




## Vocational continuing training in Spain: Contribution to the challenge of Industry 4.0 and structural unemployment

José Ramón Aranda Jiménez , Irene Campos-García , Carmen De-Pablos-Heredero 

Universidad Rey Juan Carlos (Spain)

*joser.aranda@gmail.com, irene.campos@urjc.es, carmen.depablos@urjc.es*

Received September, 2021

Accepted November, 2021

---

### Abstract

**Purpose:** To diagnose the situation of vocational continuing training in Spain and propose improvements to its management to reduce the structural unemployment rate, taking into account the effects of Industry 4.0 and COVID-19.

**Design/methodology:** Study of the background and current context of vocational continuing training and Industry 4.0 in Spain based on a review of previous academic literature, legislative developments in education and training, and various reports from public and private institutions on productivity and employment.

**Findings:** Definition of eight challenges and lines of action related to completing the implementation of Industry 4.0 and adopting coordinated policies to develop VCT, improving the governance of the FCP by the public administration, promoting training in work and vocational training and guidance for the unemployed, meeting business recruitment needs, promoting business–university relationships, and reducing unemployment.

**Practical implications:** Adapting vocational continuing training to economic sectors where there is more demand for employment and to regions where there is more structural unemployment can contribute to the overall reduction of structural unemployment in Spain. These decreases could have immediate consequences for those who become employed and allow a quicker recovery in future economic crises.

**Originality/value:** This study, despite the scarce empirical evidence that exists about Spanish vocational continuing training, provides a vision of the four areas in which it is developed professional training, postgraduate training, on-the-job training, and training for the unemployed to provide thirty proposals that, through education and training, promote the competitiveness of the Spanish economy and permanent employment.

**Keywords:** Public administration, Education, Employment, Companies, Spain, Vocational continuing training, Industry 4.0

**Jel Codes:** M51, M53, O14

**To cite this article:**

Aranda Jiménez, J.R., Campos-García, I., & De-Pablos-Heredero, C. (2022). Vocational continuing training in Spain: Contribution to the challenge of Industry 4.0 and structural unemployment. *Intangible Capital*, 18(1), 20-38. <https://doi.org/10.3926/ic.1870>

**1. Introduction**

In recent years, Industry 4.0 (I4.0) has been the reference framework to increase the competitiveness of industrial production and other economic sectors using electronics and information technology (Bartodziej, 2017; Liao, Deschamps, Loures & Ramos, 2017; Zhong, Xu, Klotz & Newman, 2017). First appearing at the end of the 20th century (Rostow, 1988), the I4.0 concept has been applied in all the most technologically advanced countries in the second decade of the 21st century: in the USA with the Advanced Manufacturing Partnership, in the European Union (EU) with the Horizon 2020 programme, in China with the Made in China 2025 plan, and in Japan with the 5th Science and Technology Basic Plan and Industrial Value Chain Initiative (Bartodziej, 2017; Molnar & Houtman, 2011; Zhong et al., 2017).

Previous research has confirmed the positive influence of I4.0 on the competitiveness of companies, highlighting the improvement of the industrial environment through greater flexibility with customers (Bartodziej, 2017), the optimization of decision-making (World Economic Forum, 2018), efficiency and productivity of resources, and innovation (Rübmann et al., 2015). However, its effect on employment is being widely discussed. From a qualitative perspective, there is a certain consensus that the number of jobs with medium-level skills will decrease, increasing the number of jobs requiring low and high-level qualification (Eberhard et al., 2017; Hecklau, Galeitzke, Flachs & Kohl, 2016; Hirschi, 2018; OECD, 2019). However, from the quantitative perspective of employment, there is a greater disparity of opinions about the number of jobs to be created or destroyed by the application of I4.0. While some authors argue that the number of jobs will increase due to the demand for low and high-skilled work- for example, in data analysis, artificial intelligence, digital transformation, marketing, and sales and development (Eberhard et al., 2017; Hecklau et al., 2016; World Economic Forum, 2018)-, other authors show a negative balance. For example, Siegfried and Berger (2020) indicate that workers for simple tasks will become less necessary. Hirschi (2018) reveals that 47% of jobs in the United States are at risk of partial or total automation. Nedelkoska and Quintini (2018) also claim that in OECD countries, 14% of jobs are at risk of automation, with the consequent job destruction. In addition, the effects of COVID-19 on employment may accelerate the expected replacement of workers in the next 10 years (Smit, Tacke, Lund, Manyika, & Thiel, 2020).

With regard to the changes and challenges posed by I4.0 in the workplace, vocational continuing professional training (VCT) takes on special importance. Attending to the needs of knowledge society workers aged 24 to 65, it aims to bridge the gap between obsolete qualifications and the qualifications necessary to maintain employment, improve present and future employability, and, in the case of the unemployed, obtain a job (Tikkanen, 2009). According to the EU, VCT encompasses any activity undertaken by adults to improve their knowledge, competencies, and skills related to work (Cedefop, 2020a) and includes formal, non-formal, and informal activities, as well as help and advice for the job search (Lischewski, Seeber, Wuttke & Rosemann, 2020). To be effective, VCT must be based on adequate didactics for adults and knowledge of technological changes in order to organise the learning of the knowledge, competencies, and skills required for its purposes (Beer & Mulder, 2020).

VCT has benefits for individuals, increasing their employability, professional development, and life satisfaction; for companies, responding to the requirements of technological and socioeconomic changes (Cedefop, 2014); and for society, promoting inclusive economic growth, social cohesion, competitiveness, and social capital, as education is the basis, through increased productivity, for more permanent employment (González, 2021). For

these reasons, the European Center for the Development of Vocational Training has recently proposed increasing the participation of EU adults in VCT to 32% by 2025 (Cedefop, 2015).

Specifically, this proposal allows, on the one hand, update to inadequate qualifications to avoid worker obsolescence and alleviations of the problems related to risk groups (people with elementary education, veteran employees, and women) and, on the other hand, provision of knowledge and skills demanded in the labour market to promote personal development and improve professional position. Finally, working to increase adult participation in VCT would help soften the impact that the COVID-19 pandemic is having on employment and facilitate faster recovery and transformation (World Economic Forum, 2020).

In Spain, the Vocational Training System for Employment in the Workplace has the task of educating and empowering people for work, updating their skills and knowledge throughout their professional lives (Bieger, Álvarez & García, 2020). However, the Spanish VCT situation has room for improvement: according to the World Economic Forum (2020), the percentage of active employees with sufficient digital skills is 55.2%, while that figure amounts to, for example, 62.5% in Germany and 77.0% in Singapore. Meanwhile, the perceived ease of access to VCT has been measured at 24% in Spain, but 42% in Germany (Cedefop, 2020b). Also, in Spain, no active training measures have yet been taken to help workers and companies during COVID-19, while other countries have launched specific programs- such as Singapore's Enhanced Training Support Packages- that include a significant increase in funding to subsidise training expenses among companies affected by COVID-19 (World Economic Forum, 2020).

Furthermore, the Spanish labour market is characterised by high unemployment: since the 2008 financial crisis, its unemployment rate has been, on average, 15% above that of Germany and the Netherlands and 11% above that of France (EUROSTAT, 2020). This high unemployment has led to a high rate of job insecurity and low wages, which has resulted in low productivity that has limited growth (González, 2021). The influence of the COVID-19 pandemic has brought the number of effective employments- affiliates minus ERTes, Record of Temporary Employment Regulation- at the beginning of 2021 to 17.5 million, compared to 19.1 million before COVID-19, and spending on unemployment benefits, as of the beginning of 2021, to an annual average of 36 billion euros, compared to the 17 billion annual average in 2018 (Funcas, 2021). In addition, one of the great handicaps of the Spanish economy is its structural unemployment, which has not been improved through economic expansion cycles or in the long term, and whose value is estimated between 15% and 16%. The consequences of this problem materialise mainly in more limited economic growth figures and the loss of competitiveness due to decreased use of productive capacity (López, 2019).

