CURRENT STATUS OF INDUSTRY 4.0

REPORT I - EUROPEAN AND NATIONAL LAW SUPPORT

INDUSTRY 4.0 for VET

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INTRODUCTION

Current industry 4.0 technologies offer enormous opportunities for economic and social development but are also giving rise to numerous legal issues, some of which already existed, and others which are completely unprecedented. New or not, the fast development of technological innovation constantly leads to really complex situations in the legislative field and, consequently, to legal uncertainty.

Fields where meaningful changes and new legislation is needed abound. For instance, as industry 4.0 implies massive quantities of data and information being used and exchanged, rules on privacy, cybersecurity, data storage and copyright become necessary. Industry 4.0 also obliges legislators to rethink the relationships between company-employee or company-customer, which requires important modifications in the field of labour law. The legislative framework affecting liability, such as product liability, contractual liability or assignment of risk, becomes also necessary in order to regulate, for instance, who should be responsible if a company produces a damaged or defective good. This is quite difficult to ascertain in the context of smart factories, where production networks operate as a whole through collaborative relationships amongst companies. Finally, industry 4.0 offers customers the possibility to get highly customized-designs. In this case, a legal framework regulating whether the company or the customer owns the property rights is needed.

These are just some examples, but there are multiple legal scenarios that should be addressed with an effective jurisdiction in order to promote a legal-friendly environment that allows different social actors to benefit from industry 4.0. Despite its importance, tackling these issues is extremely difficult due, amongst other things, to the slow pace of legislative changes, especially when compared to rapid technological development. In this context, European SMEs are one of the most affected groups because they do not have the necessary resources and skills to deal with the complex nature of law in the field of industry 4.0. This is an important barrier for the implementation of new technologies in the EU, as SMEs represent an important group in the current European economic landscape.

While it is clear that the promotion of industry 4.0 technologies must include the legislative support as a cross-cutting issue, the real situation across European countries differ. Through this report, the consortium members of the project InVET made a deep analysis and categorization of European and national laws regarding the Industry 4.0 in Italy, Spain, Austria and the Czech Republic in order to explore this incipient topic. The results of this analysis are exposed below.

LAW SUPPORT OF THE INDUSTRY 4.0 IN THE EU

As the fourth industrial revolution is unfolding worldwide, the legislative framework governing all Member States of the European Union must be adapted in order to reap all the benefits of technological progress. Although national initiatives play an important role in this change of paradigm, European Institutions have stated in multiple occasions the need of a common legislation in terms of industry 4.0.

As explained in the official communication of the European Commission (EC) "*COM (2016) 180 final*", this new legislation should try to address those aspects that national governments cannot achieve unilaterally, as they require a collaborative approach in order to attain the proposed impact. In the same Communication, the EC manifested the urge to adopt legislative and regulatory changes to tackle topics related to industry 4.0. Amongst others, the Commission mentioned *"issues relating to data generated by the multitude of new smart products, liability of more autonomous systems and safety with the increasing need for interaction between humans and smart devices"* (European Comission, 2016)*.*

The beginning of this collective effort arrived with the launch of the REFIT, the Digital Single Market Strategy (DSM) in 2015 and the Digitalising European Industry Strategy (DEI) in 2016. Most of the legislative changes connected with the implementation of industry 4.0 in the EU have been done within the scope of these three initiatives.

Firstly, in order to make this process as affective as possible, the EC launched the programme REFIT (Regulatory Fitness and Performance programme), which is playing a key role in the EU's legal transition. One of the priorities of the programme is to simplify European laws and to ensure that unnecessary legal burdens are removed in order to support economic agents in the transition to the fourth industrial revolution (European Commission, 2018).

On a similar vein, the DSM and the DEI Strategy have already brought key legislative changes to the European arena. On September 2018, the Commission published a factsheet outlining all the actions taken to establish "*a common regulatory framework fit for the digital age*" and *"to unlock the digital potential of Europe"*, in the words of the EC. This document shows that, since the official launch of the DSM Strategy, 30 legislative initiatives have been presented, from which 19 were agreed between the Parliament, the Commission, the EU and the Council, while 11 are still on the table (European Union, 2018). It is important to highlight that these actions intend to develop a digital-friendly regulatory framework in order to create a common Digital Single Market. This means that digitalisation is the main objective of the legislative changes, and thus, other central issues related to industry 4.0 have not been addressed yet. Despite this, there are several new and old laws directly affecting the implementation of industry 4.0 technologies in the EU.

Two of the legislative changes already implemented involve the creation of two regulatory instruments aimed at increasing trust and security within the Digital Single Market. These are the General Data Protection Regulation and the ePrivacy Regulation. Both are also highly connected with the development of the European Data Economy, which intends to *"unlock the re-use potential of different types of data and its free flow across borders"* (European Commission, 2018c).

The General Data Protection Regulation[1] (GDPR) came into force on May 2018 and it was created with the purpose of safeguarding personal data of individuals, a fundamental right especially important in the context of the digital age. According to the Commission, "*the GDPR offers businesses simplified rules, creates new business opportunities and encourages innovation*" (European Comission, 2016a). The new regulation carries important implications for the industry 4.0, as new technologies are based on an intensive collection and linkage of data. One of the most affected group of actors are businesses based on the Internet of Things, which should align their production processes to comply with the provisions of the GDPR. A reform made on 9/11/2018 also addressed the issue of barriers removal of non-personal data within the EU. This has important implications for connected production and the development of emerging technologies such as cross-border autonomous systems and artificial intelligence (European Council, 2018). Finally, through the Directive 2003/98/EC, the EC encourages the re-use of public-sector information, which can also contribute to the development of key technologies related to the industry 4.0.

A new ePrivacy Regulation was also developed and was planned to be applicable from 25th May 2018 but, after some delay, it will finally enter into force in 2019. It will repeal the existing Directive from 2002 and it is expected to work complementary with the GDPR. According to the Commission, the Regulation "*will further increase legal certainty and the protection of users' privacy online, while also increasing business use of communications data, based on users' consent*" (European Comission, 2016a). This regulation has many implications for the industry 4.0, smart factories and the Internet of Things (IoT). More specifically, it is concerned with safeguarding information in electronic and machine-to-machine communication.

Cybersecurity is also being a central theme of the SDM Strategy. The Cybersecurity Act (29th May 2018) represents a mechanism to *"enhance its cyber resilience by setting up an EU-wide certification framework for information and communication technology (ICT) products, services and processes"* (European Council, 2018). This Act can be especially useful for the certification of different products connected to the industry 4.0, such as connected cars and smart medical devices. In any case, certification will be voluntary if other member states' law or an EU law states the contrary.

Although data protection, ePrivacy and cybersecurity have been the main fields of action, there have been other legislative changes implemented as part of the DSM Strategy. From these, three

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[1] Regulation (EU) 2016/679 of the European Parliament and of the Council

legislative measures should be highlighted. These are named by the European Commission as "the triple win for European consumers" and aim to alleviate the fragmentation of the online market and to ensure a better access for all consumers to the DSM. More specifically, the measures are:

1) retail roaming charges, abolished from 15 June 2017

2) Cross border portability of online content services, which became applicable in all EU Member States on 1 April 2018

3) ending of unjustified geo-blocking (European Comission, 2016a).

The EU is also aware that standardisation and harmonisation are some of the preconditions to maximise interoperability between heterogeneous and complex technologies and products that form the basis of the industry 4.0. This, in turn, is also key for the development of a single and highly competitive digital market. Several legislative initiatives can be found in this field guided by the DEI and the official Communication released in April 2016 (COM (2016) 176 final), which presents the EU's ICT Standardization priorities. In this communication, the EC sets up a coherent standardization plan based on two pillars. Through the first one, the EC proposes five areas where standardization is urgently needed. These are IoT, 5G, cybersecurity, Cloud and Big Data. The second pillar is focused on fostering leadership and commitment amongst different social actors relevant for the creation of standards (e.g.: national institutions, standard-setting bodies, research community etc.).

In this aspect, a new European Interoperability Framework was also put forward by the Commission in 2017. The presented approach is focused on giving guidance and recommendations to public administrations in the EU with the aim of fostering interoperability in the field of European public services. However, up to this date, there is no homologous regulation for business standards. In this regard, digital horizontal and vertical enterprise interoperability is especially important for the context of the industry 4.0 and for B2B activities and, for some experts, actions might be needed in this field. Interoperability is also highly connected with the Intellectual Property Framework which, according to the EC, it is one of EU's biggest challenges.

In another vein, on the context of an increased demand of wireless broadband services, the Commission agreed on the decision of spectrum coordination. In this regard, in February 2016, the Commission also agreed on the use of high quality 700 MHz band in the EU. Apart from improving internet access and enabling cross-border applications to be developed, this decision will also have important implications for the production and use of connected cars, remote healthcare, smart cities and other innovative services. As stated in the Midterm Report of the DSM Strategy, Member States will have until 2020 to implement this decision.

A set of legislative measures were also implemented in order to boost cross-border e-commerce. These include fully harmonized digital contract rules; cooperation between national consumer

authorities; affordable cross-border partial delivery services and simpler VAT declaration procedures, as stated in the mid-term review of the implementation of the DSM Strategy.

So far, there are no rules concerning liability issues related to IoT devices. In case something occurs, the Product liability directive, the General Product Safety Directive and the machine Directive would be applicable. However, in mid 2019 the European Commission, together with a group of experts, is expected to publish a report with orientations and guidelines on how the current legal framework should be adapted regarding the liability framework connected to artificial intelligence, the Internet of Things (IoT) and robotics. In addition, the EU Parliament called upon the commission to make civil rues laws on robotics and is currently developing a report on a European industrial policy on artificial intelligence and robotics.

The present analysis of the EU's legislative framework regarding industry 4.0 can be useful to draw several conclusions. Firstly, it demonstrated that European Institutions are taking significant steps to create the right legislative conditions to fully benefit from the digital and industrial revolution that Europe is currently experiencing. However, these initiatives should be understood in a wider picture, together with other policies and programmes. Although most of the initiatives aim to develop a digital-friendly regulation and do not directly address the issue of industry 4.0, there are many laws affecting the use of industry 4.0 technologies. Some of the most important areas of change are data protection, e-privacy or cybersecurity. Moreover, this overview of the European legal framework also serves to highlight that there is still a lot of work to do, especially in some areas such as product liability, safety conditions in smart manufacturing or interoperability. Another conclusion is that, even though actions have already been implemented in a wide variety of fields, the process is slow-paced. One of the reasons is that, amongst other challenges, European legislators must try to find the right balance between legitimate business interests and the fundamental rights of European citizens regarding data protection and privacy (European Comission, 2016a). Some upcoming events, such as the European Parliament elections in 2019 could slow down this process even more.

LAW SUPPORT OF THE INDUSTRY 4.0 IN SPAIN

In terms of legislation and industry 4.0, Spain is adopting a rather retractive approach, accommodating to the legislation of the European Union and to technological advancements, instead of actively adapting the current framework to meet the challenges that industry 4.0 poses. Spanish national strategy to support industry 4.0 named "Industria Conectada 4.0", included in 2017 a Working Group focused on Standardisation, which aims to develop new laws and standards in terms of industry 4.0 at a national and international level. So far, this is the only mechanism strictly specialised in the development of law support to the industry 4.0 in Spain.

But before analysing this type of support to the industry 4.0 in the Spanish context, something important to bear in mind is the level of decentralisation of its political system. Even though the legislative power is mainly vested in the national Parliament, the Constitution guarantees certain degree of legislative autonomy to the seventeen Autonomous Communities and also assigns different resources to each of them for the control and implementation of the enacted legislation. This makes regions to epitomise different realities in terms of legislation and support for the industry 4.0 and makes the analysis difficult.

Another important issue to take into account is the political scenario. In this regard, the current political party in power (PSOE) has proven to be committed with the fourth industrial revolution. In the specific field of law, the present government has recently put forward several legislative initiatives.

Firstly, the Minister of Industry, Commerce and Tourism announced the decision to develop a new Industrial law, given that the current one dates back to 1992. Although the available information is quite limited, the Minister stated that the aim of the law, which will be soon presented in the Congress, will be to adapt the current law to the developments of the XXI century and to provide industry with new tools to face the new challenges connected to technological changes (Europa Press, 2018).

Another objective of the government is to adapt the educational system to the requirements of the industry 4.0, which will require changes from the legislative point of view.

In a similar vein, the Minister also developed a reform in the labour contracts of the automotive sector, one of the most important industrial sectors in Spain, which is making great advancements in the implementation of industry 4.0 technologies. The objective of this reform is to strengthen this specific sector by boosting employment and the rejuvenation of the staff. Unlike the previous initiatives, this action was finally implemented though a royal Decree Act in December 2018.

These are the most recent updates, but there are other key legislative changes implemented in the Spanish regulatory framework. Probably, the most famous one is the new organic law in Spain about personal data protection and safeguarding of digital rights, named "Ley Orgánica 3/2018". This law

was approved on December 5, 2018 and was triggered, in part, by the EU's General Data Protection Regulation (GDPR) of May 2018. The law aims to guarantee and protect two basic rights of citizens, which are the fundamental right of every person to the protection of personal data, enshrined by the Article 18.4 of the Spanish Constitution, and citizen's digital rights. The latter include, amongst others, the right of digital security and education or the right to digitally disconnect in the workplace.

In addition, industry 4.0 has brought about numerous changes in international standards and norms connected to key aspects of smart factories and industry 4.0 such as interoperability, connectivity, IoT or robotics. In this vein, the Spanish government has created several Specifications. For instance, "UNE 0060 Industry 4.0- Management system for digitalisation" was created in 2018 in order to enhance industrial digitalisation in Spain by promoting an effective management system based on a series of requirements.

In addition, Spain counts with several laws and national regulations that, although not new, directly affect issues related to industry 4.0, such as cybersecurity. The most relevant one in this field is the "Law for the protection of critical infrastructure". This law has been recently modified by adding new obligations on certain operators of digital services, following what was stated by the European NIS Directive. In terms of cybersecurity, the coordinator of the Spanish Centre of Industrial Cybersecurity emphasises the lack of a specific cybersecurity legislation in the industrial context and the slow legislation as two weaknesses of Spain (Centro de Ciberseguridad Industrial, 2019).

Another expected field of change is labour law. Although there are no major modifications so far, there are multiple demands coming from important workers' unions to adapt aspects of the labour conditions to the new reality of industry 4.0. A specific proposal is to tackle security concerns in the industrial context, given that the current directive is from 1995 (although it was subject to several regulations). In this regard, the Spanish Strategy of Security at Work 2015-2020 highlights the importance of paying attention to the new risks emerging from the use of new technologies in the workplace, although legislative actions have not been implemented so far. Other demand of trade unions is to tackle the issue of the skills mismatch that is flourishing in the Spanish economy.

To conclude with, it could be stated that the Spanish legislative framework is not changing at the same pace than technology does, which could seriously compromise governments' plans to move towards an industry 4.0 model. Although there are multiple national and local initiatives supporting the adaptation of the Spanish industrial fabric to industry 4.0 in fields such as awareness, training or financial support to SMEs, these actions could fall short if the laws and regulations are not properly adapted to the new reality. Probably, an essential requirement would be to increase the adaptive capability of the Spanish legislative framework to keep it up-to-date with technology. This could be done, amongst other things, by investing financial resources, by creating specific tools and by making use of the existing ones, such as the Standardisation Working Group of the initiative Industria Conectada 4.0. In addition, a more stable political climate would definitely help to reduce

this gap between law and technology. In this aspect, the next elections, which will take place on April 2019 will determine the future of the law support in Spain.

LAW SUPPORT OF THE INDUSTRY 4.0 IN AUSTRIA

In Austria, the main laws and regulations concerning industry 4.0 are derived from European laws and regulations that are implemented at national level. There are laws that refer thematically to industry 4.0, but none that regulate the direct uniform handling in industry 4.0.

In Austria, the main laws supporting and relevant for industry 4.0 are the international ones, which are of European scope like the General Data Protection Regulation (GDPR), the E-Invoicing, eIDAS-Regulation, Guidelines for reuse of public sector information (PSI), Service Directive, Guideline for Network and Information Security (NIS-RL) or the Web-Accessibility-Guideline.

Other laws which are partly supporting industry 4.0 are the national E-Government-Act, the General Administrative Procedure Act (Allgemeines Verwaltungsverfahrensgesetz) and the Telecommunication Act (Telekommunikationsgesetz).

The E-Government Act - the core of Austrian eGovernment law - entered into force on 1 March 2004 and was last amended on 1 July 2016, in particular as a result of adaptations to the Regulation on electronic identification and trust services for electronic transactions in the internal market (eIDAS Regulation). The law forms the legal basis for the eGovernment instruments and modules used. Facilities such as the citizen card, the area-specific personal identification number or the electronic delivery can also be used by the business sector. This means for the industry 4.0 sector (as for any other business sector), that the data and information transfer is regulated.

The highest principles of the e-government law are:

- Freedom of choice between modes of communication for connection to the public administration.
- Ensuring safety and privacy in electronic data transfer through the creation of appropriate technical means such as the Citizen Card.
- Accessibility for disabled people to public administration information and services by complying with international standards governing web accessibility.

(Bundesministerium für Digitalisierung und Wirtschaftsstandort[1], 2019).

The General Administrative Procedures Act (AVG – Allgemeines Verwaltungsverfahrensgesetz) regulates the bases of administrative procedures – for the industry 4.0 sector as much as for any other business field.

For the field of e-government, § 13 AVG is relevant, which regulates the possibilities of establishing contact between citizens and public authorities. Thus, the electronic transmission of attachments is

possible, for example via e-mail or fill-in online forms. The authority may also publish a text stating how and to which addresses applications may be submitted electronically, whether an electronic signature is necessary and which formats are required for electronic applications (§ 13 (2)). (Bundesministerium für Digitalisierung und Wirtschaftsstandort[2], 2019).

The purpose of the Telecommunications Act 2003 (TKG 2003) is to ensure that the population and the economy are supplied with reliable, affordable, high-quality and innovative communications services by promoting competition in the field of electronic communications. This Act supports communications services in the industry 4.0 sector as much as in any other business field.

The aims are to achieve the following objectives:

- A modern communication infrastructure to promote quality of location at a high level

- Prevention of distortions of competition or restrictions on competition

- Promoting the interests of the population, with the interests of users and the elderly and those with special needs being particularly favorable.

(Bundesministerium für Digitalisierung und Wirtschaftsstandort[3], 2019).

As shown with the previously cited laws, most of the relevant Regulations and Acts have been enacted in the early 2000s and since then there have not been any substantive laws due to the fact that EU Laws, directives and regulations are reflected in the national legislation. The Austrian Laws and Regulations are directly linked to the European Laws and Regulations.

As illustrated earlier there are laws that refer thematically to industry 4.0, but none that regulate the direct uniform handling with and within industry 4.0.

Most processes are regulated by certifications or regulations. These regulations were mostly created and established by various stakeholders and Research, Innovation and Standardization Communities in the labour market. They serve to make work processes, products and services comparable and measurable - including those which are connected to industry 4.0. They contain recommendations on methods, processes and procedures as well as measures and

- enhance the general understanding and benefits of standardization,
- support the integration standardization,
- provide tools and instruments for an improved involvement of standardization and
- make standardization visible within the community.

