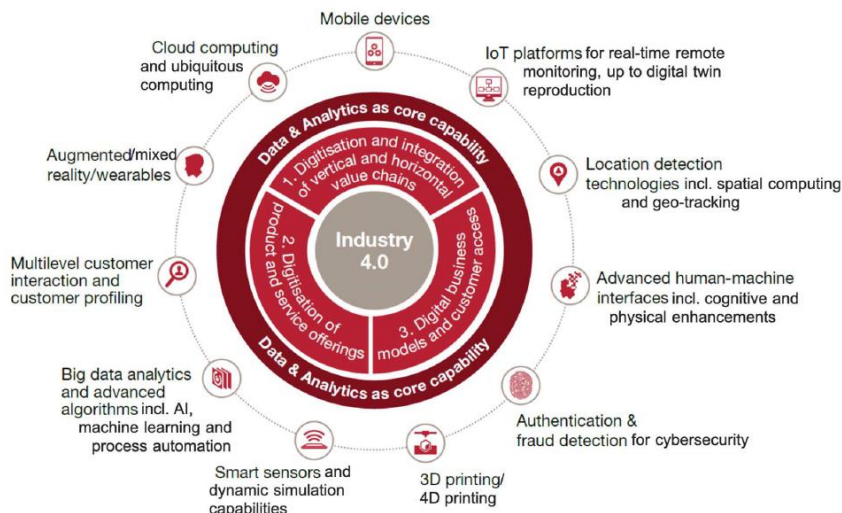


Figure 3. Industry 4.0 framework and contributing digital technologies. Source: ¹

From these key technological developments there are core digital and technical skills to enhance the Industry 4.0.

Technology Adoption in Companies
Mobil devices
IoT (platforms for real-time remote monitoring, up to digital twin reproduction)
Location detection technologies including spatial computing and geo-tracking
Advanced human-machine interface including cognitive and physical enhancements
Authentication & fraud detection for cybersecurity
3D printing/ 4D printing
Smart sensors and dynamic simulation capabilities
Big data analytics and advanced including AI, machine learning and process automation
Multilevel customer interaction and customer profiling
Augmented/mixed reality/wearables
Cloud computing and ubiquitous computing

Table 2. Digital technologies. Source: WEF

Spain has reinforced these technological trends at national level created the **Digital Enabling Technologies (THD)** that have become essential for promoting innovation and digitalization of SMEs. The THD will have a significant impact on all productive sectors and on citizens,

¹ European Commission; Final Report; Skills for Industry; Curriculum Guidelines 4.0; Future-proof education and training for manufacturing in Europe. Link: <https://op.europa.eu/en/publication-detail/-/publication/845051d4-4ed8-11ea-aece-01aa75ed71a1>

presenting a great opportunity for employment, innovation and entrepreneurship. The Digital Enabling Technologies (THD) are:

- a. IOT, Bigdata, Artificial Intelligence, Blockchain, supercomputing and future 5G networks, among others.

These THDs have a high capacity for disruption and impact, in addition to having an enabling, horizontal and strategic nature for the digital transformation of any productive sector. The availability of a competitive offer of THD products and services constitutes a catalyst for accelerating digital transformation processes, but also a great opportunity for the industrial sector of digital technologies.

In this scenario, Spain has taken action with the strategic objectives of public intervention to:

- Promote a competitive national industrial sector in the THD, which assumes a necessary leadership and tractor agent of the digital transformation processes in the different productive sectors.
- Contribute to accelerating transformation processes in sectors of the economy that are less digitally mature, with greater inertia and complexity, or that present barriers with greater impact, cooperating with competent and leading sectoral agents.
- Through different programs and plans, SEAD has been developing these objectives, using instruments such as:
 - > Public aid in competitive competition for the financing of projects.
 - > Public procurement of innovation for the development of pilots and demonstrators.
 - > Technical standardization activities (standards, guides and reference models) and their international promotion.

Furthermore, Spain has also included a strategy called the National Plan for Digital Skills, referring to hard skills for employees and working conditions with the aim to:

b. Reduce the digital gap due to gender, increasing the number of women ICT specialist

This line seeks to close the digital gender gap (which grows as more advanced and specialized is the use of technology) to ensure the full participation of women in digital society and economy, encouraging training in digital skills for women and girls.

The digital gender gap can be explained by the late and slow incorporation of women into successive digital transformation processes over time: it began in the 1990s, when ICTs begin to be part of everyday life, continues in the first decade of the 21st century, when the use of the Internet to carry out activities such as making purchases online, operating with banks or communicate was generalized. Currently, and even more so after the situation generated by the

COVID-19 pandemic, ICTs have become an element present in all activities of daily life and, therefore, the lack of digital skills, generates a risk of exclusion, social and economic.

According to DESI (2020), only 3.9% of Spanish professionals can be considered ICT specialists; and even more: only 1.4% are women. Furthermore, while the number of ICT specialists has been increasing in the last 5 years, the number of women ICT specialists is stagnant. On the other hand, considering the sustained growth of job opportunities For ICT specialists, the low presence of women in this area reduces their chances of future employability.

c. Ensure that Spain has ICT specialists. Training in digital skills of people at the service of Public Administrations

The public sector, which currently exceeds 50% of GDP, plays an essential driving role in the digitization process of Spanish society and will be the protagonist in the recovery project social and economic after the COVID-19 crisis. That is why training in digital skills for public employment, it has a separate and differentiated entity from the private sector given that:

- a. it is essential to develop the digital skills of employees public, both those of a general nature and those of specialized ICT personnel, so that the Administration carry out an internal transformation (in procedures, relationship with managed and organizational culture) that allows it to properly develop its role as regulator, promoter and facilitator of the digital transformation of Spain, and;
 - b. training in the field of Public Administrations forms a subsystem with specific characteristics, as set out in Law 30/2015, of September 9, which establishes regulates the Vocational Training System for employment in the workplace, and in the Agreement Training for the Employment of Public Administrations.
- d. **Guarantee that Spanish companies in general, and SMEs in particular, have the necessary digital skills to tackle their digitization**

This line aims to join the digitalization of SMEs, serving as a guide in the definition of digital transformation processes, identifying digital skills necessary (both by entrepreneurs and management personnel, as well as by of workers) to address these processes, integrating public policies of employment and promotion of the industry, and incorporating young people as agents of digital transformation. The importance of digitization as a driver of innovation, of the transition ecological, and a vital element to improve competitiveness and productivity is collected within the Strategic Framework in SME Policy 2030, where the following lines are proposed, among others of action for the digitization of SMEs:

1. Incorporate digital tools in relation to SMEs with the Administration.
2. Facilitate the digital transformation of SMEs as a key element in their life cycle.
3. Improve the availability of various financing channels for the digitization of SMEs.
4. Develop assistance programs for SMEs in industry 4.0, which allow diagnosing the degree of maturity of SMEs in this field and design a digital improvement plan to from diagnosis.
5. Support for the incorporation of enabling technologies – KET (nanotechnology, micro and nanoelectronics, photonics, advanced materials, advanced manufacturing systems and industrial biotechnology) in the manufacture of its products, whether in the processes of manufacturing, in the materials they use or in the products they market).

- Establish mechanisms that promote the incorporation of SMEs into the circuit of vocational training.

The KET technologies are those trends identified by GARTNER, which are critical to business and innovation from 2022, and shown in the following figure:



Figure 4. Technology Trends 2022. Source. GARTNER

These are the top 12 strategy technology trends for 2022 in order of priority:

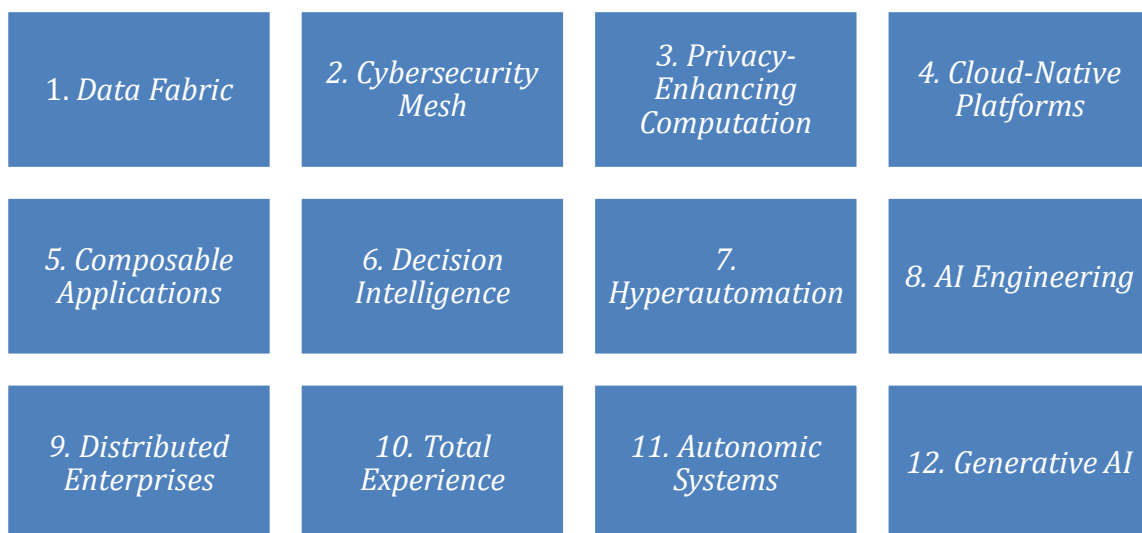


Figure 5.-. Technology trend. Source: Gartner

Gartner identifies technology trends critical to business and for companies in Spain to consider and to take action. From this strategic value of these technology trends, we can foresee the digital transformation of companies is a transversal process that affects all activities that are

developed linked both to the production processes, as well as to the sale, diffusion, marketing, people or economic management to name a few.