Against this backdrop, the purpose of this study is to propose improvements to VCT in Spain to reduce unemployment, considering the effects produced by I4.0 and COVID-19. This paper aims to diagnose the Spanish situation in VCT in order to offer recommendations that could contribute to improving current levels of employment and the application of I4.0. The justification of the purpose of the study is based on the immediate consequences that it would have for the affected people, on the decrease in the unemployment rate, and, in the medium and long term, on the faster recovery of the Spanish economy in future economic crises.

The paper is structured as follows. The second section analyses the background and current context of VCT and I4.0 in Spain. In the third section, Spanish VCT is studied and compared to others in the European context. In the fourth section, theoretical models of VCT are confronted with what happens in Spanish practice to define the main challenges and lines of action. Finally, the conclusions are presented.

## **2. VCT and I4.0 in Spain: Background and current context**

VCT encompasses any activity undertaken by adults- employed or not- to improve their knowledge, competences, and skills related to work through formal activities such as training courses to obtain qualifications, non-formal activities such as seminars and on-the-job training, and informal activities without specific learning objectives, as well as job search help and advice (Cedefop, 2020b; Lischewski et al., 2020). In Spain, the implementation of the VCT encompasses four areas: (1) vocational training; (2) continuing postgraduate training

in universities or other institutions, whether educational or business; (3) on-the-job training provided by companies; and (4) specific programs for the unemployed.

## 2.1. Areas of Continuing Professional Training

### 2.1.1. Vocational Training

Spanish Vocational Training (VT) aims to facilitate the transition from education to work to meet the needs of the productive sectors (Bieger et al., 2020). This type of training began in 1871 and is currently integrated into the education system. According to Organic Law 3/2020, VT maintains a perspective throughout the life of potential students and consists of three levels- basic, intermediate, and higher degree- also covering specialisation courses. The content of the three levels of Spanish VT can be compared with the content of Levels 2 to 4 of the International Standard Classification of Education (for more details, see “The European Framework of Qualifications for Lifelong Learning” (Ministry of Education, 2021)).

The total number of students enrolled in VT has doubled in the last decade, reaching 888,000 students in the 2019–20 academic year- 791,000 by face-to-face teaching and 97,000 by distance learning (Undersecretariat MEFP, 2020). To understand the importance of VT, the scope of the training areas it covers is also relevant: there are currently 26 “professional families” linked to the productive sectors, providing, in total, 668 qualifications that allow the design of training offers and that are translated into VT qualifications or certificates of professionalism (Ministry of Education and Vocational Training, 2020). Among the professional families most in demand in 2020 are administration and management (136,000 students), healthcare (131,000 students), computer science and communications (95,000 students), sociocultural services (89,000 students), and electricity and electronics (70,000 students) (Undersecretariat MEFP, 2020).

Spanish VT includes a wide variety of students with different experiences, training, nationalities, and motivations. To face this challenge, according to Bieger et al. (2020), the balance of the academic level must be found because if it is low, the employability of its graduates will be jeopardised, and if it becomes too high, it may be unachievable for people with learning difficulties. On the other hand, regarding teaching methods, VT must replace the chair–blackboard classroom model with new forms of learning, since the centre must be a space, face-to-face or at a distance, in which a learning experience takes place (Bieger et al., 2020). Finally, VT must collaborate with universities to the task of providing society with the talent it demands (Arenas, 2020). In this regard, Sancha and Gutiérrez (2019) indicates that the participation of students and companies should be encouraged to achieve the goal of providing people who, by 2025, will hold 49% of mid-level jobs. The author adds that VT should provide the necessary number of training centres and implement a professional guidance service, both for young graduates and unemployed adults.

Currently, the Strategic Plan for Professional Training of the Educational System 2019–2022 breaks down sixteen objectives, among which we can highlight the stable incorporation of companies and social partners into the VT system, the development of the dual VT model and the promotion of the distance modality of VT, as well as the simplification of the procedures for accreditation of professional competences and basic competences aimed at adults (Ministry of Education and Vocational Training, 2020). To achieve the objectives of VT in 2022 and resolve its current weaknesses, the Ministry of Education and VT has proposed its Plan for Vocational Training, Economic and Social Growth, and Employability, with an endowment of 1,500 million euros, as “the double structuring of the VT system- the educational system and the training for employment- has been revealed to generate tension and inefficiency in all the countries that raised it, having started a process of reflection regarding the uniqueness of the system” (Ministry of Education and Vocational Training, 2021, p. 20). This plan proposes further principles such as public–private collaboration, the guarantee of training and professional qualification for the entire population, and the incorporation and progression in the labour market. It also proposes working in ten strategic areas–basic and professional skills, accessibility for a system unique to VT, digitisation, innovation, entrepreneurship, renovation of the training catalogue, resizing the offer, promoting dual VT, networks of centres and professional guidance (Ministry of Education and Vocational Training, 2021).

Both plans laid the foundations of the Organic Law for the Organization and Integration of Vocational Training approved in September 2021.

Dual VT deserves special mention. It is conceived as a formal programme by which a recognised qualification is obtained. Learning in dual training takes place alternately- in the workplace and in an educational institution- and integrates theory and practice based on real work. There are different modalities, ranging from internships as part of the educational curriculum to stays with a training contract (Pineda-Herrero, Fernández-de-Álava & Espona-Bracons, 2018). Dual training has advantages, such as the job placement of students, a lower unemployment rate, and the efficiency of the companies' recruitment process, but it can give rise to some negative characteristics, such as the subordination of training to the specific needs of companies and the development of precariousness in the labour insertion of young people (Pin, Roig, Susaeta & Apascarietei, 2015). In 2019, dual vocational training was delivered in 26.3% of VT centres for 26,340 students, the number of enrolled in dual training being more important in STEM families (45.2%) and industrial families (37.4%) (Observatorio de la FP, 2021).

### 2.1.2. Continuing Postgraduate Training

Continuing postgraduate training (CPT) provides the acquisition of knowledge and skills throughout professional life. In Spain, it is provided by universities and other educational or business institutions. It is necessary for people to acquire the knowledge required by the labour market. This need is manifested by the opinion of university graduates- more than two-thirds perceive a mismatch between the supply of graduates and the demand for knowledge and skills in the labour market- and by the opinion of companies that demand an increasing number of capabilities that universities do not provide (European Commission, 2020). The solution, even if a partial one, to this misalignment lies in the CPT, which corresponds to Levels 5 to 8 of the ISCED and the European Qualifications Framework (Ministry of Education, 2021).

In Spain, the CPT is incompletely regulated by government institutions (only universities are regulated by the Organic Law of Universities, reformed in 2007). In 2021, 6,092 university master's degrees were awarded, apart from the university degree titles (Aneca, 2021), but most of them aim at the complementary training of graduates immediately after obtaining the degree and therefore would not be part of the CPT.

The cooperation of the majority of Spanish companies with universities is limited to paid internships for students in the final years of their careers and to cooperation in research and development. The number of companies that have an executive on university councils is 20%, similar to the number of academics on board of directors (Blázquez, Masclans & Canals 2019). In the future, most Spanish companies are willing to collaborate in defining the necessary profiles and skills so that universities can design programmes and courses in relation to their needs. However, most companies do not plan to be involved in the design of university programmes and courses (Blázquez et al., 2019).

Among the cooperation between companies and universities, it is worth highlighting the case of joint designs of CPT courses, although this cooperation is not yet frequent. For example, the Master in SAP (Systemanalyse/Programmentwicklung) Logistics Project Management, taught at the Rey Juan Carlos University, aims to incorporate graduates of university degrees into the management consulting labour market, enhancing their professional development with the acquisition of specific knowledge in project management, process design, and implementation of information systems based on SAP to understand, implement, and optimise the SAP system in business logistics processes, as well as develop skills for project management. Through this degree, nine promotions through face-to-face teaching and two promotions in online teaching have already been incorporated into the labour market, which represents about 400 students. In addition to collaborations between companies and universities, there are certain companies whose primary purpose is not training enter the field of CPT. For example, Google offers three fully online training programs- data analytics, project management, and user experience design- with a duration of six months and requiring five hours of studying per week. Google grants its graduates a professional certificate equivalent to a 4-year degree. A total of 250,000 students have already enrolled in these Google courses in less than three years (Fernández, 2020).



