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VOCATIONAL EDUCATION  
AND TRAINING FOR THE  
FUTURE OF WORK

SPAIN

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# **Vocational education and training and the future of work: Spain**

Policy strategies and initiatives to prepare vocational education  
and training (VET) for digitalisation and future of work  
technologies



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# Executive summary

This report is part of the ReferNet work plan. Its aim is to show to what extent Spain is carrying out some type of action and/or specific programmes or initiatives to align VET systems (both IVET and CVET) to the skills demands arising from digitisation, automation and new technologies as well as the use of these technologies to facilitate new forms of student learning.

The report is organised in five sections, in accordance with Cedefop's guidelines, to describe some of the strategies, initiatives and most significant practices implemented in following areas:

- Digital or 4.0 strategy;
- VET 4.0 initiatives;
- Intelligence 4.0 for VET;
- VET 4.0 learning practices
- Adapting to artificial intelligence and automation

The most comprehensive strategies for digitalisation in Spain are the Digital Agenda for Spain (ADpE) and the Connected Industry 4.0. Regional governments are also launching their own strategies for digital transformation, aligned with national ones.

The Digital Agenda for Spain sets the road map to achieve specific objectives for the development of the economy and the digital society in Spain, in alignment with the Digital Agenda for Europe, in 2015 and 2020.

The Connected Industry 4.0 initiative aims to promote the digital transformation of Spanish industry by the promotion of the Industry 4.0 concept and the development of competencies related to it, and the collaboration between industrial companies or the development of digital enablers.

The section about VET 4.0 initiatives introduces various initiatives in place to foster acquisition and improvement of skills related to i.4.0 and digitalisation, such as some public funding schemes for the skilling of workers – employed, unemployed and young people; prospecting future training needs derived from technological changes; the design and development of new professional qualifications and adaptation of existing ones to these new requirements.

Intelligence 4.0 for VET has been used by Fundae to identify patterns in learning contents and to define and propose a new training actions' classification methodology which could identify new learning contents delivered by companies.

The last section, on VET 4.0 learning practises, sums up practices put in place in IVET and CVET in recent years addressing teachers and student's needs.

There are still great challenges facing digital transformation in Spanish industry which will require a wide variety of measures to promote and support research and innovation, entrepreneurship, the development of network infrastructures, and the rising qualification level of the population in general, and of certain groups in particular, preventing and limiting possible social imbalances.

Updating and designing new qualifications to meet the demand for skills of the i.4.0 era, setting up mechanisms for the rapid design of new qualifications to reduce mismatches and flexible structures to offer such qualifications are some of the initiatives in the pipeline.

Nevertheless, an efficient coordination of strategies is necessary to guarantee the success of this transformation, as well as fine governance systems to allow a positive final balance, contributing to sustainable and inclusive development.

## CHAPTER 1.

# Introduction

The Government of Spain, since 2000, has adopted successive plans for the development of the Digital Society, aligned with European strategies, to maximise the impact of public policies on ICT and achieve the transformation and modernisation of the Spanish economy and society. In fact, there is a secretary of state for the Digital Advance, dependent on the Ministry of Economy and Business <sup>(1)</sup>.

Social partners are also aware of the deep changes this new industrial revolution will impose on the world of work, and from their own scope they have contributed their vision on these issues <sup>(2)</sup>.

The situation of digitalisation of Spain has evolved substantially in recent years <sup>(3)</sup> (Figure 1). According to the Digital Economy and Society Index (DESI) 2019 <sup>(4)</sup>, Spain ranks 11th out of 28 EU Member States (Figures 1 and Figure 2), the same position as in 2018. Spain reaches an outstanding position in Digital Public Services, where it ranks fourth in the EU, climbing two positions from last year. It is also above EU average in the implementation of ultrafast broadband coverage (ranking 8<sup>th</sup>) and in the preparation for the future 5G (7<sup>th</sup>). However, it is in the human capital dimension where Spain performs worst, ranked 17<sup>th</sup>, particularly at basic digital skills, as just over 55% of people between 16 and 74

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(1) The Secretary of State for the Information Society and the Digital Agenda was renamed S. S. for the Digital Advance in July 2018.

(2) Declaración de los Agentes Sociales instando al desarrollo de un Pacto de Estado por la Industria. [Social partners' declaration urging the development of a State Pact for Industry]. <https://www.alianzaindustria.es/wp-content/uploads/2017/06/Declaracion-Pacto-de-Estado.pdf>

CEOE (2018). *Plan digital 2025: la digitalización de la sociedad española*. [Digital Plan 2025: the digitalisation of Spanish society]. [http://plandigital2025.ceoe.es/wp-content/uploads/2018/04/Plan-digital-2025-web\\_VF-EDICIO%CC%81N-23-04-2018.pdf](http://plandigital2025.ceoe.es/wp-content/uploads/2018/04/Plan-digital-2025-web_VF-EDICIO%CC%81N-23-04-2018.pdf)

CC.OO. (2018a). *La digitalización de la industria. Afrontar los cambios en el empleo y en las relaciones laborales*. [The digitisation of industry. Addressing changes in employment and labour relations].

<http://www.industria.ccoo.es/83180efa9c0d491718a04c1e866ba833000060.pdf> and <https://industria.ccoo.es/84cc6ed1b14f4f760cdb94c4deef3d8a000060.pdf>

(3) <https://ec.europa.eu/digital-single-market/en/desi>

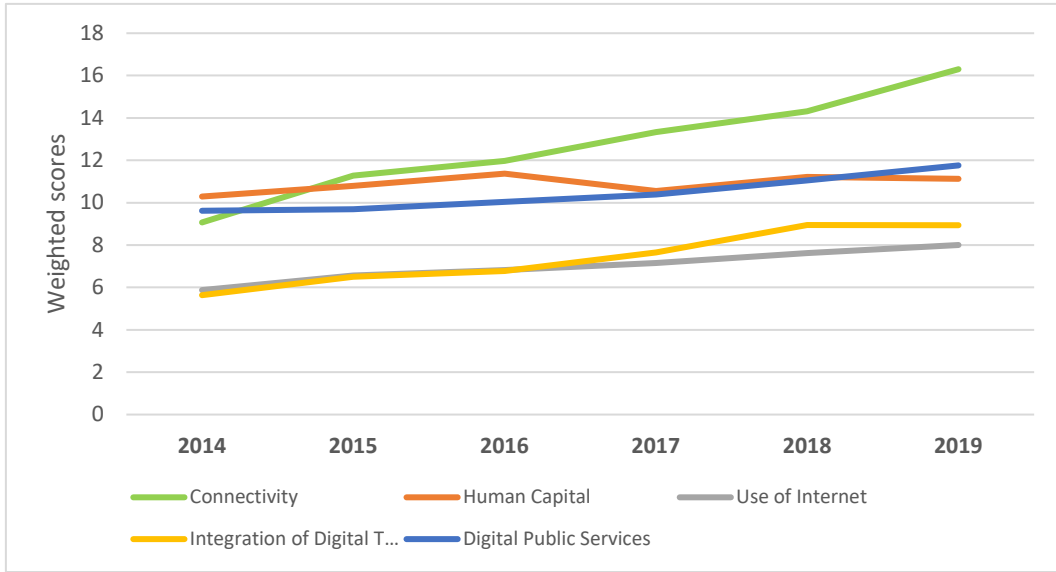
(4) European Commission (2019). Digital Economy and Society Index (DESI). 2019 Country Report: Spain.

[http://ec.europa.eu/newsroom/dae/document.cfm?doc\\_id=52223](http://ec.europa.eu/newsroom/dae/document.cfm?doc_id=52223)

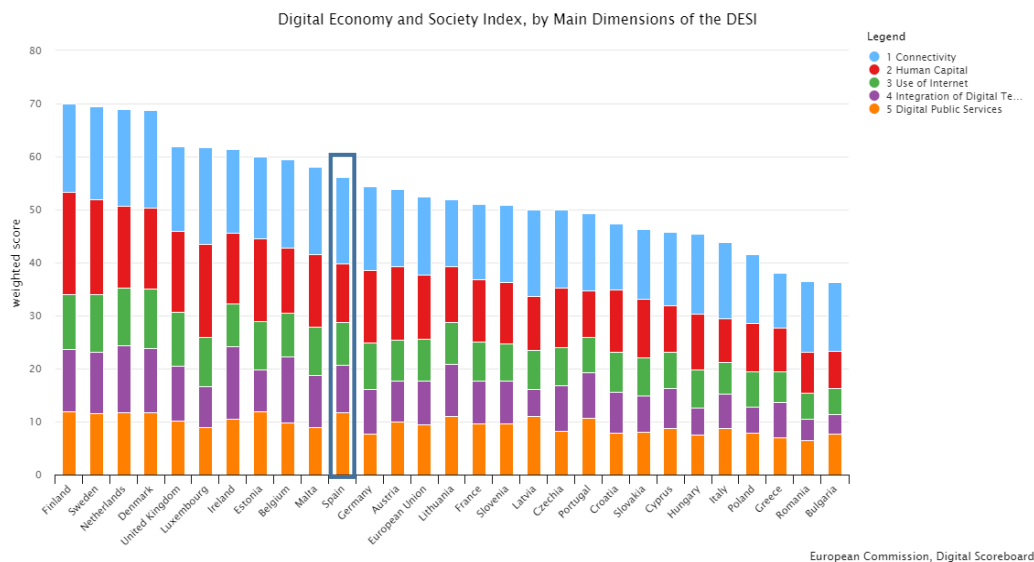


years of age have basic digital skills (EU average stands at 57%); the proportion of ICT specialists represents a lower percentage of the workforce compared to the EU average (2.9% compared to 3.7% in the EU); and ICT graduates in Spain account for 3.9% of the total. Female ICT specialists account for a mere 1% of total female employment (Figure 2).