The inter-company standardization for companies comprises the global business (international standards such as ISO, IEC, etc.), the national business (ÖNORM, etc,), as well as the exclusively intra-industry business (e.g. eCl@ss, etc.).

LAW SUPPORT OF THE INDUSTRY 4.0 IN THE CZECH REPUBLIC

The sad fact is, that there is NOT any law, which will set up some standards, tax benefits etc. Someone could except law support for the implementation of industry 4.0 in such an industrial country as the Czech Republic is, but there is not.

There are no laws, directives, acts and regulations at all. Only let´s say "connection" is GDPR, which comes as a directive from the EU and it´s implemented on the core level. It means, that in Czech we implemented what we have to, but there is not anything above the level which EU set up for all countries.

Which areas should be supported by law, from our point of view? Definitely it should by tax benefits to make implementation of industry 4.0 not so expensive. Also, modification in school system, bigger support for technical school at all levels is so badly needed. These two topics are crucial and without law support, the real progress in the area of IR 4.0 can´t be done, for sure. As a next step there should be prepare legal act focusing on cybersecurity, to ensure privacy, security of data, know-how etc.

After that, several topics should be covered by law, which could be adapted from western countries, where such a legislative is active for several years, for example:

1. Data/big data
2. Digitalization
3. AI
4. IoT

Trade unions are active, from time to time, they have enough power to do something with many things, for sure. But the true is, that in the Czech Republic, they have a lot of topics, which are more painful for them e.g. minimum wage. Unions are aware, that IR4.0 is coming / is here and that should be quite a big impact on a very big part of their members. Still, they have different priority in this moment. Nevertheless, it´s obvious, that when the right time comes, the unions will play an important role in pushing government to make some steps, which will support employees in many ways.

Only one conclusion what can be said is, that there should exist a legal act, which will support those companies, which wants to implement some kind of products/services. Such an implementation cost a lot of money, but the positive effect is not only for the company but also for the industry as a whole. …and one of the mottos during the elections is, that the Czech Republic should not be just a fitting shop for the western countries, but we shall produce goods with added value!

International cooperation with Germany:

Visit of Chancellor Angela Merkel in August 2016 revolved around industry 4.0, memorandum of understanding signed between the Czech Institute of Informatics, Robotics and Cybernetics and the German Research Centre for Artificial Intelligence (DFKI) Call for Czech-German research cooperation in May 2017 under the DELTA Programme of the Technology Agency of the Czech Republic focused on industry 4.0

International cooperation with Japan:

Memorandum of understanding between the Japanese Robot Revolution Initiative and Czech Alliance Society 4.0 / Confederation of industry of the Czech Republic signed in Tokyo on 28 June 2017.

Projects related to industry 4.0 can be supported by various funds. On the national level, those are mainly the programs of the Technology Agency of the Czech Republic and the TRIO programme (subsequent programme to be announced) of the Ministry of industry and Trade. The Operational Programme Enterprise and Innovation for Competitiveness is also relevant for industry 4.0, as is the EU framework programme Horizon 2020.

LAW SUPPORT OF THE INDUSTRY 4.0 IN ITALY

This essay reconstructs the evolution of the Italian legislation for what concerns the industry 4.0. After a brief summary of the current state of the Italian economy, the paper aims to describe which have been the most important steps in the evolution of the legislation related to this topic. Among the different contributions that are presented, a particular attention is devoted to the Budget law of 2017, which represent a cornerstone for all the developments that will characterize this subject.

New technologies and productive models lie at the heart of so-called industry 4.0. This concept has recently come into the socio-economic and political debate all around the world. These technologies have been developed for a long time in the most developed countries of the world, making that the importance of this sector in the respective economies has significantly increased. It has been the legislative effort which allowed those countries to adapt their economic system to the needs resulting from this new form of economy. Contrary to the general trend, Italy presents a significant delay for the exploitation of technologies of the industry 4.0, especially if compared with OECD countries. This delay is explained by two trends, namely the failure to modernise the companies to models in line with these new technologies, and to the lack of professional training courses for the respective staff[2]. Nonetheless, starting from the last years, Italy has recorded a slowly development of the industry 4.0 to indicate the effects of a deep innovation, both in the industrial manufacturing

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[2] As an example, "7 companies out of 10 have not done yet anything or almost to form, equip themselves and understand how to decline the "Industry 4.0" in their own reality of SMEs". To deepen this point, see www.IlSole24Ore.com, *Italia in ritardo su industria 4.0*, Laura Cavestri, 27 gennaio 2016.

processes and in the markets of products and services, deriving from the widespread diffusion of internet and the consequent interconnection between real/material and digital/immaterial dimension.

Italy is a country that combines a series of peculiar characteristics, that make it unique in the European panorama. First of all, Italy is a country characterized by a great prevalence of small and medium industries, which have an important impact in the national economy. Furthermore, despite the economic crisis, Italy has one of the largest manufacturing sectors in Europe. Nevertheless, Italy is one of the countries that suffered more the effects of the economic crisis, considering that it has one of the worst unemployment rates in Europe, and the situation is even worse for young people. It is precisely for the aforementioned reasons that 4.0 could represent a decisive element for the revival and economic sustainability of the country.

Once defined an overview of the Italian economic, the goal of this report is to highlight which are the legislative innovations have been implemented in the Italian context aimed at improving industry 4.0. Following the aforementioned trend, some legal provisions have been implemented in order to facilitate the development of the industry 4.0. This change has been determined at two institutional levels. The first one concerns the two Chambers of the Italian Republic, the chamber of Deputy and the senate, which have given their contribution mainly by reports and recommendations, and then by the Government, which inserted the industry 4.0 as a focus topic of the 2017 Budget law.

The first step concerning the modernization of the country towards new technologies date back in 2012. With the decree-law n. 179 of 2012 (the so-called Growth decree, converted with modifications from the law n. 221/2012), concerning tax incentives investment in innovative start-ups is introduced for the first time the definition of a new innovative enterprise, the start-up. For this type of company a reference framework, articulated and organic at national level, is set up. This framework intervenes on different subjects such as administrative simplification, the labour market, tax breaks, the bankruptcy law. In the following years, some significant changes were made concerning innovative start-ups, which have been simplified and extended in access requirements, in order to make legislation more effective in encouraging innovative entrepreneurship. The legislation in favour of innovative start-ups it does not concern only one sector but refers potentially to the whole world productive[3].

The Chamber of Deputy and the Senate of the Republic, which in Italy represents the body in charge of the legislative production, have promoted direct and indirect measures to promote the development of industry 4.0. The interest in this topic has been brought to the general attention by an informal association, the parliamentary intergroup for the technological innovation[4], in 2015. The mentioned intergroup, born to promote the technological innovation in Italy, presented a series of

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[3] D.l. n. 179 del 2012 "Ulteriori misure urgenti per la crescita del Paese".
[4] Testo dell'Interpellanza C. 2/00646, su OpenParlamento.

issues to promote the dissemination and implementation of the Internet of things (IoT)[5], within the stability law, which however were not approved.

The Chamber of deputy was engaged to identify a strategy for the industrial politics, and to support the Government in the Plan for industry 4.0. In particular, the Commission for the productive activities, commerce and tourism approved on February the 2nd of 2016 the exploratory analysis "Industria 4.0. Quale modello applicare al tessuto industriale italiano. Strumenti per favorire la digitalizzazione delle filiere industriali nazionali" (Industry 4.0. What model to apply to Italian industrial structure? Tools to improve the digitalisation of the national sectors of industry). The plan, after a detailed analysis of the Italian economic situation, was approved in June 2016. This study served a series of purposes, because it "provides an analysis of the current economic context, identifies the declining and growing economic sectors, provides data on employability and employment, and focuses on the sectors that already started to use the most advanced technologies"[6]. These studies have been the cornerstone on which the "Piano Industria 4.0" has been subsequently developed.

On the other side, the Senate move substantially on this topic on March 2017, within the study on "l'impatto sul mercato del lavoro della quarta rivoluzione industriale" (n.974)[7]. This document represents a detailed survey for what concerns some key aspects of the industry 4.0, namely the consequences on the labour law, the different knowledge, skills and abilities required, well-being and security at workplace, and other connected aspects. For what concerns the legal aspect, the study highlights the positive and negative aspects of this 4.0 industrial revolution. The production sector and the labour work are going to change rapidly, changing the main characteristics of the labour law as it was structured. The reduction of transition costs will have several positive effects, an easier match between supply and demand for services, a better use of people of their own time, an increase in the demand for well-qualified workers, considered the growing competition between entrepreneurs. Nevertheless, the survey points out some negative consequences for the labour market. First, a progressive deconstruction of the security tools of traditional works, the ambiguity of some contractual forms, and an increasing competition between workers[8]. This document wants to stimulate reflection on the positive effects that industry 4.0. can have on Italian economy and its essential role in his recovery, but on the same time make clear that some specific legal provision

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[5] The *Internet of things* (IoT) is defined as a "network of objects equipped with identification technologies, connected to each other, able to communicate both to each other and to nodal points of the system, but above all able to constitute a huge network of things where each of them is traceable by name and in reference to the position". *Internet of Things*, www.treccani.it, Lessico del XXI Secolo (2012).
[6] Cit. *Il futuro di Industry 4.0 in Italia*, Gruppo di lavoro Ricerca e Sviluppo, AmCham Italy, White paper, June 2018, p.38.
[7] Senato della Repubblica, 11ª Commissione Lavoro, previdenza sociale, March 2017.

[8] *Ibidem.*, pp. 11-12.

should be planned for what concerns the protection of most marginalized workers, namely young people and low skilled ones.

We can summarize that these efforts have facilitated the entry of the industry 4.0 issue in the public Italian agenda, and served as the basis for the most important legislative changes.

That is why, these studies have been reflected in legislative provisions some months later. It is in 2016 when the Renzi Government was in charge when the issue of industry 4.0 has grown to become one of the most important issue to debate, so far to be included in the Budget Law for 2017[9]. In the law, some key points are directly dedicated to the industry 4.0.

We can recall ART.3, which is about the extension of measures concerning amortisations, that provides "a new measure of increase of the 150% of the amortizations on goods to high technological content"[10]. This provision is intended to support and incentivize companies that invest in new capital goods, such as software and IT systems, functional to the technological and digital transformation of the production process. Indeed, paragraph 2 introduces a new benefit for the new instrumental material goods to high content technological actions to favour the processes of technological transformation in key industry 4.0 an increase of the 150% acquisition cost, allowing so to amortize a value equal to the 250% of the cost of purchase.

ART.13 mark an important innovation for what concerns measures for investments. This section contains for year now the so called "Nuova Sabatini"[11], a tool granting of subsidized loans for the purchase of new machines, plants and equipment by small and medium-sized enterprises. In the Budget law, two changes are applied to this tool. First, is length is extended by two years until 2018, and new funds are allocated for this period. Second, and more relevant for the aim of this essay, Nuova Sabatini range of action become more focused in facilitate the transition of the production system to digital manufacturing. For this aim, "investments in technology are eligible for the facilitation measure, including big data, cloud computing, ultra-broadband investments, cyber security, advanced robotics and mechatronics, augmented reality, 4D manufacture, radio frequency identification (RFID)[12]. Furthermore, these measures guarantee a contribution to partially cover the interest paid by the company on bank loans of between 20,000 and 2,000,000 euros, granted by banks affiliated with the MISE, which draw on both a specific ceiling of Cassa Depositi e Prestiti, and to ordinary stock. The contribution is calculated on the basis of a 5-year conventional amortization plan with an interest rate of 2.75% per annum and is increased by 30% for investments in industry 4.0 technologies. Furthermore, the Nuova Sabatini allows priority access to the Central Guarantee Fund to a maximum of 80%.

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[9] Legge di Bilancio 2017, Dossier XVII Legislatura, Novembre 2016.
[10] Cit., *ivi*, p. 30.
[11] Art. 2, d.l. n. 69/2013, "la Nuova sabatini per l'acquisto di beni strumentali".
[12] Cit., Legge di Bilancio 2017, p.66.

ART.14 is about the extension and strengthening of investment facilities in start-ups and innovative SMEs. A large part of these measures are also extended to innovative SMEs, operating in the field of technological innovation.

Some important provisions are identified in ART.21, which create a financing found for investments related to some strategic sectors. Among these, a relevant one is represented by high- tech industrial activities, which is perfectly in line with the industry plan 4.0 proposed by the Government.

ART.43-45, are devoted to financing found for excellence of University department. This new found - which has a budget of 271 million of euro - is aimed at incentivising, with a five-year financing, the activity of University departments that is thanks for the excellence in research and in the scientific, organizational and didactic planning, as well as with reference to industry 4.0 research applications[13].

These are the most important changes Italian legislation had in the last years. Fortunately, Italian legislation has moved in the direction to regulate such an important aspect of its economy. It is no coincidence that this legislative update is one of the factors that has helped a (albeit slow) economic recovery in recent years. Furthermore, despite Budget Law 2017 was approved two years ago, its main content was not too much modified by the following Governments, demonstrating its effectiveness.

CONCLUSIONS

The present report has been useful to get a better understanding of the legislative approaches adopted by the governments of Italy, Spain, Austria, the Czech Republic and the EU with regard to industry 4.0.

A general conclusion that can be drawn is that, despite the importance that this topic has for the successful transition of the European Union towards an industry 4.0 model, this aspect has gone commonly unnoticed or even neglected by many national governments and legislators. In this regard, the discussions and debates focused on this issue in the partner countries are just beginning and consequently, specific jurisdiction related to industry 4.0 is still rare (e.g.: Spain or Italy) or almost non-existent (e.g.: Austria and the Czech Republic). This contrasts with the fact that the four countries have launched national initiatives to support industry 4.0 technologies.

Another common characteristic is that the European legislation plays an important role in the legal national frameworks of the four countries analysed. In all the cases it has incentivised changes and urged national governments to adapt their jurisdiction to technological advancements, which

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[13] *Ibdem*, p. 194.

confirms the value that European initiatives have to trigger and to address certain aspects that national governments could not achieve unilaterally.

Amongst the legal initiatives analysed in the EU, the GDPR, the e-Privacy Regulation and the Cybersecurity Act stand out due to their important implications for industry 4.0. In this sense, the Digitalising European Industry Strategy has played a key role in the development of the European initiatives reviewed, but despite all the advances, it could be said that we are at the beginning of a long process.

Connected to the previous idea, in the majority of the contexts studied the legal initiatives aim to develop a digital-friendly regulation -which is a necessary step– but do not directly address the issue of industry 4.0 from a holistic perspective. In this case, Italy would be, to some extent, an exception.

When looking at the national contexts, despite sharing some characteristics, the legislative support in each of the countries differ.

In the case of Spain, the context represents a fertile ground for the creation of new legislation. The government seems to be proactive to integrate industry 4.0 in the Spanish legislative framework, there is a national initiative focused on industry 4.0 and social actors such as labour unions are demanding a revision of the current law. However, only minor changes have been implemented so far. In this sense, the general and regional political elections of April 2019 will determine the future of the law support in Spain.

In Austria, most of the laws reviewed are directly linked to the European legislation, while others date back from the 2000s. Since then, there have not been any substantive changes aimed at regulating certain aspects of industry 4.0. The most relevant ones would be the e-government Act, the Telecommunications Act and the General Administrative Procedure Act, which refer thematically to industry 4.0 but are connected to the topic in an indirect way.

Similarly, in the Czech Republic there are no laws connected to industry 4.0 except those from the EU. This is striking, given the huge weight of the industrial sector in the country and the recent political narrative based on the idea that the Czech Republic should produce goods with added value. This negative scenario could be potentially reverted due to the role of social actors such as trade unions.

Finally, when compared with Spain, Austria and the Czech Republic, Italy seems to have taken more significant steps in this field. In this country, the Budget Law (2017) represents the most important initiative in terms of legislation related to industry 4.0. This law includes several articles dedicated to the topic of industry 4.0 through which the Italian government aims to incentivize the acquisition by companies and SMEs of capital goods related to technological transformation by means of several financial mechanisms.

These are, in summary, the most important ideas that can be drawn from the report. Apart from that, this analysis also serves to prove that there is still a lot of work to do. In this sense, this will not be an easy journey due to several barriers, including the fast development of technological innovation, the fast-evolving scenario of the labour market or the slow-paced nature of legislative changes. However, overcoming these barriers is an essential requirement to develop a legal-friendly environment that allows different social actors to benefit from industry 4.0.

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CURRENT STATUS OF INDUSTRY 4.0

REPORT II – CURRENT EUROPEAN AND NATIONAL SUPPORT OF THE INDUSTRY 4.0 BY GOVERNMENTS

INDUSTRY 4.0 for VET

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MURAU

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INTRODUCTION

As many have already highlighted, the future of manufacturing is going digital and industry 4.0 technologies like artificial intelligence, cloud computing, robotics, the Internet of Things or big data have already changed the nature of our economy and society. In this era of major technological disruption, the digital transformation of the European industry is an essential requirement to ensure the economic and social competitiveness of the European Union. Amongst other advantages, industry 4.0 technologies hold the promise of increased productivity, mass customisation, improved quality, flexibility and speed in manufacturing processes.

However, to capture the benefits of industry 4.0, companies, governments and other economic and social actors must successfully face multiple challenges. Amongst the main obstacles to be overcome the need for investment, changing business models, data issues, legal questions of liability, intellectual property standards or skill mismatches stand out as the most problematic (European Parliament, 2015). Together with many others, these are the reasons behind the low adoption rate of digital technologies in European enterprises in comparison to other regions. In this aspect, over 41% of EU companies have yet to adopt any of the new advanced digital technologies according to the Digital Transformation Monitor of 2017.

Ministries, institutions from the European Union and central and other regional governments have a central role to harness the full potential of new industry 4.0 technologies. This can only be done by developing comprehensive actions aimed at taking advantage of the opportunities while mitigating the dizzying challenges mentioned before. In the EU, political and industry actors have shown their commitment to work together and several initiatives have already been launched at different levels– according to the Digital Transformation Monitor 2018, 68% of EU Member States have already put in place comprehensive digital transformation policies. The most common targeted measures of support coming from policy-makers include infrastructure, access to finance, education, regulation and standardization or governance (e.g.: strategic plans).

Through this state-of-the-art analysis, the partnership of the project InVET "Industry 4.0 for VET" seeks to point out the most relevant regional, national and European support initiatives towards industry 4.0, including a summary of attitude of national governments and a comparative summary of identified differences. Given the overview of the context provided before, this is a vital exercise to stimulate and share knowledge, as well as to foster the exchange of good practices amongst the EU.

CURRENT EUROPEAN SUPPORT OF THE INDUSTRY 4.0

With the goal of underpinning industrial competitiveness and reversing the trend of de-industrialisation in Europe after the economic and financial crisis, the European Commission launched the official Communication entitled "For a European Industrial Renaissance" (COM (2014) 0014) in January 2014. In the document, the Commission reiterated the target of increasing the relative share

of industry up to a 20% of the total value added in the EU by 2020. Although this objective seemed overly ambitious in 2014, it is now more plausible due to the technological advances of the fourth industrial revolution and the implementation of European policies, plans and programmes aimed at supporting the transition towards industry 4.0. In fact, the EU has been working to set up a path to turn the fourth industrial revolution to EU's advantage. Three of the most relevant and highly connected initiatives through which the EU intends to achieve this objective are the Digital Agenda for Europe, the Digital Single Market Strategy and the Digitalising European industry Strategy.