### 2.1.3. On-the-Job Training Facilitated by companies

Work-centred learning is a proven springboard for obtaining a good job and acquiring skills in line with the needs of the labour market (González Vázquez et al., 2019). Since 1992, the Spanish government has tried to promote this type of training with successive National Agreements on Continuous Training and Tripartite Agreements on Continuous Training for Employed Workers (Pineda & Sarramona, 2006). Currently, sector-wide agreements are being signed. For example, the State Agreement on Vocational Training for Employment in the Economy Sector and the Digital Industry establishes actions for training programmed by companies, training offered to employed and unemployed workers and training in alternation with employment (BOE, 2020). On the other hand, the State Foundation for Employment Training is a team specialising in management, knowledge of professional sectors, and measurement of the impact of vocational training for employment (FUNDAE, 2020).

In 2020, 72.6% of Spanish companies provided training for their employees. In total, 3.9 million workers were trained (1.9 million belong to large companies with more than 500 workers, 0.9 million to small companies with up to 50 workers, and the rest to medium-sized companies). On average, the number of training hours per participant per year was 13.8. Regarding the type of workers trained, those with medium- or higher-level training were the majority, specifically 80.7%. The types of training actions were face-to-face (58.1%) and tele-training (40.6%) (FUNDAE, 2021). From the point of view of financing, the funds to companies in 2020 have been 661 million euros, which represents 57% of the available funds (FUNDAE, 2021). Currently, Spanish companies prioritise training their employees in the digital technologies they require, as despite all the training efforts made so far, Spanish companies expect to, by 2023, find it difficult to hire people with knowledge in big data, digital marketing, artificial intelligence, and blockchain, both at the university level and at the VT level (Blázquez et al., 2019).

### 2.1.4. Specific Training Programmes for the unemployed

Currently, the Spanish government has plans for the training of the unemployed within its VET plans, such as the Strategic Plan for Vocational Training of the Educational System 2019–2022 (Ministry of Education and Vocational Training, 2020) and the Plan for Vocational Training, Social Growth and Employability (Ministry of Education and Vocational Training, 2021). However, the autonomous communities, town halls, and private institutions are in charge of providing this type of training. For example, in the Basque Country, training is offered in two types of training specialties: that of Accreditable Specialties (linked to a certificate of professionalism) and that of Registered Specialties (not linked to a certificate of professionalism) in a catalogue that adds new training specialties to the State Catalogue, offering 2,215 training activities for the 2018–20 period, with a relevant influence on employment in the Basque community. Also in the Basque Country, a guidance service is offered to job seekers, supporting them with definition of professional goals, CV writing, and job search channels (Basque Employment Service, 2021). For its part, the Autonomous Community of Madrid, due to COVID-19, redefined its training priorities in the calls for training for employment, giving priority to the sectors of digital skills, logistics, supplies, cleaning, Industry 4.0, and socio-health, and it has a plan to help the self-employed to subsidise part of the expenses necessary to start their business activity (Community of Madrid, 2021).

In Spain, the most relevant groups of unemployed people –women over 45 and young people– have their own characteristics with regard to training (Amber & Domingo, 2019). The application of specific training programmes for the unemployed can be measured by the percentage of unemployed who received training for employment. This data in 2019 was 5.2% (Observatorio de la FP, 2021).

## 2.2. Industry 4.0 in Spain: Implementation and development

Most of the indices and surveys on the implementation of I4.0 in Spain show intermediate results. According to Roland Berger (2017), Spanish companies are at a midpoint of innovation and sophistication of their production processes, with an index of 2.3 on a total scale of 1 to 5. Spain has also made progress in the DESI index -which is based on five dimensions: connectivity, human capital, use of internet services, integration of digital technology, and digital public services- from 50.2 to 57.5 on a scale of 1 to 100 between 2018 and 2020, with a

growth in the same period of 14.5%, although in the human capital factor, 50% of the Spanish population lacks basic digital skills (European Commission, 2021a). Specifically, according to the Everis Spain Consultancy (2019), in a survey of senior managers- mainly from the manufacturing, automotive, and mass consumption sectors- it is indicated that 70% of Spanish companies have their production processes fully or partially computerised, but only 5% of them have implemented I4.0 in all their processes. Also, according to Observatory I4.0 (2020), the exponential growth of digitisation in the industrial sector is reaffirmed, with an increase in digital transformation plans and a greater awareness of the need to carry it out, encouraged by the situation of the COVID-19 pandemic. However, there are differences in the level of implementation of I4.0 due to the size of the companies. According to Fundación Telefónica (2020), 23% of large and medium-sized companies make regular use of cloud computing, but this figure falls to the very low level of 9% in the case of microenterprises. There are also differences in analysis through Big Data, used by 10% of SMEs and large companies, although two-thirds of all Spanish companies are not advancing quickly enough in the digitisation process.

In Spain, the responsibility for digital affairs in the Central Public Administration rests with three state secretariats: digitalisation and artificial intelligence, telecommunications, and digital infrastructure, economy, and business support. For its part, the Ministry of Economic Affairs and Digital Transformation is working on the human capital factor to improve digital skills in six areas: citizenship, education, sustainable employability, SMEs, employment and productivity, and gender (European Commission, 2021a). Likewise, there are currently three other ministries- Education, Universities, and Labour- with responsibility for VCT. Each instance of the public administration involved in VCT has objectives in relation to VCT for I4.0. However, companies and business organizations, as well as training entities, have expressed their views on the VCT necessary for I4.0. It seems necessary to develop a policy to collect and evaluate the proposals made, following the coordinated model that exists in some EU countries.

In the field of human capital, and as an example of collaboration and coordination between companies and social institutions, the Joint Commission for the Digital Economy (comprising DigitalES, Ericsson, Everis, Huawei, Vodafone, Orange, Telefónica, UGT, and CCOO) has launched a new training catalogue for the digital economy sector, with more than 50 new training actions, in different fields demanded by companies where there are insufficient professional profiles. This catalogue, according to the Spanish Association for Digitization, will be a reference of knowledge and skills to anticipate needs and to propose present and future solutions in the field of professional training. Also, the Multisectoral Association of Spanish Electronics and Communications Companies (AMETIC), in its 2021 White Book for the Development of Digital Skills, proposes ten lines of work that should positively impact the economic reconstruction of the country, proposing a framework and digitalisation plans to be developed in the next five years. For example, the Digital Professions Certification Center certifies professionals and training schools or training companies in areas such as digital business framework and technology business execution, with four degrees of specialisation-technical, advanced, specialized, and expert- in addition to competencies in softskills key to the performance of professionals in the digital age.

### **3. Continuing Professional Training in Spain: A comparison in the European context**

Next, a comparison is made between Spain and the EU in terms of policies, governance, participation, the labour market, and financing.

#### **3.1. Policies**

Although the EU wants to promote VCT because it is necessary for economic and business growth, as well as individual development (Lischewski et al., 2020), there is no single VCT policy model for all countries. According to Markowitsch and Hefler (2018), four models can be found among the EU countries that differ in orientation of education, financing, or the role of the public administration, external agencies, and social partners. For example, generally speaking, the liberal model predominates in the UK; the centralized model is typical of countries such as Belgium and Germany; the participatory model is applied in France; and the coordinated model is implemented in the Netherlands and, again, Germany.