**Figure 1 Evolution of DESI components in Spain, 2014-19**



**Figure 2 Digital economy and society index**



Digitisation is not taking place at the same pace in all productive sectors or in all regions. The industrial sector seems to be leading the digital transformation, mainly in the more industrialised regions. Although the initiatives promoted by the Spanish authorities have largely focused on this sector, services and agricultural branches are also undergoing major transformation related to digitisation and support plans have been deployed. Offering the public the option of dealing with the authorities online remains one of the Government's main goal as it modernises public services <sup>(5)</sup>.

According to OECD forecasts (OECD 2019) <sup>(6)</sup>, as well as Cedefop analysis (2018) <sup>(7)</sup>, more than half of the jobs in Spain will be affected by automation in the near future: 21.7% are in danger of disappearing and 30.2% can undergo major transformations. The Spanish situation is worse than the average of OECD member countries and only Greece, Slovenia and Slovakia present a greater risk than our country.

Other reports (PwC 2018) are even more pessimistic since they estimate that successive waves of digitalisation affecting Spain could make 34% of existing jobs disappear after 2030.

On the other hand, it is also possible that this job loss is compensated by the growing demand for new occupations linked to the technology itself. In this sense, the Observatory for the Analysis and Economic Development of the Internet (ADEI 2017) estimates that 3.2 million jobs linked to digitalisation will emerge until 2030 and another 600,000 linked to posts with a high human component (personal care, protection services etc.) are less likely to be replaced by machines.

Spain is no stranger to the debate on the implications of this new industrial revolution. In recent years several congresses, meetings and discussions of various kinds have been held, and several documents, articles and news have been published on the subject. In the opinion of the Economic and Social Council, 'although in Spain there is a certain consensus that the process must be accompanied by an improvement in competences and digital skills of the

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(5) The REINA Report analyses the most representative indicators of the situation and use of information and communication technologies and systems in State Administration.

[https://administracionelectronica.gob.es/pae\\_Home/pae\\_OBSAE/pae\\_Informes/pae\\_InformeREINA/pae\\_InfDescarga.html#.XD3CB1xKiUk](https://administracionelectronica.gob.es/pae_Home/pae_OBSAE/pae_Informes/pae_InformeREINA/pae_InfDescarga.html#.XD3CB1xKiUk)

(6) OECD (2019) Employment Outlook 2019: The Future of Work, OECD: Paris.

(7) Pouliakas (2018) Automation risk in the EU labour market: a skill needs approach, [https://www.cedefop.europa.eu/files/automation\\_risk\\_in\\_the\\_eu\\_labour\\_market.pdf](https://www.cedefop.europa.eu/files/automation_risk_in_the_eu_labour_market.pdf)

population <sup>(8)</sup> and an effort to avoid digital exclusion, the effects this digital transition may have in the job market are very uncertain' <sup>(9)</sup>.

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- (<sup>8</sup>) Some regions are carrying out different initiatives to certify the digital competence of citizens: Basque Country. Ikanos Project: <https://www.ikanos.eus/>; Catalonia. ACTIC (Accreditation of Competences in Information and Communication Technologies): [https://actic.gencat.cat/es/actic\\_informacio/actic\\_que\\_es\\_l\\_actic\\_/](https://actic.gencat.cat/es/actic_informacio/actic_que_es_l_actic_/); Castilla and León. TuCertiCyL: <https://tucerticyl.es/como-funciona>; Galicia is certifying digital competencies in office automation: [https://sede.xunta.gal/detalle-procedemento?langId=es\\_ES&codtram=PR525A](https://sede.xunta.gal/detalle-procedemento?langId=es_ES&codtram=PR525A)
- (<sup>9</sup>) CES (2017). *Informe sobre la digitalización de la economía*. [Digitalisation of the economy report]. Madrid: CES  
<http://www.ces.es/documents/10180/4509980/Inf0317.pdf>

## CHAPTER 2.

# Digital strategies 4.0 and VET in Spain

In this section, the Digital Agenda for Spain and the Connected Industry 4.0 <sup>(10)</sup> are described. Other initiatives, such as the Agenda for the Strengthening of the Industrial Sector <sup>(11)</sup>, seek to promote the digital transformation of Spanish industry through joint and coordinated action of the public-private sector. In turn, regional governments are also launching their own strategies for digital transformation, aligned with national ones <sup>(12)</sup>.

An Entrepreneurial National Strategy was recently announced <sup>(13)</sup> which will include a law to 'promote the development of the ecosystem of start-ups or emerging technology-based companies' <sup>(14)</sup>.

### 2.1. Digital Agenda for Spain

The Digital Agenda for Spain (2013) (ADpE) [Agenda Digital para España] <sup>(15)</sup>, is the road map for fulfilment of the objectives set out by the Digital Agenda for Europe <sup>(16)</sup> in 2015 and 2020, as well as the achievement of specific objectives for the development of the economy and digital society in Spain. It is structured around six major objectives and several specific plans.

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<sup>(10)</sup> <http://www.industriaconectada40.gob.es/Paginas/index.aspx>

<sup>(11)</sup> <http://www.industriaconectada40.gob.es/Paginas/index.aspx>

<sup>(12)</sup> Initiatives that, in terms of boosting Industry 4.0, are being carried out by the central and regional administrations:  
<http://www.industriaconectada40.gob.es/Documents/Catalogo-I40-CCAAAGE.pdf>

<sup>(13)</sup> It was made by the President of the Government at the closing of the Spain South Summit '18 on October 5<sup>th</sup>.  
<http://www.expansion.com/economia/2018/10/05/5bb74ebc268e3eff258b45a9.html>

<sup>(14)</sup> Public consultation on the future 'Act of Start-ups' closed on January 25, 2019.  
<http://www.mineco.gob.es/portal/site/mineco/menuitem.ac30f9268750bd56a0b0240e026041a0/?vgnextoid=661927b8442c7610VgnVCM1000001d04140aRCRD&vgnnextchannel=67f3a570b4ee3610VgnVCM1000001d04140aRCRD>

<sup>(15)</sup> [https://avancedigital.gob.es/planes-TIC/agenda-digital/DescargasAgendaDigital/Plan-ADpE\\_Agenda\\_Digital\\_para\\_Espana.pdf](https://avancedigital.gob.es/planes-TIC/agenda-digital/DescargasAgendaDigital/Plan-ADpE_Agenda_Digital_para_Espana.pdf); y <https://avancedigital.gob.es/planes-TIC/agenda-digital/Paginas/agenda-digital-para-Espana.aspx>

<sup>(16)</sup> <https://ec.europa.eu/digital-single-market/>

The sixth objective is about promoting digital inclusion and literacy and the training of new ICT professionals <sup>(17)</sup>. Among its specific measures, the following measures can be highlighted for the purpose of this article:

- update the National Catalogue of Professional Qualifications in terms of ICT skills and training, and include this update in the training offers that accredit professional qualifications;
- maximise efficiency in the management and allocation of training funds for continuous training in ICT, both for private and public sector workers with special attention to the use of online virtual training platforms;
- assign part of the resources available for CVET to the acquisition and upgrading of digital skills of ICT professionals;
- readjust vocational training related to ICT including, among other actions, specialization courses in the education remit;
- promote an improvement in the university offer aimed at training ICT professionals through their adaptation to market needs, contemplating new professional profiles in the field of ICT and increasing the efficiency of the system.

Likewise, the measures developed to introduce the potential of digitalisation among companies have been multiple and diverse. Some of these measures are the organization of workshops and start-up demonstration centres, in which companies in the sector can show products and services aimed at improving its productivity and competitiveness, such as the Demonstrator Centre for Tourism Innovation <sup>(18)</sup>, Smart Cities <sup>(19)</sup> or the National Reference Centre for Electronic Commerce and Digital Marketing <sup>(20)</sup>. Other support measures have provided individualised advice and funding for the implementation of ICT services and solutions.

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<sup>(17)</sup> <https://www.plantl.gob.es/objetivos-agenda-digital/promover-inclusion-digital/Paginas/alfabetizacion-digital.aspx>

<sup>(18)</sup> <https://www.spegc.org/empresas-y-emprendedores/cdtic/>

<sup>(19)</sup> <https://www.red.es/redes/es/que-hacemos/ciudades-inteligentes>

<sup>(20)</sup> They are public institutions specialised in the different sector branches, in charge of carrying out innovation and experimentation initiatives in the area of vocational training. <https://www.red.es/redes/es/que-hacemos/profesionales-digitales/profesionales-digitales>

Within the framework of the Confidence Plan in the Digital domain <sup>(21)</sup>, several MOOCs on ICT security and minors <sup>(22)</sup> have been developed, aimed at teachers and families. Other activities are face-to-face workshops; an awareness campaign on TV, and the Cybercamp event <sup>(23)</sup> for the promotion of the cybersecurity industry focused on different groups: families, students, professionals, entrepreneurs and job seekers.

## 2.2. Connected Industry 4.0 Strategy

The Connected Industry 4.0 initiative (CI4.0) (2015) <sup>(24)</sup>, consistent with the Digital Agenda, and included in the Agenda for the Strengthening of the Industrial Sector <sup>(25)</sup>, aims to promote the digital transformation of Spanish industry <sup>(26)</sup> through joint and coordinated action between the public and private sectors <sup>(27)</sup> and the social partners.