According to a study on digital skills in Spanish companies, there is a significant digital gap between large companies and SMEs, highlighting that 86% of SMEs Spanish women do not have a digitization plan, and only 2% are concerned about this fact, according to the DESI index. This represents a significant brake on the competitiveness of the Spanish economy, given that, according to OECD data, a 10% increase in the digitization of companies could generate an increase of 3.2% of annual GDP.

e. Promotion of ICT specialists (both vocational training graduates such as university students)

The goal of this line is to satisfy the current and future needs of specialists in digital technologies, both above the basic level and specialized, attending to the demands of the productive sector and the needs for innovation in new products and services digital.

In the area of training, the State has exclusive jurisdiction in regulating the conditions of obtaining, issuing and homologation of academic and professional titles, the programming general education and the design of the basic curriculum in order to ensure common training and the official nature and validity throughout the national territory of the different qualifications.

For this reason, several measures are proposed to collaborate in the curricular programming in the university and vocational training incorporating specific digital skills (cybersecurity, artificial intelligence, data analysis, web design, user experience design) users, block chains, fintech...) most demanded by the industry, adapting the degrees already existing or creating new ones when necessary.

In order to have a general overview of the hard skills adopted in Spain as well as the emerging skills, emerging jobs and redundant jobs based on these skills, the information is gathered

from the Work Economic Forum (WEF), from their document called as The Future of Jobs Report, published on October 2020. In this section we will show:

e1. Technology adoption in Spain

The WEF identified the technology adaption in Spain, as the e percentage of technology adopted in companies, information shared from companies surveyed:

	Technology Adoption in Companies	Percentage
1	Big data analytics	96%
2	Artificial intelligence (e.g. machine learning, neural network, NLP)	96%
3	Cloud Computing	92%
4	Encryption and cyber security	88%
5	E-commerce and digital trade	88%
6	Text, image and voice processing	84%
7	Augmented and virtual reality	77%
8	Distributed ledger technology (e.g. blockchain)	74%
9	New materials (e.g. nanotubes, graphene)	70%
10	Robots, non-humanoid (industrial automation, drones, etc.)	68%

Table 3. Technology Adoption in Spain. Source: WEF

e2. Emerging and redundant job roles in Spain

The WEF also published the emerging and redundant job roles, identified as being in high demand or increasing redundant within their organization. These emerging and redundant job roles are:

	Emerging Roles	Redundant Roles
1	Internet of Things Specialists	Data Entry Clerks
2	Data Analysts and Specialists	Administrative and Executive Secretaries
3	Big Data Specialists	Accounting, Bookkeeping and Payroll Clerks
4	AI and Machine Learning Specialists	Accountants and Auditors
5	Digital Transformation Specialists	Statistical, Finance and Insurance Clerks
6	Software and Applications Developers	Business Services and Administration Manager
7	Project Managers	Financial Analysts
8	Process Automation Specialists	Client Information and Customer Service Workers
9	FinTech Engineers	Claims Adjusters, Examiners, and Investigators
10	Assembly and Factory Workers	Assembly and Factory Workers

Table 4. Emerging and Redundant Jobs in Spain. Source: WEF

3. SPANISH DIGITALIZATION

To measure Spain's situation and progress in the field of digitalization, we use the DESI indicator (Digital Economy and Society Index), published by the European Commission, which

also allows us to compare Spain with the main EU countries. This is a synthetic indicator that takes into account five pillars: connectivity, human capital, integration of digital technology in companies and digital public services.

Spain ranks 7th of 27 EU Member States in the 2022 edition of the Digital Economy and Society Index (DESI). The country is making relative progress and overperforming versus previous years, especially on integration of digital technology (ranking 11th, 5 positions above 2021), and also on digital public services (5th compared to the 7th place in 2021) and human capital (10th compared to 12th). Spain is an EU leader in connectivity and ranks 3rd for the second consecutive year.

	Spain		EU
	rank	score	score
DESI 2022	7	60.8	52.3

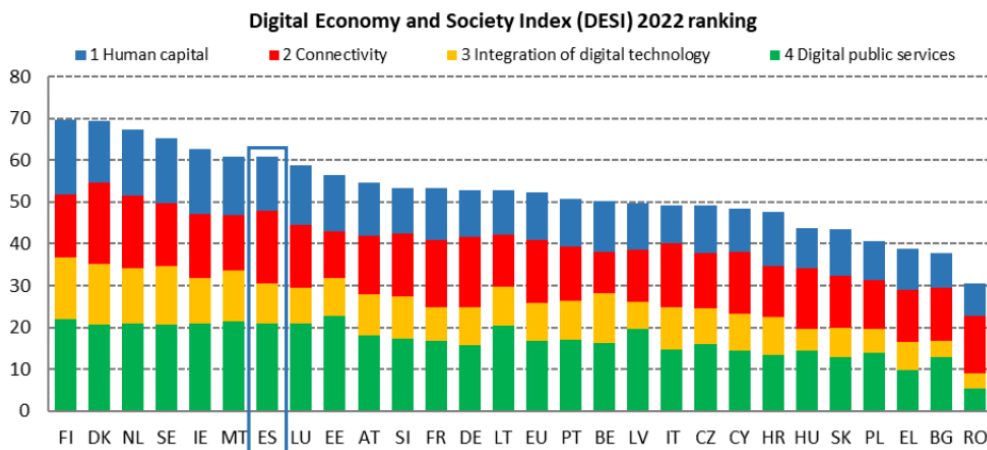


Figure 6. Digital Economy and Society Index (DESI) 2022. Source: DESI

The following figure compares Spain with the European average taking into consideration the five pillars (connectivity, human capital, integration of digital technology in companies and digital public services):



Figure 7. Spain rank in DESI. Source: DESI

If we analyze the components of the DESI index, we see that Spain stands out in one of the five pillars: digital public services, however regarding the rest of the four pillars: human capital, connectivity and digital integration of digital technology Spain remains above the European averages.

On the human capital dimension, Spain is a relatively good performer on basic digital skills whereas it is below the EU average as regards the proportion of ICT specialists and of ICT graduates. The rate of people in Spain having at least basic digital skills is above the EU average (64% compared to 54%) and has significantly increased during the last years. The number of ICT specialists in employment in Spain is 4.1% compared to the EU average of 4.5%. Several measures outlined in Spain's Recovery and Resilience Plan (RRP) support the acquisition of digital skills, especially for employees of SMEs. Those measures, together with other technology-specific initiatives such as for cybersecurity or artificial intelligence (AI), are expected to reduce the labour market gap for ICT specialists as well as the ICT gender gap.

On digital connectivity, Spain is one of the top EU performers. It continues its steady progress in the roll-out of very high capacity networks (VHCN) and is pursuing strategic reforms and investments under the Recovery and Resilience Facility (RRF) to help achieve the Digital Decade connectivity targets and reduce the digital gap between urban and rural areas.

On integration of digital technologies, the percentage of SMEs with a basic level of digital intensity and using social media is above the EU average. But Spain's enterprises are still lagging behind on new and advanced technologies such as cloud or big data. The lack of a critical mass of digitally- trained workers hinders the integration of digital technologies into Spain's enterprises in general, and SMEs and micro-enterprises in particular, who need digital-skilled professionals to develop further and become more competitive in the digital economy. The SME Digitalisation Plan 2021-2025 will help boost disruptive innovations and entrepreneurship in digital fields, together with other relevant policies and strategies already in place

Finally, on digital public services, Spain has traditionally been a front-runner and it continues to put in place new services and infrastructures to respond to the rapid development of technology and to people's needs. Spain is committed to modernize its public administration in order to make it more accessible for enterprises and the public.

Following Russia's invasion of Ukraine, Spain adopted a national response plan setting out urgent measures (e.g., updated and strengthened the national cybersecurity strategy, and the adoption of measures aligned with EU recommendations to secure 5G deployment). Several important communication campaigns have been put in place to promote cybersecurity awareness and combat disinformation. One campaign was also launched to help people fleeing Ukraine to Spain. In addition, Spain adopted the measures set out in the Council Decision (CFSP) 2022/351 concerning restrictive measures in view of Russia's actions destabilizing the situation in Ukraine.

4. SPANISH INNOVATIVE SKILLS – RESEARCH ON INNOVATIVE SKILLS TO ENHANCE STUDENTS' EMPLOYABILITY

Spain has progressively increased its participation in the successive European Framework Programs, which demonstrates the interest, experience and potential participation of the Spanish scientific and technological community in these programs. Parallel to the definition of the Horizon Europe Program, the Spanish Strategy for Science, Technology and Innovation

(EECTI) has been developed, concurring with European Framework Program period of 2021-2027. The EECTI is considered as the basic instrument to consolidate and strengthen the Science, Technology and Innovation System (SECTI).

The ECCTI is specifically designed to facilitate the articulation of the research, development and innovation policy of Spain with the policies of the European Union. The way out of the global crisis suffered by COVID-19 and the reestablishment of a powerful national R+D+i system, after the last decade of difficulties, are urgent actions that need to be addressed. Therefore, the Spanish strategic has included to target the following sectors, to enhance the employment rate and the economy of the nation:

1. Health: new therapies, accurate diagnosis, cancer and aging, and special emphasis on infectious diseases.
2. Culture, Creativity and Inclusive Society: genesis of the human being, cognition and language
3. Security for Society: inequality and migrations; the market and its tensions; the protection of society and cybersecurity.
4. Digital world, Industry, Space and Defense: AI, next generation internet, robotics, physics, mathematics, communication networks
5. Climate, energy and mobility: climate change, decarbonisation, mobility and sustainability
6. Food, Bioeconomy, Natural Resources and Environment: from biodiversity to food use of land and seas.

The strategy promotes the coordination and complementation of national and sectoral R&D&I policies with others at a European, regional and local level, fostering support for other countries in the preparation of their policies in this field, as well as that of addressing the development of a system of governance and indicators that facilitates the analysis, monitoring and evaluation of the results with respect to the objectives set.