The Digital Agenda for Europe (DAE) was launched in May 2010 with the objective of boosting the potential of Information and Communication Technologies (ICTs). The DAE is one of the top seven priorities for the 2020 European Strategy, which sets out EU's vision of growth up to 2020. Among the seven building blocks that form the DAE, the creation of a digital single market is considered one of the most relevant targets.

In order to ensure the creation of a common digital market, the Commission established the Digital Single Market Strategy (DSMS), which was adopted on May 2015. In more detail, this strategy aims to support economic agents across all industrial sectors in their technological transformation towards the industry 4.0, as well as "*to ensure access to online activities under conditions of fair competition, consumer and data protection, removing geo-blocking and copyright issues*" (European Commission, 2018a). It plans actions along three main pillars: 1) Better access for consumers and businesses to online goods and services across Europe; 2) Creating the right conditions for digital networks and services to flourish and 3) Maximising the growth potential of the European Digital Economy (European Commission, 2018a).

The completion of the DSM strategy has been identified by the European Union (EC) as one of the ten political priorities at the European level and most forms of support to the development of the industry 4.0 have arrived within the framework of this plan. This demonstrates that the European Union has strategically opted to focus in the digitalisation of a common European market in order to pave the way for the coming of the new-generation information technologies.

After the presentation of the DSM strategy, the EC launched the Digitalising European Industry Strategy (DEI) in April 2016. It represents a key element of the DSM Strategy, being especially concerned with the topic of industry 4.0. Two years after its official publication, the EC continues to implement measures within the framework of this strategy in order to ensure Europe's continuity as a leader in digital technologies. More specifically, the DEI Strategy seeks to guarantee that all European industries, whatever their size, industrial sector or geographical location, can take the most out of the digital innovations to upgrade its products, improve its processes and adapt its business models to the digital age (European Union, 2018b). The strategy is structured around five main points, which are supposed to work synergistically with current national initiatives on the industry 4.0, securing a coherent European approach. These include

1) A European Platform of National Initiatives on Digitalising Industry

2) Digital Innovation Hubs

3) Strengthening leadership through partnerships and industrial platforms

4) A regulatory framework fit for the digital age

5) Preparing Europeans for the digital future (European Union, 2018a).

In order to analyse more in depth how the EU is supporting the potential of technological advancements across industries in Member States, an overview of each pillar is needed.

Figure 1: The five pillars of the Digitalising European Industry Strategy

The first field of activity is concerned with the creation of a European platform of National Initiatives on Digitalising Industry. With this platform, the EC aims to tackle specific challenges posed by the fourth industrial revolution by coordinating and aligning national initiatives and European efforts and thus, avoiding duplicating of actions. So far, this platform is taking the form of a forum, organised twice a year in Brussels. In their last meeting, representatives from ministries, national initiatives, businesses and union associations met in order to exchange good practices and ensure that all Member States are going in the same direction. This type of coordination has already led to specific partnerships and European co-investments in fields such as the high-performance computing. In this respect, the European High-Performance Computing Joint Undertaking was created with the aim of developing a European supercomputing ecosystem, making this type of technology available for public and private organisations, including SMEs.

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As part of the second strategical pillar to achieve DEI's goals, the EC has invested a great amount of resources (100 million per year from 2016 to 2020) on the creation of Digital Innovation Hubs (DIHs). DIHs are usually formed by R&D centres and highly innovative organisations that support companies that want to improve their business models and value chains by means of digital innovations. Amongst other benefits, DIHs allow businesses to have access to infrastructure, technology testing, financing advice or networking. Moreover, DIHs play a key role as training providers on digital competences for SMEs, a dimension that will be further strengthened during the next years.

The creation of DIHs and the strong focus on skills training are policies aimed at ensuring the digital transformation of all companies. This is especially important in the context of the EU, where 90% of the European SMEs feel that they are lagging behind in digital innovation and only one out of five companies across the EU are highly digitalised (European Union, 2018a).

In addition, the EC is investing in the creation of a pan-European network of DIHs in order to facilitate communication and coordination. So far, a European Catalogue of DIHs has been created and currently acts as a virtual repository with relevant information of each DIH. The EC is also implementing training programmes for new DIHs to cover underrepresented geographical areas. Other specific initiatives supporting the establishment of the pan-European network include the Smart Anything Anywhere Initiative (SAE), the ICT Innovation for Manufacturing SMEs Program (I4MS) for SMEs and mid-caps, The Open Data Incubator for Europe (ODINE) or the European Coordination Hub for Open Robotics Development.

A common research and development agenda and public-private partnerships (PPP) are other mechanisms used at the European level to foster innovations related to the industry 4.0. An example of successful PPP is the Big Data Value PPP, formed by the EC and the Big Data value Association, who joined forces to make Europe a global leader in the Big Data market. Another example is the Public-Private Partnership for Robotics "SPARC", which aims to increase the availability of robots in manufacturing and service industries, amongst other fields.

The EU has also started to implement funding for initiatives related to the industry 4.0. One of the most important funding mechanisms currently available is Horizon 2020 (2014-2021), a research and innovation programme that will be essential to achieve high performance in key technologies such as 5G, robotics or cybersecurity. For instance, through this tool the EU will invest almost EUR 500 million in research and innovation related to the Internet of Things. Since 2014, projects have been also financed on topics such as systems-of-systems, embedded systems and monitoring and control.

But Horizon 2020 is not the only financial instrument related to the development of the industry 4.0. The five European structural and investment funds (ESIF), for instance, have in their top investment priorities for Research and Development the creation of the digital single market and the development of digital technologies. Other examples of networks and investment platforms are The Connecting Europe Broadband Fund or the European Fund for Strategic Investments (EFSI), from the European

Investment Bank. In this regard, the Commission is currently studying the option of involving the European Investment Bank in some kind of programme to facilitate financing for SMEs in their transition towards the new industrial revolution.

The EU is also facilitating the creation of ICT standards and an interoperability strategy in order to allow connected devices to communicate easily and safely, which is key to take the leap forward to smart manufacturing. The Commission launched the 2018 Rolling Plan for ICT Standardisation which contains all the legislative and non-legislative initiatives that will be implemented in this area. It also sets out the main standardisation priorities, which include 5G, Internet of Things, cloud computing, cybersecurity and data technologies. Additionally, a European Multi Stakeholder Platform on ICT standardisation has been formed by government representatives of the EU and EFTA countries, European institution and stakeholders representing the industry and consumers. This platform will provide advice on the implementation of the Rolling Plan.

The fourth pillar of the DEI Strategy aims to provide a regulatory framework for the digital age. One of the most important initiatives within this action is the creation of the European Data Economy, which intends to unlock the potential of data across Europe. The value of data in terms of European GDP is constantly increasing and it will represent the 4% of the overall EU GDP in 2020 if the correct measures are put into place, according to the Commission in the Midterm Report of the DSM Strategy in 2017. Given the central role of data in the European economy, the Commission published in a recent communication (25 April 2018) the next measures for the creation of the European Data Space. These include actions "*without unjustified or disproportionate rules restricting companies' location choices for data storage and processing*" (European Union, 2018a).

Apart from the legislative changes (e.g.: GDPR and the free flow of non-personal data), the goal of pursuing a European Data Space has brought other policies such as the European Cloud Initiative, which will make easier for European scientific community, industry and public sector to grasp the advantages of new technologies, especially big data. More specifically, this initiative will make large numbers of information fully available and stored in the cloud for these actors, who will be able to use it for R&D purposes.

Another important field of action has been cybersecurity. This issue is of outmost importance at the European context, as according to the EU, 80% of the companies in experienced at least one cybersecurity incident (European Union, 2018a). The proposed measures to deal with this situation include the creation of a European Cybersecurity Agency, a new European Certification Scheme for products and services, the creation of European Cybersecurity Competence and Research Centres or a plan for how to respond to large-scale cyber-attacks.

Regarding Artificial Intelligence (AI), the initiatives that have been developed at the European level include "a European approach to AI" based on three pillars:

1) connect and strengthen AI research centres across Europe

2) support the development of an "AI-on-demand platform" that will provide access to relevant AI resources in the EU for all users

3) support the development of AI applications in key sectors (European Commission, 2018b).

Finally, the fifth strategically field of action of the DEI Strategy comprise those policies aimed at fostering digital skills. This seems crucial to tackle the shortage of professionals to support the transition towards the fourth industrial revolution, as well as to prepare citizens for the changes it will bring. This goal is materialised in several initiatives that aim to coordinate and support the work of Member States, and which are being implemented under the framework of the New Skills Agenda for Europe. Three of the most relevant ones are the Digital Skills and Jobs Coalition, the programme Erasmus + and the Digital Education plan. The first one was launched in December 2016 and aims at improving digital skills by bringing together Member States, NGOs, companies, educational centres and other social actors. In the case of the programme Erasmus+, the EU stated in its last Strategic plan that fostering digital skills amongst society was one of its main priorities. Moreover, Erasmus + is offering traineeships in fields such as artificial intelligence, software development or data analytics. Lastly, the Digital Education Action Plan includes 11 actions under three main priorities. These are making better use of digital technology for teaching and learning, developing digital competences and skills and improving education through better data analysis and foresight (European Commission, 2018c).

Although the Commission is the main public body in charge of developing the initiatives previously described, their implementation could not be possible without the work of other organisations and institutions, both European and national. Some of the most important stakeholders include the European Trade Confederation, European Trade unions or the Ministries of Industry of Member States.

From this analysis, it can be concluded that the European Union finds itself into a path to digitise its industry. The multiple measures, strategic plans and policies reviewed have made clear that one of the main European objectives is to fully exploit the potential of industry 4.0. All these actions have been mainly put into motion within the framework of the Digitalising European Industry Strategy. Through this strategic document, the EU is adopting the role of coordination amongst Member States, with a clear focus on coherence and alignment with and among national initiatives on industry 4.0. Moreover, through its investments in international partnerships, platform networks or Digital Innovation Hubs, the EU is clearly manifesting the importance of cooperation between actors across Member States. This is, in summary, the key for successfully facing fierce global competition. The analysis also serves to point out that many actions are being implemented, but challenges still remain. In this aspect, the fourth industrial revolution occurs in interplay with multiple actors with different interests, which makes it really complex for the EU to coordinate actions in this field. Moreover, the EU faces the challenge of balancing regional inequalities and competition from other parts of the world. Finally, some experts have pointed out several areas where EU's actions could be improved. These include the

effects of digitalisation in the work environment and on social cohesion or the need of a growth strategy that connects the fourth industrial revolution with a vision of sustainable development (Buhr & Stehnken, 2018).

CURRENT SUPPORT OF THE INDUSTRY 4.0 IN SPAIN

Spanish economy has already started its transformation towards a new industrial model based on the industry 4.0, but this change is happening at a slower pace than in other neighbour countries. With the objective of turning the current scenario in its favour, the government of Spain has been implementing a series of initiatives intended to boost digitalisation and industry 4.0. From these, the program "Industria Conectada 4.0" is the most important governmental response to face the challenges and requirements of industry 4.0. As many experts agree, one of its most distinctive characteristics is the fact that it is strongly adapted to the specifics of the Spanish industrial context.

The industrial sector in Spain has followed a similar trajectory than most of the countries of the European Union. Its relative importance in terms of added value of the GDP started to decrease in 2007, reaching minimums in 2013 (The World Bank, 2019). This was due to a variety of global factors, including the relocation and externalisation of services, the economic crisis and the technological gap caused by the transformation and digitalisation of production processes. Despite this, the industrial sector is currently experiencing an upward trend, representing the 16,4% of the Spanish GDP in 2018. This demonstrates that, although this figure is lower than the average of the EU (17,6%), the industrial sector is still an important engine for the Spanish economy.

Several studies developed by BBVA, Keyland or PwC concluded that the index of implementation of industry 4.0 in Spain is still low and technologies such as virtual reality or big data for industrial processes are hardly present in companies. However, the last figures of the DESI index show that Spain has made great advancements and is quickly progressing. In this regard, Spain outranks the average of the European Union in terms of digital transformation and is categorised with the "medium performing countries" (European Commission, 2018). Even though Spanish industry is far from reaching the global leaders in terms of industry 4.0, it has proved that this sector is quite important to underpin innovation and to extend this technology to other areas of society. For instance, in 2015, around 40% of companies that were involved in innovative activities in Spain belonged to the industrial sector. Moreover, the expenditure of the industrial sector in innovation was 6.500 millones de euros, which represents the 47,5% of the total expenditure of Research and Development (CEOE, 2017).

Following EU's steps, the present Spanish government has also set the target of increasing the relative share of industry up to a 20% of the GDP. The reindustrialisation plan known as "Plan Reindus" and the Agenda for Strengthening the Industrial Sector in Spain are the main governmental instruments to increase Spanish industrial competitiveness and to support the achievement of this objective, set for

2020. These programs also represent the general framework for other national initiatives aimed at supporting the incorporation of industry 4.0-related technologies.

The new wave of support to the industrial sector in Spain came hand in hand with a proactive government's attitude towards industry 4.0. According to the previous government, led by the conservative party "Partido Popular", the role of industry 4.0 was to increase the contribution of the industrial sector to the national GDP, creating jobs and adding to the positive trade balance (Ministerio de industria, Energía y turismo, 2015). Apparently, this pattern of support towards industry 4.0 will continue with the present government, led by the Spanish Socialist Workers Party (PSOE). In this aspect, the current Minister of Industry Reyes Maroto stated in September 2018 that the government is committed with the digital transformation of the economy and society (Agencia EFE, 2018). She also expressed, with a sense of urgency, that the transition towards industry 4.0 is a need. This decision is reflected in the latest government's budget, which shows government's plans to invest more than 800 million euros in industrial and technological innovation projects and 100 million in the initiative "Industria Conectada 4.0". In addition, the Minister of Industry has recently announced a new industrial national strategy ("Pacto por la industria"), responding to numerous petitions from trade unions. According to the government, the main pillars of this agreement will be digitalisation and sustainability.

If finally implemented, these plans would give continuity to the work made under the scope of the Spanish Digital Agenda, one of the first initiatives for the digitalisation of the industry developed in Spain. This agenda, created by the Spanish government in 2013 and inspired by the Digital Agenda of Europe and the Digital Single Market Strategy, was envisaged to boost the digital economy and society in Spain. Similarly, it also served as an umbrella to include and coordinate all the government's actions related to ICT and the Information Society. Its approach was inter-governmental and was jointly led by the Ministry of Energy and Tourism, and the Ministry of Finance and Public Administration. It was formed by seven strategic action plans on different areas containing specific lines of action, depicted in Figure 1. Some of the most important changes triggered by this initiative include actions to reduce the digital divide, programmes for the re-use of public sector information or programmes for the supporting essential enabling technologies.

Figure 1: Strategic action plans of the Digital agenda for Spain

Source: The author. Adapted from (Ministerio de industria, Energía y turismo, 2015).

The Digital Agenda gradually paved the way for the development of a more cohesive national strategy that directly addressed, for the first time in Spain, the challenge of industry 4.0. The initiative was named "Industria Conectada 4.0" or Connected Industry 4.0 (CI 4.0) and was launched in 2015 by the Ministry of Economy, Industry and Competitiveness in Spain under the previous government to complement the Spanish Digital Agenda and the Agenda for Strengthening the Industrial Sector. Nowadays, it represents the most important initiative to address the transition towards industry 4.0 while effectively enhancing Spain's industrial competitiveness.

The General Secretary of Industry and SMEs is in charge of implementing the strategy, which is mainly financed by the state. CI 4.0 has four strategic action lines that were defined after a period of consultation with experts, public and private companies, civil society and in partnership with multinational companies such as Santander, Indra or Telefonica, who are actively involved in the programme.

Figure 2: Action lines, strategic areas and objectives of Connected industry 4.0

Action Line	Strategic Areas	Objectives
1. Awareness and education	- Awareness creation and communication - Academic and job training	-Guarantee knowledge of I 4.0, its enablers and benefits. -Ensure the availability of I 4.0 skills.

2. Encourage multidisciplinary collaboration	-Collaborative environments and platforms	-Foster collaboration by promoting environments and platforms that are adapted to industry and focused on 4.0 technologies.
3. Enhance digital enablers	-Promote digital enablers -Support technological businesses	-Boost R&D in I 4.0 technologies. -Boost the business development of technology providers.
4. Support the digital transformation of the industry and SME strategic areas	-Support to industry's adoption of I 4.0 -Regulatory Framework and Standardisation -I 4.0 projects	-Support and enhance the adoption of industry 4.0 by companies -Regulatory framework and standardisation. -Financing industry 4.0.

Source: The author. Adapted from (Ministerio de industria, Energía y turismo, 2015).

The strategy CI 4.0 has several distinctive characteristics that are worth mentioning. Firstly, while it envisages to involve bottom-up initiatives, it is rather based on a top-down structure. In fact, the development of a common vision that included the interests of a wide range of stakeholders from different backgrounds proved to be a key challenge in this policy initiative (Digital Transformation Monitor, 2017). Another relevant characteristic is the importance given to the "digital enablers", which are an essential part of the initiative. Digital enablers are understood as the necessary technologies that will harness the potential to drive industrial digitalisation forward. In this aspect, the initiative distinguishes amongst three types of digital enablers: 1) intra and inter- enterprise application, 2) communication and data treatment and 3) hybridisation of the physical and the digital.

Figure 3: Digital enablers of the Initiative Connected Industry 4.0

	Process - Product - Business model
Intra and inter- enterprise application	• Business solutions • Big data and analytics • Collaborative platforms
Communication and data treatment	• Cybersecurity • Cloud computing • Connectivity and mobility
Hybridisation of the physical and the digital	• 3D printing • Advanced robotics • Sensors and embedded systems

Source: The author. Adapted from (Ministerio de Industria, Comercio y Turismo, 2018).

Apart from the digital enablers, the strategy also tackles other important areas for the development of the industry 4.0, such as technology infrastructure, the development of skills, the promotion of knowledge sharing or awareness-raising.

CI 4.0 clearly draws its inspiration from the EU and other countries' initiatives, but the strategy does not simply replicate what has been previously done and it is in line with the country context. According to a recent report of the European Digital Transformation Monitor, this has been key to spark a high degree of interest within target groups (Digital Transformation Monitor, 2017). In this regard, CI 4.0 is particularly focused on supporting SMEs and micro enterprises by providing them personalised services based on their needs. This makes sense, as SMEs play a key role within the Spanish industrial fabric. This objective has been materialized in several initiatives, explained below.

First of all, the program "Activa Industria 4.0" offers a total of 400 SMEs personalised consultancy services provided by expert agencies in the implementation of industry 4.0 technologies. The program responds to a central theme of the IC 4.0, which is to make information available for companies. In December 2018, there were several pilot cases that had been already implemented and nowadays, each region has open calls for those SMEs who wish to benefit from this service.