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<sup>(21)</sup> One of the nine plans of the ADpE. It complements other initiatives such as the European Cybersecurity Strategy and mainly the Spanish Cybersecurity Strategy. <https://www.plantl.gob.es/planes-actuaciones/Paginas/plan-confianza-ambito-digital.aspx>

<sup>(22)</sup> A channel has been launched to request the removal of especially sensitive content on the Internet created by the Spanish Agency for Data Protection (AEPD). In addition, the Ministry of Education, through INTEF, and in collaboration with the AEPD has created a website on Child Safety in digital media that will gather resources, guides, reports and materials prepared by different entities for this purpose. More information at

<https://www.aepd.es/prensa/2019-09-24-mar-espana-carmen-calvo-canal-prioritario.html>;

<https://sedeagpd.gob.es/sede-electronica-web/vistas/formNuevaReclamacion/canalprioritario.jsf>;

<https://intef.es/Noticias/canal-para-la-retirada-de-contenidos-especialmente-sensibles-en-internet/>

Besides, a website for teachers, families, students, schools and public authorities, with the aim of protecting minors in their interaction with the Internet was presented at the end of December 2019: <https://intef.es/aseguratic/>; <https://www.educacionyfp.gob.es/prensa/actualidad/2019/12/20191217-aseguratic.html>

<sup>(23)</sup> <https://cybercamp.es/en>

<sup>(24)</sup> <http://www6.mityc.es/IndustriaConectada40/informe-industria-conectada40.pdf>

<sup>(25)</sup> <https://www.mincotur.gob.es/industria/es-ES/Servicios/Paginas/agenda-sector-industrial.aspx>

<sup>(26)</sup> In this framework, the industrial sector refers to the manufacturing industry - group C of the NACE classification (rev.2) of 2010.

<sup>(27)</sup> Examples of this public-private collaboration: Agreement with Cisco to carry out digital training actions and training of professionals in information technologies and digital economy in areas of training for employment, continuing training, professional training

The strategy has three main objectives: increase industrial added value and qualified employment in this sector; favour the future industrial model for the Spanish industry; and develop differential competitive levers for the Spanish industry and boost its exports.

Four lines of action have been defined to fulfil these objectives. Those directly related to training focused on awareness and training on CI4.0 and the promotion of collaborative environments or platforms. An example of the work of raising awareness is the Congress CI4.0 <sup>(28)</sup>, in its third edition in 2019. Regarding training in digital competences, it is included as one of the objectives of the Digital Innovation Hubs (DIH), as well as the setting up of the inter-ministerial working group on training in CI4.0. Other actions are as follows:

- publication of the <http://www.industriaconectada40.gob.es> website, which houses all the information generated. It includes a free self-diagnosis tool (HADA) <sup>(29)</sup> which allows each company to know its degree of technological maturity in various areas and its comparative situation with respect to other organisations with different levels of maturity, resources and activity;
- financial support to specific areas/projects of CI4.0 development:
  - ‘Activa’ Programme <sup>(30)</sup>, where a personalised advice for SMEs is offered. The aim is to select specialised entities in Industry 4.0 to develop a consultancy project to help industrial companies in their transformation towards Industry 4.0; A pilot programme of innovation in cybersecurity of SMEs has been launched in 2019 <sup>(31)</sup>, so that SMEs may determine their current security level and establish the level they have to achieve to protect their corporate systems and information.
  - financial support for CI4.0 projects <sup>(32)</sup>, focused on financing digitalisation projects to industrial companies for their digital transformation process. This programme was rewarded with 30 million Euro for 2018 <sup>(33)</sup>. It consists of loans to R&D&i projects to help the manufacturing industry in its adaptation to the new digital reality. The thematic areas covered by the

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and university training: <https://www.incibe.es/sala-prensa/notas-prensa/agenda-digital-impulsa-colaboracion-publico-privada-el-ambito>

<sup>(28)</sup> <https://cic40.es/>

<sup>(29)</sup> <https://hada.industriaconectada40.gob.es/hada/register>

<sup>(30)</sup> Activa industria 4.0. <https://www.eoi.es/es/empresas/industria-40>

<sup>(31)</sup> <https://www.industriaconectada40.gob.es/programas-apoyo/Paginas/ACTIVA-Ciberseguridad.aspx>

<sup>(32)</sup> <http://www.mincotur.gob.es/PortalAyudas/IndustriaConectada/Paginas/Index.aspx>

<sup>(33)</sup> <https://www.mincotur.gob.es/es-es/GabinetePrensa/NotasPrensa/2018/Paginas/20180713-ayudas-industria-manufacturera.aspx>

programme range from massive data processing to advanced robotics. In practice, it means promoting research in applications that use the information gathered in the production chain, data visualisation, new 3D printing processes, collaborative human-machine robotics, and augmented and virtual reality projects.

- The National Connected Industry 4.0 Awards <sup>(34)</sup> have been created to recognize the efforts and merits of Spanish industrial companies in the field of digitalisation, conceived as a tool for identification, dissemination and recognition of successful Spanish projects in the field of Industry 4.0.

A Working Group made up of different public authorities has been set up to promote coordination and foster the different industry 4.0 initiatives implemented in Spain. All the regions and other public bodies carrying out actions related to industrial digitalisation participate in it.

With the aim of adapting the skills and qualifications of the present and future industrial workforce, to the requirements of new technologies, the strategy Connected Industry 4.0 <sup>(35)</sup> promotes dialogue between competent public authorities to develop a complete training offer in the field of Industry 4.0.

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<sup>(34)</sup> <https://www.industriaconectada40.gob.es/congreso/Paginas/premios.aspx>

<sup>(35)</sup> Developed by the General Secretariat of Industry and SMEs in collaboration with the School of Industrial Organisation Foundation.



## CHAPTER 3.

# VET 4.0 initiatives

The Spanish Activation Strategy for Employment 2017-20<sup>(36)</sup> aims to consolidate the economic recovery by promoting training to meet the challenges of the present and future labour market deriving from globalisation and digitalisation<sup>(37)</sup>. It establishes the measures to be carried out, at both the state and regional level, by the Public Employment Services (PESs). Among the measures adopted, it includes putting in place actions to promote the training of employed workers, for the acquisition and improvement of skills in the field of transformation and the digital economy, in line with the Digital Agenda.

Act 30/2015<sup>(38)</sup>, which reformed VET in the employment remit, addresses the changes needed to modernise the production model, designing a system of monitoring and prospecting of the labour market based on the coordination of all agents: administrations, social agents, experts, etc.

In December 2018 an Action Plan for Youth Employment 2019-21<sup>(39)</sup> was presented. It aims to promote the training of this group in linguistic, digital and strategic sectors. The Plan includes fifty measures, divided into six axes. In relation to the purpose of this report, we can highlight the following:

- in quantitative terms, one of the objectives is the training in digital skills of at least 225 000 young people: 75% in basic skills and 25% in advanced digital skills, which represents 40% and 38% respectively of the young population under 30 years;

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<sup>(36)</sup> <https://www.boe.es/buscar/doc.php?id=BOE-A-2017-14858>

<sup>(37)</sup> It lays down the measures to be carried out both at the state and regional level, by the Public Employment Services (PES). For more information see VET in country Report: Spain (2018) (to be published)

<sup>(38)</sup> Head of State (2015). Ley 30/2015, de 9 de septiembre, por la que se regula el sistema de formación profesional para el empleo en el ámbito laboral [Act 30/2015, of September 9, which regulates the vocational training for employment system in the labour scope]. Boletín Oficial del Estado, No 217, 10.9.2015, pp. 79779-79823. <https://www.boe.es/boe/dias/2015/09/10/pdfs/BOE-A-2015-9734.pdf>

<sup>(39)</sup> The measures it collects have to do with the Sustainable Development Goals of the 2030 Agenda and serve to reach Goal 8.6: By 2020, considerably reduce the proportion of young people who are not employed and do not study or receive training. [https://www.sepe.es/contenidos/personas/encontrar\\_empleo/plan-choque-empleo-joven-2019-2021.html](https://www.sepe.es/contenidos/personas/encontrar_empleo/plan-choque-empleo-joven-2019-2021.html)

- start-up support to technology-based projects for young women, providing a consultant to advise these entrepreneurs about their business plan and offering monitoring services;
- specific training actions for young women from rural areas in ICT technologies and new future sectors, taking advantage of the possibilities of new technologies and with trainers and tutors, including online teaching;
- promotion of entrepreneurship, self-employment and new job opportunities offered by the digital economy and the different formulas of the social economy and the economy of digital platforms, within employment activation policies.

### 3.1. Design and development of new Professional Qualifications

Within the framework of the Plan for Promoting the Digital Economy and Digital Content <sup>(40)</sup>, the White Paper for the Design of University Degrees in the Digital Economy <sup>(41)</sup> was published in 2015, in which the industry, the universities and the administration participated. Its purpose was to set guidelines to develop higher level qualifications according to the real demand of professionals. These were summarised in 41 professional profiles linked to the demand by companies of specialists in the field of digital economy <sup>(42)</sup>.

To support the digital transformation, foreign languages have been included in Intermediate and Higher levels IVET curricula, when required by the professional profile <sup>(43)</sup>.