The Statistical Office of the European Union Eurostat is used to analyze the R&D&i indicators in Spain, which provides statistics and high-quality data on R&D throughout Europe based on collecting data and reporting data on research and experimental development using Frascati

Manual. In this sense, the statistical office collects a series of data at the European, national and regional level, for a series of specific indicators in national level we summarized in the following table:

Indicator	Description
Indicator 1	R&D intensity - gross domestic spending on R&D
Indicator 2	Percentage of people employed in high technology referred to the total employment
Indicator 3	Percentage with respect of R&D personnel referred to the active population
Indicator 4	Patent application per million inhabitants

Figure 8. Main Eurostat Indicators referring to R&D&i at the national level. Source: EUROSTAT

In the case of R&D intensity, if we look at the latest data available for the Spain with respect of Europe (year 2020), it is possible to see that the gape in R&D expenditure as % of gross domestic spending (GDP) has decrease from 0,98% on 2019 to 0,91% on 2020, as shown in the following figure:

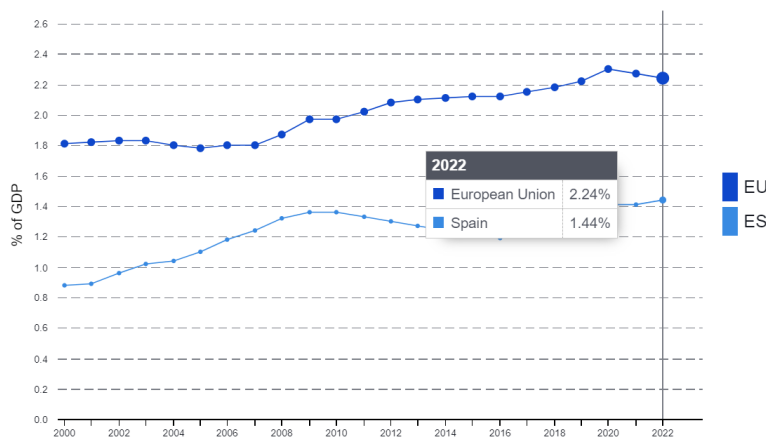


Figure 9. R&D intensity - gross domestic spending on R&D. Source: EUROSTAT

Regarding the percentage of total employment referred to high technology, a very positive trend can be seen in the case of the Spain from 2018 to 2020 comparing to Europe, as shown in the following figure:

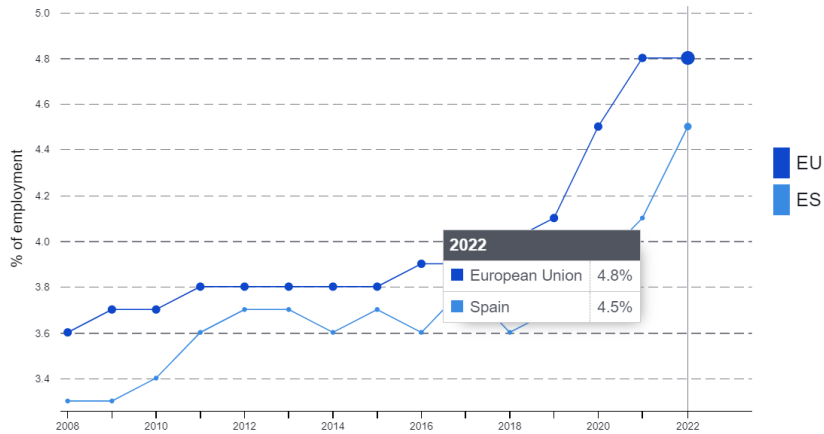


Figure 10. People employment referred to high technology. Source: EUROSTAT

It can be noticed from previous figure, a very pronounced rise from 40,1% to 42,3% in Spain and 45,2% to 46,8% in Europe in the same period of time (2018-2020). A close rate of people employed, in Spain with respect of Europe, in high technology manufacturing and knowledge-intensive service sector is a good sign that shows Spain's roadmap for R&I&i is aligned with the European Commission initiatives to a more sustainable economy.

A less notable evolution than in relation to the Spain level in R&D personal related to the percentage of activate population is shown in the following figure:

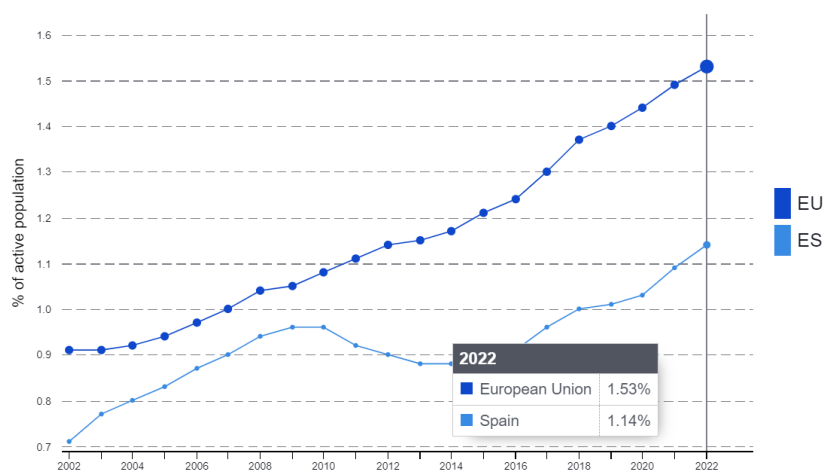


Figure 11. R&D as % of active population. Source: EUROSTAT

A much more similar evolution, of Spain versus Europe, with the application of patents per million inhabitants than in relation to the national level, is shown in the following figure:

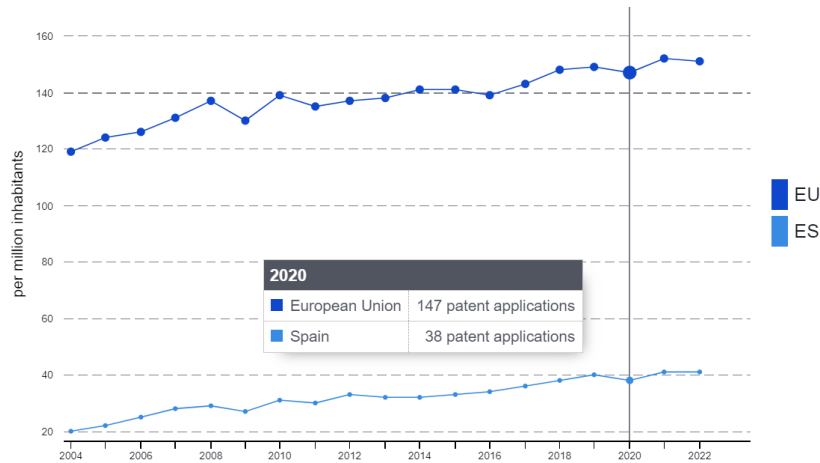


Figure 12. Patents application per million inhabitants. Source: EUROSTAT

It can be concluded, therefore, that although it is true that Spain have a positive trend in terms of employment in R&D, it is necessary to continue giving a boost, especially in terms of patents application.

5. DIGIWORK. BEST PRACTICES OF DIGITAL TRANSFORMATION

1	Best practice name:	Spain Digital Enterprise (“España Empresa Digital”)
2	Sector:	All sectors
3	Organisation implementing/disseminating the practice:	The chamber of commerce of Spain (“Cámara de Comercio de España”)
4	The goal:	<p>The main objective of the Industry 4.0 Program is to contribute to the improvement of the competitiveness of SMEs, micro-SMEs and self-employed in the industrial sector, through the adoption of a culture, use and permanent use of ICTs in their business strategies, to achieve sustained economic growth, as well as to minimize the impact of the COVID-19 crisis.</p> <p>They provide entrepreneurs with personalized advice and assistance for the digital transformation of your company.</p>
5	Description / Focus:	<p>The main objective of the program is the identification of solutions and actions adapted to the needs of the SME, with three basic lines of action:</p> <ul style="list-style-type: none"> • Intra-company / inter-company management applications: business solutions, intelligence solutions (Big Data and Analytics) and control, collaborative platforms. • Communications and data processing: Computing and cloud, connectivity and mobility • Hybridization physical and digital world: Additive manufacturing (3D scanning and printing), advanced robotics, sensors and embedded systems (IoT, VR/AR, simulation).
6	Target groups:	Self-employed, businessmen/woman and entrepreneurs with an industrial SME registered in the IAE census.