In order to work in a complementary way, the government released "Hada", an online self-assessment tool that was created to enable enterprises to know their level of digitalisation. According to the official webpage of the tool, Hada aims to provide a free, modern and high-quality solution to assess the level of maturity of SMEs in relation to the new paradigm of industry 4.0. The information gathered, in turn, will help the government to develop new policies and initiatives to support SMEs.

Other line of support is the availability of financing mechanisms for companies that wish to incorporate new technologies and innovations to digitalise their current business models and to create technologically advanced products and services. There are several official calls for those organisations wishing to undertake these kinds of physical transformations, the last being in December 2018.

Moreover, the Spanish government published a catalogue analysing regional 4.0 initiatives in terms of four variables (awareness, strategy, consultancy/support and financing programmes). This represents a key step to foster knowledge-sharing, regional cooperation and a collaborative environment that is especially important in Spain, due to the high degree of decentralisation of its political structure and territory. The contents of the catalogue allow us to conclude that the 17 autonomous regions (first order territorial divisions) that constitute the Spanish territory show great disparities in terms of industry 4.0-related initiatives. While Catalonia, the Basque Country and Castilla y León are leading in the national territory, the Canary Islands, Balearic Islands and Castilla-La Mancha are the three territorial divisions with less policy initiatives to support industry 4.0 (Ministerio de Industria, Comercio y Turismo, 2018). Some regional initiatives worth to mention are "Estrategia Basque 4.0", or "Plan de Industria 4.0 de Castilla y León".

Spanish policy support to the industry 4.0 is also aligned with EU's initiatives. For instance, considerable efforts have been made in the field of Digital Innovation Hubs. Moreover, the government has created three high level groups focused on standardisation, public administrations and digital innovation hubs, in order to strengthen the work in these areas. Finally, other actions include initiatives to educate people in the academic and work fields, the creation of collaborative platforms to gather all the social agents involved in the transformation of the industry, national congresses about industry 4.0-technologies and their implementation in Spain or a "National Observatory of Commerce 4.0", which is currently being designed.

In conclusion, the strategy Connected Industry 4.0 represents the most cohesive and complete response of the Spanish government in terms of industry 4.0 implementation. While it works in line with EU's actions, it also responds to the specific challenges of the national territory. So far, its focus on SMEs and on unlocking the potential of digital enablers are two key aspects of its success. Regarding the government's attitude towards industry 4.0, this could be categorised as positive and proactive. However, the planned industry 4.0-related initiatives could be compromised due to the highly complex scenario that characterises Spanish politics nowadays. Amongst other factors, the difficulties to approve the general budget for 2019, the short legislature of the current government or the next elections, to be held in April 2019 could slow down governments' plans and thus, threaten the competitiveness of the industrial sector in Spain. Moreover, regional governments will also play an essential role in the future development of industry 4.0 in Spain due to their relatively high degree of political autonomy. Therefore, the next autonomic elections, which will be also conducted in 2019 (May) will also hold the key to the future development of industry 4.0 in the country.

CURRENT SUPPORT OF THE INDUSTRY 4.0 IN AUSTRIA

The Austrian Ministry of Transport, Innovation and Technology has initiated different programs within the last years concerning industry 4.0 but with the future relevance of this topic, there is still a lot of room for improvement and innovation. Especially in other departments of the government are no records of programs concerning industry 4.0 which could improve the knowledge across all sectors. This is as important as by digitizing the individual processes all operational services and areas, both vertical (sales, production, finance) and horizontal (suppliers, partners, customers) value chains, are connected (Karliczek, 2019).

The most relevant conclusion concerning the Austrian government´s attitude towards industry 4.0 is, that they do initiate programs, but it needs more optimization, updating and public transportation as most of the public and the economy is not away of the possibilities. Luckily networks have been developed (f.ex. Plattform Industry 4.0) which will make a contribution to increase future prosperity for everybody in Austria. "The aim is to make the best possible use of the new technological developments and innovations of digitization (industry 4.0) for companies and employees and to make change socially responsible for society" (Verein Industrie 4.0 Österreich, 2019).

The Austrian Ministry of Transport, Innovation and Technology initiated 2014 the foundation of an association called "Plattform Industrie 4.0" with a multi-stakeholder approach containing firms, labour unions and special interest groups of various societal fields. On a national level "Plattform Industrie 4.0" is due to its constitution and its constellation the most relevant body in Austria's policy framework setting the political and research agenda.

The main idea behind the association can be defined with fostering the collaboration of the relevant stakeholders and the facilitation of technological developments and innovations in the context of digitization in order to contribute in meeting the challenges with sustainable solutions that companies, research institutions and society face. The diverse backgrounds are considered to be especially fruitful since industry 4.0 is seen as societal challenge which necessarily needs not only industry, science, regional and national policy makers, but also trade unions and NGOs. The status by March 2018 of the association shows the involvement of about 44 organizations with a good share of companies, research organizations and various NGOs and further institutions.

Operatively the association formed expert groups with overall 200 experts which cover relevant and current topics on industry 4.0, delivering roadmaps, guidelines, strategies, analytical documents and events. Since its embeddedness into the wider policy framework Plattform Industrie 4.0 influences the research agenda and also influences the national and regional agencies on their subsidy policies (European Commission, 2017; Verein Industrie 4.0 Österreich 2019).

The RTI Initiative "Production of the Future" was launched by the Federal Ministry of Transport, Innovation and Technology (BMVIT) in 2011 and was aimed at developing a comprehensive strategy for research, technology and innovation in the production sector. The program includes an intensive exchange with representatives from the manufacturing industry, research institutions, stakeholder groups and disseminators and supports Austrian companies, research and university institutes and other organizations in creating and extending collaborations.   (Austrian Federal Ministry for Transport, Innovation and Technology, 2018).

The goals of the program are:

- "Efficient resources and resource management, efficient production technologies to increase international competitiveness and to strengthen Austria's position as an industrial location
- Flexibilizing production to enhance Austria's production expertise
- Manufacturing high-tech products to underscore Austria's position as an innovation center" (Austrian Federal Ministry for Transport, Innovation and Technology[1], 2019).

Projects can be realized and financed in all technical disciplines. The subdivision of the projects takes place in the following categories:

- "Efficiency and quality in manufacturing
- Advanced materials, surfaces and coatings and nanotechnology

- Critical raw materials
- Bio-based industry".

Particular emphasis is placed on "industry 4.0", meaning advanced manufacturing with the support of information technology" (Austrian Federal Ministry for Transport, Innovation and Technology[1], 2019)

The Austrian Research Promotion Agency (FFG – Österreichische Forschungsförderungsgesellschaft), founded on 1 September 2004, is the national funding agency for industrial research and development in Austria and offers Austrian businesses and research facilities quick and uncomplicated access to research funding. The FFG is wholly owned by the Republic of Austria, represented by the Federal Ministry for Transport, Innovation and Technology (bmvit) and the Federal Ministry for Digital and Economic Affairs (BMDW).

"The purpose of the FFG is to promote research, technology, development and innovation for the benefit of Austria. The tasks of the FFG are stipulated follows:

- To manage and finance research projects in the business and science sectors, impulse programmes for the economy and research facilities, and networks fostering cooperation between science and industry.
- To manage cooperative programmes and projects with the EU and other European and international partners.
- To represent Austria's interests at relevant European and international institutions on behalf of the Austrian government.
- To provide consultation and support to intensify Austria's involvement in European programmes, especially in the EU Framework Programme for Research, Technology and Innovation and the Framework Programme for Competitiveness and Innovation.
- To provide support and strategy development services for decision-makers in the Austrian innovation system.
- To improve public awareness of the importance of R&D" (Österreichische Förderungsgesellschaft 2019).

"The online platform „Sustainable Development" provides communication and information transmission in the context of Research and Technology Programs in the area of Renewable Energy and Environmental Technologies. It is a service from the Austrian Ministry of Transport, Innovation and Technology (BMVIT)" (Austrian Federal Ministry for Transport, Innovation and Technology[2], 2019).

The Austrian Program on Technologies for Sustainable Development has been developed at the Federal Ministry of Transport, Innovation and Technology (BMVIT) in cooperation with a network

of experts and is being implemented with the assistance of the „Austrian Industrial Research Promotion Fund". Individual subprograms are being attended by "umbrella-managements".

What activities will be supported by the program:

- Generation of innovative approaches and project definitions
- Activities focusing on fundamental research
- Applied research and development
- Networking and cooperation between individual projects
- Support for implementation (promotion, trainings, etc.)
- Pilot and demonstration projects

(Austrian Federal Ministry for Transport, Innovation and Technology[2], 2019).

The most important official stakeholder is (as stated above) the Austrian Federal Ministry of Transport, Innovation and Technology.

The network „Plattform Industrie 4.0" is the most important connected Network. In a broad alliance, important social, political, economic and scientific actors actively participate in shaping the future world of production and work.

The board of managing directors consist of

- the director of Siemens Digital Factory Central Eastern Europe,
- the President of the Austrian Patent Office,
- the Vice Rector for Research at the University of Technology Graz
- the Director of the Upper Austrian Research GmbH
- the Director professional of the association of the mechanical engineering industry
- the Technology Control Contract of the Manufacturing Magna Steyr
- the Deputy Director and Division Head Economics of the Vienna Chamber of Labor
- the Head of Research, Technology & Innovation, Federation of Industrialists (Industriellenvereinigung)
- the Director of the FILL Gesellschaft m.b.H
- the Director of the professional association electrical and electronics industry and
- the Federal Secretary of the Production Union.

(Verein Industrie 4.0 Österreich, 2019).

Another important player within the industry 4.0 field is the Federation of Industrialists (IV). The IV is the voluntary and independent representative of Austrian industry and related sectors. The IV is an association with currently more than 4,400 members. Since 1946, the IV has participated in all law-making processes as a recognized political partner. A federal organization, nine regional groups and the Brussels IV office represent the concerns of their more than 4,400 members from the

manufacturing, credit and insurance industries, infrastructure and industry-related services - in Austria and Europe. The IV members represent more than 80 percent of domestic manufacturing companies.

In essence, the work of efficient and modern organization is based on four pillars:

- advocacy
- network
- service
- Think tank

Their claim to the interface between business and politics is to shape the future of Austria's society with innovative concepts and expertise. At the European level, the Federation of Industrialists, one of Europe's most modern and most powerful employers 'associations, is the voice of Austrian industry in the industry and employers' association BusinessEurope (Vereinigung der Österreichischen Industrie, 2019).

The Austrian Federal Ministry of Transport, Innovation and Technology has initiated some programs concerning industrialization and industry 4.0 in the labour market. These programs focus on the promoting and supporting of research, technology, innovation and in general research and development. For the whole labour market, it is important for the future, to not only include technologies but also the individuals working with and infected and depended on the transformation of digitalization.

Dynamic work processes and the increasing availability of information does not only change individual workplaces, but also intra- and inter-company interaction and social cooperation in the team. Acceptance and cooperation on an individual and company-wide level must be trained and cultivated as part of digitization, so as not to handicap success and avert the danger of an "artificial divide". Thus, increased learning, qualification and flexibility requirements as well as an increased level of self-regulation are required, which requires ambiguity tolerance, dealing with uncertainties, decision-making competence and resilience among employees (Klumpp, Hagemann, Ruiner, Neukirchen & Hesenius, 2019).

The network „Plattform Industrie 4.0" is the most important stakeholder within industry 4.0 in Austria. There is a lot of cooperation in between the different actors and representatives within companies and stakeholders concerning industry 4.0.

Digitization has to be seen as a socio-technical system that, as such, has an impact on all facets of a company: hierarchies and ways of working, but also business processes and models, are changing and having an impact on day-to-day work (Klumpp et al., 2001).

To get the best impact out of the investments in digital technologies it needs more cooperation between different involved sectors (such as manufacturing companies, public authorities and training centres).

For the future, it is important that there will be an even better collaboration between the government, stakeholders, businesses and educational institutions to enable a successful future in an industry 4.0-driven world.

There are already some beginnings - now it's up to the contributors to build and strengthen an even larger merging community of interests with governmental support.

CURRENT SUPPORT OF THE INDUSTRY 4.0 IN THE CZECH REPUBLIC

Průmysl 4.0 (Industry 4.0) is a national initiative aiming to maintain and enhance the competitiveness of the Czech Republic in the wake of the Fourth Industrial Revolution. The concept was firstly presented during the 57th International Engineering Fair in Brno, September 2015 and approved by the Government of the Czech Republic on 24th August 2016. The Ministry of Industry and Trade plays a key role in the implementation process, however, there is a strong interdisciplinary cooperation between the ministries, social and industrial partners and academia. The long-term goal of the Initiative is to maintain and enhance the competitiveness of the Czech Republic at the time of in-mass onset of the so-called Fourth Industrial Revolution in the world.

The Initiative includes measures to promote investment and standardization as well as applied research, and deals with issues related to the cybersecurity, logistics, and normalization. The Czech Republic is a country with one of the longest industrial traditions, and it is an ambition for its future to remain tied to the industry. The Fourth Industrial Revolution brings with it a number of challenges, but above all, it provides a unique opportunity to ensure the long-term competitiveness of the Czech Republic in the global competitive environment. The Czech Republic has one of the highest shares of industrial production per GDP among EU countries (approximately 32% GDP). Furthermore, the country has strong industrial ties to Germany, which is its strategic business partner1. Czech companies mainly supply industrial components to its neighboring country, thus integrating into the German industrial supply chain. Next, to be a reaction to the German 'Industrie 4.0' initiative Průmysl 4.0 also seeks to counteract the often fragmented and misleading portrayal of I40 by correctly describing the concept as well as its impact on society.

There are three core objectives:

1) to enhance the ability of Czech companies to participate in global supply chains
2) to be more efficient in manufacturing – faster, cheaper and more effective
3) to cooperate with R&D and industry association, universities etc. within the development of the SW, new technologies, patents.

The initiative is based on the state-of-art analysis carried out by a team of experts from industry, academic and research communities called the Core Team Průmysl 4.0. The team is led by professor

Mařík from the Czech Institute of Informatics, Robotics and Cybernetics. The document analyses the 4th industrial revolution, in particular regarding the technological perquisites and vision of Průmysl 4.0, its requirements concerning applied research and standardization. It also investigates the impact on the labour market, education system and regulatory framework. Extensive document comprising 11 chapters provides analysis of the current state of Czech industry, future trends and possible risks, and gives suggestions for specific steps to be taken in the future

Fact is that the Czech industry 4.0 was not just influenced, but is sourced from INDUSTRIE 4.0 (Germany), INDUSTRIE DU FUTUR (France), technological cluster FABRICA INTELLIGENCE (Italy). Also, as a good example of industry 4.0 learned and focused on the same initiative in the USA (INDUSTRIAL INTERNET). Asian countries (China, Japan, South Korea) knows well about the 4th industrial revolution very well, and they focus on the potential plus for their companies.

The Ministry of Industry and Trade established a coordination platform Alliance Society 4.0 bringing together experts and policymakers to prepare an action plan for the implementation of Průmysl 4.0 taking into consideration the current Czech Action Plan on Digital Market Development. The Alliance Society 4.0 was formed as a continuation of government efforts with the National Initiative. Led by the Czech Republic Digital Agenda Coordinator, involves several ministers and key government councils. It was officially approved by the Czech government in February 2017. In September 2017, the Czech government approved the Action Plan for Society 4.0, which is aimed at implementing the transformation of the country. The main pillars of the document include connectivity and mobility, education and the labour market, e-governance, security, industry, entrepreneurship and competitiveness.

Very close cooperation works mainly within companies, organizations, academic sphere and state institutions such as:

- Confederation of industry of the Czech Republic
- Czech-Moravian Electrical and Electronic Association
- Technology Agency of the Czech Republic
- National Training Fund
- CzechInvest
- Czech Technical University in Prague
- Siemens

Lately, another institution will start to cooperate/work on the implementation of the industry 4.0:

- Office of the Government of the Czech Republic
- Ministry of Education, Youth, and Sports
- Ministry of finance
- Ministry of Transportation of the Czech Republic

- Ministry of Labour and Social Affairs
- Czech office of standards, metrology, and testing

Funding model is based on existing Operation Programmes of the involved ministries and the Technological Agency of the Czech Republic. Most of the grants goes through Agency for Entrepreneurship and Innovation (API) which is a state contributory organization subordinated to the Ministry of Industry and Trade of the Czech Republic. It fulfills the role of the Intermediate Body for grant programs of the Operational Program Enterprise and Innovation for Competitiveness (OP PIK), which can co-finance business projects in the manufacturing industry and related services. OP PIK offers grants in various topics, it focus on hard projects with a co-financing from the company (mostly 40-60%). Companies can prepare project proposal for a grant on: new technology, green/save energy, ICT, development of the new technologies/products etc. Still the real situation is, that it is not enough (allocated money), the administrative workload and bureaucracy about the grant is very high, moreover flexibility of the grant is pretty low so it´s very difficult to use the grant effectively without any impact on the actual production system/process of the manufacturing company. Level of financial support for soft skills projects (means education) is almost clear zero! There are grant projects focusing on trainings, but just on the often topics like soft skills, basic IT (Office etc.), but not for more expensive expert trainings which is so needed and demanded by the companies.

On the political scene, there is not any political party which focus on this topic, it seems, that it´s not a very popular topic which grabbing can bring a vote for them. Much more active are associations like Chamber of Commerce of the Czech Republic, Automobile association of the Czech Republic and trade unions etc.

In a nutshell, as the main problem and challenge for the implementation of the industry 4.0 we should focus on:

- Push the government to support IR 4.0 and several levels.
- Change the level of knowledge (on the general level) about the Průmyslu 4.0 is very low – people often think, that Průmyslu 4.0 means just digitalization – people should be inform about the IT4.0 with all it´s "+" or "-" parts.
- Too much people work in the manufacturing companies and other work, where mainly low-skilled employees could be found and that should be partly be solved by bigger support of school – money, stuff, equipment.
- The educational system and other educational institutions, VET schools, UNI's are not ready at all to make all changes which have to be made. Also, companies which aim at the adult education are not ready.

CURRENT SUPPORT OF THE INDUSTRY 4.0 IN ITALY

This report focuses on the efforts made by Italian Governments during the last years in promoting industry 4.0. After an introduction related to the Italian economy, the core of this paper concerns the "Piano Industria 4.0" the ambitious plan promoted by Minister Calenda during Renzi Government aimed to introduce the industry 4.0 tools into Italian economy. A short part will be finally dedicated to the stakeholders which are interested in this topic, to conclude with the general that can be drawn from the whole report.

Industry 4.0 represents a key element for the economic development on a global scale of a country, in particular for those that are facing economic troubles. This is the case for Italy. We can resume the difficulties of the Italian context considering two indicators, the gross domestic product and the unemployment rate. Considering the comparison with other member states, Italy is one of the European countries where the GDP suffered one of the most significant contractions.