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<sup>(40)</sup> One of the several plans in which the Digital Agenda for Spain is deployed. <https://www.planetl.gob.es/planes-actuaciones/Paginas/plan-impulso-contenidos-digitales.aspx>

<sup>(41)</sup> <http://www.cciit.es/images/ccii/recursos/Libro-Blanco.pdf>

<sup>(42)</sup> These profiles result from the combination of three major trends of the digital economy sector (digital networks and infrastructures, data science and digital security) with different professional roles: technicians/specialists; directors/responsible; analysts; designers; developers/programmers; administrators; architects; project managers; auditors; consultants. Some examples of these professional profiles are development and manufacture of smart devices and objects; cyber-physical systems for the industry; bioelectronics and bio-computing;

<sup>(43)</sup> The Organic Act 8/2013, of December 10, for the Improvement of the Educational Quality foresees the inclusion of a foreign language in all Basic VET programmes. In Intermediate VET level, an English module has been included, provided that the professional profile requires so. Specifically, it has been incorporated into six diplomas of five sector branches. In Higher VET Level, one or two professional modules of foreign language have been included, when required, in 14 diplomas of five sector branches. In addition, the Autonomous Communities, within their scope, are

The National Institute of Professional Qualifications (INCUAL) <sup>(44)</sup> is currently carrying out prospective studies to assess the needs of adaptation of existing occupational standards to the requirements derived from Industry 4.0 and, where appropriate, defining new occupational standards:

- development of several occupational standards directly related to i.4.0; in the sector branch of Sales and Marketing: Social networks, E-commerce and digital marketing; in Information and communications technology branch: Connected devices; in Construction and civil engineering: Development of projects with BIM (Building Information Modelling) technology, among others;
- a new order to regulate its Professional Observatory is being prepared and will contemplate, among other actions, the creation of a specific transversal observatory on Industry 4.0, with representatives of several ministries and of leading companies in i.4.0;
- analysis of the relevance that i.4.0 has for each sector and its associated occupational standards and the redesign of those standards that require incorporating competencies related to these new demands;
- creation of new VET degrees within the education remit: several Specialisation Courses <sup>(45)</sup> (corresponding to EQF 5) are being developed. These courses will aim to complement the skills of those who already have a VET degree and allow lifelong learning in the field of technologies associated with i.4.0;
- adaptation of current VET qualifications. In the education system, the curricular specification of VET courses is carried out at three different levels: at state level, the ministry of education elaborates the basic curriculum of each VET degree and specialisation course. At regional level, regional authorities specify the detailed curricula of each qualification, adapting the basic curriculum to the socio-productive features of their territories. At education centre level, the teacher in charge and the sector branch department develop a classroom programme (curricular specification) considering the details of the socio-productive environments of each centre as well as student's characteristics. Regarding i.4.0 technologies, actions have been taking place at this third level, while there is no progress in the other two levels.

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implementing different measures to raise the linguistic competence of students in a foreign language.

<sup>(44)</sup> <http://incual.mecd.es/>

<sup>(45)</sup> The specialisation courses are training programmes for VET graduates who wish to expand and adapt their professional skills to the new demands of the different productive sectors. They were foreseen in Royal Decree 1147/2011 but had not been developed yet.

Work is also underway to update the professional certificates (CdPs) programmes, taking into account the progress made in each sector as well as the changes derived from the use of digital technologies. Over 160 CdPs programmes have been submitted to the general council for vocational training since October 2018, which incorporate updates from occupational standards and new needs arising from technological advances. The professional training offered by the Spanish National Public Employment Service (SEPE) <sup>(46)</sup> includes, in the Catalogue of Training Specialties <sup>(47)</sup>, various training programmes related to new technologies such as robotics, analytics, Big Data, artificial intelligence, Machine Learning, cognitive technologies, nanotechnology and Internet of Things (IoT), among others, as well as training actions for the acquisition of basic and advanced digital skills and languages.

A first meeting for the detection of training needs was held in autumn 2019, with the participation of sectoral representatives of employers' and trade unions associations, directors of National Reference Centres and SEPE and Fundae officials. The meeting's objective was to obtain a methodological procedure proposal to articulate the role of the different agents in the determination of training needs and their conversion into training specialties. A pilot test was initiated regarding the digital sector with the collaboration of the national reference centre in charge of IT and communications <sup>(48)</sup>.

Finally, many regions, within their devolved competences, have developed their own plans to support VET <sup>(49)</sup>. We can highlight the Basque Country <sup>(50)</sup>

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<sup>(46)</sup> <https://www.sepe.es/>

<sup>(47)</sup> See Sancha, I.; Gutiérrez, S. (2018). Vocational education and training in Europe – Spain. Cedefop ReferNet VET in Europe reports; 2018 (to be published).

<sup>(48)</sup> Centro de Referencia Nacional de Desarrollo informático y comunicaciones <https://cftic.centrosdeformacion.empleo.madrid.org/>

<sup>(49)</sup> For example: Cantabria: [https://www.educantabria.es/docs/fp/General/III\\_Plan\\_de\\_Cualificaciones\\_y\\_de\\_FP\\_Cantabria.pdf](https://www.educantabria.es/docs/fp/General/III_Plan_de_Cualificaciones_y_de_FP_Cantabria.pdf); Castilla y León: <http://www.educa.jcyl.es/fp/es/plan-general-fp-2016-2020>; Rioja: <https://www.larioja.org/educarioja-fp/es/noticias-fp/plan-formacion-profesional-empleo-2016-2019-13a22b.ficheros/872263-Plan%20Formaci%C3%B3n%20Profesional%20y%20Empleo%20La%20Rioja%202016-2019.pdf>; etc.

<sup>(50)</sup> Basque country is currently in their fifth VET plan, from 2018-21: <http://www.euskadi.eus/gobierno-vasco/-/plan-gubernamental/11-v-plan-vasco-de-formacion-profesional-2018-2021/>. Its VET plans have contributed to the improvement of quality in vocational education and training; the promotion of creativity and innovation, including entrepreneurship in VET; and the introduction of new technologies. The creation of the Basque Country Centre for Applied Innovation in Vocational Training (Tknika) (<https://www.tknika.eus/en/#>) and the Institute of Applied Creativity in Vocational Training ([https://ethazi.tknika.eus/wp-content/uploads/sites/29/2018/10/ideatk\\_gida\\_es.pdf](https://ethazi.tknika.eus/wp-content/uploads/sites/29/2018/10/ideatk_gida_es.pdf)) are examples of these efforts. All these actions are in line with the science, technology and innovation plans and

which has become a benchmark at European level, having in mind that the core national VET curricula are set by the education ministry but it is their adaptation and implementation at region and VET centre levels, as well as the different forms of provision, that contribute to its added value.

## 3.2. Training of workers in digital skills

In recent years, several programmes have been launched for the training of employed and unemployed workers (especially young people) in digital skills. These programmes are carried out by different entities. In this section, three entities and their programmes are reviewed.

### 3.2.1. SEPE and Fundae

A call for grants for the training of workers in professional skills related to technological changes and digital transformation was published in May 2018 <sup>(51)</sup>. Some specific technologies were considered priority areas in this call <sup>(52)</sup>. Besides, the social partners in the different sectors, through their joint commissions, agreed the training actions that could be funded according to present and future needs of each sector. The Sectoral joint commissions identified training specialties derived from technological and digital evolution, spanning from, for example, development of mobile applications with android, SCRUM, business intelligence, cyber security or programming and configuration of connections in the cloud, to drone management for industrial use, virtual scenography systems and augmented reality, and many others related to e-commerce.

This call, with a budget of more than 50 million Euros, finances three types of training actions:

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the Smart Specialisation Strategy RIS3

([https://ec.europa.eu/regional\\_policy/sources/docgenerator/informat/2014/smart\\_specialisation\\_en.pdf](https://ec.europa.eu/regional_policy/sources/docgenerator/informat/2014/smart_specialisation_en.pdf)). Further info at: <http://www.cedefop.europa.eu/en/news-and-press/news/spain-basque-country-vet-innovation-offers-good-practices-future-employment>

<sup>(51)</sup> <https://www.fundae.es/Empresas%20y%20organizaciones/Pages/Convocatoria-TIC.aspx>

<sup>(52)</sup> Broadband communications (hybrid networks, interactive television, telephony 5G, optical fibre, etc.); Cybersecurity, robotics and management and maintenance of 3D printers; Artificial Intelligence, virtual reality; Drones; Automotive with electric motor or autonomous driving; Cloud computing; Internet of things and Home automation; Advanced Analytics (Big Data, Business Intelligence, R Language, Report Analytics, Python Language, among others); Cognitive Computing; Location Services; Electronic administration; Advanced design; and Development of information systems

- Acquisition of technological or digital competences, crosscutting to the different productive sectors. Nearly 400 training actions for over 21,000 participants have been approved, 15% of the funds allocated to this type.
- Acquisition of specific technological or digital competences of each productive sector. It represents around 79% of the training actions to be funded, with an estimation of over 144,000 participants.
- Professional competences in the key sectors for technological development (telecommunication operators, consultancies and engineering companies). This type will cover 8,000 participants and around 5% of the training actions and 6% of the funding.

The funded training plans can run up to a year and are aimed at employed workers in general; In crosscutting training schemes, women, people with disabilities, workers with low qualification levels and those over 45 years of age are prioritised. Each sector defined its own priority groups in the sectoral schemes.

As a summary of the main results from this call of proposals, the following facts can be highlighted:

- Nearly 16 million euros have been allocated to 786 courses related to cybersecurity with more than 70,000 workers expected to participate; Trade and marketing and Hospitality sectors concentrate nearly 16% of the funding, and the education sector nearly 6%.
- In the area of data (big data), both from the perspective of advanced analytics and information systems development, almost 12 million euros were allocated for training activities (about 25% of available funds).
- In the construction and extractive industries sector, more than one million euros were allocated to training linked to advanced design, mainly BIM (Building Information Modelling) training actions.
- Specifically related to artificial intelligence and virtual reality; 89% of the funds allocated to training actions have been prioritized in the health sector (1.5 million euros). Agriculture and livestock places the priorities within training actions on location services (one million euros).