7	Dissemination / implementation method:	<ul style="list-style-type: none"> • Awareness-raising seminars held in regional and national chambers. • Specific workshops and seminars • Forums to improve training and confidence in the digital environment. • Digital maturity model (self-diagnosis test).
8	Results / impact with a focus on sector and individuals, like students or employees:	<p>There are a multitude of success stories (Gaviplas SL, Grupo Alcamín SL, Alvaro Avant, Go British, Conciencia Nutricional, etc.), which are shown in the following web address: https://empresadigital.camara.es/casos-de-exito</p>
9	Sustainability:	
10	What were the obstacles?	
11	What innovative skills (if any) the described above best practice might have developed to enhance students employability?	<p>Spain Digital Company currently has three aid programs, co-financed by the European Regional Development Fund, aimed at SMEs and the self-employed affected by the COVID-19 crisis. These three aid programs are:</p> <ul style="list-style-type: none"> • TICCAMARAS • CIBERSECURITY • INDUSTRY 4.0 <p>All of them allow companies to assess the degree of digitalization of each company and how the each specific program can help them in the current context of the crisis derived from COVID-19, in the incorporation of new solutions that allow them to improve their business, increasing the productivity and maximizing their opportunities.</p>
12	References:	https://empresadigital.camara.es/programas/industria-4-0

1	Best practice name:	National Plan for Digital Skills
2	Sector:	Digital skills (in general)

3	Organisation implementing/disseminating the practice:	Ministry for Economic Affairs and Digital Transformation Ministry of Education and Vocational Training Spain
4	The goal:	The aim of the National Plan for Digital Skills is to provide a roadmap, in order to identify the measures needed (on a national, regional and local level) to ensure that all citizens have access to relevant resources so they can acquire and develop digital skills. The National Plan for Digital Skills of Spain was launched by the President of the Government of Spain, Pedro Sánchez in 2021 together with 2 other National Digitalisation plans: <u>the Digitalisation of SMEs Plan 2021-2025</u> and <u>the Digitalisation of the Public Authorities Plan</u> . The different digitalisation strategic plans are launched within the context of the <u>Digital Spain Agenda 2025</u> .
5	Description / Focus:	<p>The National Plan for Digital Skills - Spain addresses a variety of challenges related to digital inclusion, access to technology, and lifelong learning for all. It aims to address these by:</p> <ul style="list-style-type: none"> • Ensuring no Spanish citizen is left behind and promoting inclusion in the digital world. • Bridging the gender digital divide, through actions aimed at increasing the number of women studying, graduating and working in the information and communication technology (ICT) field. • Supporting the acquisition of adequate digital skills for education, among teachers and students, and at all levels of the education system. • Fostering the development of more advanced digital skills amongst the working population. <p>Ensuring that Spanish companies in general, and specifically small and medium sized enterprises (SMEs), have sufficient digital skills and access to a skilled talent pool of qualified workforce, in order to manage the impact of the digital transformation.</p> <p>The Plan sets out seven lines of action and sixteen measures, aimed at improving digital skills in seven different areas. The focus areas operate within the framework of the 4 pillars set forward by the Digital Skills and Jobs Coalition: digital skills for all citizens, digital skills in education, digital skills for the labour force, and digital skills for ICT professionals and other digital experts.</p>

6	Target groups:	<ul style="list-style-type: none"> • Digital skills for the labour force. • Digital skills for ICT professionals and other digital experts. • Digital skills in education. • Digital skills for all.
7	Dissemination / implementation method:	<p>The Ministries responsible for different digital skills thematic segmentations and various target groups will supervise the implementation of the projects and measures put forward in the Plan. Each responsible Ministry operates within the framework of its sectoral arrangements with the Autonomous Communities - via agreements and other instruments of public-private collaboration.</p>
8	Results / impact with a focus on sector and individuals, like students or employees:	<p>No results yet.</p>
9	Sustainability:	<p>The total budget for the Spanish Digital Skills Plan is €3,75 billion, including €3,59 billion from the Spanish Reconstruction, Transformation and Resilience Plan.</p>
10	What were the obstacles?	<p>Risk of increasing the digital divide by segmenting by socioeconomic level. Non-formal education increases its offer faster than formal education, offering more opportunities to students from higher income families.</p> <p>Risk that the digital training of Spanish students may be deficient compared to other European countries, which may hinder their integration into the labor market and the competitiveness and modernization of the Spanish market.</p>
11	What innovative skills (if any) the described above best practice might have developed to enhance students employability?	<p>Specialized digital competences are defined in Article 2(f) of the Regulation of the European Parliament and of the Council establishing the Digital Europe program for the period 2021-2027 as "the competences and skills needed to design, develop, manage, deploy and maintain the technologies funded under this regulation.</p>

		<ul style="list-style-type: none"> "advanced digital skills" means the professional skills and competencies that require the knowledge and experience to understand, design, develop, develop, manage, test, deploy, use and maintain the experience necessary to understand, design, develop, manage, manage, test, deploy, use and maintain the technologies, products and services supported by the technologies, products and services supported by the Program referred to in Article 7; https://www.boe.es/doue/2021/166/L00001-00034.pdf
12	References:	https://digital-skills-jobs.europa.eu/en/actions/national-initiatives/national-strategies/spain-national-plan-digital-skills

1	Best practice name:	Boost 4.0
2	Sector:	Industrial Sector
3	Organisation implementing/disseminating the practice:	Innovalia Association as leader (+ 52 partners from 16 countries)
4	The goal:	The program aims to "democratize access to Big Data for small and medium-sized companies". Boost 4.0, starting 1st January 2018 and with a duration of 3 years, is the biggest European initiative in Big Data for Industry 4.0.

		<p>With a 20M€ budget and leveraging 100M€ of private investment, Boost 4.0 will lead the construction of the European Industrial Data Space to improve the competitiveness of Industry 4.0 and will guide the European manufacturing industry in the introduction of Big Data in the factory, providing the industrial sector with the necessary tools to obtain the maximum benefit of Big Data.</p>
5	Description / Focus:	<p>3.6.1.1 Global Standards: Contribution to the international standardization of European Industrial Data Space data models and open interfaces aligned with the European Reference Architectural Model Industry 4.0 (RAMI 4.0).</p> <p>3.6.1.2 Secure Digital Infrastructures: Adaptation and extension of cloud and edge digital infrastructures to ensure high performance operation of the European Industrial Data Space; i.e, support of high-speed processing and analysis of huge and very heterogeneous industrial data sources.</p> <p>3.6.1.3 Trusted Big Data Middleware: Integration of the four main open-source European initiatives (Industrial Data Space, FIWARE, Hyperledger, Big Data Europe) to support the development of open connectors and big data middleware with native blockchain support in the European Industrial Data Space.</p> <p>3.6.1.3.1 Digital Manufacturing Platforms: Open interfaces for the development of big data pipelines for advanced analysis services and data visualization supported by the main digital engineering, simulation, operations and industrial quality control platforms.</p> <p>3.6.1.3.1.2 Certification: European certification program of equipment, infrastructures, platforms and big data services for their operation in the European Industrial Data Space.</p>
6	Target groups:	<p>The target group of Boost 4.0 are the factories from Automotive, Machine Tool, White Goods and Applications.</p>

7	Dissemination / implementation method:	<p>The European Industrial Data Space and Big Data Services:</p> <ul style="list-style-type: none"> • Deployed and assessed in the factories of the 10 main European manufacturing leaders. • Evaluated in 3 strategic economic sectors (automotive, manufacturing equipment and household appliances). • Adopted by 3 factories in traditional and highly regulated manufacturing sectors (textile, ceramics, aero).
8	Results / impact with a focus on sector and individuals, like students or employees:	<p>The project was developed with 11 pilot factories, where 10 were lighthouse Factories (Volvo, Philips, +GF+, Volkswagen, Whirpool, etc.)</p> <p>It implies 6 digital Infrastructures: Connectivity, fog/edge, data-center, HPC and cloud.</p> <p>There are 9 digital Manufacturing platforms involved: Engineering, planning, operations, quality control, analytics, maintenance and cybersecurity.</p> <p>And there are 4 open initiatives: Open Big Data Pipelines, Data Sovereignty, Context Information Brokering, Distributed Data Traceability.</p>
9	Sustainability:	<p>Private investment: 100 M€ Funding: 20 M€</p>
10	What were the obstacles?	
11	What innovative skills (if any) the described above best practice might have developed to enhance students employability?	<p>Only in the final conference,</p> <ul style="list-style-type: none"> • Attendees learnt how digital technologies in general but big data in particular can be adopted and integrated by industry. • Moreover, factories learnt how platforms and ecosystems will be shaped by digital industries to determine future individual business opportunities, collaboration patterns across industry and the resilience of manufacturing value chains. • Manufacturing industry learnt how next digital datadriven factory innovation will be unfolding. <p>This conference was centered in three pillars:</p>

		<ol style="list-style-type: none"> 1. Public Policies for Industry 4.0 data-driven Digital Transformation 2. Data-driven Industrial Big Data Large Scale Piloting 3. Replication, Scale-up & Ecosystem development
12	References:	https://boost40.eu/



APPENDICES



Appendix 1: Digitalisation level in Spain

Digitalisation

<p>Title of the indicator:</p>	<p>Digitalisation level in Spain</p>
<p>Value:</p>	<p>To measure Spain's situation and progress in the field of digitalization, we use the DESI indicator (Digital Economy and Society Index), published by the European Commission,[1] which also allows us to compare ourselves with the main EU countries. This is a synthetic indicator that takes into account five pillars: connectivity, human capital, use of internet services, integration of digital technology in companies and digital public services.</p> <p>Spain ranked eleventh in the EU-28 DESI ranking in 2020 and is making remarkable progress in its digital transition. While it is natural to observe an upward trend as countries make progress in the adoption of new digital technologies, between 2015 and 2020 Spain has progressed relatively fast relative to the EU average. In fact, Spain is the fourth country (after Ireland, the Netherlands and Malta) to have experienced the greatest increase in the DESI index over the last five years (see the first graph, left panel).[2] This is allowing it to reduce the gap it exhibits in relation to the Nordic countries, the leaders in digitization within the Union.</p> <p>If we analyze the components of the DESI index, we see that Spain stands out in two of the five pillars: connectivity and, especially, digital public services, a component in which Spain ranks second in DESI 2020 (see the first graph, right-hand panel). In terms of connectivity, Spain is one of the countries with the highest deployment of very high capacity networks that provided coverage to 89% of households in 2019 compared to 44% of the EU average and 45% in 2015 in Spain. Likewise, the improvement over the last five years in the coverage of high-capacity networks has been clearly higher than the European average (see second graph). Looking ahead, the successful deployment of 5G technology will be crucial,[3] as it is an extremely important technology for the development of the new industrial 4.0 paradigm.</p> <p style="text-align: center;">Índice de la Economía y la Sociedad Digitales (DESI) y sus componentes (Nivel)</p> <p style="text-align: center;"><small>Fuente: CaixaBank Research, a partir de datos de la Comisión Europea.</small></p>