Table 1. GDP in Italy and other countries. Average annual growth rates, 1995-20151

AREE	1995-2015	1995-2007	2007-2009	2009-2015
Area Euro (19)	1,4	2,3	-2,1	0,8
Italia	0,5	1,5	-3,3	-0,3
Differenziale Italia – Area Euro	-1,0	-0,8	-1,2	-1,2
Francia	1,5	2,3	-1,4	1,0
Germania	1,3	1,6	-2,3	1,9
Spagna	2,1	3,8	-1,3	-0,1

Source: Eurostat

Considering another key factor such as the unemployment rate, we discover that Italy is one of the countries that suffered more the effects of the economic crisis in occupational terms. This trend is even more worrying considering classes per age. From the research of the European Union, it is evident that youth unemployment in Italy is twice the EU average[1].

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[1] www.euronews.com, *Disoccupazione giovanile: in Italia è il doppio della media europea*, Cristiano Tassinari, 31st July 2018.

Unemployment rate. International comparison, 2006-2017[3]

2016-2017 Previsioni FMI

Italia Francia Germania Area Euro Regno Unito USA
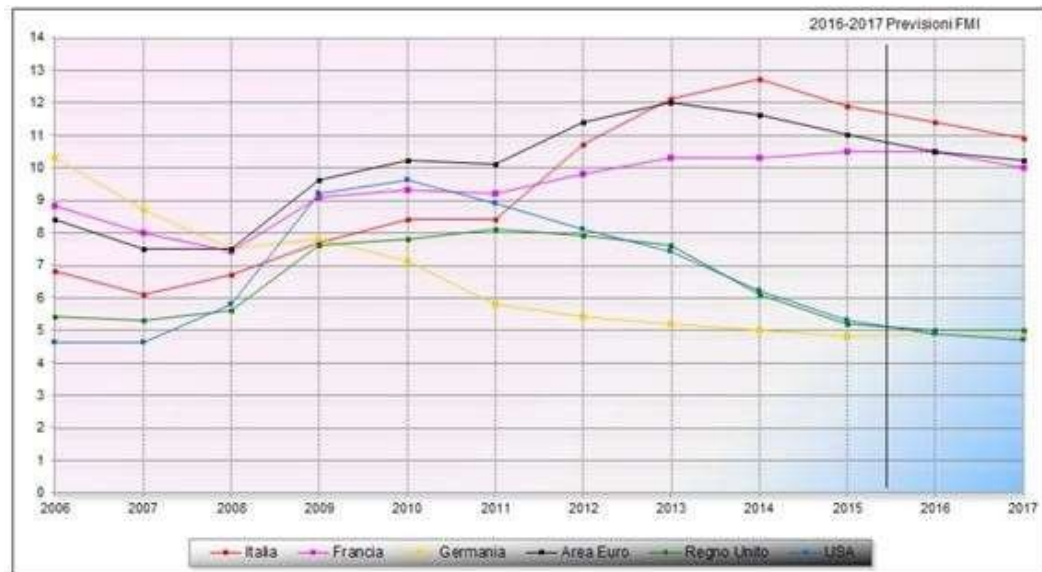
Source: For European countries, European Commission, for the U.S.A, FMI. www.agi.it, OCSE, Ocse: Pmi spina dorsale economia italiana, sono 99, 9% delle imprese, 9th September 2014.

Nonetheless, Italy is a country that combines a series of peculiar features. Italian economy is characterized by the prevalence of small and medium enterprises[4] and by one of the largest manufacturing sectors in Europe. Indeed, despite the economic crisis of recent years, Italy remains a major manufacturing power. It has a high technical know-how, which characterizes the various production chains, and which is reinforced by universities specialized in scientific subjects. We only think that "Italy is among the top six countries in the world for added value generated by manufacturing"[5], and it represents alone the 15% of the entire national GDP[6]. The digitalization of manufacturing is characterized by an increase in production flexibility. Indeed, Italian manufacturing companies are the engine of growth and economic development, considering their capacity to produce wealth and employment, to contribute to financial, economic and social stability. The implementation of innovation practices would be a perfect tool in order to increment the productivity of the manufacturing sector, and the overall suitability of the Italian economy.

Nevertheless, despite the potential of such industry for the Italian economic context, no public power has ever foreseen a detailed plan for the development of the industry 4.0 until the XVII legislature.

Concerning the issue of industry 4.0, things changed at the beginning of 2016. The first governments that have taken over the situation in view of the modernization of the country to new technologies are those which have composed the XXVII legislature, with a particular mention to the Renzi Government.

The first institutional incentive was given by the chamber of deputy at the beginning of 20167. The survey proposed a detailed study over the Italian economy; the situation of small and medium enterprises and the potential positive effects of the industry 4.0. The efforts of Renzi Government were very important concerning the issue of innovation; we only think that the issue of industry 4.0 was inserted in the 2017 Budget Law after a deep analysis of the Italian and European Economy. Indeed, the plan was put in place following a study concerning Italian economy, and a comparative study concerning how industry 4.0 is developed in other member states. These researches have been summarized in a single document by the cognitive research on industry 4.0, made by the Commission for productive activities, trade, and tourism for the Chamber of Deputies. The different aspects of industry 4.0 are examined with particular reference to the technological context and to the main enabling technologies. The production processes, the market strategies made possible by the ICTs that originated new business models, such as the sharing economy and the maker economy, are examined in depth. The document analyses the sectors where such technologies have already been started: automation, construction, the pharmaceutical and biomedical sector.

This ambitious plan was aimed at mobilizing in 2017 additional private investments of 10 billion, 11.3 billion of private spending in research, development and innovation with a focus on the technologies of industry 4.0, plus 2.6 billion of euros for early stage private investments. The provision proposed a blended system of tax incentives, support for venture capital, the spread of ultra-broadband, training from schools to universities with the ultimate goal of encouraging and encouraging companies to adapt and fully adhere to the fourth industrial revolution.

As stated by Ministry Calenda, "Industria 4.0 concerns all aspects of the life cycle of companies that want to become more competitive, offering investment support, digitalisation of production processes, enhancing worker productivity, training suitable skills and developing new products and processes"9.

For this reason, the plan industry 4.0 covers several areas of interest. The most important can be summarized in some key factors, namely:

- Hyper and Super Depreciation; it consists in the over-evaluation of 250% of investments in new tangible assets, devices and technologies enabling the transformation toward the industry 4.0
- Nuova Sabatini; it aims to support companies that require bank financing for investments in new capital goods, machinery, factory equipment for productive use and digital technologies, namely hardware and software
- ReD tax credit; aims to stimulate private resources in Research and Development to innovate process and products in order to ensure competitiveness of companies.
- Patent box; it represents an optional regime of facilitated taxation on income deriving from the use of intangible assets

- Start-ups; new innovative start-ups enjoy a framework dedicated to theme in matters such as administrative simplification, tax breaks, bankruptcy law.
- Guarantee Fund; it aim to support companies and professionals who face difficulties in accessing credit10.

Furthermore, the Piano Industria 4.0 has envisaged two new entities: the Digital Innovation Hub, centres to be set up in the territory, "leaning" on Confindustria and R.ETE. Italian companies, to help Italian SMEs in the transformation towards industry 4.0; and the Competence Centres, which refer to some Italian universities with the aim of intensifying the relationship between research and industry. At the time of his farewell to the government, at the end of May 2018, the Minister of Economic Development, Carlo Calenda, published the ranking of the competence centres. In the first place, with nine points, there is the "Manufacturing 4.0" center, whose leader is the Turin Polytechnic industrial partners such as FCA, General Motor, GE Avio, Thales Alenia). The focus is on aerospace, automotive and additive manufacturing. On the second, still with nine points, "Made in Italy 4.0", led by the Milan Polytechnic and focused on technologies for the 4.0 factory. On the third, with eight points, "BI-Rex", led by the University of Bologna but also supported by the universities of Modena, Reggio Emilia, Parma and Ferrara.

After a year since the launch of the Plan, the Minister of Economic Development Carlo Calenda has drawn up an initial assessment of the results, summarized as follows:

- orders increased on the domestic market for capital goods, with growth rates that reached 11.6% in the first half of the year;
- the number of companies that will increase R&D spending has increased;
- 3.5 billion public investments have been allocated on the ultra-broadband, thus allocating them both to infrastructures and to the satisfaction of the demand of families and businesses, so as to reach the hedging targets to 2020;
- in the first 8 months of 2017 the amount guaranteed by the Guarantee Fund increased by 10.7 percent.

In September 2018, during the Conte Government, the Deputy Prime Minister and Minister of Labor Luigi Di Maio confirmed in words the measures envisaged by the plan of Carlo Calenda but has wanted to emphasize the evolution of the industry 4.0 plan towards the Enterprise 4.0. "We are looking for - he said - to reduce the access to the Plan and make it more and more suitable for small and medium-sized enterprises. It is usual to talk about industry 4.0, but in reality, it is more and more Enterprise 4.0 ". Di Maio then focused on the topic of training: "The staff training system must be strengthened. We will introduce new measures also for the training of entrepreneurs, who need them to keep up with the times ".

Although moving in the same wave as the predecessor, the Conte Government has introduced some limitations and changes to the Industry 4.0 Plan, whose effects can only be assessed in the coming months.

The Industry 4.0 plan "represented a positive shock for Italian manufacturing" writes in this article Giovanni Miragliotta12, co-director of the industry 4.0 Observatory of the Milan Polytechnic. "The companies - he continued - have returned to invest heavily after years of near-immobility (+ 9% in 2017) and to increase manufacturing value added (+ 2.1% in the two-year period 2016-17). The companies of the offer, also thanks to the Plan, have seen increases in their market of the order of 30%. The Italy of digital manufacturing has experienced, since September 2016 a moment of great euphoria, to the point that we named the 2016-2017 Research of our Observatory "the great opportunity" ". For the Industry 4.0 Plan in Italy 2018 was the year of the transition to Firm 4.0 and the downsizing: the Conte government wanted to emphasize this evolution and introduced some changes in the text of the Def, the economic document and finance that will be definitively approved by 2018. At present, the new measures modify the incentive rates (hyper and super amortization, new Sabatini) and may no longer provide for the extension of the 4.0 training bonuses, a hypothesis that has already aroused the protests of entrepreneurs. But there is more attention to small and medium-sized enterprises (SMEs) and the advancement of the ultra-broadband plan.

On November 23rd, the president of Confindustria digitale, Elio Catania, speaking at a conference on the opportunities of industry 4.0 and of the Artificial Intelligence for SMEs of the Italian manufacturing, said: "On industry 4.0 there are some open chapters, including that of training, and our hope is that they are part of the amendments to the maneuver because they are crucial aspects for the business system".

We should recall that industry 4.0 received an important impulse by several association which promoted the positive effects for the Italian economy linked with industry 4.0. Recalling the most important ones, including the most important Fabbrica 4.0 made by Confindustria, and Indagine industria 4.0 promoted by Federmeccanica. More recently position statements are those from the Position Paper on industry 4.0 made by Area Industria e innovazione and by Centro Studi di Assolombarda Confindustria Milano Monza e Brianza.

If we take a picture of the actual situation of Italian economy concerning industry 4.0, we can be optimistic. If until 2010 no provisions were made on this filed, the last Government, despite many differences, were able to implement the industry 4.0 tools into the Italian economy. In particular, it is important to remark the positive results achieved by the Calenda plan. Despite the economic crisis, since the Industria 4.0 plan was approved, it produces positive effects on the Italian economy. Looking at the previous two figures, this is not a case that after the introduction of the Plan for Industry, both GDP and unemployment rate started to recover.

PIL (Mln €; valori concatenati rif. 2010)		Produzione Industriale (Indice media 2010=100 [1])		Occupazione (Migliaia di lavoratori)	
Impatto della crisi	- 9,5%	Impatto della crisi	- 26,1%	Impatto della crisi	- 1,057 mila
Recupero 2017	+ 4,3%	Recupero 2017	+ 8,0%	Recupero 2017	+ 953 mila

Summarizing, this report highlighted how this sector is important to reinforce Italian economic trends, and how its implementation will help the country to recover from its main problems; slow productivity and high unemployment rate.

CONCLUSIONS

This overview of the national and European support to industry 4.0 has allowed us to gain a general understanding of the specific realities of each country, as well as to reach important conclusions.

At the European level, the Digital Single Market Strategy and the Digitalising European Industry Strategy represent the most comprehensive frameworks for industry 4.0 support. The political relevance of these initiatives and the efforts and resources invested demonstrate that industry 4.0 implementation is one of the main objectives of the EU. This is strategically important to achieve the general goal of strengthening the industrial value of the EU in order to be up to the level of other regions of the world. After reviewing the most important actions implemented under the scope of these strategies, it can be concluded that the EU aims to work synergistically with current national initiatives on the industry 4.0 to secure a coherent European approach and to ensure that all the countries strive to reach the same collective objectives. Initiatives such as the DIHs or the partnerships demonstrate how this emphasis on international collaboration amongst countries could be materialised.

Additionally, Italy, Spain, Austria and the Czech Republic are four of the 15 EU countries that have launched large-scale initiatives for digitalising their industries, making clear that the adoption of industry 4.0 is a priority for their future development. These are "Industria Conectada 4.0" in Spain, "Plattform Industrie 4.0" in Austria, "Průmysl 4.0" in the Czech Republic and the "Piano Industria 4.0" in Italy. While these initiatives converge in many aspects, they also show clear differences.

For instance, the four programmes have common goals and targets. These are mainly economic, such as enhancing the competitiveness and modernization of their industries, but also social, such as the

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focus on education of the Czech Republic or on the labour market in Austria. Another common pattern is that the four initiatives do not show specific focus on certain aspects or technologies related to industry 4.0. Instead, they could be applied to multiple sectorial areas.

On the opposite side, each of them differs in terms of their design, funding structure, participatory approach and main forms of support, characteristics that are commonly aligned with other overarching national strategies.

In the case of Spain, Industria Conectada 4.0 is particularly focused on supporting SMEs and micro enterprises by providing them personalised services based on their needs. Although the program is adapted to the national territory, it also works in line with the strategy of the EU. So far, its focus on SMEs and on unlocking the potential of digital enablers are two key aspects of its success, but the outcome of the elections of April 2019 will mark the future of this initiative.

In Austria, all governmental efforts have been initiated by the Austrian Ministry of Transport, Innovation and Technology, who launched the connected network named "Plattform Industrie 4.0". This association differs from the others in the sense that it is a major coalition of diverse actors that function around working groups. This platform also works alongside with other initiatives such as the Austrian Program on Technologies for Sustainable Development, which demonstrates that research is also a primary form of support of industry 4.0 in Austria.

The homologous initiative in the Czech Republic is Průmysl 4.0 (Industry 4.0). A differentiation factor is that, although it is led by the Ministry of Industry and Trade, it is based on a strong interdisciplinary cooperation between the ministries, social and industrial partners and academia. One of its main lines of action are grant programs aimed at co-financing industrial projects related to new technologies. However, bureaucratic barriers, flexibility and financial issues are some of the main challenges that the government will have to tackle in the near future.

Finally, in Italy the initiative "Piano Industria" stands out for its clear focus on research and development and for its emphasis on the development of new products and technologies aimed at improving manufacturing processes. This characteristic contrasts with the rest, which (with the exception of Austria) are more focused on industry 4.0 implementation.

After gaining a better understanding of the situation in Spain, Austria, the Czech Republic and Italy, it can be stated that, despite the advances, there is still a lot of room for improvement and innovation in the partner countries, as well as in the EU. In most of the countries reviewed and, in the EU, the support to industry 4.0 tends to be scattered across several initiatives or programmes and, although the EU aims to foster collaboration amongst partner countries, more systematic forms of cooperation and exchange of good practices are needed. In addition, we agree with the idea portrayed in the Digital Transformation Monitor Report of 2017, which argues that the national initiatives lack clear and measurable annual targets, as well as monitoring mechanisms.

In light of this situation, national governments and European institutions will have to continue striving to fully exploit the benefits of advanced technologies.

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CURRENT STATUS OF INDUSTRY 4.0

REPORT III – EUROPEAN AND NATIONAL EDUCATIONAL SYSTEMS

INDUSTRY 4.0 for VET

CONTENTS

1

INTRODUCTION

The effects of the fourth industrial revolution have no boundaries. In fact, industry 4.0 technologies are permeating every aspect of our economy and society, and the educational systems of the EU and its Member States are no exception. This has been widely acknowledged by multiple economic and social actors, including the European Commission, who stated in the White Paper on the Future of Europe that *coping with technological changes will require a massive investment in skills and a major rethink of education and lifelong learning systems*.

This need appears to be imminent in light of the profound skills mismatch that the EU is facing, especially in the field of digital and ICT skills. In this aspect, four of ten employers faced difficulties when finding workers with the required skills, while unemployment rates peaked and 39% of adult employees were over skilled and trapped in low quality jobs, according to the European Centre for the Development of Vocational Training. Additionally, as jobs and other aspects of our daily life are becoming more and more digital with the advent of the fourth industrial revolution, citizens must strive to enhance key skills such as adaptive thinking, problem solving or creativity in order to be successful in the job market.

In short, the EU and all the member countries need to invest in the creation of educational systems that work synergistically with the changes happening at the industry, which is one of the keys to achieve smart, sustainable and inclusive growth. But, in order to delve into this matter, a deep analysis and understanding of the current educational systems of the Member States is required, together with an overview of the role of the EU in this matter.

Through this report, the partner organisations of the project InVET "Industry 4.0 for VET" will identify and compare the actual situation of the educational systems in each of the partner countries, which are Italy, Spain, Austria and the Czech Republic. This analysis will include a review of the strengths, weaknesses and current challenges that these countries are facing in terms of education, which represents the first step to understand to what extent can industry 4.0 be included in their educational systems.

EDUCATIONAL SYSTEM IN THE EUROPEAN UNION

European institutions have traditionally acknowledged the vital role of education for the economic and social development of the EU, coined as the backbone of growth and inclusion. This is reflected in Article 14 of the Charter of Fundamental Rights of the European Union, which establishes that

"*everyone has the right to education and to have access to vocational and continuing training*" (The European Union, 2000).

Although actions in the education field were carried out for many years before, the commitment of the EU with the promotion of education was legally recognised in 1992 through the Maastricht Treaty and ratified in the Treaty of Lisbon in 2007 (Articles 165-166 TFU). With these documents, the EU defined its specific approach towards education, which is focused on supporting, complementing, facilitating and coordinating actions between Member States. In this aspect, the most relevant tools used by the EU to supplement the capacity of Members States are educational policy cooperation, tools for funding, the setting of common goals and sharing good practices.

It is believed that this complementary, but limited role will benefit Member States, who are completely liable for the educational policies in their own territory. As stated in the official page of the EU, this form of educational support attempts to address common challenges such as the disruption caused by technological development, ageing societies, skills mismatches or global fierce competition, which will be key for the future of the EU.

In order to find the right balance between national sovereignty and a coherent collective approach when tackling these issues, the EU periodically sets common objectives in the educational field. The main approach used by the EU to encourage Member States to attain the objectives and targets set is the Open Method of Coordination, which is based on several monitoring activities such as the sharing of best practices, peer reviews, peer counselling, peer learning activities (PLAs) and the preparation of country reports. The specific recommendations per country are seen as an effective mechanism to guarantee that the problems related to education are comprehensively addressed in each country. This method could be defined as decentralised in the sense that European institutions supervise national actions, especially the European Commission, but it is the responsibility of governments to implement the necessary changes in national policies in order to achieve the objectives.