A new call for grants for the financing of training schemes at a state level was published <sup>(53)</sup> early 2019. With a budget of 350 million Euros, though not

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<sup>(53)</sup> MITRAMISS (2019). Extracto de la Resolución de 17 de enero de 2019, del Servicio Público de Empleo Estatal, por la que se aprueba la convocatoria para la concesión, de subvenciones públicas para la ejecución de programas de formación de ámbito estatal, dirigidos prioritariamente a las personas ocupadas [Excerpt from the Resolution of January 17, 2019, of the National Public Employment Service which approves the call for the concession of public subsidies for the execution of training programmes of state scope, directed primarily to employed people]. Boletín Oficial del

specifically addressed to the scope of the i.4.0, this call contemplates training actions aimed at anticipating the needs for qualifications of the production system, with priority for the internationalisation of companies, entrepreneurship, innovation, technological development of production processes, digitalisation, and energy efficiency, among others. Though the call is not specifically addressed to the scope of i.4.0, 25% of the training specialties to be offered are related to digitalisation and technological development, more than 80 million euros will be allocated to finance the skills of ICT, with an estimated participation of 200,000 people.

SEPE and Fundae worked on the development of a collaboration framework with large technology companies<sup>(54)</sup> in 2019, for the dissemination and implementation of free training courses in digital skills for active workers, particularly in SMEs, and the unemployed. It is expected that the first agreements with some of these companies will be signed by the end of 2019, which will allow workers access to these companies' free courses<sup>(55)</sup> through Fundae's website.

### 3.2.2. Red.es

Red.es is a public entity for the promotion of the information society. It develops programmes to boost digital economy, innovation, entrepreneurship, training for young people and professionals and support for SMEs by promoting the efficient and intensive use of ICT.

In addition to many other measures, Red.es implements several schemes<sup>(56)</sup> to meet the demand of digital professionals<sup>(57)</sup>, the improvement of employability and entrepreneurship in the digital economy: scholarships for students of training programmes in digital economy<sup>(58)</sup> and funding training and employment schemes to companies and entities, always in the field of ICT. Besides, several MOOCs<sup>(59)</sup> on digital professions have been developed.

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Estado, No 21, 24.01.2019, pp. 3676-3679.

<https://www.boe.es/boe/dias/2019/01/24/pdfs/BOE-B-2019-2823.pdf>

(54) Amazon Web Services (AWS), CISCO, Everis, Facebook, Fundación Telefónica, Google, Huawei, Microsoft, Oracle, Red Hat and SAP were the first technological companies approached.

(55) <http://www.fundae.es/actualidad/noticias/detallenoticia/2019/09/23/se-presenta-el-marco-de-colaboraci%c3%b3n-con-las-grandes-empresas-tecnol%c3%b3gicas-para-el-acceso-a-cursos-de-formaci%c3%b3n-digital>

(56) [https://www.red.es/redes/sites/redes/files/Plan\\_Estrategico\\_red.pdf](https://www.red.es/redes/sites/redes/files/Plan_Estrategico_red.pdf)

(57) <https://www.red.es/redes/es/que-hacemos/profesionales-digitales>

(58) MINETUR (2015). *Libro blanco para el diseño de las titulaciones universitarias en el marco de la economía digital*. [White paper for the design of university degrees in the framework of the digital economy] Madrid: Ministerio de Industria, Energía y Turismo. <http://www.cciit.es/images/ccii/recursos/Libro-Blanco.pdf>.

(59) <https://www.red.es/redes/es/que-hacemos/profesionales-digitales/moocs>



### **The 'Digital Professionals Youth Employment' scheme**

With a budget of almost 20 million Euros, it offers training to young unemployed people registered in the national youth guarantee system aimed at the digital industry and new business models and facilitates their access to jobs that promote the digital transformation of companies. The training projects must include a commitment to hire <sup>(60)</sup> a certain percent of trainees in the field of ICT and the Digital Economy <sup>(61)</sup>.

### **Funding scheme to promote continuous training and improvement of employability in the field of ICT and the digital economy.**

With a budget of nearly 11 million Euros, this scheme <sup>(62)</sup> is intended to develop training projects that improve the employability of employed workers, as well as unemployed or inactive, favouring both access and greater stability in employment and fostering the progression in professional careers. It also aims to contribute to the digital transformation of companies with special attention to the diverse needs of working people of small and medium enterprises and the needs of qualification and professional upskilling of the most disadvantaged groups.

Two types of projects can be funded: on the one hand, those addressing the training needs of the applicant entity; and secondly, those aimed at employees of other entities, also allowing the participation of unemployed or inactive people within certain limits. Both training actions (mandatory) and expert services of personal training or coaching (optional) can be funded.

### **Support for training programmes in the field of the Digital Economy**

The funds <sup>(63)</sup> are aimed at both public and private educational entities and universities, in the field of the digital economy, so that these centres can offer discounts in fees for training programmes in Digital Economy. The training centres are in charge of preparing the training programmes and selecting the students receiving the grant. The call has a total budget of up to 2 000 000 Euros, with

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<sup>(60)</sup> The hiring commitment means that at least 30% of the young people who complete the training will be employed for at least 6 months in positions related to ICT and the Digital Economy (maximum of 5% as self-employed workers).

<sup>(61)</sup> It is financed by the ESF of the 2014-20 programming period and the Youth Employment Operative Programme (POEJ). A total of 33 employment projects will be developed through 82 training actions in 15 Autonomous Communities. <https://www.red.es/redes/es/que-hacemos/profesionales-digitales/j%C3%B3venes-desempleados>

<sup>(62)</sup> <https://perfilcontratante.red.es/perfilcontratante/busqueda/DetalleLicitacionesDefault.action?idLicitacion=7165&visualizar=0>

<sup>(63)</sup> <https://www.red.es/redes/es/que-hacemos/profesionales-digitales/formacion-postgrado>



200 000 Euros being the maximum budget allocated to training grants per training centre.

### 3.2.3. EOI schemes

The Spanish School of Industrial Organisation [Escuela de Organización Industrial] (EOI) <sup>(64)</sup>, and its associated foundation, has as its main goal to improve the competitiveness of Spanish companies:

- National Reference Centre (NRC): In collaboration with Red.es, EOI manages the NRC of electronic commerce and digital marketing in the field of professional training. Courses are primarily aimed at employed workers (IVET and CVET teachers and experts), such as digital marketing and search engine; Digital customer experience; Competitive intelligence on the web; and Big Data Analytics;
- National Operational Programme on Youth Employment (budget 39 million Euros). As an example, the programme includes a Training pathway on Digital Transformation for employment <sup>(65)</sup>. The Project, implemented by EOI with the partnership of Google, is aimed at improving the employability of young people who have dropped out of school from an early age, have lost their jobs or have difficulties to find the first job. It also enables young people with high educational levels to reskill. Their training itinerary includes the need to take a 40 hours MOOC on the Google platform followed by a mentoring phase. EOI helps companies with up to 5 000 Euros to hire them.

The total budget of this programme was 1.4 million Euros, 54% for training and mentoring, and 46% for hiring support.

There are also postgraduate & executive Courses on issues related to i.4.0 (for example, Artificial Intelligence & Deep learning; Blockchain; Business Intelligence and Big Data; Cibersecurity).

Other actions for digital transformation of SMEs are incorporated in the Employment, Training and Education Operational Programme (Budget 10 million Euros), and within the SMEs' Strategic Framework.

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<sup>(64)</sup> It is a public foundation created in 1955, which has trained more than 60 000 professionals and has contributed to the creation and modernisation of more than 50 000 SMEs. More info at <http://www.eoi.es/portal/en/about-eoi;jsessionid=D3EA89819386AD4662A04770042F1EA0>

<sup>(65)</sup> <https://www.eoi.es/es/cursos/26013/curso-de-transformacion-digital-para-el-empleo-ambito-nacional>

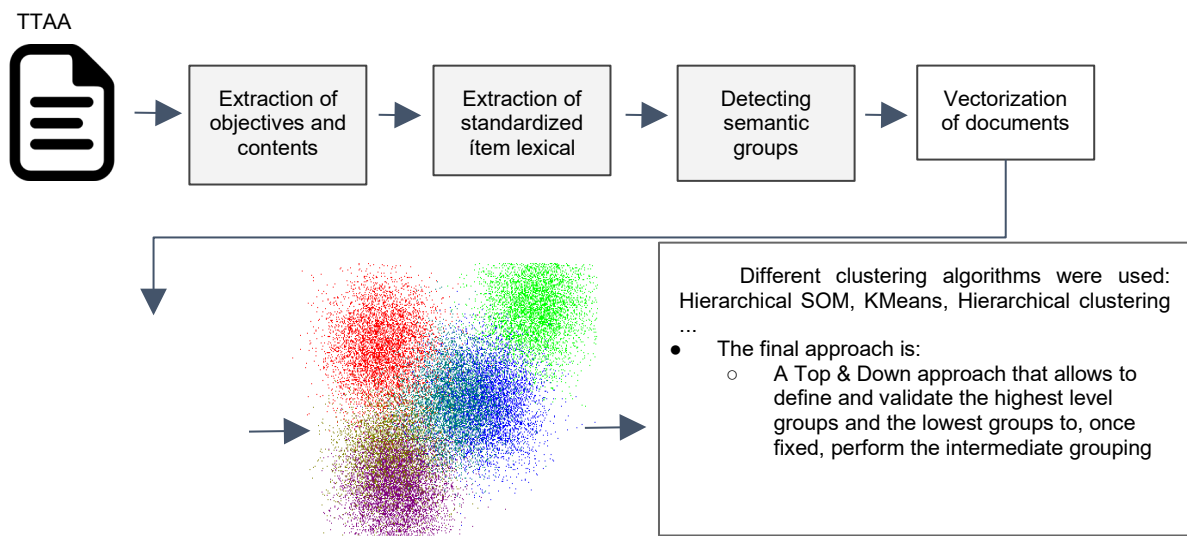
## CHAPTER 4.