Spanish VCT policies are diverse and can be framed in the four models defined by Markowitsch and Hefler (2018). There are policies of Spanish VCT that are centralised by the state or regional public administration: the definition of VET programmes, the authorisation of VET centres, the approval of university VCT programmes, the co-financing of part of the on-the-job training facilitated by companies, and the management of specific training for the unemployed. There are also participatory policies, such as the policies proposed for future VET, as indicated in the Strategic Plan for Vocational Training of the Educational System 2019–2022 and in the Plan for Vocational Training, Economic and Social Growth, and Employability. For its part, the programming of specific training courses for the unemployed is a coordinated policy. Finally, there are liberal policies, such as the definition of on-the-job training programmes provided by companies and the VCT provided by non-university institutions.

### 3.2. Governance

There are three types of governance for VCT among EU countries. One of them is led by companies without regulation by the public administration, with companies having full responsibility for defining training programmes. The United Kingdom is one such example. Another is characterised by top-down leadership in which the responsibility lies with the public administration, although the latter may delegate part of its responsibilities to companies, and Bulgaria is an example of this type. Finally, there is also governance based on corporatist leadership, in which companies and unions share the main responsibility through collective agreements and legislative proposals. An example of this type is France. However, there is also mixed governance, as is the case in Italy. The governance in Spain of the VCT participates in all three types of governance. Specifically, corporate-led governance occurs in on-the-job training facilitated by companies, although the partial financing of this training is regulated by the public administration. Top-down, top-led governance also occurs in VET and specific programmes for the unemployed. Finally, corporatist governance occurs in some sectoral VCT plans signed by employers and unions (Cedefop, 2015).

### 3.3. Participation

According to Cedefop (2020a), people often view VCT as less attractive than general education, and little is known about what people think of VCT. However, the image of VCT is important in identifying its strengths and weaknesses. A study involving 40,466 European individuals over 25 years of age highlighted that (1) at least two-thirds of respondents agree that VCT should be a priority investment and that 70% believe it will become more important within 10 years; (2) the most common reasons for participating in VCT, according to 96%, are personal development and improvement of job skills; and (3) the benefits of VCT are career progression, finding a new job, earning an increase in income, and reducing unemployment (Cedefop, 2020b).

Siegfried and Berger (2020) have also analysed the reasons for and barriers to the development of VCT, indicating that for employees, the highest degree of acceptance occurs with the highest levels of education and that interest in VCT grows with age up to a certain value, from which it begins to decrease. The sector of activity where employees work also influences the acceptance of VCT since those most affected by VCT are those who work in companies where the technology used changes more rapidly. Among the barriers to participation in VCT, lack of counselling, inadequacy of the educational offer, and excessive requirements stand out, with establishing social contacts and improving self-confidence being the main reasons for participation. Siegfried and Berger (2020) also claim, from the point of view of companies, that the main reason for developing VCT programmes is to maintain competitiveness. Size influences its VCT offering, with the largest companies being the most capable of offering this type of training to their employees. The main barriers for companies are linked to costs and the possibility of turnover of trained personnel.

For their part, Lischewski et al. (2020) indicate that participation in VCT depends on people's previous level of education. In all countries, adults with a tertiary level of education participate in VCT more than those with other levels of education, but there are no significant gender differences in participation. The type of employment contract also influences participation in VCT, as adults with permanent contracts participate more. Similar to Siegfried and Berger (2020), these authors reveal that the size of the companies influences the number



of more VCT activities and that the sectors with more pressure for innovation also offer more training. The factors that influence participation in VCT programmes are: (1) individual (age, family care, gender, and country of origin); (2) work-related (type of contract, seniority, and experience in unemployment); (3) based on learning biography (level of education achieved and learning efficiency); and (4) institutional (economic activity sector, learning culture, workplace innovation, work environment, number of employees, and number of company locations).

Finally, Cedefop (2020b) highlights that the most relevant actions to encourage adults to participate in VCT are flexible hours, financial support, certification of learning, more information and guidance, as well as adaptation of learning to individual needs. Currently, internet access to VCT is important, but in Spain, only 24% of workers judge that there are many opportunities for VCT online (Cedefop, 2020b).

### **3.4. Work Market**

The labour market in the EU has been characterised in the last decade by three conditioning factors (Smit et al., 2020). The first is that highly skilled people enjoyed job growth in the past decade in all EU regions, and lower skilled jobs grew only in dynamic and stable regions. The second is that job growth was concentrated in a few regions. Third, labour mobility in the EU increased due to the movement of workers from less wealthy regions to dynamic cities in the decade before the COVID-19 pandemic. Currently, the COVID-19 crisis is strongly affecting European labour markets: on the one hand, it may accelerate labour market movements previously forecast for 10 years, and the implementation of I4.0 could negatively affect people with low levels of education; on the other hand, it can accelerate employment imbalances between European countries. In Europe, unemployment will reach pre-COVID-19 levels between 2021 and 2024 (Smit et al., 2020), although in Spain, according to the BdE (2021), these levels will be reached between 2023 and 2024.

Comparing the Spanish labour market with that of other EU countries, persistent unemployment is found above the rest of European countries. Since the 2008 financial crisis, the unemployment rate in Spain has been, on average, 15 points above that of Germany or the Netherlands and 11 points above that of France (EUROSTAT, 2020). Based on the classification of Smit et al. (2020), quite a few provinces or Spanish autonomous communities are in the regions in employment contraction (meaning they have an aged population, are agricultural regions, or have a predominance of public employment), such as Lugo, Orense, Zamora, Almería, Extremadura, León, the two Castillas, Asturias, and Huesca. In economies with stable employment (service economies, diversified areas, tourist destinations) are the Basque Country, Navarra, Zaragoza, Catalonia, Malaga, Alicante, and the Balearic Islands. Only Madrid is categorised as a superstar in employment (high-growth regions), given the presence of high-growth sectors such as finance and technology there.

### **3.5. Financing**

As the costs of VCT are one of the main obstacles to its development for both companies and trainees, the EU promotes different financing mechanisms to stimulate the participation of both groups (Cedefop, 2014, 2020b). The list of possible financial incentives to stimulate people's participation in VCT may include loans (subsidised totally or partially by the government), tax incentives, individual learning accounts, training vouchers and allowances, and training permits. On the other hand, incentives for companies may include mandatory agreements on rate reduction at the national, regional, or sectoral level and non-mandatory agreements such as subsidies, tax incentives, and reimbursement clauses (Cedefop, 2014). Of these mechanisms, in Spain, there is a decrease in the social security contributions of companies, regulated by national and sectoral agreements, and free training is provided to unemployed people. On the other hand, 66% of adults in Spain fully agree that governments should prioritize investment in VCT (Cedefop, 2020b).

## **4. Challenges of the VCT in Spain: Some proposals**

Based on the previous diagnosis, this section presents the main challenges facing Spanish VCT. In addition, several actions were identified. These can contribute to and facilitate the overcoming of these challenges.

#### 4.1. Completing the Development and Implementation of I4.0 in Spain

I4.0 increases the competitiveness of companies by improving the industrial environment; greater flexibility for customers (Bartodziej, 2017); optimization of the decision-making process (World Economic Forum, 2018), efficiency, and productivity of resources used; and innovation (Rübmann et al., 2015). However, in Spain, the main barrier for the development of I4.0 is the qualification of human capital, as recognised by the Plan for Vocational Training, Economic and Social Growth, and Employability, which proposes “vocational qualifications for the whole population” (Ministry of Education and Vocational Training, 2021).

Although Spanish companies are making remarkable progress in their digital transition, only 50% of people between 16 and 74 years old present basic digital skills (Fundación Telefónica, 2020). In addition, in terms of the supply of ICT specialists, Spain remains below the EU average and needs more medium-and high-skilled technicians to increase its innovation capacity and ensure a smooth transition to an increasingly digitised economic environment (European Commission, 2021a). According to a survey among Spanish companies, the main barriers to the implementation of I4.0 are resistance to change (30% of companies), the need for large investments (21%), and the lack of training of workers (13%) (I4.0 Observatory, 2020). Spanish companies also consider believe that the most necessary skills for the development of I4.0 are knowledge and data management, data analytics, and process management. In future, in the short and medium term, human capital needs will persist because, in ten years’ time, most companies will have integrated intelligent systems into their business processes (Telefónica Foundation, 2020) and, in the shorter term, management processes with investment foresight are the digital supply chain(raw materials management in warehouse, supply chain management) and digital manufacturing (management of production improvement in the factory, production planning) (I4.0 Observatory, 2020).