After the ET 2010 Strategy, the current strategic framework for European Cooperation in education and training (ET 2020) establishes four strategic objectives and six main priorities for the period 2016-2020. These are represented in the figure below, together with a set of benchmarks that aim to measure the progress of the objectives until 2020. The information depicted in Figure 1 reveals the determination of the EU to invest in key educational aspects such as lifelong learning, mobility, an inclusive and high-quality education and the development of key competences for the future.

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Figure 1: Objectives, strategic priorities and benchmarks of the ET 2020 Strategy

OBJECTIVES
1. Make lifelong learning and mobility a reality 2. Improve the quality and efficiency of education and training 3. Promote equity, social cohesion and active citizenship 4. Enhance creativity and innovation, including entrepreneurship at all levels of education and training
STRATEGIC PRIORITIES FOR 2016-2020
• Relevant and high-quality skills and competences for employability, innovation, active citizenship and well-being (e.g. creativity, sense of initiative and critical thinking) • Inclusive education (i.e. including the increasing diversity of learners), equality, non-discrimination and the promotion of civic competences (e.g. mutual understanding and democratic values) • Open and innovative education and training, including fully embracing the digital era • Strong support for educators (e.g. improved recruitment, selection and training processes as well as continuing professional development) • Transparency and recognition of skills and qualifications to facilitate learning and labour mobility (e.g. by means of the European quality reference framework) • Sustainable investment (including exploring the potential of the investment plan for Europe), performance and efficiency of education and training systems
BENCHMARKS
• At least 95% of children should participate in early childhood education • fewer than 15% of 15-year-olds should be under-skilled in reading, mathematics and science • the rate of early leavers from education and training aged 18-24 should be below 10% • at least 40% of people aged 30-34 should have completed some form of higher education • at least 15% of adults should participate in learning • at least 20% of higher education graduates and 6% of 18-34-year-olds with an initial vocational qualification should have spent some time studying or training abroad

- the share of employed graduates (aged 20-34 with at least upper secondary education attainment and having left education 1-3 years ago) should be at least 82%

Source: The author. Adapted from: (European Commission, 2015)

After almost a decade working on harnessing the potential benefits of education within the ET 2020 Strategy, the EU is currently immersed on the quest of building the European Education Area, an ambitious target set for 2025. This new vision of the European educational space is focused on key areas such as mobility of learners, mutual recognition of diplomas, the promotion of languages, lifelong learning or in strengthening existing educational networks. The EU is already implementing the second package of measures, focused on making improvements in each of these fields.

As part of these measures, the New Skills Agenda was adopted by the Commission in June 2016 and represents an important tool aimed at equipping European citizens with relevant skills necessary to fully participate in the labour market. The initiatives implemented within the scope of this agenda show the clear determination of the EU in investing in VET education, as proved through the action "Making Vocational and Educational Training (VET) a first choice", as well as in the promotion of digital competences.

Complementarily, the Key Competences for Lifelong Learning have also adopted especial relevance. These were developed in 2006 and aimed to define the crucial competences that European citizens should have in order to adapt to the new society. However, due to the non-static nature of key competences and in light of the new social, economic and technological trends, the European Council published a set of recommendations on May 2018, which repeals the 2006 recommendation. These new changes imply a stronger emphasis on basic capabilities, a new definition of digital competences or the enhancement of transversal competences such as creativity and problem solving, which are key to ensure the adaptation of all European citizens to the fast-changing labour market (European Commission, 2018).

Figure 2: Key competences for lifelong learning
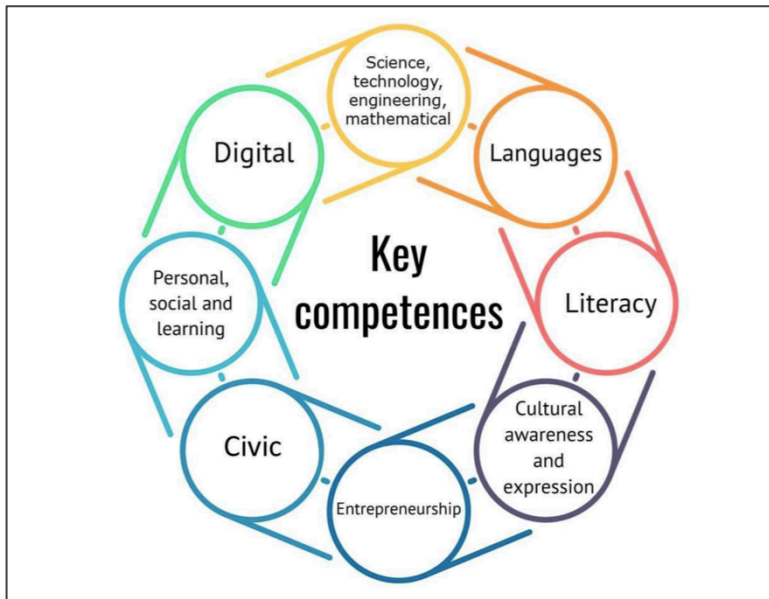
Most Member States have used Key competences as an inspiration when developing national strategies and in 2012 literacy, science and entrepreneurial competences were strongly supported by targeted initiatives, as stated by a Commission staff working document in 2018 (European Commission, 2018a).

The New Skills Agenda was adopted by the Commission in June 2016 and represents an important tool aimed at equipping European citizens with relevant skills necessary to fully participate in the labour market. This agenda is formed by ten actions, aimed at "*improving the quality and relevance of training and other ways of acquiring skills; making skills more visible and comparable and improving information of trends and patterns in demands for skills and jobs*" (European Commission, 2018b). The initiatives implemented within the scope of this agenda show the clear determination of the EU in investing in VET education, as proved through the action "Making Vocational and Educational Training (VET) a first choice", as well as in the promotion of digital competences.

The EU also places strategic importance to the assessment, comparability and recognition of competences. To make these actions easier, the European Qualifications Framework was created and currently serves as a "translation tool" to make competences easily comparable across the EU. Comparability mechanisms have also been fostered in other educational fields, such as in higher education through the Bologna process and the European Higher Education Area.

An important component of the European educational policies is their wide scope of action. In this regard, EU's initiatives are not only focused on formal education, but also on informal, non-formal and lifelong learning education. This is supported through a wide variety of methods including, for instance, volunteering opportunities, traineeships or cultural and sports activities. Centralised and decentralised funding programmes such as Marie Curie actions, but specially the programme Erasmus+, represent the most important tool to reach a wide variety of population groups in different types of educational spaces (VET, high education, non-formal education, primary education etc.). Although the programme is mostly targeted at youth, there are actions seeking to impact other population groups such as students, teachers, youth, adults, interns etc. Erasmus+ counts with a budget of €14.7 billion from 2014 to 2020 and the Commission has shown its determination to continue with the program.

The EU also recognises the strong link existing between education and the rise of actual problems such as xenophobia, nationalism or social exclusion. In this regard, the actions of the EU on the educational field go hand in hand with the promotion of common European values such as freedom, democracy and equality. In fact, what all educational initiatives have in common is the emphasis on inclusive education, a transversal priority.

The Commission's annual publications on education and training shed some light on the actual situation of the EU in terms of education. One of the main conclusions of the last reports is that Member States are improving in their target to achieve more inclusive and efficient educational systems and, in fact, some of the goals set for 2020 are close to be achieved. This is the case of reducing the rate of early leavers aged 18-24 below 10% (European Commission, 2017). On the negative flip-side, the reports also highlight the fact that the educational level of European citizens is still strongly determined by their socioeconomic situation and that, in some cases, the EU is even moving far away from the benchmarks. In this aspect, the level of 15-year-olds un-skilled in reading, mathematics and especially science is an issue of concern. The report also indicates that migrants are one of the most excluded groups, a statement supported by worrying facts. For instance, in 2016 the 33,9% of the residents of the UE that were born abroad had a low level of basis competences and had not completed compulsory education, while this figure was only 14,8% for people born in the EU (European Commission, 2017). Apart from differences among social groups, inequalities between Member States still persist. In fact, the Commission advices that some governments must undergone deep and real reforms, especially in the field of basic competences (European Commission, 2017). Finally, it is worth mentioning that real government expenditure in education keeps increasing in the EU, but it is still far from reaching the levels previous to the economic crisis.

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In summary, this report has shown that, given the importance of education for the future of the EU, the coordinating role of European institutions becomes necessary. A new wave of European educational and training policies has been boosted since the European 2020 Strategy for smart and inclusive growth started to be implemented in 2010. These actions pursue, amongst others, the strengthening of lifelong learning, mobility, quality and inclusive education and the enhancement of Key competences. Moreover, due to the strong connection between education and social welfare, there is an increasing need to invest in educational systems which do not perpetuate inequalities. This purpose will only be achieved if Member States undertake serious actions. As 2020 is approaching, the EU will have to reflect on what has been achieved and how to address the existing challenges but for now, the European Education Area will pave the way for the improvement of education in Europe.

EDUCATIONAL SYSTEM IN SPAIN

The education system in Spain has five different stages:

1. Pre-primary education is up to 6 years of age. Although it is not a compulsory education stage, the second cycle is free in all publicly-funded schools (public schools and publicly-funded private schools). Public schools providing it are called pre-primary schools and those also offering primary education are called pre-primary and primary schools.

Basic education is compulsory and free in publicly-funded schools. It lasts ten years and it is divided into two stages:

2. Primary education, provided in primary schools. It covers six academic years, usually studied between the ages of 6 and 12
3. Compulsory secondary education, studied in secondary schools, between the ages of 12 and 16. At the end of this stage, students receive the first official certificate, the Lower Compulsory Secondary Education Certificate, which allows them to have access to upper secondary education or the world of work.

Then we have high school and university or VET:

4. Upper secondary education is also provided in secondary schools. It lasts two academic years, usually studied between the ages of 16 and 18. It offers two possibilities:
    4.1. Bachillerato (as a general branch), and
    4.2. Intermediate vocational training (as the professional branch). This is also provided in vocational training integrated institutions and in national reference institutions.

The reforms of vocational training provision include:

- creation of basic vocational training cycles: they can be taken by students aged 15-17, among other entry requirements that have been established.
- development by the education authorities of dual vocational training in the education system.

5. Higher education comprises university and professional studies. University education is provided in universities, and advanced vocational training is provided in the same institutions as those offering intermediate vocational training.

There is also an Adult education and training which covers different types of provision offered by the education and employment authorities, and provided by institutions from different nature. Adult education and training is aimed at people aged over 18 and, as an exception, workers aged over 16 who cannot attend school in ordinary regime, like for instance high performance athletes.

Moreover, the Intermediate vocational training is organised into different VET grades, which are made up of vocational modules, vary in length and include theoretical and practical contents corresponding to the different professional fields.

The 2013 "Organic Law for the Improvement of the Educational Quality" (LOMCE), introduced the following issues:

- Creation of a new level of Basic Vocational Training that replaces the Programs of Initial Professional Qualification (PCPI), whose improvement allows obtaining a title of the educational system.
- Intermediate VET grade: can be accessed after having obtained the Compulsory secondary education ("ESO" in Spanish) degree or doing a specific test of access to the intermediate level for which it is necessary to be 17 years old. At the end of these studies you obtain the title of Technician in the corresponding area.
- Higher VET grade: can be accessed either having obtained the Baccalaureate degree or by obtaining the Intermediate degree from the same branch. At the end of the studies you get the title of Superior Technician in the corresponding area.

All the VET grades refer to the National Catalogue of Vocational Qualifications and their curricula adapt to the requirements of the National System of Qualifications and Vocational Training.

Despite all the educational changes in Spain, there are still two endemic problems. One is the early drop out, which is around the 28% of the students (FP IESE, 2018), when the average in Europe is 14%, and with the objective for the year 2020 of a 10%.

The other main problem is the employability of young Spanish graduates. The vocational training can be the lever that supports the Spanish business world, whose objective is to obtain the best training for their workers and the greater adequacy of them to the productive needs, avoiding inefficiencies such as overcapacity or lack of specific profiles. An innovative and adapted offer to the needs of both students and the labor market could be key in reducing this percentage of early drop.

The next table shows the variation of students of non-university studies regarding the previous course (FP IESE, 2018):

	Forecast for academic year 2017/18	Variation regarding the previous course	
		Absolute number	%
Total	8.138.170	10.338	0,1
Infant Education	1.738.316	-36.948	-2,1
First cycle	458.926	1.702	0,4
Second cycle	1.279.390	-38.650	-2,9
Primary School	2.932.160	-8.066	-0,3
Special Education	36.213	251	0,7
Secundary School	1.916.725	32.502	1,7
High School	692.536	5.603	0,8
Distance High School	45.231	578	1,3
Vocational Training	810.621	17.122	2,2
Basic Training Cycles	71.475	2.176	3,1
Middle Grade Training Cycles	348.853	3.488	1

Higher Grade Training Cycles	390.293	11.458	3
Other Training Programs	11.599	-126	-1,1

Figures indicate the consolidation of the growth in the VET studies, especially in Basic VET (growth of 3.1% with respect to the previous year) and in Higher VET (growth of 3%).

The professional families that have aroused more acceptance among students are Health, Administration and Management, Computing and Communications, Electricity and Electronics, Hospitality and Tourism, and Transportation and Vehicle Treatment.

The institutionalized vocational training, as we know it today, has a rather short history in Spain and is characterized by the permanent difficulty to consolidate in the education system. The linkage of the origin of Vocational Training with the rise of industrialization in Western countries is precisely one of the factors that most authors allude to explain the delayed and slow development of VET in Spain.

These data would also support the unequal development in different regions, showing a special uprooting in the Canary Islands or Extremadura and a faster development in regions such as the Basque Country, Asturias or Catalonia.

Vocational Training in Spain is composed of two systems:

- Regulated Vocational Training, which depends on the Ministry of Education and regional governments
- Training System for Employment, linked to the Ministry of Employment and regional governments.

Another "specific" feature of Spanish employability is that presents, in comparison with Europe, an overabundance of low-skilled labor and, at the same time, a notable shortage of intermediate qualifications (Figure 1). This situation presents a great challenge for the VET. The Spanish government is aware of that and tries to promote VET studies.

Modelos de cualificación en Europa y España

Año 2007

PORCENTAJE DE POBLACIÓN OCUPADA DE 25 A 64 AÑOS SEGÚN LOS NIVELES DE EDUCACIÓN

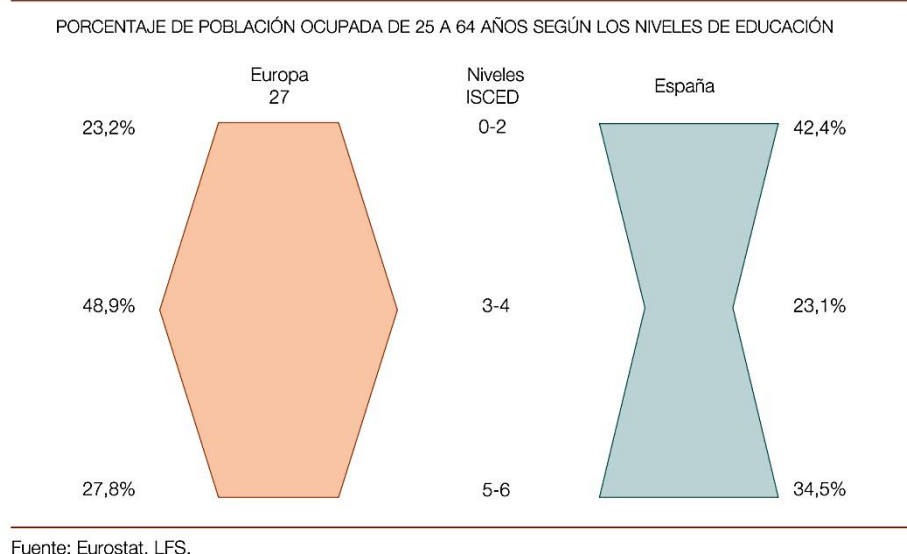| Europa 27	Niveles ISCED	España
23,2%	0-2	42,4%
48,9%	3-4	23,1%
27,8%	5-6	34,5%

Fuente: Eurostat. LFS.

Figure 1 (ISCED: International Standard Classification of Education)

The intermediate level represent almost 50% of the population in European countries, while in the case of Spain it does not reach even a quarter of the population.

The challenge for Spain is to make an attractive VET, in terms of employability but also in terms of social relevance and prestige, in order to overcome the perception as a "second alternative for students with problems".

One of the first challenges that we face is to adapt the studies to the "technological and knowledge society", separating them in a certain way from the excessive industrial bias. That may be a way of promoting the employability of VET students, which is also one of the most relevant factors when it comes to attracting students: "more awareness of the good employment outcomes of Vocational Education and Training (VET) can make it a genuine first choice for more people" (New Skills Agenda for Europe).

Another important aspect would be to facilitate the lifelong learning of the employees, by allowing a flexible entry and exit of the labor market in order to train them in different moments of their careers.

VET is sometimes based on the availability of media and teachers rather than on the needs of companies.

Companies will need, more and more, technicians and intermediate professionals with transversal skills or competences like a proactive attitude, flexibility, ability to adapt to changes, work in multidisciplinary teams, etc.

EDUCATIONAL SYSTEM IN AUSTRIA

Before 1774, education in the Austrian hereditary lands was reserved for the upper classes of society. It was primarily the task of the church, monastery schools were the only educational institutions. As school fees were generally to be paid in these institutions, rural serfs in particular and the poorer urban strata of the population remained largely uneducated and were usually unable to read and write.

Under the reign of Maria Theresia, the state school system emerged in the Archduchy and the crown lands. The regent realized that the state people are the bearers of the state and that the power position could only be held with the help of an educated population.

In 1869, the school system in Austria was standardized. The most important changes:

- The teaching obligation has been extended from six to eight years. Compulsory education was from this point on the eight-year compulsory school.
- Limiting class size to a maximum of 80 students, which has been a tremendous educational advance.
- The final withdrawal of educational supervision by the church; Education was completely subordinated to the state.
- As an alternative, a three-year public school was completed after five years of elementary school. This could also be attended by girls, but where they were taught according to a different curriculum (less arithmetic and geometry, as for handicrafts).

In 1918 Otto Glöckel implemented a decisive and until today valid school reform. After the National Council elections Glöckel Under Secretary of State in the Interior Ministry, which corresponds to the function of today's Minister of Education. Glöckel began to replace the bureaucrats who had made the decisions in education by pedagogical experts. For the reforms in the Austrian school system Glö-ckel used the school reform commission.

Every child - irrespective of gender and social situation - should receive optimal education. From 1919 girls could be admitted to boys' schools and thus for the first time had the opportunity to reach university entrance qualification even under financial constraints.

The introduction of coeducation took place in 1975, since 1979, boys and girls are no longer separated in the elementary and later in physical education at elementary schools. In 1982, Austria ratified the Convention on the Elimination of All Forms of Discrimination Against Women.

Since 1993 there has been the possibility for disabled primary school pupils, since 1997 also in the secondary area (lower secondary school, lower secondary school), to be taught integratively.