	<p>On the other hand, Spain is below the EU average in the digital indicators referring to human capital. Although there is an improvement in several aspects of this component, it is noteworthy that just over 40% of the Spanish population still lacks basic digital skills and 8% have never used the Internet. Portugal also lags far behind in the area of digital human capital, somewhat behind Spain, pushing the Portuguese country to 19th position in the overall DESI index, behind the EU-28 average.</p> <p>Still in the area of human capital, it is noteworthy that one of the objectives of the Spain Digital Agenda 2025 is for 80% of people to have basic digital skills by 2025,[4] as it is essential to have a workforce with these skills to be able to take advantage of the opportunities offered by new technologies. Furthermore, digital skills in the population are another of the elements highlighted by the European Commission (as well as the aforementioned connectivity) as relevant to ensure a strong and sustained economic recovery over time in the current context.</p>
References:	<ol style="list-style-type: none"> 1. https://ec.europa.eu/digital-single-market/en/digital-economy-and-society-index-desi 2. El DESI de España ha aumentado en 16,2 puntos frente a 13,7 puntos del promedio de la UE-28. 3. En 2020, España no ha mejorado en preparación para el 5G porque tuvo que suspender las subastas de las bandas de radiofrecuencia por la COVID-19. Sin embargo, dicha licitación se está llevando a cabo en los primeros meses de 2021. Así, el pasado 22 de febrero se subastaron 20 MHz en la banda de 3,5 GHz, una de las bandas prioritarias para el despliegue de redes 5G. 4. https://avancedigital.mineco.gob.es/programas-avance-digital/Paginas/espana-digital-2025.aspx 5. https://www.caixabankresearch.com/es/analisis-sectorial/digitalizacion/espana-carrera-digital

Digital skills

Title of the indicator :	Digital skills in Spain
Value:	<p><u>The challenge of digital transformation in Spain</u></p> <p>Currently, one in three people between 16 and 74 years of age in Spain lack basic digital skills and 6.1% of the population has not connected to the Internet in recent months. Digital skills are essential to improve the well-being of households and the economy as a whole, as well as to decrease inequality (Baum et al., 2014 and Haefner et al., 2020, Hernández and Maudos, 2021).</p> <p>The NGEU offers the opportunity to enhance such competencies. The plan aims to accelerate the digital transformation of the Spanish economy and society. To this end, it commits 29% of the nearly 70 billion euros budgeted for the period 2021-2023.</p> <p>Among the strategic projects is that of boosting training and digital inclusion of people. The aim is for 80%* of the Spanish population to achieve at least a basic level of digital skills.</p>

In this context, the National Digital Skills Plan has an estimated investment of 3,593 million euros. In addition, 3,999 million euros will go towards promoting digital connectivity, boosting cybersecurity and the deployment of 5G.

The European Union establishes the Digital Competence Framework (2016), which identifies five key axes for a global definition of digital skills (information and data literacy, communication and collaboration, digital content creation, security and problem solving).

Building on these European framework guidelines, Eurostat and OECD have defined a harmonized digital competence indicator consisting of four dimensions based on information available from household ICT use and equipment surveys:

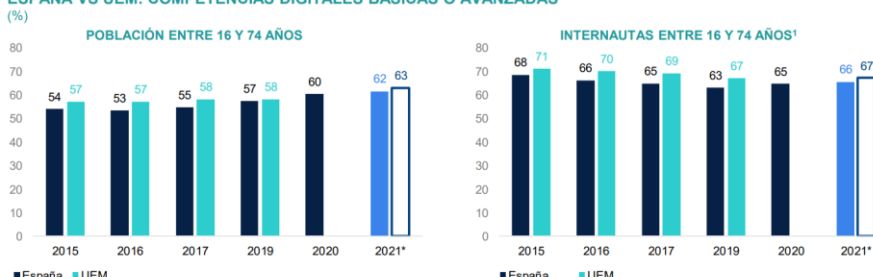
- Information.
- Communication.
- Problem solving.
- Software.



*Véase el Anexo para más detalles.
Fuente: BBVA Research a partir de Eurostat y ONTSI

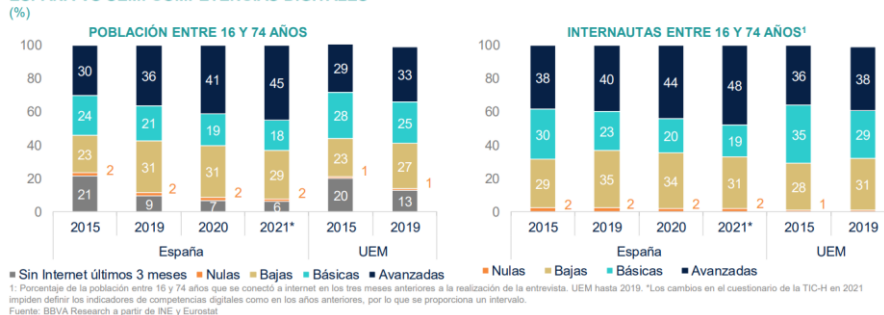
¿Han mejorado las competencias digitales en España desde 2015?

ESPAÑA VS UEM: COMPETENCIAS DIGITALES BÁSICAS O AVANZADAS



■ España ■ UEM
1: Porcentaje de la población entre 16 y 74 años que se conectó a internet en los tres meses anteriores a la realización de la entrevista. UEM hasta 2019. *Los cambios en el cuestionario de la TIC-H en 2021 impiden definir los indicadores de competencias digitales como en los años anteriores, por lo que se proporciona un intervalo.
Fuente: BBVA Research a partir de INE y Eurostat

ESPAÑA VS UEM: COMPETENCIAS DIGITALES



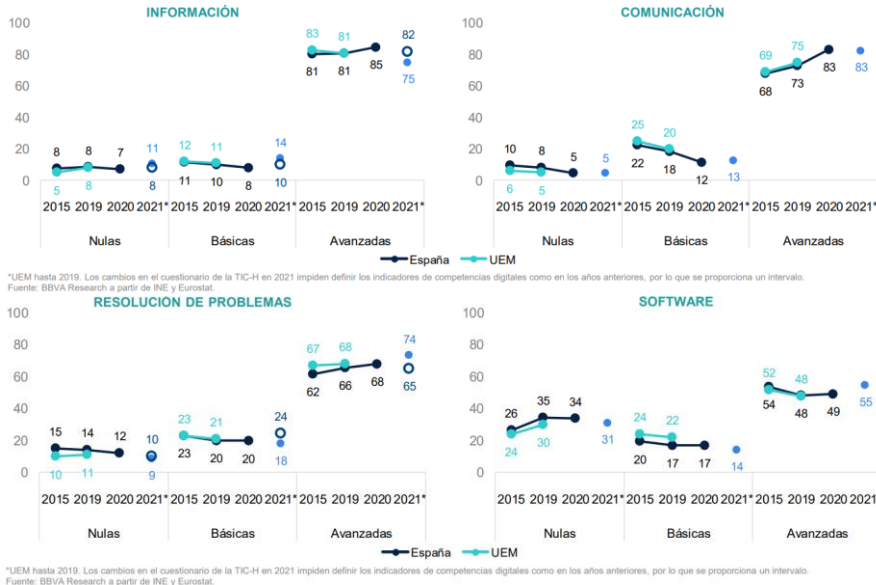
The structure of the Spanish population by level of digital skills is more polarized than that of the EMU. The percentage of internet users (last 3 months) with advanced skills improved by 4 points in 2020 (2 points between 2015 and 2019), but more than a third of the population has low or no skills.

Deficits in communication, problem-solving and software skills (1/2)

Software

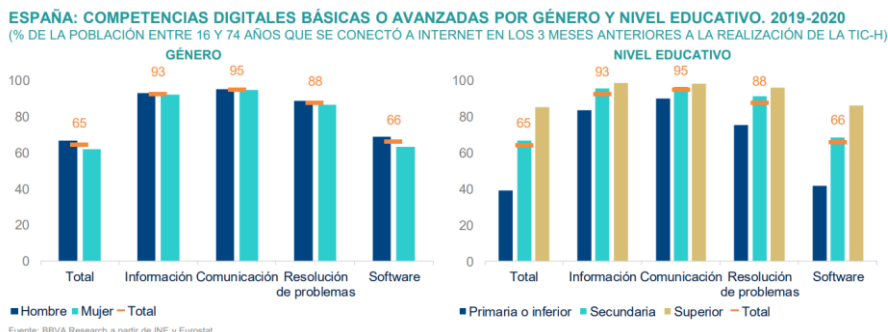
ESPAÑA VS UEM: COMPETENCIAS DIGITALES

(% DE LA POBLACIÓN ENTRE 16 Y 74 AÑOS QUE SE CONECTÓ A INTERNET EN LOS 3 MESES ANTERIORES A LA REALIZACIÓN DE LA TIC-H)



The differential with EMU focuses on basic and advanced communication and problem-solving skills and basic software skills. The improvement in information and communication skills in 2020 contrasted with the evolution of the software skills.

Typology of the digitally 'competent' in Spain (Gender and educational level as examples)



The differences in the aggregate indicator of digital competencies between individuals are mainly driven by the problem-solving and software dimensions. Communication and information search and analysis skills play a minor role.

Typology of the digitally 'competent' in Spain (Who has the most digital skills?)

SPAIN: TYPOLOGY OF PEOPLE WITH HIGHER DIGITAL COMPETENCIES (POPULATION GROUPS BETWEEN 16 AND 74 YEARS-OLD WHO WERE CONNECTED TO THE INTERNET IN THE 3 MONTHS PRIOR TO THE SURVEY AND WHO HAVE AT LEAST BASIC DIGITAL SKILLS)

Características del sustentador principal:
 Hombres.
 Jóvenes (16 - 24 años).
 Nacionalidad española.
 Estudios universitarios.
 Estudiantes y trabajadores no manuales.
 Uso diario de Internet.