The following proposals are recommended to complete the development and implementation of I4.0 in Spain:

- Define the training content of the technicians needed for the implementation of I4.0 at different levels and in different sectors of economic activity.
- Permanent updating of the training catalogue of the digital economy sector. In May 2021, the Ministry of Education and 65 digital organizations committed to the development of the National System of Qualifications and Vocational Training.
- Update, in line with AMETIC (2021), an industry needs collection model to develop sectoral training programmes.
- Strengthen the skills of lecturers and managers in the digital age, with a special focus on SMEs.

#### 4.2. Reduction of unemployment

A high level of unemployment persisted at the end of the second quarter of 2021. The number of employed Spaniards, including labour force adjustment plans (ERTEs), has dipped to 19.6 million, which is 2% less than the 20 million at the end of 2019 (INE, 2021). In agreement with Hidalgo, Victoria and Martínez (2021), in the field of training, the measures implemented so far seem insufficient for the access of the unemployed to the labour market. Increasing this access would require the following:

- Providing specific and cross-cutting skills and training to promote the mobility of workers between sectors of economic activity and acquiring the necessary skills in a changing technological environment.
- Facilitating, through VCT in regions with more structural unemployment, geographical mobility towards Spanish regions that are centres of innovation and talent creation, in a manner similar to the ALMA-Erasmus Employment (European Commission, 2021a).
- Finally, basing the two above proposals on quantitative studies of current employment and its short- and medium-term development, together with an analysis of its training needs. These analyses should be carried out for each of the employment regions in Spain.

### 4.3. Adopting Coordinated Policies to Develop VCT for I4.0

The public administration assumes an important role in using collaborative models to improve the development of VCT for I4.0. The adoption of coordinated model policies, in line with its overall policy of value co-creation in the design and redesign of public services, could help to drive and refine such development. In particular, it proposes the following:

- The social partners must take the initiative to renew VCT training programmes.
- Public administration must regulate training programmes, taking into account the criteria of the social partners.
- Training providers should define their programmes based on the needs of enterprises. A partial example is the initiative “Alliance for Vocational Training: A Country Strategy,” which involves companies, sectoral employers, social partners, and educational entities.
- Finally, to adopt this coordinated model in Spain, the various ministries of the state administration involved, the corresponding representatives of the autonomous communities, must be integrated into a single commission, including firms, business associations, social representatives, and educational institutions, so that the different initiatives and action plans are coordinated between the public administration and social representatives.

### 4.4. Meet business recruitment needs

The business requirements for the level of training to meet the market’s recruitment needs are being modified, and job vacancies specifying a VCT degree among their requirements (42.6%) surpassed those requiring a university degree (38.5%) for the first time in 2018. According to Bieger et al. (2020), this trend will continue, and in 2025, the percentages will be 49% for VCT and 37% for university graduates. Bieger et al. (2020) also indicate that the five skills and attitudes most in demand by Spanish companies are commitment, learning ability, proactivity and initiative, flexibility, adaptiveness, and teamwork. Regarding the deficiencies of university training, Spanish companies estimate that there are knowledge gaps in 68% of university students, specifically 54% in professional skills and 72% in attitudes.

There is no study quantifying job needs in Spain, but relevant research has been carried out at the EU level: Smit et al. (2020) indicate that the types of work most in demand in Europe are technology workers (10–15 million), ICT professionals (5–10 million), high-skilled workers (20–25 million), skilled professionals (35–40 million), and low-skilled white-collar workers (35–40 million). At the same time, companies consider the training offered by the Spanish education system to be inadequate.

Therefore, to meet business recruitment needs, the following would be necessary:

- Quantify the training needs of current and foreseeable employment in the short and medium term to adapt the educational and training programmes of different educational and training institutions.
- Update public and private sector education programmes to match labour market needs as much as possible.
- Encourage cooperation between firms and universities and VT centres.

### 4.5. Improving the governance of VCT by the public administration

The management of the VCT by the central public administration is divided into four ministries: Economic Affairs and Digital Transformation, Vocational Education and Training, Labour, and Social Economy, and Universities. In addition, regarding the types of governance that occur in the EU (Cedefop, 2015), in Spain, VCT leadership is complex. Top-down governance by the public administration takes place in VCT and in specific programmes for the unemployed. Companies lead on-the-job training, although the partial funding for this

training is regulated by the public administration. Finally, corporate governance occurs in some sectoral plans of VCT signed by employers and unions. In addition, the Strategic Plan for Vocational Training in the Education System 2019–2022 sets out the objective of the stable incorporation of firms and social partners into the VCT system and the principle of public-private partnership (Ministry of Education and Vocational Training, 2020).

Therefore, and in agreement with the above, it would be necessary:

- To improve coordination between the different state ministries and the corresponding autonomous communities to coordinate VCT policies with other policies, such as those involving the labour market, innovation, and emigration.
- To delegate part of the public administration's responsibilities to enterprises and social partners to improve data exchange and coordination with VCT centres, universities, and public employment services.
- To promote the role of firms to play a leading role in the training and retraining of workers and to help public administrations optimise the provision of training.
- To formalise collaboration between companies, universities, social partners, and VCT providers to propose actions to public administrations, as in the case of AMETIC, which calls for certificates in digital skills so that the sector has the professionals that the market demands through the collaboration between universities and large companies (AMETIC, 2021).

#### **4.6. Promoting the business-university relationship**

Spanish university programmes are not related to the skills and knowledge that companies need, and most companies are not involved in defining the profiles necessary for universities to design programmes and courses in relation to their needs. According to the Government of Spain (2021), there is a wide and growing gap between what the Spanish university teaches and what companies need due to inadequate qualifications, outdated curricula, poorly connected to reality, and skills acquired during university, which is a major constraint on the employability of graduates and the productivity of the country. A further consequence of the gap is the significant percentage of university graduates in lower-skilled employment; in 2019, 35% of the employment contracts signed by university graduates in Spain were jobs below their qualifications (Arenas 2020; Blázquez et al., 2019).

Furthermore, an analysis of postgraduate training in Spanish universities reveals that the majority of university master's programmes do not have vocational continuing training as an objective (Aneca, 2021). This gap is partially covered by a few joint enterprise–university programme initiatives.

Other cooperation between companies and universities is usually and almost exclusively (1) paid internships for students in last career courses and (2) research and development. Most Spanish companies would also be in favour of collaborating in the definition of the necessary profiles and defining their competences so that universities design programmes and courses fit their needs (Blázquez et al., 2019). Universities can also offer firms spin-offs companies and technology transfer activities (Rasmussen & Borch, 2010), as well as licensing, research, and consultancy contracts (Gál & Ptacek, 2011). One example is the Institute of Technological Research, created in 1984, belonging to the Higher Technical School of Engineering ICAI of the University of Comillas, whose fundamental objective is to promote research and training of postgraduates in various technological fields through their participation in research projects. Its funding comes mainly from projects contracted with companies, mostly contracts with private companies, as well as participation in competitive public calls, mainly with the European Commission (IIT, 2021).

Firms and universities have common objectives in the training of people, but before the above situation is diagnosed, it would be necessary:

- To update university degree programmes with a focus on the skills required in professional life to reduce the percentage of university graduates overqualified for their jobs.
- To include in the offer of university programmes some options for active workers, with an appropriate methodology to ensure that these programmes are compatible with work schedules and geared to the retraining needs of workers.
- To propose models of relationships between universities and companies in the field of VCT to define the contribution of universities to the practical knowledge of what is currently demanded in the short and medium term.
- To increase the university services offered to companies, such as research projects, licensing, and consultancy development, and spin-off creation programmes.
- To invite appropriate companies to participate jointly and formally in the programming of certain training programmes.