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After a good showing in the PISA 2000 study, the Austrian school system slipped into midfield. Thus, Austria and Germany, with their highly diversified school systems, were well behind the countries that have a community school system. After closer analysis, in addition to the vague expression of "appropriate differentiation," another loophole exists for the introduction of a comprehensive school for six to fourteen-year-olds. Since only a differentiation of secondary schools is required, a change in the division into primary and secondary school could circumvent the uncertain interpretation of appropriate differentiation. Thus, the current elementary school could be renamed Primary School I and the AHS lower grade primary school II and only a four to five-year secondary school (AHS, BHS, etc.) remain, which already meets the demand for a "reasonable differentiation". Such a system exists, for example, in the USA, where secondary school does not start until the age of 14. Nowhere does the constitution precisely define "secondary school" or "primary school" or its duration.

As of October 1, 2007, the training of teachers has been reorganized. The Pedagogical Academies, Vocational Education Centers, Religious Education Institutes, and the Pedagogical Institutes have been grouped into Pedagogical Colleges. Here the education of all compulsory school teachers and the further education of all teachers take place. The education of high school teachers is still taking place at universities.

In Austria, educational matters are traditionally a federal task and are predominantly carried out by the Ministry of Education. However, primary and lower secondary education is a matter of the country, which means that federal and state schools have different service rights. This constellation has been one of the central aspects of comprehensive education reform for many years. Due to the European-wide professionalization of the education sector (university degree for all teachers), the distinction between federal and state teachers is losing more and more purpose.

The Ministry of Education performs the following tasks:

- Schuler direction
- School maintenance, with the exception of compulsory schools (compulsory general education schools: elementary and secondary school / new middle school, special school, polytechnic school, vocational compulsory schools / vocational schools)
- School abandonment
- Teacher education
- Nostrifications (recognition of foreign certificates).

The Ministry of Education is subordinated to the Länderschulräte (in Vienna). You are responsible for:

- school inspection,

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- School subsidies of the federal government as well
- Administration of the federal schools as well as their teachers

In November 2015, it became known that educational directorates should be set up in all federal states, which should replace the previous state school councils and school departments of the state government. Since 2019, the education directorates have been established in all nine federal states.

The Ministry of Science is responsible for the higher education sector (tertiary education). The tasks include in particular:

- universities
- Fachhochschulen (accreditation, supervision)
- Scientific institutions and research institutions including the Austrian Academy of Sciences
- Scientific Library, Documentation and Information Systems
- Student advocacy and study grants and scholarships
- Studentenmensen and promotion of the construction of dormitories

The structure of the Austrian school system is regulated in § 3. School Organization Act: Structure of the Austrian Schools: (1) The Austrian school system is a unit in its structure. Its structure is determined by the age and maturity stages, the various talents and the tasks of life and Professional goals determined. The acquisition of higher education and the transfer from one type of school to another is to be made possible for all suitable pupils. Pupils and parents are to be informed about the tasks and requirements of the different types of school and in particular in the 4th and 8th grade as well as before the completion of a kind of school to advise on the further educational path to be recommended according to the interests and achievements of the pupil.

The different types of schools in Austria, systematic classification, colored according to ISCED

The schools are divided

1. according to their educational content in:

a) general education schools,

b) Vocational schools.

2. according to their educational level in:

a) primary schools,

b) secondary schools,

c) Academies.

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Primary schools are

1. the elementary school up to and including the 4th grade,

2. the appropriate levels of the special school.

Secondary schools are

1. the upper school of elementary school,

2. the secondary school,

3. the Polytechnic School,

4. the appropriate levels of the special school,

5. the vocational schools,

6. the middle schools,

7. the higher schools.

Are compulsory schools:

1. the general education compulsory schools (primary schools, secondary schools, special schools, polytechnic schools),

2. the compulsory vocational schools (vocational schools).

After elementary school, a general secondary school (AHS) lower level or the New Middle School (formerly secondary school) is attended for four years. For admission to an AHS you have to have a certain grade record and / or take an entrance exam. A visit to a new middle school is possible for everyone

After completing the eighth grade, there are four main types of school: upper secondary school, vocational secondary school (BHS), vocational secondary school (BMS) and polytechnic school followed by vocational school. All schools are available to everyone, regardless of the school they have previously attended, but especially at the BHS, students are selected according to grades and aptitude tests.

BHS and AHS complete with the Matura, which entitles to attend universities, polytechnics, colleges of education, academies and colleges. The Pillar of Vocational Training is summarized in the areas of BMHS (Vocational and Secondary Vocational Education) and by additions to the teaching profession.

The subdivision into pre-school education, primary education, lower secondary education, upper secondary education, post-secondary education, tertiary education is according to the UNESCO's International Standard Classification of Education (ISCED) classification.

Austria, like Germany, is one of only a few Western European countries to have a differentiated upper secondary school system (between eleven and fifteen). After completing elementary school, you usually attend an AHS (high school) or the New Middle School. The choice of the type of school should be made depending on previous school success and talent.

Attendance is compulsory both at the Hauptschule / Neue Mittelschule and in the lower secondary school. Students are taught according to a subject teacher system. Training at these schools takes four years.

With the exception of private schools, attendance at secondary schools is free. Only materials for lessons, a deductible for the student license card as well as membership fees to the parents' association, computer costs or other additional services are paid.

In 2008, the school trial New Middle School (NMS) was started. The NMS has been run as a mainstream school since autumn 2012 and will replace all main schools by means of a graduated plan from 2015/16.

More talented students tend to attend a general secondary school (AHS) after elementary school, but in rural areas, because of the greater distances to secondary schools, the New Middle School is often chosen. In order to be accepted at an AHS lower level, this must be specifically noted in the elementary school leaving certificate. In German and mathematics, the performance must have been rated "good" or "very good". If these requirements are not met, an entrance examination is required.

Pupils of the highest achievement group of a new middle school with no worse grade than "satisfying" are also accepted as newcomers after the fifth, sixth or seventh grade.

- Basically, the general secondary school is called high school. The Gymnasium in the classical sense serves above all the comprehensive humanistic general education.
- The Realgymnasium is set up for those who are interested in science, that means with increased instruction in these subjects (mathematics, geometric drawing). The teaching subjects of the Realgymnasium are more or less equivalent to those of the Hauptschule, but the lessons are more complex and deeper into the subject than in the New Middle Schools.
- The business school Realgymnasium also has an economic focus (economics and social studies).

Pupils with an EHS grade at an AHS can be enrolled in secondary VET schools.

Secondary education includes the upper secondary general secondary school (AHS), the intermediate vocational education (BMS) and secondary school (BHS), together BMHS, and postgraduate training. The secondary schools complete with the Matura, the middle schools with diploma. Vocational schools also include training in a teaching profession, including business license.

In the fifth grade AHS (ninth grade) begins the AHS upper school. The three forms of AHS will be continued and in some cases refined.

In general, from the ninth grade on, another foreign language is taught, often Latin, French or Italian, more rarely Ancient Greek, Russian, Spanish or a neighboring language.

In the context of school autonomy, a school-specific emphasis can be made in all gymnasialen forms.

Furthermore, it is possible to take the Matura at a high school for working people (evening gymnasium). Evening Gymnasiums offer especially working people, but also early school leavers from a day school the opportunity to obtain a full-fledged Matura.

Vocational School

In Austria there are two types of vocational schools in the tertiary sector:

Berufsbildende höhere Schulen (BHS) can be attended after the eighth grade and, in addition to vocational training, also offer the opportunity to acquire the diploma and matriculation exams after five years. The advantage over an AHS here is that you get both the study qualification (with the Matura) as well as a complete higher professional education.

However, the training lasts one year longer for the AHS. With regard to the number of hours, the training at the BHS is about 3500 hours longer, which in real terms corresponds to about two school years.

Vocational secondary schools (BMS) are specialized or commercial schools. These convey vocational qualifications and general education. The training lasts three to four years and ends with a final exam. Vocational middle schools impart theory and practice in the fields and disciplines they offer. The training should enable the graduates a direct entry into the desired professional life and replaces trade licenses.

EDUCATIONAL SYSTEM IN THE CZECH REPUBLIC

The Charter of Fundamental Rights and Freedoms, which is a part of the Constitution of the Czech Republic, upholds the general right to education, the right to free education at primary, secondary and (depending on ability and capacity) university level. The main administrative responsibility stays with

the Ministry of Education, Youth and Sport, although more responsibilities were recently delegated to municipal and local authorities. Since 1990 establishment of private schools was made possible. Private schools receive a state contribution towards running costs and are allowed to charge tuition fees.

School attendance has been compulsory since 1774. It lasts for a period of 9 years, usually from the ages of 6 to 15, mostly at the basic school (základní škola). Catchment areas are defined, but the choice of school is free. The school year begins on 1st September and ends on 31st August of the following year. Lessons of 45 minutes are spread over 5 days a week. There are 22-25 lessons in a week in the first stage (year 1-5), 27-30 lessons in the second stage (year 6-9). The average class size is about 21 pupils. The coeducational classes are made up of pupils of the same age. At the first stage, all subjects are taught by the same teacher, while at the second stage teachers usually specialise in two subjects.

The national teaching standards authority sets the objectives and the basic curriculum. To achieve them, various educational programmes can be employed when approved. There are three national programmes. Each establishment is free to use teaching methods and textbooks (from a list approved by the Ministry of Education, Youth and Sports). Pupils are assessed (by teachers) on the basis of written and oral performance (and homework) and classified on a scale of 1 to 5. Continuous assessment is summarised in a report at the end of each semester. Verbal assessment is authorised at the first stage of basic school. This kind of assessment is used by 8 % of teachers. Meetings with parents are organised to discuss the progress made by their children. Pupils demonstrating learning difficulties have to repeat the year. The drop out rate is 0.78 %.

There are three main types of secondary schools in the Czech Republic: general secondary school (gymnázium), secondary technical school (střední odborná škola - SOŠ) and secondary vocational school (střední odborné učiliště - SOU). A prerequisite for acceptance is successful completion of a compulsory education and successful meeting of the entrance requirements. The headmaster decides to accept some applicants without an entrance exam and to set the content of the exam. Gymnázium (ISCED 3A) provides a general, academic education. Its main aim is to prepare students for university studies. The duration is 4 years after 9 years of basic school, although there are also other types of gymnázium (see above). At the end of their time at the gymnázium students take a final exam (maturita). 17.4 % of young people entering all types of secondary schools at the age of 15 enrol in a gymnázium. Besides that 7.95 % of the population group is enrolled in the gymnázium at a lower age. There are 346 schools of this type (nearly 1/5 of them are private ones). A secondary technical school (ISCED 3A, B) usually provides a complete secondary vocational education which takes 4 years and concludes with a final exam (maturita) and sometimes also lower-level secondary vocational education (2- or 3-year courses). The school prepares students for technical

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work in one of about 260 branches. About 40 % of teaching time is devoted to general education and 60 % to vocational technical education. Practical lessons are taught in laboratories and workshops at schools. 37.5 % of youth enters this type of upper secondary school and this proportion is increasing. The number of these schools is 804 (about ¼ of them are private ones). Secondary vocational school (ISCED 3B) offers apprenticeship training mostly in 3-year (and sometimes 2-year or 1-year) courses ending in a final exam and apprenticeship certificate. Practical training represents about one half of teaching time and it aims at the acquisition of manual skills. The number of branches amounts to about 280. Approx. 45 % of young people enter this type of secondary school and this proportion is decreasing. There are also 4-year courses organised by secondary vocational schools. They end in a maturita exam. The courses lead to highly skilled worker qualifications or serve as an extension study to those who continue their study after their successful apprentice training. There are 565 secondary vocational schools, of which approx. 1/6 are private ones. The curricula of all secondary schools must meet the requirements of the appropriate educational standards approved by the Ministry of Education, Youth and Sports.
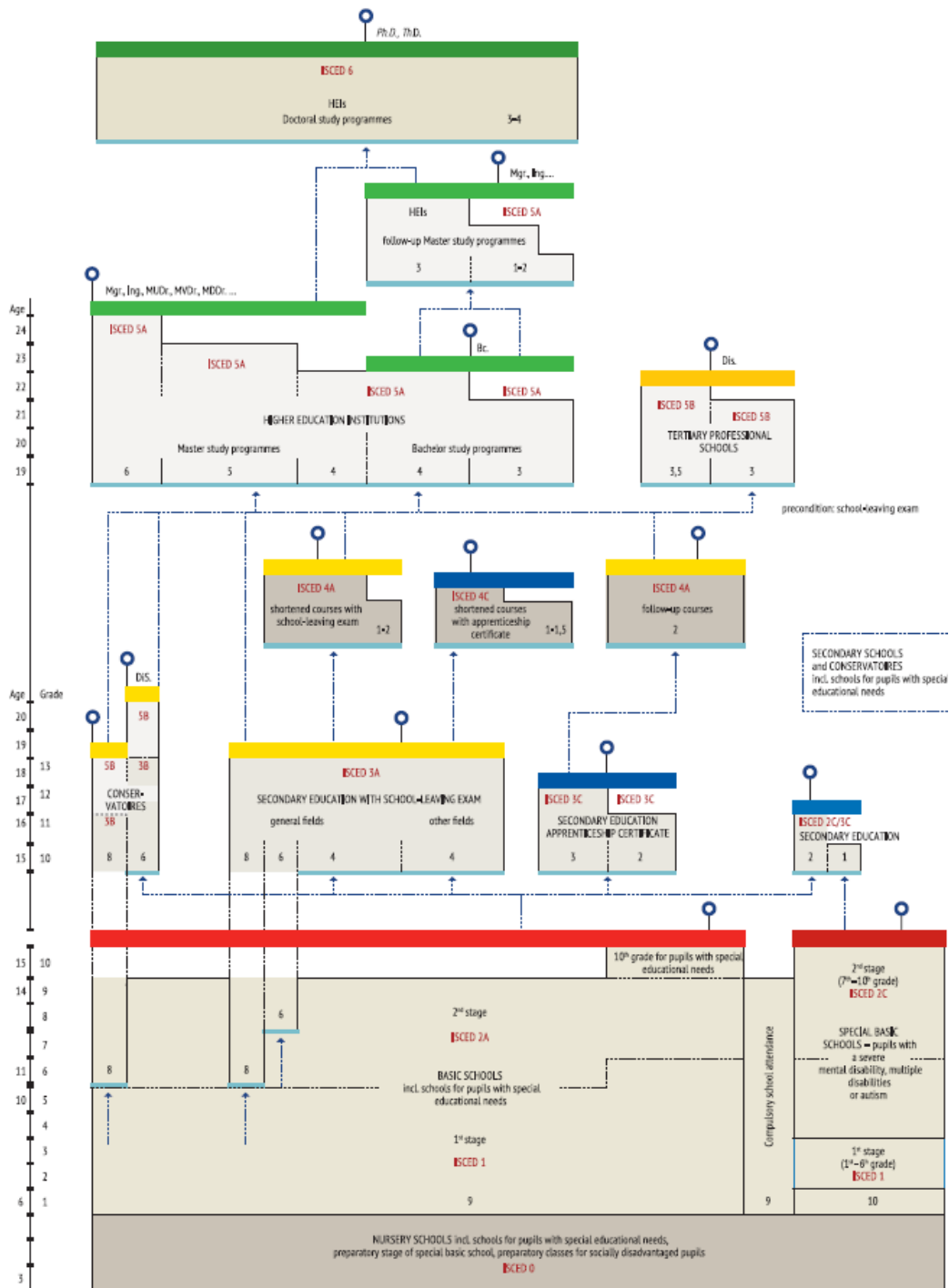
A higher professional school (vyšší odborná škola), ISCED 5B, provides the necessary qualifications for demanding technical activities which do not require a university degree. The programmes last a minimum of two years and a maximum of three and a half years. The graduate receives the title DiS. (specialist with a diploma). There are 164 of these schools (1/3 are private schools) teaching in approx. 200 branches. Students pay a fee for tuition. Higher education institutions can be either university or non-university types, both defined as vysoká škola. The type of institution is declared in its statute, and must comply with the verdict of the Accreditation Commission. They offer education at three tertiary levels: bachelor study programmes (usually 3 years, ISCED 5B) and master study programmes (usually 5 years, ISCED 5 A) are available for applicants who have passed the maturita exam and have met the other admission criteria incl. entrance exam. The third level of higher education, doctoral study programmes (usually 3 years, ISCED 6), is open to graduates of the master study programmes. Traditional university-type institutions may offer all types of study programmes while non-university institutions are characterised by providing mainly bachelor study programmes. Most university-type institutions are divided into faculties. Today, there are 39 higher education establishments in the Czech Republic, state and private. Approx. one third of all admitted applicants study the shorter bachelor study programmes and two thirds the longer master study programmes. The demand for higher education is high, only one half of applicants are admitted.

The Ministry of Education, Youth and Sports is the central body in the field of education. It develops strategic documents and drafts the proposals of laws and other regulations concerning education in the country. The nursery, primary, secondary and higher vocational schools are administered by the

department of education within self-governing regional bodies in 14 regions of the Czech Republic. The municipalities are also involved in the administration of the nursery and basic schools. The Czech School Inspectorate is the central controlling body. It is responsible for monitoring education results, the quality of management, the efficient use of funds and ensuring compliance with binding regulations at all levels except for universities.

Schools are usually funded by the state through the budget of the Ministry of Education, Youth and sports and budgets of regional authorities and municipalities. The funding is based mostly on the per capita method. The financial means for staff costs, textbooks and teaching aids are allocated by the Ministry to regional authorities. The operational costs and investment of nursery, primary, secondary and higher vocational schools are covered by the regional or local authorities. Universities are funded by the Ministry of Education.

Educational system in the Czech Republic is not flexible, that´s one of the weakest point of the whole system. Especially high schools are not doing well to prepare technically prepared and motivated student. It´s not mainly about the teachers, but about the curriculum which often do not reflect modern trends enough, or with such a delay, that it´s not interesting for the pupil anymore. Also, the stigma of memorizing the facts, instead of use another modern teaching methods (practical examples, thinking rather than just reading...) are still often used. In case, that these two things could change, the results will be more more skilled employees on the job market. Plus, even a high school student will have more value on the market!

Ph.D., Th.D.

ISCED 6

HEIs
Doctoral study programmes   3—4

Mgr., Ing....

HEIs   ISCED 5A

follow-up Master study programmes

3   1—2

Mgr., Ing., MUDr., MVDr., MDDr. ....

ISCED 5A

ISCED 5A   Bc.

ISCED 5A   ISCED 5A   Dis.

HIGHER EDUCATION INSTITUTIONS   ISCED 5B   ISCED 5B

Master study programmes   Bachelor study programmes   TERTIARY PROFESSIONAL SCHOOLS

6   5   4   4   3   3,5   3

precondition: school-leaving exam

ISCED 4A   ISCED 4C   ISCED 4A

shortened courses with school-leaving exam   shortened courses with apprenticeship certificate   follow-up courses

1—2   1—1,5   2

SECONDARY SCHOOLS and CONSERVATOIRES incl. schools for pupils with special educational needs

DIS.