# Intelligence 4.0 for VET

During 2016 and 2017, several Fundae departments worked together with an external company to use Big Data technologies to identify patterns in learning contents in order to automatically group them, pinpoint new learning contents and improve the classification system.

The idea was to dive in a selection of data fields from the training actions the learning contents registered, in Fundae's web portal, by the companies applying for discounts on their social security contributions for training. The goal was to group them in a comprehensible way, identify new learning areas and develop an automatic classification methodology for future training actions. The previous classification system could not take in new demands, especially in technological areas.

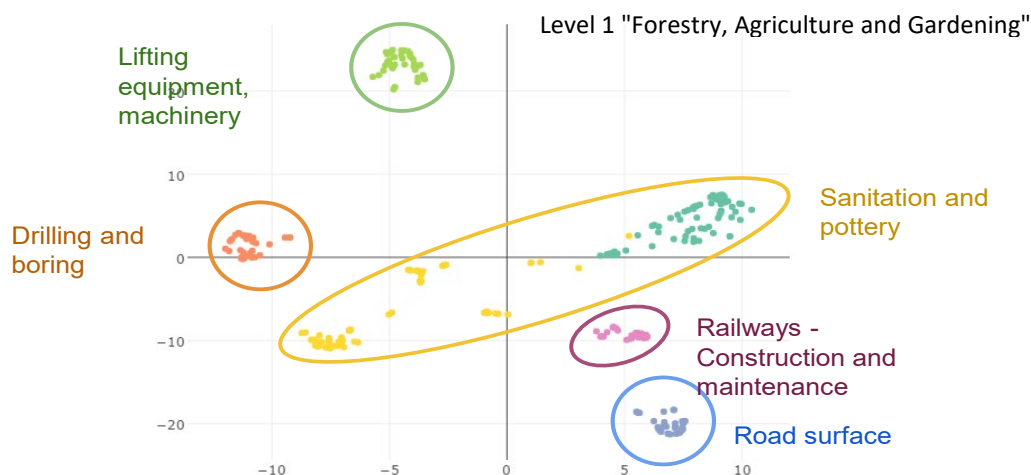
**Figure 3** Clustering of training actions



A first phase addressed the analysis of more than 300 000 training actions and concluded with a new content classification system structured into four levels. The results allowed comparison with the contents of the repertoire of training actions of Fundae, prepared by the Sectoral Joint Commissions, as well as with the training specialties of the public employment systems and the INCUAL's occupational standards.

These first analyses were validated by both the external contractor and Fundae. After this validation, a process of automatic detection and classification of subgroups was carried out that allow decision-making, such as i) creating new level 4 groups ii) integrating those training actions into another group or iii) creating a new level 1 group (Figures 3 and 4).

**Figure 4 Example of analysis of themes and clustering**



The novelty of using algorithms developed through these techniques allowed to identify new learning contents delivered by companies. The classification algorithms search mainly in the denomination, objectives and contents fields of the training actions, assigning to each action the probability of belonging to a category (probability scores) and also establishing a novelty score.

These innovations, combined with other qualitative methods and together with the analysis of the Sectoral Joint Commissions, can substantially support the anticipation of specific training needs in specific sectors or occupations or that are common to various sectors.

At present, work is being done on the direct incorporation of this classification system into Fundae's operations, which will allow the immediate classification of the training actions. A software tool is being developed to classify training actions on this Hierarchy using an automatic classification algorithm based on text mining that compares the textual information of the new training actions with the information provided by the Hierarchy, adding an indicator of accuracy in the assignment.

This will not only streamline the management processes with the users, but it will also help to quickly detect new training contents that can be submitted to the

Sectoral Joint Commissions, which will finally define whether the learning contents meet their sector workers' skills needs.

## CHAPTER 5.

# VET 4.0 learning practices

Both in IVET and CVET, new technologies have been promoted in recent years to favour the learning of those people whose social, work or family circumstances prevent or make it difficult for them to participate in face to face training programmes <sup>(66)</sup>.

Through the National Institute of Educational Technologies and Teacher Training (INTEF), in collaboration with the regions and autonomous cities, several projects have been put in place to improve the acquisition of these skills among teachers and students:

- the Connected schools scheme (Escuelas Conectadas) <sup>(67)</sup> facilitates access to the ultrafast broadband of Spanish educational centres;
- the Procomún open educational resources platform <sup>(68)</sup> that, in addition to allowing the visualisation and downloading of learning objects for pre-university education, integrates a social network and incorporates semantic technology that links it with other similar digital networks ([Europeana](#), [Redined](#), [Biblioteca Nacional](#), [Museo del Prado](#), [Hispana](#) y [Dbpedia](#));
- the reference digital competence framework for teachers <sup>(69)</sup> (for the entire educational system) has been developed; and
- the School of Computational Thinking, Future classroom lab <sup>(70)</sup> or eTwinning <sup>(71)</sup> projects are more focused on students.

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<sup>(66)</sup> See Sancha, I.; Gutiérrez, S. (2018). Vocational education and training in Europe – Spain. Cedefop ReferNet VET in Europe reports; 2018 (to be published).

<sup>(67)</sup> This programme pays special attention to include all the centres located in rural areas and difficult to access, which, due to their location, have greater difficulties in accessing the new connectivity services. <https://www.red.es/redes/es/que-hacemos/e-educaci%C3%B3n/escuelas-conectadas>

<sup>(68)</sup> It facilitates access to the repository of open educational digital resources (REA), in which didactic material catalogued in a standardised way through metadata (LOM-ES), coherent with the curriculum of previous teachings to the University <https://intef.es/recursos-educativos/procomun/>

<sup>(69)</sup> More information at <http://www.cedefop.europa.eu/en/news-and-press/news/spain-common-digital-competence-framework-teachers> and <https://aprende.intef.es/mccdd> and <https://aprende.intef.es/mccdd>

<sup>(70)</sup> <http://fcl.intef.es/acerca-de-future-classroom-lab>

<sup>(71)</sup> <https://www.etwinning.net/en/pub/index.htm>

According to the latest released statistics <sup>(72)</sup>, 31.5% of the centres participate in experiences related to the use of educational technologies. Approximately 43% of secondary education and VET public schools participate, and 35% in the case of private centres. Around 40% of the educational centres have at least one virtual learning environment (VLE), climbing to 68.6% for public secondary schools and VET centres. Of those centres with VLE service, it is used by 88.7% of the students. The availability of services in the cloud reaches 60.1% in secondary and VET centres.

The ministry of education, in collaboration with the European Commission is promoting educational centres to be digitally competent. This collaboration has focused during 2019 on the use of the SELFIE evaluation tool, which takes as reference the DigCompOrg framework. Thus, in April a “SELFIE Forum” was held in Madrid, the first international event on the SELFIE tool, co-organized by the European Commission, through the Joint Research Centre of Seville (JRC) and the ministry of education through INTEF <sup>(73)</sup>. Along the same lines, and with the purpose that the educational centres have a reference after carrying out the self-assessment, the ministry of education, through the National Institute for Educational Evaluation (INEE) and INTEF, in collaboration with the JRC of the European Commission and the Autonomous Communities, is carrying out a sample study on the degree of development of digital competence of schools throughout the state.

On the other hand, some autonomous communities are launching schemes with the aim of promoting and supporting the transformation of teaching centres into digitally competent educational organisations, such as PRODIG in Andalucía <sup>(74)</sup>, CoDiCe TIC in Castilla-Leon <sup>(75)</sup>, or *Madurez tecnológica* in Basque country <sup>(76)</sup>.

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(72) Ministerio de Educación y Formación Profesional. *Nota: Estadística de la Sociedad de la Información y la Comunicación en los centros educativos no universitarios. Curso 2016-2017 [Note: Statistics of the Information and Communication Society in non-university educational centres. Course 2016/017].* <https://www.educacionyfp.gob.es/dam/jcr:d5e98bed-4b07-4354-832e-48c9e9dd56de/nota-resumen.pdf>

(73) <https://intef.es/Noticias/selfie-forum-teaching-and-learning-in-the-digital-age/>

(74) Starting in the academic year 2018-19  
<http://www.juntadeandalucia.es/educacion/portals/web/prodig/definicion>

(75) Starting in the academic year 2018-19  
<http://www.educa.jcyl.es/es/programas/nuevo-modelo-certificacion-codice-tic-curso-2018-2019>

(76) <https://www.euskadi.eus/madurez-asignaturas-eima-tecn-informacion/web01-a3hsare/es/>

## 5.1. Specific training for VET teachers

The portfolio of digital teaching competence <sup>(77)</sup> was launched as an experimental tool, which aims to be an instrument for the improvement of teachers' digital competence through continuous self-assessment and the updatable record of teaching experiences, learning and training.

Additionally, the regions, within the scope of their own competences, have been designing training plans for their VET teachers, which contemplate technologies associated with Industry 4.0. See, for example, the Community of Madrid training plan <sup>(78)</sup>.

Likewise, in the field of vocational training for employment, the national reference centres <sup>(79)</sup> programme technical training courses for trainers, which include digital technologies <sup>(80)</sup>. The general objective of these programmes is to develop their technical capacity, improve their didactic skills and increase their professional skill, in areas related to their respective sector branch. Courses are primarily aimed at employed workers (IVET and CVET teachers and experts), such as digital marketing and search engine; Digital customer experience; Competitive intelligence on the web; and Big Data Analytics.