#### **4.7. Enhancing on-the-job training**

Work-centred learning is a proven springboard for good employment and skills matching labour market needs (González Vázquez et al., 2019). In addition, the retraining of the adult population will become an important building block for the prosperity of countries, equally as important as the training of the younger population.

Among all formal and non-formal VCT activities in Spain, only 48% of small businesses offer training to their workers. According to Cedefop (2015), Spain is in the fourth group of countries in work-based learning, and the average duration of on-the-job training is decreasing. In addition, the percentage of workers who have not updated their training since joining their current job is 20% in the EU, but 30% in Spain.

However, in addition to formal and non-formal training, certain management policies that increase the training and qualification of participating workers, even if they are not courses, seminars, or trainee ships, should be considered on-the-job training. In general, knowledge is created through the conversion processes between implicit knowledge and explicit knowledge (for more details, see the SECI model proposed by Nonaka and von Krogh (2009)).

Enhancing on-the-job training would require the following from public administration:

- Encouraging business-social partners agreements to set up training schemes planned by enterprises, along the lines of the State Agreement on Vocational Training for Employment in the Digital Economy and Industry (BOE, 2020).
- Extending the best methods of on-the-job training through a foundation to disseminate these training and innovation plans for knowledge and use in other companies.

#### **4.8. Improving Vocational Training and guidance for the unemployed**

Adequate training for jobseekers would reduce the number of unemployed and adapt employment to their socio-economic realities in each region. In Spain, the proportion of unemployed people participating in training programmes coordinated by public administrations has fallen by more than half in the last two decades. Specifically, the percentage of unemployed people who received training for employment in 2019 was 5.2% (VT Observatory, 2021). The main challenges of training for the unemployed in Spain are linked to insufficient and unstable funding, lack of efficient coordination of public administrations, and mismatch of training provision with the changing needs of firms. This is why training provision is insufficient in terms of quality and usefulness and is undervalued and in demand by both the unemployed and their potential employers. Consequently, the Vocational Training, Economic and Social Growth, and Employability Plan envisages working ten strategic areas: basic and vocational skills, accessibility for a single VCT system, digitalisation, innovation, entrepreneurship, the renewal of the training catalogue, the re-sizing of supply, the promotion of dual vocational training, networks of



centres, and vocational guidance, which can be applied to training for the unemployed (Ministry of Education and Vocational Training, 2021).

Addressing the above challenges would require the following:

- Increasing the participation of the unemployed in retraining programmes by increasing the funding for such programmes.
- Considering the differences between employment regions in Spain. Consequently, the management of training for the unemployed should be the responsibility of the autonomous communities. However, the state administration must provide and coordinate common policies and funding.
- Including, among the policies common to all regions, attention to the most relevant groups of unemployed people with specific characteristics for training.
- Supplementing specific training for the unemployed with individual counselling and career guidance schemes to improve the efficiency of this specific training since vocational guidance makes investment in training profitable if it is selected based on the real interests and needs of individuals (Amber & Domingo, 2019).
- Testing the results of new virtual adult education methodologies with the intention of disseminating their use in the different training programmes for the unemployed, both in the theoretical content, the explanation of examples and cases, as well as in the practical exercises required.

Table 1 summarises the main challenges and proposals that could contribute to improving the situation of the VCT in Spain and therefore the levels of unemployment.

Challenges of VCT in Spain	Proposals
1. Complete the development of I4.0 in Spain	1.1 Define the training contents to implement I4.0 1.2 Continuously update of the digital training catalogue 1.3 Develop sectoral training programmes 1.4 Strengthen the digital skills of lecturers
2. Reduce unemployment	2.1 Provide skills to promote cross-sectoral mobility 2.2 Facilitate VCT in regions with more structural unemployment 2.3 Conduct, by region, quantitative employment surveys
3. Adopt coordinated policies to develop the VCT for I4.0	3.1 Renew the VCT at the initiative of the social partners 3.2 Consider the criteria of the social partners by the public administration (PA) 3.3 Define training according to the firm's needs 3.4 Adopt a coordinated model as a basic policy for VCT
4. Meet business recruitment needs	4.1 Quantify the training needs of employment in the medium term 4.2 Update training to the needs of the labour market 4.3 Encourage cooperation between universities and firms
5. Improve the governance of the VCT by the public administration	5.1 Improve coordination between the state PA and the autonomous PA 5.2 Delegate PA decisions to enterprises and social partners 5.3 Promote the role of firms in the retraining of workers 5.4 Formalise the collaboration of VCT companies and suppliers
6. Promote the firms–universities relationship	6.1 Orient university degrees towards professional competencies 6.2 Offer university programmes to active workers 6.3 Propose models of university–business relationships 6.4 Increase university services to firms 6.5 Increase participation of companies in university programmes
7. Enhance on-the-job training	7.1 Promote agreements between firms and social partners 7.2 Extend the best methods of training on-the-job
8. Improve vocational training and guidance for the unemployed	8.1 Increase their participation in training programs 8.2 Manage the training of the unemployed by autonomous PA 8.3 Include training for young people, women, and people over 45 8.4 Complete training with career guidance plans 8.5 Value virtual adult education methodologies

Table 1. Summary of Challenges and Proposals for the Spanish VCT

## 5. Conclusion

Given the requirements of I4.0 and the high unemployment rates that have characterised the Spanish labour market, VCT has been established as a way to contribute to employability and increased competitiveness of the economy. This paper has aimed to consider all aspects of VCT in Spain with an overall vision in the four areas where it is developed (vocational training, postgraduate training, on-the-job training, and training for the unemployed), facilitating the identification of its deficiencies and its main challenges. The diagnosis that has been carried out reveals a lack of coherence in the number and profile of people trained in certain fields and the demand for professional profiles that do not fit with an excess of people with higher, non-specialized, or non-professional training. On the other hand, the implementation of I4.0 in Spain is in an incipient state. Finally, this study shows excessive fragmentation in the actions included in the VCT due to the lack of coordination between the different actors involved.

To improve VCT and reduce unemployment in Spain, the following lines of action are proposed: complete the development and implementation of I4.0 in Spain, adopt coordinated policies to develop VCT for I4.0, meet the needs of recruitment companies, improve the governance of VCT by the public administration, promote the relationship between companies and universities, enhance on-the-job training, and improve training and career guidance for the unemployed. Each of these lines has included a series of proposals that, however, could be ordered according to the priority of their implementation and the results obtained in neighbouring European countries. Regarding the public administration, it is considered especially relevant to (1) define the training contents to implement I4.0 taking into account business needs; (2) improve coordination between the state and regional public administration; (3) delegate decisions of the public administration in companies and social partners; (4) promote cooperation between universities and companies; (5) increase the participation of the unemployed in training programmes; and (6) include specific training for unemployed youth, women, and people over 45 years of age. In relation to the collaboration between the public administration and the social partners, it is considered a priority to offer qualifications to promote intersectoral mobility towards the fastest growing economic sectors and facilitate VCT in regions with more structural unemployment according to the specific job demand of those regions. Finally, it is a priority for companies and universities to offer university programmes to active workers based on professional needs and the time available, and to establish models of cooperation between companies and universities oriented towards VCT.

For this, public administrations, educational institutions, companies, and other social institutions must work together. Separately, they will not be able to respond to all challenges or implement the necessary actions to improve Spanish VCT (World Economic Forum, 2020). There must be common objectives in these institutions that share knowledge and are respected in the skills and competencies that distinguish each one, using for their achievement policies of the coordinated model existing in the EU with mixed governance according to needs (Markowitsch and Hefler, 2018; Cedefop, 2015). These institutions should, through the work of commissions, forums, or clusters created for this purpose (as is the case, for example, of the Forum for the Alliance of Dual Vocational Training), agree on the specific types of policies and governance appropriate for the development of VCT in Spain (Lischewski et al., 2020) and establish an action plan where, among others, the thirty proposals presented here are implemented.

## Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

## Funding

This article has been financed with funds from OPENINNOVA High Performance Research Group (URJC-V921) and the Bridge Research Project V946 -URJC entitled “The contribution of dialogic practices to teamwork quality: a proposal for evolving the relational coordination model”.

## References

- Amber, D., & Domingo, J. (2019). Empleo y Aprendizaje Permanente en España: Implicaciones en la formación de las personas adultas. *Currículo sem Fronteiras*, 19(3), 1225-1242. <https://doi.org/10.35786/1645-1384.v19.n3.25>
- AMETIC (2021). *Libro Blanco de AMETIC para el Desarrollo de Competencias Digitales*. Available at: <https://ametic.es/es/publicaciones/libro-blanco-de-ametic-para-el-desarrollo-de-competencias-digitales>. Accessed 27th April 2021
- Aneca (2021). *Información sobre Grados y Másteres universitarios en España*. Available at: <https://www.aneca.es>. Accessed 30th March 2021
- Arenas, A (2020). *La Universidad a través de la formación profesional*. Available at: <https://www.icaei.es/articulo-revista/universidad-formacion-profesional-a-la-universidad-a-traves-de-la-formacion-profesional/>. Accessed 20th March 2020
- BdE (2021). *Informe anual 2020*. Available at: [https://www.bde.es/f/webbde/SES/Secciones/Publicaciones/PublicacionesAnuales/InformesAnuales/20/Fich/InfAnual\\_2020.pdf](https://www.bde.es/f/webbde/SES/Secciones/Publicaciones/PublicacionesAnuales/InformesAnuales/20/Fich/InfAnual_2020.pdf). Accessed 24th May 2021
- Bartodziej, C.J. (2017). *The concept industry 4.0*. In *The concept industry 4.0* (pp. 27-50). Springer Gabler, Wiesbaden. [https://doi.org/10.1007/978-3-658-16502-4\\_3](https://doi.org/10.1007/978-3-658-16502-4_3)
- Basque Employment Service (2021). *Formación*. Available at: [http://apps.lanbide.euskadi.net/apps/fr\\_menu?idioma=C](http://apps.lanbide.euskadi.net/apps/fr_menu?idioma=C). Accessed 6th May 2021.
- Beer, P., & Mulder, R.H. (2020). The Effects of Technological Developments on Work and Their Implications for Continuous Vocational Education and Training: A Systematic Review. *Frontiers in Psychology*, 11, 918. <https://doi.org/10.3389/fpsyg.2020.00918>
- Bieger, C., Álvarez, S., & García, P. (2020). *El reto de la formación profesional en España*. IESE
- Blázquez, M.L., Masclans, R., & Canals, J. (2019). *El futuro del empleo y las competencias profesionales del futuro: La perspectiva de las empresas*. IESE. <https://doi.org/10.15581/018.ST-490>
- BOE (2020). *Acuerdo estatal de formación profesional para el empleo en el sector de la economía y la industria digital*. BOE 17th June 2020, sec. III. Pág. 41153.
- Cedefop (2014). *Policy Handbook: Access to and participation in continuous vocational education and training (CVET) in Europe*. Luxembourg: Publications Office of the European Union.
- Cedefop (2015). *CVET in Europe: The way ahead*. Luxembourg: Publications Office of the European Union. Cedefop reference series.
- Cedefop (2020a). *Perceptions on adult learning and continuing vocational education and training in Europe*. Second opinion survey – Volume 1. Member States. Luxembourg: Publications Office. Cedefop preference series; N° 117. <http://data.europe.eu/doi/10.2801/717676>
- Cedefop (2020b). *Como valoran los europeos el aprendizaje de adultos y la educación y Formación Continua Profesional*. ISBN 978-92-896-2999-7.
- Community of Madrid (2021). *Ayudas a trabajadores que se establezcan por cuenta propia*. Available at: <https://www.comunidad.madrid/servicios/empleo/ayudas-personas-trabajadoras-autonomas-emprendedoras-entidades-economia-social#constitucion-cuenta-propia>. Accessed 22nd June 2021.
- Eberhard, B., Podio, M., Alonso, A.P., Radovica, E., Avotina, L., Peiseniece, L., et al. (2017). Smart work: The transformation of the labour market due to the fourth industrial revolution (14. 0). *International Journal of Business & Economic Sciences Applied Research*, 10(3), 50-53.
- European Commission (2020). *European Skills Agenda for Sustainable Competitiveness, Social Fairness and Resilience*. Available at: <https://ec.europa.eu/social/main.jsp?catId=1223&langId=en>. Accessed 23rd April 2021

- European Commission (2021a). *Índice de la Economía y la Sociedad Digitales 2020. España*. Available at: <https://ec.europa.eu/digital-single-market/en/digital-economy-and-society-index-desi>. Accessed 28th April 2021
- EUROSTAT (2020). *Employment and unemployment*. Available at: [www.ec.europa.eu/eurostat/web/lfs](http://www.ec.europa.eu/eurostat/web/lfs). Accessed 22nd March 2021.
- Fernández, E (2020). *Los certificados profesionales de Google, una oportunidad para las universidades*. Available at: <https://valenciaplaza.com/los-certificados-profesionales-de-google-una-oportunidad-para-las-universidades>. Accessed 5th April 2021.
- Funcas (2021). *Afiliación a la Seguridad Social*. Available at: <https://www.funcas.es/prensa/fuerte-aumento-de-la-afiliacion-y-el-empleo-efectivo-en-junio/>. Accessed 6th July 2021
- Fundación Telefónica (2020). *Sociedad Digital en España 2019*. Available at: <https://www.fundaciontelefonica.com/noticias/informe-sociedad-digital-espana-2019/>. Accessed 27th April 2021
- FUNDAE (2020). *Formación para el empleo. Balance de situación 2019*. Available at: <https://www.fundae.es/Publicaciones>. Accessed 7th April 2021.
- FUNDAE (2021). *Acciones de formación en las empresas*. Available at: [https://www.fundae.es/docs/default-source/publicaciones-y-evaluaciones/s%C3%ADntesis-est/2020/1-1\\_principales-indicadores-de-actividad.pdf](https://www.fundae.es/docs/default-source/publicaciones-y-evaluaciones/s%C3%ADntesis-est/2020/1-1_principales-indicadores-de-actividad.pdf). Accessed 5th May 2021
- Gál, Z., & Ptaček, P. (2011). The role of mid-range universities in knowledge transfer in non-metropolitan regions in Central Eastern Europe. *European Planning Studies*, 19(9), 1669-1690. <https://doi.org/10.1080/09654313.2011.586186>
- González, F. (2021). *El trilema del empleo: Poco, barato y precario*. Available at: <https://www.republica.com/la-bolsa-o-la-vida/2021/08/18/el-trilema-del-empleo-poco-barato-y-precario/>. Accessed 20th August 2021
- González Vazquez, I., Milasi, S., Carretero Gomez, S., Napierala, J., Robledo Bottcher, N., Jonkers, K. et al. (2019). *The changing nature of work and skills in the digital age*. EUR 29823 EN, Publications Office of the European Union, Luxembourg, 2019, ISBN 978-92-76-09206-3. <https://doi.org/10.2760/679150>, JRC 117505
- Government of Spain (2021). *España 2050. Fundamentos y propuestas para una Estrategia Nacional a Largo Plazo*. Available at: [https://www.lamoncloa.gob.es/presidente/actividades/Documents/2021/200521-Estrategia\\_Espana\\_2050.pdf](https://www.lamoncloa.gob.es/presidente/actividades/Documents/2021/200521-Estrategia_Espana_2050.pdf). Accessed 28th May 2021.
- Hecklau, F., Galeitzke, M., Flachs, S., & Kohl, H. (2016). Holistic approach for human resource management in Industry 4.0. *Procedia Cirp*, 54(1), 1-6. <https://doi.org/10.1016/j.procir.2016.05.102>
- Hidalgo, M., Victoria, C., & Martínez, A. (2021). *Las claves del mercado laboral español en pandemia, según la Encuesta de Población Activa*. Available at: <https://www.esade.edu/ecpol/es/>. Accessed 17th March 2021.
- Hirschi, A. (2018). The fourth industrial revolution: Issues and implications for career research and practice. *The Career Development Quarterly*, 66(3), 192-204. <https://doi.org/10.1002/cdq.12142>
- I4.0 Observatory (2020). *Estudio Smart Industry*. Available at: <https://observatorioindustria.org/wp-content/uploads/2020/11/III-Informe-Smart-Industry-4.0-v.6.pdf>. Accessed 28th April 2021.
- INE (2021). *Encuesta de Población Activa, trimestre 2/ 2021*. Available at: [https://www.ine.es/dyngs/INEbase/es/operacion.htm?c=Estadistica\\_C&cid=1254736176918&menu=ultiDatos&idp=1254735976595](https://www.ine.es/dyngs/INEbase/es/operacion.htm?c=Estadistica_C&cid=1254736176918&menu=ultiDatos&idp=1254735976595). Accessed 11th August 2021.
- IIT (2021). *Proyectos*. Available at: <https://www.iit.comillas.edu/proyectos/>. Accessed 30th June 2021.
- Liao, Y., Deschamps, F., Loures, E.D.F.R., & Ramos, L.F.P. (2017). Past, present and future of Industry 4.0- A systematic literature review and research agenda proposal. *International journal of production research*, 55(12), 3609-3629. <https://doi.org/10.1080/00207543.2017.1308576>