Características del hogar:
 Más ingresos netos mensuales (≥ 3000 €).
 Mayor tamaño del hogar (adultos y menores).
 Disponibilidad de ordenador y móvil.

Características del lugar de residencia:
 Zonas densamente pobladas.
 Comunidad de Madrid.

Who is most likely to have advanced digital skills?

Age, employment status, frequent internet use and education are the most relevant variables to explain differences in digital skills, both at the aggregate level and at the to explain the differences in digital skills, both at the aggregate level and in the four dimensions analyzed (information, communication, problem solving and software). four dimensions analyzed (information, communication, problem solving and software). Having ICT equipment at home (computer or tablet) increases the probability of having advanced digital skills by more than 20 points. The impact is greater for problem-solving and software skills. The cell phone only plays a relevant role in boosting communication skills.

Household income level matters, especially in dimensions that require a higher investment in training, such as problem solving and software. investment in training, such as problem solving and software.

Women, foreigners and residents of sparsely populated areas are less likely to acquire advanced digital skills, even after removing the of acquiring advanced digital skills, even

after eliminating the impact of income differences. income differences. Still, the gap is narrow (between 3 and 7 points).

The probability of having advanced skills falls as the number of adults in the household increases, especially in the problem-solving dimension, which suggests that there may be economies of scale in the acquisition of skills in the household. economies of scale in the acquisition of skills in the household (i.e., only some members specialize in ICT), or that the improvement in the number of adults in the household may be due to ICT), or that skill upgrading has a non-monetary cost (e.g., in time).

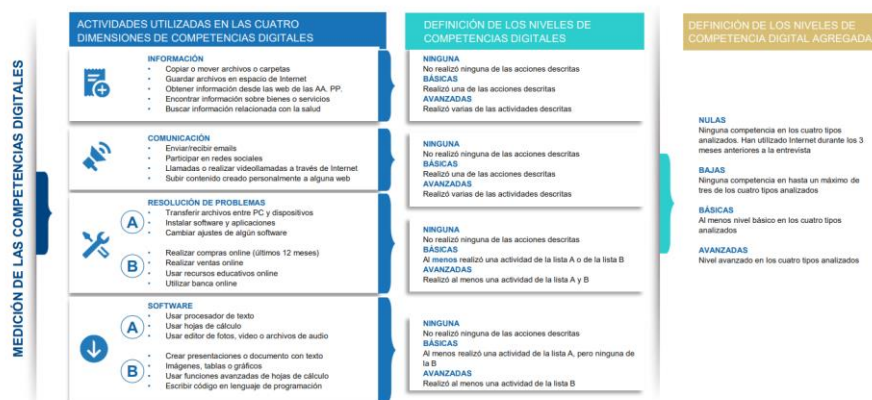
Apart from differences in the composition of the population, the autonomous community of residence has a secondary effect on digital skills. has a secondary effect on digital skills. Only Catalonia and, to a lesser extent, Madrid show a positive, but small, differential. At the other extreme, the Basque Country stands out.

There is a slight upturn in digital skills in 2020 that is not explained by changes in the characteristics of the population, which is concentrated in the Basque Country. population characteristics, which is concentrated in the communication dimensions (social networks and video calls, among other factors). (social networks and video calls, among other factors) and problem-solving (e.g., buying and selling over the Internet). for example). The advance of digital skills made up for the decline in mobility and face-to-face activities during the pandemic. activities during the pandemic.

The likelihood of having advanced software skills declines since 2015 regardless of how irrespective of how population characteristics have changed. This result suggests that the acquisition of digital skills follows a staged diffusion process [2 y 3]. In a first stage, information and communication skills improve; the progress of software skills is later.

How digital competencies are defined?

¿Cómo se definen las competencias digitales?



Referencia:

1. BBVA Research (2021) Competencias digitales: ¿qué son y quién las tiene? <https://www.bbva.com/en/publicaciones/spain-digital-skills-what-are-they-and-who-has-them/#:~:text=The%20percentage%20of%20the%20population,in%20the%202025%20Digital%20Agenda.>
2. Bass, F. M. (1969). A new product growth model for consumer durables. Management Science, 15(5), Theory Series, p. 215-227.
3. Rogers, E. M. (2003). Diffusion of Innovations, 5ª Edición, Free Press, Nueva York.

Advanced technologies in enterprises

<p>Title of the indicator:</p>	<p>Advanced technologies used in Spanish enterprises</p>																		
<p>Value:</p>	<p>On the Integration of digital technologies by business, Spanish businesses are still not taking full advantage of the online economy and SMEs are lagging behind on digitalisation. Digital transformation and the uptake or deployment of emerging technologies can boost the innovative capacity of the Spanish economy, driven by SMEs; in 2021, Spain launched the SME Digitalisation Plan 2021-2025⁴ to boost disruptive innovations and entrepreneurship in digital. The country also launched a National Strategy for AI⁵, and participates in significant large-scale European projects. In addition, Spain has adopted an ambitious digitalisation plan for SMEs, has boosted digital skills in education and employment, and has usefully prioritised RRF funding for that purpose with a strong set of coherent support actions.</p> <p>Spain performs very well in e-government and continues to make progress with new developments, e.g. defining a reference framework to manage identification⁶ and cooperating with Germany on building an ecosystem of digital identities, including a cross-border pilot and an information exchange in the area of self-sovereign identity⁷. In 2020, Spain adopted a specific plan for the digitalisation of its public administration⁸ and a law on electronic trust services, and created the Data Office Division. In 2021, it also approved the Regulation of action and operation of the public sector by online communication.</p> <div data-bbox="395 1326 1295 1870"> <table border="1" data-bbox="443 1729 842 1814"> <thead> <tr> <th colspan="2">1 Human capital</th> <th colspan="2">Spain</th> <th colspan="2">EU</th> </tr> <tr> <th>DESI 2021</th> <th>rank</th> <th>score</th> <th>score</th> <th>score</th> <th>score</th> </tr> </thead> <tbody> <tr> <td>DESI 2021</td> <td>12</td> <td>48.3</td> <td>47.1</td> <td></td> <td></td> </tr> </tbody> </table> </div> <p>On Human capital, Spain ranks 12th among the 27 EU countries. 57% of the people in Spain have at least basic digital skills, just above the EU average but still far from the target of 80% of the European population with at least basic digital skills by 2030⁹. In addition,</p>	1 Human capital		Spain		EU		DESI 2021	rank	score	score	score	score	DESI 2021	12	48.3	47.1		
1 Human capital		Spain		EU															
DESI 2021	rank	score	score	score	score														
DESI 2021	12	48.3	47.1																

36% of the Spanish labour force still do not have basic digital skills¹⁰, hampering further digitalisation of businesses and uptake of advanced digital technologies. The proportion of ICT specialists increased to 3.8% of total employment in 2020; in 2018, the share of ICT specialists accounted for 3.5%. Despite some progress, the shortage of ICT specialists is still a productivity constraining factor, especially for SMEs. The gender imbalance remains significant and female specialists only account for 20% of all ICT specialists (just above the EU average of 19%).

	Spain			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
1a1 At least basic digital skills	55%	57%	57%	56%
% individuals	2017	2019	2019	2019
1a2 Above basic digital skills	32%	36%	36%	31%
% individuals	2017	2019	2019	2019
1a3 At least basic software skills	58%	59%	59%	58%
% individuals	2017	2019	2019	2019
1b1 ICT specialists	3.5%	3.6%	3.8%	4.3%
% individuals in employment aged 15-74	2018	2019	2020	2020
1b2 Female ICT specialists	18%	20%	20%	19%
% ICT specialists	2018	2019	2020	2020
1b3 Enterprises providing ICT training	21%	22%	20%	20%
% enterprises	2018	2019	2020	2020
1b4 ICT graduates	4.0%	3.9%	4.2%	3.9%
% graduates	2017	2018	2019	2019

Supporting the digital skills of its population is among the 10 priorities of Spain's digital strategy, Digital Spain 2025¹¹. This strategy acknowledges that the lack of digital skills, both basic and advanced, hampers the country's digital transformation. In early 2021, a specific National Digital Competences Plan¹² was adopted. To reach ambitious targets, in line with those set in the Digital Decade Communication for basic digital skills and ICT specialists, the strategy for digital skills contains seven action lines: 1) digital skills training, with special emphasis on population groups at risk of digital exclusion; 2) bridging the digital gender divide; 3) digitalising the education system and developing digital skills for learning; 4) digital skills training throughout working life (focusing on the working population in the private sector and the unemployed); 5) digital skills training for public sector workers; 6) digital skills training for SMEs; 7) increasing the supply of ICT specialists (via vocational training and university education).

This plan is an essential instrument in promoting digital skills development in Spain. It will be critical for the acquisition of digital skills by people in Spain in general, and by workers and ICT professionals in particular. The strategy as a whole will benefit from a total investment of EUR 3.75 billion.