At the level of teaching methodologies (including VET), INTEF, responsible for the integration of ICT in non-university education stages, is currently developing interactive and multimedia digital education resources (including professional training) to be published on its portal, such as massive open online courses (MOOC), nano massive online open courses (NOOC), self-paced open online courses (SPOOC), and social learning activities in virtual communities <sup>(81)</sup>.

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<sup>(77)</sup> <https://portfolio.intef.es/>

<sup>(78)</sup> <http://www.madrid.org/bvirtual/BVCM16458.pdf>

<sup>(79)</sup> They are public institutions specialised in the different sector branches, in charge of carrying out innovation and experimentation initiatives in the area of vocational training. <https://www.sepe.es/HomeSepe/Personas/formacion/centros-de-referencia-nacional/que-son-los-CRN.html>

<sup>(80)</sup> <https://www.sepe.es/HomeSepe/Personas/formacion/plan-perfeccionamiento-profesorado/cursos-perfeccionamiento.html>

Examples: <https://www.eoi.es/es/conocenos/centro-de-referencia-nacional>

<sup>(81)</sup> More information at <http://formacion.intef.es/> and <http://enlinea.intef.es/courses>

## 5.2. Students and learners

Educational administrations promote various initiatives <sup>(82)</sup> to equip students with adequate digital skills, such as the promotion of digital platforms that serve as technological support to the teaching-learning process (Moodle). In some cases they are combined with specific initiatives of equipment, for example, the initiative of Technological Innovation Institutes of the Community of Madrid <sup>(83)</sup>, the Learning Factory <sup>(84)</sup> started up recently by the Aragon administration or its plan for a technological campus (Campus Tech) which will develop training for strategic sectors such as renewable energy, agro-food and technological-digital, with areas related to programming, Big Data, or blockchain <sup>(85)</sup>.

At national level, the most recent initiative, launched for the 2018-19 academic year, is the Computational Thinking School, aimed at primary, lower (ESO) and upper secondary (baccalaureate) and VET levels in the education system. Coordinated by INTEF in collaboration with the regions, this initiative tries to offer open resources, training and technological solutions that help teachers to incorporate these skills in the classroom <sup>(86)</sup>. Within the framework of the School of Computational Thinking <sup>(87)</sup>, and specifically for upper secondary and IVET, a

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<sup>(82)</sup> For example: a) Illes Balears: Programa RobotIB - <http://www.caib.es/govern/sac/fitxa.do?codi=3735479&coduo=1&lang=es>; b) Extremadura: Innovated - <https://emtic.educarex.es/innovatedsite>; c) Galicia: Edudixital - <http://www.edixgal.com/2018/03/edudixital-estrategia-galega-para.html>; d) La Rioja: AvanzaTIC - <https://www.larioja.org/edu-innovacion-form/es/actividades-formacion/proyectos-innovacion-educativa-pies/avanz-tic>; e) Castilla La Mancha. Carmenta - <http://www.educa.jccm.es/es/centros/tecnologia-educacion/carmenta>; f) Canarias: Programa Brújula20 - <http://www3.gobiernodecanarias.org/medusa/ecoescuela/ensenas/producto/programaciones-didacticas-y-situaciones-de-aprendizaje-del-programa-brujula20/>

<sup>(83)</sup> [https://www.educa2.madrid.org/web/institutos\\_it](https://www.educa2.madrid.org/web/institutos_it)

<sup>(84)</sup> It is a replica of a real factory of the automotive sector that allows development of all training aspects related to the sector: manufacturing, production, logistics, management, communications and processes. The Government of Aragon is working on the design of a Technology Campus as a training centre for technological topics such as programming, hardware and data (Big Data), among others. <http://aragonhoy.aragon.es/index.php/mod.noticias/mem.detalle/id.231159>

<sup>85</sup> [https://cifpa.aragon.es/jornada\\_innovacion\\_fp/](https://cifpa.aragon.es/jornada_innovacion_fp/)

<sup>(86)</sup> The School of Computational Thinking proposes to incorporate the Scratch 3.0 language into primary school; the classes of creative technologies in secondary, besides the programming of robots in baccalaureate and VET. More information at <https://intef.es/tecnologia-educativa/pensamiento-computacional/>

<sup>(87)</sup> Computational Thinking describes the thinking processes involved in the formulation of a problem to admit a computational solution that involves abstraction, algorithmic thinking, automation, decomposition, debugging and generalisation <http://code.intef.es/>



robotics simulator has been created which will allow students to start programming robots, drones and autonomous cars, while at the same time they learn mechanical and electronic concepts in an attractive way.

For the academic year 2019/20, the initiative will include artificial intelligence (AI). Training and resources will lead the participating teachers to develop projects that include AI in all non-university levels. At the level of Upper Secondary and VET, it is intended that teachers and students create apps for mobile devices - mainly using App Inventor – that integrate AI solutions <sup>(88)</sup>.

At regional level, several regions have included programming, technology and robotics as compulsory in lower secondary education <sup>(89)</sup>.

Each VET centre, in the scope of its autonomy, can incorporate those methodologies and technological solutions that best contribute to the development of its training objectives. It is at this level where teaching methodologies aiming at the development of soft skills demanded by i.4.0 are implemented. In some cases, they also participate in international projects through European programmes, such as Erasmus + <sup>(90)</sup>.

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<sup>(88)</sup> More information at <https://intef.es/tecnologia-educativa/pensamiento-computacional/>

<sup>(89)</sup> The report *Programación, robótica y pensamiento computacional en el aula. Situación en España y propuesta normativa. Informe final* [Programming, robotics and computational thinking in the classroom. Situation in Spain and normative proposal. Final report] was published in October 2018. It describes the current situation of these teachings in Spain and makes a normative proposal on the introduction of these skills in the curriculum of Early Childhood Education, Primary, Compulsory Secondary and Baccalaureate. <http://code.intef.es/wp-content/uploads/2018/10/Ponencia-sobre-Pensamiento-Computacional.-Informe-Final.pdf>

<sup>(90)</sup> For example, Jobs4tech Project, whose general objective is to align vocational training with the needs of the labour market in the sector of new technologies, and specifically in virtual and augmented reality, to improve the employability of its students, and in which Spanish centres participate. [https://www.jobs4techproject.eu/?\\_ga=2.232292892.2089231855.1545388235-355164169.1545388235](https://www.jobs4techproject.eu/?_ga=2.232292892.2089231855.1545388235-355164169.1545388235)

## CHAPTER 6.

# Adapting to AI and automation

### 6.1. Artificial Intelligence national strategy

A national coordinated plan is being drafted to offer a strategic framework for developing national AI strategies, according to the Coordinated Plan on artificial intelligence published by the European Commission (COM 795).

In the meantime, a Spanish R&D&i Strategy in Artificial Intelligence has been developed, considered as the embryo of the future National Strategy for Artificial Intelligence.

An “Inter-ministerial Group of AI” was launched at the end of 2018 by the Spanish government to work actively in the elaboration of the National AI Strategy. This National Strategy, based on the different sector strategies, should facilitate a co-development space in common areas, a road map of its own and a commitment to investment, infrastructure, learning and training to create a national and European ecosystem around AI. It is aligned with efforts aimed at meeting the sustainable development goals set in the Action Plan for the Implementation of the 2030 Agenda in Spain.

A second by-product of this initiative is a Map of Artificial Intelligence Capabilities <sup>(91)</sup> which has already been carried out and will be part of the future National AI Strategy.

The Strategy for AI in R&D&i in Spain establishes a series of priorities and recommendations, which take into account the issues of education and vocational training and lifelong learning in relation to AI.

One of these priorities, priority 2. *Establishing strategic areas in which it is necessary to focus the efforts of R&D&i activities*, places education as one of the relevant areas for the development of the technologies on which AI is based, for example, enabling the application of new educational models aimed at personalized learning. First, students would play a more active role in their learning process by knowing their own evolution and being more aware of how to optimize it. Second, it would allow educational and training centres to identify those students who require more support.

Besides, priority 4. *Planning training and professionalization actions in the field of AI*, addresses one of the biggest problems facing the development of AI in Europe, i.e. the shortage of experts. It implies the need for transversal and specific

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<sup>(91)</sup> <https://mapa.estrategiaia.es/mapa>

training in topics related to AI both for the development of professionals in the area and for the necessary updating of knowledge of society in general.

To meet this objective, it recommends adapting the educational model, contemplating the formative hybridisation of sciences, technologies and humanities and training to think and act and not just to know. This educational process should be approached from a broader perspective than STEM studies, moving to STEAM studies.

## 6.2. Teachers training for AI

The School of Computational Thinking and Artificial Intelligence is one of the main actions promoted by INTEF to address AI in the educational field as well as some other initiatives for teachers' continuous professional development (CPD).