- Lischewski, J., Seeber, S., Wuttke, E., & Rosemann, T. (2020). What influences participation in non-formal and informal modes of Continuous Vocational Education and Training? An analysis of individual and institutional influencing factors. *Frontiers in psychology*, 11, 2821. <https://doi.org/10.3389/fpsyg.2020.534485>
- López, D. (2019). El desempleo estructural, el gran hándicap de la economía española. Available at: <https://economipedia.com/actual/el-desempleo-estructural-el-gran-handicap-de-la-economia-espanola.html>. Accessed 11th August 2021.
- Markowitsch, J., & Hefler, G. (2018). Staying in the loop: Formal feedback mechanisms connecting vocational training to the world of work in Europe. *International journal for research in vocational education and training*, 5(4), 285-306. <https://doi.org/10.13152/IJRVET.5.4.3>
- Ministry of Education and Vocational Training (2020). *I Plan Estratégico de Formación Profesional del Sistema Educativo 2019-2022*. BOE 16th June 2020.
- Ministry of Education and Vocational Training (2021). *Plan de modernización de la Formación Profesional*. Available at: <https://www.educacionyfp.gob.es/prensa/actualidad/2020/07/20200722-planfpmoncloa.html>. Accessed 24th March 2021.
- Ministry of Education (2021). *El marco europeo de cualificaciones para el aprendizaje permanente (EQF)*. Available at: <https://www.educacionyfp.gob.es/dctm/mecu/tabla-descriptores-eqf.pdf?documentId=0901e72b808e75be>. Accessed 30th March 2021.
- Molnar, M., & Houtman, C. (2011). *The Advanced Manufacturing Partnership and The Advanced Manufacturing National Program Office*. National Institute of Standards and Technology.
- Nedelkoska, L., & Quintini, G. (2018). *Automation, skills use and training*. OECD Social, Employment and Migration Working Papers, No. 202, OECD Publishing, Paris (pp.7-10). <https://doi.org/10.1787/2e2f4eea-en>
- Nonaka, I., & von Krogh, G. (2009). Tacit Knowledge and Knowledge Conversion: Controversy and Advancement in Organizational Knowledge Creation Theory. *Organization Science*, 20(3), 635-652. <https://doi.org/10.1287/orsc.1080.0412>
- Observatorio de la FP (2021). *Panel de indicadores*. Available at: <https://www.observatoriofp.com/panel-indicadores/espana> (Accessed 13th June 2021)
- OECD (2019). *OECD employment outlook 2019: The future of work*. OECD Publishing.
- Pin, J.R., Roig, M., Susaeta, L., & Apascari, P. (2015). La formación profesional dual como reto nacional. IESE Business School y Fundación Citi: Barcelona, Spain.
- Pineda, P. (2007). La formación continua en España: balance y retos de futuro. *RELIEVE. Revista Electrónica de Investigación y Evaluación Educativa*, 13(1- 2007), 43-65. <https://doi.org/10.7203/relieve.13.1.4212>
- Pineda, P., & Sarramona, J. (2006). El nuevo modelo de formación continua en España: Balance de un año de cambios. *Revista de educación*, 341(705), 36.
- Pineda-Herrero, P., Fernández-de-Álava, M., & Espona-Bracons, B. (2018). *Formación profesional dual. Las motivaciones de las empresas del sector de la automoción en España para involucrarse en formación profesional dual: Dual vocational education and training-VET-Companies' motivations for VET in the Spanish automotive sector*. Ministerio de Educación.
- Rasmussen, E., & Borch, O. (2010). University capabilities in facilitating entrepreneurship: A longitudinal study of spin-off ventures at mid-range universities. *Research policy*, 39(5), 602-612. <https://doi.org/10.1016/j.respol.2010.02.002>
- Roland Berger (2017). *Índice de Preparación para Industria 4.0*. Available at: <https://www.rolandberger.com/en/?country=ES>. Accessed 7th May 2020.
- Rostow, W.W. (1988). *The fourth industrial revolution and American society: Some reflections on the past for the future. Cooperation and Competition in the Global Economy*. Balling Publishing Co., Cambridge, Mass.



- Rübmann, M., Lorenz, M., Gerbert, P., Waldner, M., Justus, J., Engel, P. et al. (2015). *Industry 4.0: The future of productivity and growth in manufacturing industry*. Boston Consulting Group (BCG) Raporu.
- Sancha, I., & Gutiérrez, S. (2019). *La Formación Profesional en España 2018*. Fundae, 2019
- Siegfried, C., & Berger, J. (2020). Perspectives on Participation in Continuous Vocational Education Training—An Interview Study. *Frontiers in Psychology*, 11, 1096. <https://doi.org/10.3389/fpsyg.2020.01096>
- Smit, S., Tacke, T., Lund, S., Manyika, J., & Thiel, L. (2020). *The future of work in Europe*. McKinsey Global Institute.
- Tikkanen, T. (2009). The learning society as a greying society: Perspectives for older workers and lifelong learning, *Modernising vocational education and training*, 2, 15-19.
- Undersecretariat MEFP (2020). *Estadística de las Enseñanzas no universitarias. Datos avance 2019-2020*. Available at: GRUPO TÉCNICO DE ESTADÍSTICA ([educacionyfp.gob.es](http://educacionyfp.gob.es)). Accessed 19th April 2021
- VT Observatory (2021). *FP dual*. Available at: <https://www.observatoriofp.com/panel-indicadores/espana>. Accessed 5th May 2021.
- World Economic Forum (2018). *The Global Competiveness Report*. Geneva: World Economic Forum.
- World Economic Forum (2020). *The future of jobs report 2020*. Geneva: World Economic Forum.
- Zhong, R.Y., Xu, X., Klotz, E., & Newman, S.T. (2017). Intelligent manufacturing in the context of industry 4.0: A review. *Engineering*, 3(5), 616-630. <https://doi.org/10.1016/J.ENG.2017.05.015>

Intangible Capital, 2022 ([www.intangiblecapital.org](http://www.intangiblecapital.org))



Article's contents are provided on an Attribution-Non Commercial 4.0 Creative commons International License. Readers are allowed to copy, distribute and communicate article's contents, provided the author's and Intangible Capital's names are included. It must not be used for commercial purposes. To see the complete license contents, please visit <https://creativecommons.org/licenses/by-nc/4.0/>.