The Educa en Digital programme¹³, presented in June 2020, includes actions to foster further digitalisation of the Spanish education system, therefore promoting greater social inclusion. It has supported: the completion of a high-speed connectivity programme in public schools; provision of equipment for the most vulnerable people; and the modification of basic legislation on education, assigning a more relevant role to digitalisation in educational centres, both in the learning process and in the curriculum. In addition, amid the COVID-19 pandemic, the government launched a package of emergency actions in response to difficulties in distance teaching, making online training tools and open educational resources available to the educational community. It included

	<p>actions to foster further digitalisation of the Spanish education system, thereby further supporting social inclusion.</p> <p>Actions to upskill and reskill the Spanish workforce and tackle the existing shortage of ICT specialists in Spain are also ongoing. Multiple initiatives have been developed, including ones to promote the needs of SMEs, such as Digital Talent, or Digital Professionals, an initiative providing training and facilitating job placements in those areas where advanced digital skills are required.</p> <p>In addition to these massive investments, public-private collaboration that aims to achieve the European targets for digital skills are of fundamental importance. AMETIC, the business association of the digital industry, is running the Spanish Digital Skills & Jobs Coalition¹⁴, encompassing more than 150 organisations (companies, public administrations, training centres and universities) active in promoting digital skills in Spain. In May 2021, the coalition launched the Spanish Digital Skills & Jobs Platform, which is connected to the European platform¹⁵, as the one-stop-shop for information on digital skills and training materials in the Spanish context. AMETIC will also actively participate in the recently created Hub for Digital Skills, a public-private institutional associative body which will guide the implementation of the Spanish RRP and its actions for digital skills.</p> <p>During the 2020 edition of Code Week, 1,126 events were organised in Spain; it attracted 90,469 participants, 43% of whom were women, and 57% of the activities were organised in schools.</p> <p>The Talento Hacker initiative was launched in April 2021. This free cybersecurity training initiative, which aims to promote cybersecurity learning among different types of audiences, attracted a total of 1,258 teams and 437 individual registrations (5,341 participants) in its first edition.</p> <p>Overall, sound implementation of the new plan and investments will most likely bring a lasting impact for the people in Spain and the country's economy. In a more digitalised society, focusing on the groups among the population that are the least likely to use digital technologies and boosting the participation of women in the digital economy will enable everybody to make the most of Spain's digital transformation. The special attention given to the upskilling and reskilling of the labour force, in both the public and private sectors, will allow Spain to tap into the potential of the digital economy, and therefore contribute to a robust recovery.</p>
<p>Reference:</p>	<ol style="list-style-type: none"> 1. https://ec.europa.eu/newsroom/dae/redirection/document/80482 2. Target defined in the European Pillar of Social Rights action plan. 3. Data from Digital Agenda Key Indicators: https://bit.ly/3qJ6pkZ 4. https://portal.mineco.gob.es/RecursosArticulo/mineco/ministerio/ficheros/210204_Digital_Spain_2025.pdf 5. https://portal.mineco.gob.es/RecursosArticulo/mineco/ministerio/ficheros/210902-digital-skills-plan.pdf 6. https://www.educacionyfp.gob.es/en/prensa/actualidad/2020/06/20200616-educaendigital.html 7. https://ametic.es/en/prensa/ametic-lanza-la-web-digital-skills-and-jobs-coalition-spain-para-mejorar-las-competencias 8. https://digital-skills-jobs.europa.eu/en/about/national-coalitions/spain-digital-skills-and-jobs-coalition



Appendix 2: Policies, plans, laws, initiatives, guidelines

Policy documents for the planning period 2021-2027

National Development Plan of Spain

Program name:	"España Digital 2025"
Designed for the sector:	Overall
Period:	2021 - 2025
Aid amount:	<p>€70 billion</p> <p>Public investment in the 2020-2022 period would be around €20 billion, of which approximately €15 billion would correspond to the various programs and new Community financing instruments of the Next Generation EU Recovery Plan, which establishes that digitalization must be one of the main axes for mobilizing these resources.</p> <p>This would be in addition to the expected private sector investment of some 50 billion euros, in a moderate scenario of deployment of the measures.</p>
Focus on:	<p>Spain Digital 2025 will focus its objectives on promoting the country's digital transformation as one of the fundamental levers to relaunch economic growth, reduce inequality, increase productivity and take advantage of all the opportunities offered by new technologies, with respect to constitutional and European values, and the protection of individual and collective rights.</p> <p>Digital Spain 2025 contains a collection of measures, reforms and investments, organised around ten strategic axes, aligned with the digital policies defined by the European Commission for the new period.</p> <p><u>Aims:</u></p> <ol style="list-style-type: none"> 1. Ensuring adequate digital connectivity for 100% of the population, helping to eliminate the digital divide between rural and urban areas (2025 goal: 100% of the population with coverage of 100 Mbps) 2. Continuing to lead Europe in the deployment of 5G technology, incentivising its contribution to increasing economic productivity, social progress and territorial cohesion (2025 goal: 100% of the radio spectrum ready for 5G). 3. Strengthening the digital skills of workers and of the public as a whole (2025 goal: 80% of people with basic digital skills, of which 50% will be women). 4. Strengthening Spain's cybersecurity capacity, consolidating its position as one of Europe's centres of business capacity (2025 goal: 20,000 new specialists in cybersecurity, AI and data).

	<p>5. Promoting the digitalisation of public administrations (2025 goal: 50% of public services available on mobile apps).</p> <p>6. Accelerating the digitalisation of companies, with a special focus on SMEs and start-ups (2025 goal: 25% of SME business volume provided by e-commerce).</p> <p>7. Accelerating the digitalisation of the production model by means of projects which drive sectoral transformation and produce structural effects (2025 goal: 10% reduction in CO2 emissions as a consequence of digitalisation).</p> <p>8. Making Spain more attractive as a European business, work and investment platform in the audiovisual field (2025 goal: 30% increase in audiovisual production in Spain).</p> <p>9. Supporting the transition to a data economy, safeguarding security and privacy and making the most of the opportunities offered by artificial intelligence (2025 goal: 25% of companies using AI and big data).</p> <p>10. Guaranteeing citizens' rights in the new digital environment (2025 goal: a national charter of digital rights).</p>
Short description: (100-200 words)	Spain Digital 2025 includes nearly 50 measures grouped into ten strategic axes with which, over the next five years, it is intended to promote the country's digital transformation process, in line with the digital strategy of the European Union, through public collaboration -private and with the participation of all economic and social agents in the country. More than 15 ministries and public bodies and more than 25 economic, business and social agents have participated in the elaboration of this digital agenda.
Reference:	España Digital 2024; https://portal.mineco.gob.es/es-es/ministerio/estrategias/Paginas/00_Espana_Digital_2025.aspx

National Industrial Policy Guidelines 2021-2027

Program name:	Recovery, Transformation and Resilience Plan: I&R&I Line
Designed for the sector:	Support for innovation and sustainability schemes in the manufacturing industry and aims to promote the implementation of innovation and sustainability schemes in the manufacturing industry.
Period:	May – June 2023
Aid amount:	188 M€
Other indicators:	N/A

Focus on:	The thematic areas of the call cover aspects such as: circular economy and eco-innovation applied to the improvement of value chains; decarbonisation, energy efficiency, new renewable energy sources and reduction of polluting emissions; advanced materials and products; and innovation in quality and safety processes.
Short description: (100-200 words)	The first line is the R&D&I Line, which aims to promote the implementation of innovation and sustainability plans in the manufacturing industry.
References:	https://planderecuperacion.gob.es/como-acceder-a-los-fondos/convocatorias/BDNS/696111/orden-por-la-que-se-efectua-la-convocatoria-de-concesion-de-ayuda-a-planes-de-innovacion-y-sostenibilidad-en-el-ambito-de-la-industria-manufacturera-en-el-marco-del-plan-de-recuperacion-transformacion-y-resiliencia-en-el-ano-2023

Program name:	Recovery, Transformation and Resilience Plan: Line “Activa Financiación”
Designed for the sector:	This programme has two action frameworks: Activa-SMEs, dedicated to projects carried out by small and medium-sized enterprises, and Activa-Large implementations, supporting projects carried out by any type of company.
Period:	May – June 2023
Aid amount:	30 M€
Other indicators:	N/A
Focus on:	Industry 4.0
Short description: (100-200 words)	The second is the ACTIVA_Financing Line, which aims to support the development of industrial research projects, experimental development projects, as well as innovation projects in terms of organisation and processes, in the field of Connected Industry 4.0.
References:	https://planderecuperacion.gob.es/como-acceder-a-los-fondos/convocatorias/BDNS/695856/orden-por-la-que-se-efectua-la-convocatoria-de-concesion-de-ayuda-a-proyectos-de-i-d-i-en-el-ambito-de-la-industria-



	conectada-4-0-activa-financiacion-en-el-marco-del-plan-de-recuperacion-transformacion-y-resiliencia-en-el-ano-2023
Reference:	1.



Appendix 3: Projects

Title:	Big Data for Factories
Acronym (if any):	Boost 4.0
Website:	https://boost40.eu/
Period:	2018 - 2020
Source of funding:	Co-funded by the Horizon 2020 Framework Programme of the European Union Under grant agreement No 780732
Partners:	Innovalia, CARSA
Short overview:	Boost 4.0, starting 1st January 2018 and with a duration of 3 years, is the biggest European initiative in Big Data for Industry 4.0. With a 20M€ budget and leveraging 100M€ of private investment, Boost 4.0 will lead the construction of the European Industrial Data Space to improve the competitiveness of Industry 4.0 and will guide the European manufacturing industry in the introduction of Big Data in the factory, providing the industrial sector with the necessary tools to obtain the maximum benefit of Big Data.
Main results in regard to Industry 4.0:	<p>11 pilot factories: Automotive, Machine Tool, white Goods and Appliances</p> <p>6 Digital Infrastructures: Connectivity, fog/edge, data-center, HPC, cloud.</p> <p>9 Digital Manufacturing Platforms: engineering, planning, operations, quality control, analytics, maintenance and cybersecurity.</p> <p>4 Open Initiatives: Open Big Data Pipelines, Data Sovereignty, Context Information Brokering, Distributed Data Traceability.</p>
Reference:	

Title:	Future Internet Web-Entrepreneurship for 3D Printing Virtual Fabrication in Europe
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Acronym (if any):	FABulous
Website:	https://fabulous-fi.eu/
Period:	2014 – 2016
Source of funding:	European Commission
Partners:	Innovalia, CARSA, Bwcon, Imec, Bizkaia Talent, Engineering Group
Short overview:	FABulous aims to create and support a FI service ecosystem for 3D printing technologies, bringing together infrastructures and investors with innovators and entrepreneurs in the field of design, manufacturing, logistic and content-based services.
Main results in regard to Industry 4.0:	FABulous has accelerated 100 startups and entrepreneurs. 10 of them have consolidated their business, 40 have developed a commercial application and the other 60 have launched a web service prototype.
Reference:	