The School of Computational Thinking and Artificial Intelligence, of an experimental nature, is being developed in collaboration with the regions' educational authorities, with the purpose of offering educational resources, training and technological solutions to explore integration ways in the digital era. Actions for 2019/2020 academic course will involve the participation of more than 1,050 teachers and will affect approximately 20,000 students. Participation is structured in the following levels and themes:

- Level I - Computational thinking and artificial intelligence without a computer. This level is aimed at early childhood (five years old) and primary education (three first years) teachers. At this level, children would have to work using unplugged activities experimenting with logic games, glasses, ropes, cards or physical movements, to represent and understand different concepts related to AI, as algorithms or data representation. No previous knowledge is required by the teachers.
- Level II - Artificial intelligence with Scratch 3.0. This level is aimed at teachers at primary Education (4th, 5th and 6th), as well as lower compulsory secondary education (1st and 2nd). At this level, students must recognise how the computer systems they use in their daily life use AI to perceive the world using sensors, reason, learn and interact with humans. In addition, students should reflect on the impact that AI can have on society, both positively and negatively. Students have to build their own software creations, such as a simple video game, integrating AI solutions, especially those related to machine learning. Teachers need to know how to programme (for example, with a course of at least 30 hours on Scratch programming).
- Level III - artificial intelligence with MIT App Inventor. This level is aimed at teachers at secondary education (3rd and 4<sup>th</sup> grades in lower secondary,

baccalaureate and intermediate and higher VET levels). At this level, to achieve the same objectives set for level II, applications development projects for mobile devices integrating AI solutions will be carried out. Teachers need to know how to programme (having completed a course of at least 30 hours on Scratch programming, for example).

Regarding the teachers CPD, a course on “Vocational Training and Technological Innovation. Industry 4.0”<sup>(92)</sup> took place at the summer school<sup>(93)</sup> which takes place annually at the UIMP, with specific sessions on intelligent manufacturing, artificial intelligence in education, mainstreaming of different enabling technologies (AI, IoT and Big Data).

Online tutoring courses on AI for teachers of vocational, secondary, primary and early childhood are being planned for 2020, as well as to offer massive open training aimed at the educational community in general.

### 6.3. Artificial intelligence applied to VET

Government in office is putting in place different initiatives to face the challenges that the education system faces in this area, such as the creation of an inter-ministerial group to develop a National Artificial Intelligence Strategy and the implementation of new vocational training degrees related to computational thinking, robotics and artificial intelligence, among others, as well as the creation of a digitalisation module for all existing qualifications in IVET.

The I Strategic Plan for Vocational Training, approved in November 2019<sup>(94)</sup>, lays down some of these measures:

- transformation of the national observatory of qualifications into sectoral observatories including one for Industry 4.0, Artificial Intelligence and fifth generation networks (5G);
- inclusion of new contents associated with key competences when designing the VET diplomas, i.e. languages, digital competence, internationalisation, entrepreneurship, applied creative thinking, innovation in SMEs, etc;

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<sup>(92)</sup> <https://www.educacionyfp.gob.es/dam/jcr:fd551e87-5ab7-49bf-a62d-120a6a04c4a6/20190619-fp-4.0.pdf>.

<sup>(93)</sup> The education ministry, through INTEF and in agreement with the Menéndez Pelayo International University, organise a summer school aimed at teachers and technical support services staff at centres funded or supported by public funds at pre-university levels. More info at: <https://intef.es/Noticias/cursos-de-verano-2019/>

<sup>(94)</sup> <https://www.educacionyfp.gob.es/dam/jcr:1bc3728e-d71f-4a8e-bb99-846996d8a2f2/i-plan-estrat-gico-de-formaci-n-profesional-del-sistema.pdf>

- development of new VET degrees associated with the new emerging demands of the productive sectors (at least 15 new diplomas/specialisation courses per year);
- incorporation of a “Digitalisation applied to the productive sector” module in all VET diplomas.

On the other hand, and related to careers guidance, a new tool is being designed based on the analysis of existing data in Public Employment Services, using artificial intelligence technologies, in order to offer relevant information to guidance practitioners for decision making based on previous success stories.

## CHAPTER 7.

# Conclusions

A productive model with great sectoral diversity, an atomised business structure and digital skills deficits, which affect workers, managers and owners of micro-enterprises, are some of the great challenges facing digital transformation in Spanish industry.

Supporting this transformation requires not only a wide variety of measures to promote and support research and innovation, entrepreneurship, the development of network infrastructures, but also a rise in the qualification level of the population in general, and of certain groups in particular, and the creation of quality employment with high added value.

An efficient and good coordination of the strategies implemented for the digital transformation in the Spanish education and training sectors and the economy is necessary to guarantee the success of this transformation, especially when different departments and governance levels are involved, allowing to undertake joint actions and profit from synergies.

Measures deployed care for both the development of infrastructure and facilitating the integration of these technologies in companies, public services and in educational centres, as well as for the training of workers and employers, and citizenship in general. This training is not only the result of specific training actions, but also in non-formal and informal ways, thanks to other types of actions and personal experiences, both individual and professional.

In the education sector, digital skills are included at basic education (compulsory) before the VET or high school stages, so that students reach those with a minimum of digital competence. These skills are being reinforced in some cases with others more specific to i.4.0 such as programming or computational thinking. However, the challenge of reducing the mismatch between demand and supply of ICT specialists still persists. Updating and designing new qualifications to meet the demand for skills of the i.4.0 era, setting up mechanisms for the rapid design of new qualifications to meet new demands, and flexible structures that offer such qualifications are required.

New teaching methodologies are required, extending beyond initial levels, which favour collaborative learning, problem solving and innovation, and the development of soft skills demanded by i.4.0, while stimulating the choice of STEM professions as aging and low birth rates add demographic challenges to those

already deriving from technological changes. The incorporation of female students, still a minority in these subjects, is an objective to be reinforced.

From the training in employment side, several measures have also been put in place to train workers - employees, unemployed and young people - in technologies linked to the i.4.0.

However, we cannot forget that professional competences are acquired and developed not only in the educational-training system, but also through non-formal and informal learning and through experience. Beyond favouring the acquisition of knowledge via e-learning, learning needs to be promoted through other methodologies (such as project-based learning, gamification, virtual reality, etc.). It is necessary that there are adequate mechanisms, new criteria and methodologies, in line with the new production models, which facilitate education-training and employment transitions, to favour adequate, positive and permanent attitudes to this endless transformation.

Finally, the process of digital transformation is affecting the whole of the society and the economy and modifying the traditional balance of economic and social organisation. This requires governance systems that allow the final balance of the process to be positive, thus contributing to sustainable and inclusive development.

Social dialogue plays an important role in preventing and limiting possible social imbalances, especially in working conditions.

## Abbreviations and acronyms

ADEI	Observatorio para el Análisis y Desarrollo Económico de Internet [Observatory for the Analysis and Economic Development of the Internet]
ADpE	Agenda Digital para España [Digital Agenda for Spain]
BOE	Boletín Oficial del Estado [Official State Gazette]
CAM	Comunidad autónoma de Madrid [Madrid autonomous community]
CC.OO.	Comisiones Obreras [Comisiones Obreras Union]
CdP	Certificados de Profesionalidad [Occupational Certificates or Professional certificates]
CEOE	Confederación Española de Organizaciones Empresariales [Spanish Confederation of Business Organisations]
CES	Consejo Económico y Social [Spanish Economic and Social Council]
CFP	Consejo de Formación Profesional [Council on Vocational Training]
CI	Connected Industry
CRIF	Centro Regional de Innovación y Formación [Regional Centre for Innovation and Training]
DIH	Digital Innovation Hubs
EOI	Escuela de Organización Industrial [School of Industrial Organisation]
ESO	Educación Secundaria Obligatoria [Lower secondary compulsory education]
EU	European Union
HADA	Herramienta de autodiagnóstico digital avanzada [Advanced digital self-diagnostic tool]
i.4.0	Industry 4.0
ICT	Information and communication technologies
INCUAL	Instituto Nacional de las Cualificaciones [National Institute of Qualifications]
INE	Instituto Nacional de Estadística [National Statistics Institute]
INTEF	Instituto Nacional de Tecnologías Educativas y de Formación del Profesorado [National Institute of Educational Technologies and Teacher Training]
IVET	Initial vocational education and training
MEyFP	Ministerio de Educación y Formación Profesional (antes de Educación, Cultura y Deportes-MECD) [Ministry of Education and Vocational Training (formerly of education, culture and sports-MECD)]



MINCOTUR	Ministerio de Industria, Comercio y Turismo (recoge parte del anterior Ministerio de Energía, Turismo y Agenda Digital-MINETAD) [Ministry of Industry, Commerce and Tourism,(it includes areas of the previous Ministry of Energy, Tourism and Digital Agenda-MINETAD)]
MITRAMISS	Ministerio de Trabajo, Migraciones y Seguridad Social (antes de Empleo y Seguridad Social – MEYSS) [Ministry of Labour, Migrations and Social Security, formerly of Employment and Social Security-MEYSS]
MOOC	Massive Open On-line Course
NOOC	Nano Open On-line Course
PES	Public Employment Service
R+D+i	Research, development and innovation
SEPE	Servicio Público de Empleo Estatal [National Public Employment Service]
SMEs	Small and medium-sized enterprises
SNGJ	Sistema Nacional de Garantía Juvenil [National System of Youth Guarantee]
SPOOC	Self-Paced Open Online Course
UIMP	Universidad Internacional Menéndez Pelayo [Menéndez Pelayo International University]
VET	Vocational education and training
VLE	Virtual learning environment
YGI	Youth Guarantee Initiative

## Annex ICT Training Scheme 2018

	Plans approved	Funding (thousand €)	Participants*	Training actions	Hours of training
<b>Sectoral Plans</b>	258	39 346.42	144 766	1 921	7 533 717
<b>Crosscutting Plans</b>	49	7 262.43	21 949	398	1 297 812
<b>Key sectors Plans</b>	17	2 767.84	8 076	123	532 079
<b>Total</b>	<b>324</b>	<b>49 376.69</b>	<b>174 791</b>	<b>2 442</b>	<b>9 363 608</b>

\* Each worker attending a training course is a participant. A worker taking part in more than one course would be counted as many times as courses taken. In this case, the number of participants is an estimation, according to the training plans submitted and approved.

Statistic Fundae. Date of Data: 11/14/2019

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