Title:	Automation, Technology transfer and Managerial practices for the growth of SMEs, a better employability and the promotion of the entrepreneurship
Acronym (if any):	AuToMa
Website:	https://www.automa-project.eu/index.php

Period:	2016-2018
Source of funding:	Co-funded by the Erasmus+ Programme of the European Union
Partners:	LUISS GUIDO CARLI UNIVERSITY, CARSA, TECHNICAL UNIVERSITY OF KOSICE, PIAP, EUROPEAN CENTER FOR QUALITY LTD
Short overview:	AuToMa project addresses the problem of low and incongruous qualification of students and staff employed in SMEs in terms of automation systems and new technologies. It will give also to employed, unemployed and people that need to be requalified, more opportunities to find a job at national and EU labour markets.
Main results in regard to Industry 4.0:	The latest developments in the sphere of robotics, automation in manufacturing and management methods in SMEs of Industry 4.0 can be utilized to help students and staff employed gain initial competences in the abovementioned fields, improve their qualification or to requalify, to start a new business venture or to aid them in refining and updating their learning curricula.
Reference:	

Appendix 4: Companies

Title:	Innovalia
Website:	https://innovalia.org
Short overview of involvement in Industry 4.0 (activities/results/etc.):	Innovalia Association is a private R&D business unit whose main purpose is to foster technological innovation in small and medium-sized enterprises. Formed by a group of companies that combine talent, competences and resources, Innovalia Association is a reference for SMEs that demand advanced technological capabilities, highly specialised and with a trans-national cooperation dimension.
Reference:	

Title:	International Data Spaces Association
Website:	https://internationaldataspaces.org
Short overview of involvement in Industry 4.0 (activities/results/etc.):	The International Data Spaces Association (IDSA) is a not-for-profit association of more than 140 organisations, incorporated under German law. It creates standards for sharing data in data spaces, that allow participants to have full control over their data
Reference:	

Title:	BAIDATA
Website:	https://baidata.eu/en
Short overview of involvement in Industry 4.0 (activities/results/etc.):	The BAIDATA Association is helping to drive the development of data sovereignty and the data economy. Founded in collaboration with the International Data Spaces Association (IDSA), BAIDATA implements research, development and training activities to help build the public-private data

	ecosystem mostly in Industry 4.0. BAIDATA stimulates and supports regional shared data space pilot actions and promotes data space connectivity and interoperability with other regional and national data spaces and with the common European data market linked to this initiative.
Reference:	

Title:	ENEO
Website:	https://redborder.com/
Short overview of involvement in Industry 4.0 (activities/results/etc.):	ENEO provides Cybersecurity tools to a wide range of companies, institutions, telecommunication providers, etc. It makes life easier for CISO and system administrators. ENEO provides companies mostly from Industry 4.0 an open, active and scale out professional solution to solve all the needs a company may have on cybersecurity, network traffic analysis and hardware monitoring.
Reference:	

Title:	SQS
Website:	https://www.sqs.es/?lang=en
Short overview of involvement in Industry 4.0 (activities/results/etc.):	Software Quality Systems S.A. is an independent software testing company specialising in the design and implementation of verification and validation processes. SQS was created in 1998 and since then it has been offering software quality assurance services, a sector in which it has become the national market leader. During these years, SQS S.A. has offered the services of a young and highly specialised team, working in the direction that the future is heading: new technologies and the full guarantee of their optimal functioning. SQS provides support and advice on both process and product quality and has clear areas of activity: technical sectors of Industry 4.0, represented

	<p>mainly by its customers in the railway, telecommunications, electronics and automotive sectors.</p> <p>SQS's experience includes in-depth technical expertise in the design, implementation and management of complex test environments. SQS' success is due to the combination of consultancy and implementation of its own methods and tools. Its vast experience shows that implementation is crucial for the achievement of the improvements expected by the client.</p>
Reference:	

Title:	TRIMEK
Website:	https://www.trimek.com/en/
Short overview of involvement in Industry 4.0 (activities/results/etc.):	<p>TRIMEK is a company founded at the beginning of 1993, located in Altube (Spain), which focuses its activities in the area of dimensional metrological engineering, developing measuring systems such as Coordinate Measuring Machines (CMMs), 3D scanning systems, metrological management software platforms.</p> <p>Its solvent performances in recent years have led TRIMEK to count among its clients leading brands in the aeronautical and automotive industry such as: Gamesa, PSA Group, Renault, Volkswagen Group, General Motors, Daimler-Chrysler, Nissan, Suzuki, Volvo, Iveco and Gestamp.</p>
Reference:	

Appendix 5: Key Indicators

		Spain		EU-27	
		2009	2019	2009	2019
Education and training 2020 benchmarks					
Early leavers from education and training (age 18-24)		30.9%	17.3%	14.0%	10.2%
Tertiary educational attainment (age 30-34)		40.7%	44.7%	31.1%	40.3%
Early childhood education (from age 4 to starting age of compulsory primary education)		98.4%	98.0% ¹⁸	90.3%	94.8% ¹⁸
Proportion of 15 year-olds underachieving in:	Reading	19.6%	19.6% ¹⁸	19.3%	22.5% ¹⁸
	Maths	23.8%	24.7% ¹⁸	22.2%	22.9% ¹⁸
	Science	18.2%	21.3% ¹⁸	17.8%	22.3% ¹⁸
Employment rate of recent graduates by educational attainment (age 20-34 having left education 1-3 years before reference year)	ISCED 3-8 (total)	73.0%	73.0%	78.0%	80.9%
Adult participation in learning (age 25-64)	ISCED 0-8 (total)	10.8%	10.6%	7.9%	10.8% ^b
Learning mobility	Degree mobile graduates (ISCED 5-8)	:	2.2% ¹⁸	:	4.3% ¹⁸
	Credit mobile graduates (ISCED 5-8)	:	7.7% ¹⁸	:	9.1% ¹⁸
Other contextual indicators					
Education investment	Public expenditure on education as a percentage of GDP	4.6%	4.0% ^{p, 18}	5.1%	4.6% ¹⁸
	Expenditure on public and ISCED 1-2	€5 785 ¹²	€6 006 ¹⁷	€6 072 ^{d, 12}	€6 240 ^{d, 16}

	private institutions per student in € PPS	ISCED 3-4	ISCED 5-8	€6 775 ¹²	€7 400 ¹⁷	€9 679 ¹²	€7 757 ^{d, 16}	€9 977 ^{d, 16}
Early leavers from education and training (age 18-24)	Native-born	27.7%	14.4%	12.6%	8.9%			
	Foreign-born	45.2%	31.1%	29.3%	22.2%			
Tertiary educational attainment (age 30-34)	Native-born	45.8%	48.7%	32.0%	41.3%			
	Foreign-born	23.9%	31.9%	25.1%	35.3%			
Employment rate of recent graduates by educational attainment (age 20-34 having left education 1-3 years before reference year)	ISCED 3-4	63.9%	61.5%	72.2%	75.9%			
	ISCED 5-8	76.5%	77.2%	83.7%	85.0%			

Source: Eurostat; OECD (PISA); Learning mobility figures are calculated by DG EAC, based on UOE 2018 data. Further information can be found in Annex I and in Volume 1 (ec.europa.eu/education/monitor). Notes: The 2018 EU average on PISA reading performance does not include ES; b = break in time series; d = definition differs; u = low reliability; : = not available; 12 = 2012, 16 = 2016, 17 = 2017, 18 = 2018.

Table 5 – Key indicators overview

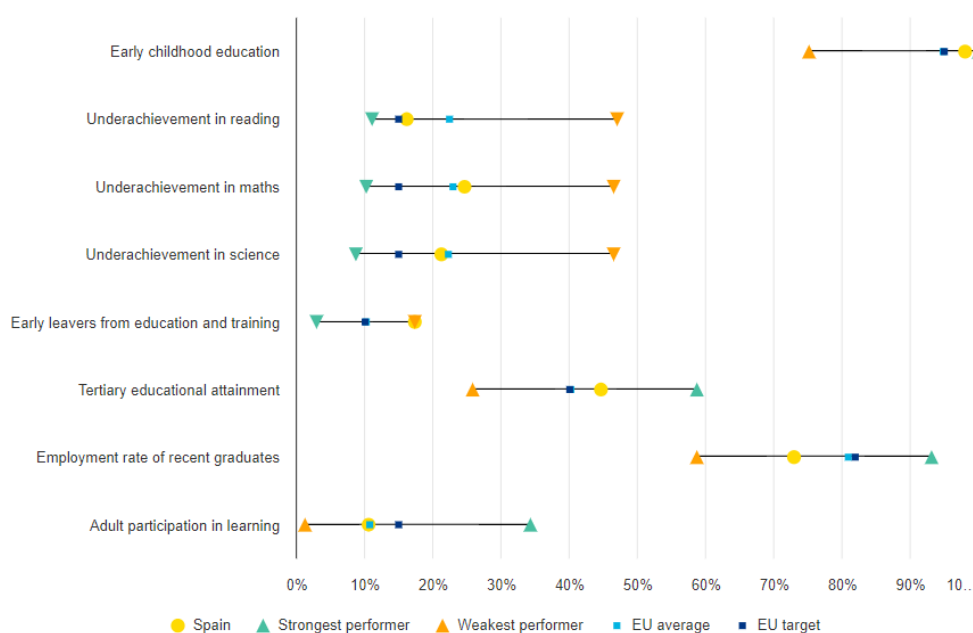




Figure 13 – Position in relation to strongest and weakest performers.

Source: DG EAC, based on data from Eurostat (LFS 2019, UOE 2018) and OECD (PISA 2018).