5B

5B   3B   ISCED 3A   ISCED 3C   ISCED 3C   ISCED 2C/3C

CONSER-VATOIRES   SECONDARY EDUCATION WITH SCHOOL-LEAVING EXAM   SECONDARY EDUCATION APPRENTICESHIP CERTIFICATE   SECONDARY EDUCATION

5B   general fields   other fields

8   6   8   6   4   4   3   2   2   1

10th grade for pupils with special educational needs   2nd stage (7th—10th grade) ISCED 2C

6   2nd stage   SPECIAL BASIC SCHOOLS = pupils with a severe mental disability, multiple disabilities or autism

ISCED 2A

8   8   BASIC SCHOOLS incl. schools for pupils with special educational needs

1st stage (1st—6th grade) ISCED 1

1st stage

ISCED 1

9   Compulsory school attendance   9   10

NURSERY SCHOOLS incl. schools for pupils with special educational needs, preparatory stage of special basic school, preparatory classes for socially disadvantaged pupils

ISCED 0

Age: 24, 23, 22, 21, 20, 19

Age / Grade: 20, 19, 18/13, 17/12, 16/11, 15/10

15/10, 14/9, 8, 7, 11/6, 10/5, 4, 3, 2, 6/1, 3

EDUCATIONAL SYSTEM IN ITALY

The main principles on which the Italian education system is based on are subsidiarity and autonomy of institutions. The State has legislative competences on the organisation, the Ministry of Education, University and Research is responsible for the national general administration of education, while The State and Region are both responsible for example of the school calendar, distribution of schools, right to study, Regions also have exclusive legislative competences in the organisation of the regional vocational education and training system. The offer from the Early Childhood Education & Care to upper secondary education at local level are organised by local authorities. Even schools have a high degree of autonomy such as curricula, school time and groups of pupils. Every three years schools draw up their own Plan for the educational offer (PTOF).

In Italy the education system is mainly a public State and compulsory education is free. There are also private and public bodies that can establish education institutions, but private schools cannot issue qualifications. State schools are financed by the State; Scuole Paritarie receive State contributions established annually by the Ministry of Education.

Education at all levels must be open to everyone. For this reason inclusion in Italian schools is a must and it is applied to pupils with disabilities, to pupils with social and economic disadvantages and to immigrant pupils. For them measures focused on personalisation and didactic flexibility are taken as well as linguistic support for immigrants with low levels of Italian. The right of education is also granted to hospitalised and detained students.

In Italy a state-born school system, or Education System has existed since 1859, when the Legge Casati (Casati Act) was published.

The Italian education and training system includes Early Childhood Education & Care:

- ECEC for children aged less than 3 years is offered by educational services (*servizi educativi*)

- ECEC for children aged from 3 to 6 years is available at preprimary schools (*scuole dell'infanzia*).

Together they make up an 'integrated system', which is not compulsory and it is organised by the Regions under the responsibility of the Ministry of education.

Compulsory education starts at 6 years of age and ends at 16 years of age that is the whole first cycle of education and two years of the second cycle. The last two years of compulsory education can be attended either in an upper secondary school or within the regional vocational education and training system.

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Students can attend either State school or *scuole paritarie* or private schools.

Everyone has a right and a duty (diritto/dovere) to receive education and training for at least 12 years within the education system or until they have obtained a three-year vocational qualification by the age of 18

➢ First cycle of education

It is compulsory and is made up of primary and lower secondary education.

- <u>Primary education</u> (*scuola primaria*) starts at 6 years of age and lasts 5 years.

- <u>Lower secondary education</u> (*scuola secondaria di I grado*) starts at 11 years of age and lasts 3 years.

Students pass from one level to the next one without exams. At the end of the first cycle of education, students who pass the final state exam in order to attend the second cycle of education.

➢ Second cycle of education

It starts at the age of 14 and offers two different pathways:

- the upper secondary school education

- the regional vocational training system (IFP).

The first two years of the second cycle of education are compulsory.

- <u>The upper secondary school education</u> (*scuola secondaria di II grado*) offers both general (liceo) and vocational (technical and vocational) programmes. Courses last 5 years. At the end of the upper secondary school education, students who pass the final exam, receive a certificate that gives them access to higher education.

- <u>The regional vocational training system</u> (IFP) offers three or four-year courses organised by accredited training agencies or by upper secondary schools. At the end of regional courses, learners receive a qualification that gives them access to second-level regional vocational courses or, under certain conditions, short-cycle courses at higher education level.

Higher education

It is offered by:

- Universities (polytechnics included):

- ✓ University degree and general (first level or three years) skills ➡️ Adequate mastery of scientific methods and specific professional

- ✓ Specialized degree of a highly ➡️ Advanced training in specific areas for the pursuit

  Qualified activity

- ✓ PhDs Centers Companies ➡️ Scientific Research in Universities, Research

- ✓ Master (I or II level) ➡️ Skills for particular professionl activities

- High level arts, music and dance education institutes (Alta formazione artistica, musicale e coreutica - Afam);

- Higher schools for language mediators (Scuole superiori per mediatori linguistici - SSML)

- Higher technical institutes (Istituti tecnici superiosi - ITS).

Only students with an upper secondary school leaving certificate can attend university courses. The specific conditions for admission to university are established by the Ministry of education.

Students with an upper secondary leaving certificate and/or students who have attended a four-year regional vocational course followed by an additional one-year course in the Higher technical education and training system (IFTS) can attend courses at higher technical Institutes.

Adult education

It includes all activities aimed at the cultural enrichment, requalification and professional mobility of adults. It is provided by centres for school education for adults (*Centri provinciali per l'istruzione degli adulti - CPIA*) and by upper secondary schools.

Organisation of general Upper Secondary Education

It lasts five years and is delivered by:

- ➢ Lycée, six types specialising in the following areas:

  1. art

  2. classical studies

  3. science

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4. foreign languages

5. music and dance (coreutico)

6. human sciences

The first two years are the same for all branches.

There are 27 hours a week in the first two year, 30 in the three-year period (except for the artistic secondary school and coreutico secondary school).

➢ Technical High Schools

Economic Sector:

1. Administration, finance and marketing
2. Tourism

Technological Sector:

1. Mechanics
2. Transports and logistics
3. Electronics & Electric engineering
4. Computer science and Telecommunications
5. Graphics and communication
6. Chemistry, Materials and Biotechnology
7. Fashion System
8. Agriculture, food processing and agro-industry
9. Construction, Environment and Territory

There are 32 hours a week, two 2-year periods and a fifth year that is the year of specialization.

The Technical High Schools are characterised by :

1. Strong integration of theoretical and practical knowledge

2. Learning outcomes declined in skills, abilities and knowledge according to the European Qualifications Framework (EQF) to facilitate the mobility pf people in the European Union

3. Central laboratories

4. Internship, apprenticeships and work based learning experience

➢ Vocational Schools:

Service Area:

1. Agriculture and rural development

2. Enology, gastronomy and tourist promotion and reception

3. Trade

4. Social Health

Industrial and artisan Area

1. Industrial production and craft

2. Maintenance and technical assistance (maintenance and support)

There are 32 hours a week, structure of the five-year path, 2-year like technical high school, last 3-year more professionalising, more alternance training.

INVALSI

Students also undergo an external assessment of their learning outcomes carried out by INVALSI (National Institute for the Evaluation of the Education System). As the system is under development, external assessment currently applies to second-year students and to fifth-year students in Secondary schools. Assessment results are returned to schools to provide teachers and school managers with useful tools for self-evaluation and to improve teaching. The data collected will be used to conclude an "Annual Report on the result of learning".

ASSESSMENT & STATE EXAMINATION

Teachers also certify the competences attained by pupils by the end of compulsory education (16 years of age) and completion of the second cycle of education.

At the end of the Secondary School there is the school State leaving examination whose aim is to verify the knowledge and skills gained during the last year of the study path, according to the general and specific objectives of each branch of study, as well as the general cultural knowledge and the critical skills the candidates.

The State examination includes two written tests and an oral test. The purpose of the first written test is to verify proficiency in Italian or the language in which the course is taught, as well as the expressive, logical-linguistic and critical skills of the candidate. The second paper tests one of the main subjects of the programme. The texts for the first and second written tests are selected by the Minister and sent to schools by the Ministry of Education. Tests are delivered to schools via data

communication. The oral test is multidisciplinary in content and covers the course programmes of the final year of school. The calendar for examinations is decided by the Ministry of Education every year.

Certification Students who pass the final State examination receive a Diploma Liceale and a certificate. In addition to the student's personal details, the Diploma contains the type of liceo they attended, the area of study and their score in the final examination.

Most relevant changes of the Italian education system in recent years.

In coherence with the objectives set at European level, attention is given to the reduction of early leaving from education and training, to the full implementation of school autonomy, to the quality of education, to students' competences, to tackling social inequalities and to guaranteeing the right to study and equal opportunities to education and training to everyone.

The most recent reform in the education and training system is included in the bill called 'The good school' introduced by the Government and approved by the Parliament in July 2015 as law no. 107.

The reform process started in September 2014, with the publication of the document 'La buona scuola – Facciamo crescere il paese' ('The good school – let's make the country grow') which defined the strategy that the Government and the Ministry of Education set for improving the quality of the Italian school system. The document was made available for public debate on the website labuonascuola.gov.it, until 15 November 2014.

Law no. 107 regulates several aspects of the education system, in particular the autonomy of schools providing them with human and financial resources and with the necessary organisational and teaching flexibility.

The implementation of some dispositions of the law has taken place gradually through specific regulations.

Law 107 also delegated the Government to adopt eight specific decrees on school education and ECEC.

The new final exam at upper secondary level

On 26 November 2018, the Ministry of education published the reference frameworks for the written tests of the new final exam of upper secondary education. The new exam has been introduced by law 107/2015 and will be held under the new structure in June 2019.

Students will sit for two written tests, instead of the previous three, and one interview. The first test, on 19 June, will evaluate students' mastery of the Italian language. The second test, on 20 June, will cover one or more subjects specific of each study branch.

For the first time, the Ministry has also provided schools with evaluation form models to have a more homogeneous evaluation of students.

The Ministry published the framework of the oral test and the list of the subjects for the second written test in January 2019.

Launch of the National plan for four-year general and technical upper secondary education

On 7 August, the Minister of education has signed a decree for the launch of the National plan for the experimentation of shorter general upper secondary study courses. According to the experimentation, the duration of general and technical upper secondary studies will be of four years instead of the current five.

The experimentation will start in school year 2018/2019 and will involve 100 classes. The Ministry will launch a national call in September and schools willing to be part of the experimentation should submit their proposal of revised study plans. Projects will be selected according to specific criteria such as high standards of innovation, the use of technology, guidance processes towards the labour market and further studies. Proposals of revised study plans should take into account that students must be guaranteed the achievement of all learning goals established for students attending mainstream programmes.

Specific scientific committees will monitor the four-year trial phase both at national and regional level.

Promotion of school inclusion of students with special educational needs

- The decree on school inclusion foresees the simplification of the procedures to activate the support measures for pupils with special educational needs. Support measures will take into account the needs of pupils with disabilities in a wider perspective, instead of focusing mainly on the type of disability and on its seriousness.

Revision of vocational school education

- The focus is on the innovation of the vocational offer and on the revision of study programmes in order to avoid overlapping with the technical paths and with the vocational training organised at regional level.

- The present six branches of studies will increased to 11 and the percentage of time dedicated to branch-related learning will increased to 40% in the first two years of study and to 50% in the last three years.

- Starting from school year 2018/2019, vocational institutes and regional vocational education and training providers will be part of the national network of vocational schools, created in order to have a more efficient vocational offer.

Right to study

- The decree on the right to study foresees the allocation of 10 million euros to students attending the last two years of upper secondary education for purchasing textbooks, for mobility and transport and to access cultural services. Students will also be exempted from fees.

Promotion of the classical culture

- The teaching of music, dance, cinema and theatre, arts, design, writing will increase, in particular at upper secondary level.

- Work-based learning will involve also public and private subjects working in the field of art conservation and production.

Revision of Italian education institutions abroad

- The decree includes dispositions aimed at harmonising the educational offer abroad with the offer in the country. Teachers will stay abroad for 6 years instead of 9 years and 50 new teachers will join the teaching staff of Italian schools abroad.

Revision of regulations on students' assessment

- The decree foresees some changes in the final examination at lower and upper secondary level starting from 2018.

- At lower secondary level, the written tests in the final exam will reduce from six to three (Italian, mathematics and foreign language). The standardised national test that, at present, is part of the final examination, will be held during the last school year.

- At upper secondary level, written test in the final exam will reduce from three to two (Italian and a subject related to the course of study). Work-based activities will be taken into account for the admission to the exam.

- In the calculation of the final mark, the overall evaluation of the last three years of studies will count up to 40 points (now it counts 25), while the two written tests and the oral test will count up to 20 points each.

- At all levels, standardised national tests will include English and will be held during the last year of primary, lower secondary and upper secondary level. Standardised tests will be taken into account for the admission to the final exams at lower and upper secondary level, but will no longer count in the calculation of the final marks.

2016: Three-year university plan

The Ministerial Decree no. 365/2016 has provided the general guidelines for the three-year planning of universities for the period 2016-2018. According to the guidelines, in the three-year period the Italian university system should reach the following targets:

- the improvement of the results obtained in the period 2013-2015;
- the modernisation of study and research spaces, innovation of teaching methods;
- the recruitment of young researchers and reward of worthy professors;
- the responsible autonomy of universities

2016: The National Plan for digital School (PNSD)

The reform law 107/2015 foresees the revision of the already existing National plan for digital school (PNSD) in order to harmonise all the measures and initiatives carried out since 2007, and to support the didactic innovation of schools by helping them to catch the opportunities offered by digital education.

The new PNSD is a plurennial plan addressed to all Italian schools. The strategy for the digital innovation of schools includes, among the other actions, the introduction, in each school, of digital promoters who have the role of helping schools in becoming centres of digital innovation. The Plan answers to the need of building an idea of education in the digital era, through a process linked to the challenges that the society must face in terms of life-long and life-wide learning.

The actions for the 'tools' section include the provision of the broadband to all schools and, within 2016, a contribution to the connection fee. Special attention is given to the school premises in order

to make them more functional to learning, with spaces able to allow different types of activities centred on innovation.

It is also foreseen the creation of a digital identity of students and teachers with a single authentication system for entering all services of the public administration (SPID).

Moreover, the PNSD strengthens the link between school and work, through entrepreneurship education and the promotion of STEAM (sciences, technology, engineering, arts and mathematics) and digital careers.

Training for digital promoters and members of the team started in early 2016 and will be followed by the specific training for school and administrative managers and, in a second step, by the specific training for all administrative and teaching staff.

The strength point of the Italian school system is the "inclusion" of students with special needs, such as disabilities, social and economic disadvantages and to immigrant pupils. Diversity is considered a resource and a richness rather than a limit. Inclusion is a process, a framework where students regardless of their ability, gender, language, cultural or ethnic origin can be given equal opportunity in school. The inclusive school has a flexible organisation, a different didactic, a rich educational assortment.

One of the weak point of the Italian school system are the vocational schools that are often considered schools attended by disengaged students, while they should be considered as a place of professional specialization. Plenty of people give their best through movement and manual activities, such as dancers, artisans and so on. There should be an implementation of such schools in order to better the national production.

CONCLUSIONS

In summary, this report has shown that, considering the importance of education in the future of the EU, it should be a primary priority to coordinate and promote an improvement in education from the European institutions. Many European policies have been studied in this report, highlighting the importance of VET education and how it is entering the most important circles in the EU.

However, there is still work to do in this area; each of the countries analysed in this report has shown the need to make VET attractive and encourage the entrance of students in VET, as well as the need to improve the academic content provided in this part of the education. From the results obtained in Spain, the challenge remains representing VET education as an attractive option that facilitates the entrance to the labour market, especially considering this is one of the main worries of the country. Also, it has been seen how it is necessary to adapt the studies to the "technological and knowledge society", in a way that separates them in a certain way from the excessive industrial bias. That may be a way of promoting the employability of VET students, which is also one of the most relevant factors when it comes to attracting students.

On the contrary, the analysis of Austria's education system has provided a vision of a system where VET education is highly developed and divided in different areas to ensure a proper control of the education depending on the requirements of the country.

Educational system in the Czech Republic has proven to have issues referring to its flexibility to adapt to new situations, especially when preparing and motivating students, as its curriculum is currently not reflecting the modern requirements that would be interesting to the student. Also, it has been highlighted the stigma of memorizing the facts, instead of use other teaching methods, an issue that is shared among many of the countries analysed.

Italian school system, although relevant for its inclusiveness are the vocational schools, has shown that many times VET education is considered only for disengaged students, while they should be considered as a place of professional specialization. Plenty of people give their best through movement and manual activities, such as dancers, artisans and so on. There should be an implementation of such schools in order to better the national production.

To conclude this report, it is seen how most of the countries engaged in it are making efforts towards a more digitalised, structured VET that promotes the entrance of new studies and encourages the interest of students in expanding their educational horizons.

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CURRENT STATUS OF INDUSTRY 4.0

REPORT IV –IMPLEMENTATION OF INDUSTRY 4.0 IN EUROPEAN EDUCATIONAL SYSTEMS

INDUSTRY 4.0 for VET

Erasmus+ - KA2 - Cooperation for Innovation and the Exchange of

Good Practices

Strategic Partnerships

Project Number: 2018-1-CZ01-KA202-048179

CONTENTS

INTRODUCTION

The availability of a skilled workforce in the field of industry 4.0 technologies is a precondition to achieve a successful transition towards the fourth industrial revolution in the European Union. However, from an educational point of view, achieving only this does not suffice. Apart from that, the educational systems of member countries need to be rethought to enhance a wide new set of capabilities amongst European citizens, with disregard of their personal, social or economic differences. The competences that citizens will need to master do not necessarily have to do only with technical skills. Instead, soft skills such as creativity, resilience, critical thinking, problem solving, or adaptation are essential to deal with the new technologies and to face the changing, uncertain and complex reality of the information age.

Achieving this requires deep changes in the educational processes at all levels (primary, secondary, higher education, VET or lifelong learning), which adds more pressure to national and EU institutions to increase the flexibility of their educational systems. However, given the specific context and the challenges of each territory, the extent to which educational systems are adapted to the new requirements of industry 4.0 vary.

In this aspect, there are multiple questions that still need to be addressed. For instance, what types of competences do educational systems foster? Are these in line with the requirements of industry 4.0? how do the ministries of education reflect the fact, that the industry 4.0 is already here? which specific plans or measures have been developed in partner countries? which barriers are preventing each country to adapt their educational systems to Industry 4.0?

Through this report, the partnership of InVET will shed some light to these emerging issues from the perspective of the partner countries and the EU. The conclusions of the comparative study will be paramount to generate knowledge in a topic that has not received much attention, as well as to pave the way to further phases of the project InVET.

IMPLEMENTATION OF INDUSTRY 4.0 IN THE EUROPEAN EDUCATIONAL SYSTEM

According to the EU and the digital scoreboard, 90% of the future jobs in Europe will require the use of digital skills, while 44% of the EU population have low or do not count (19%) with these types of competences (European Commission, 2019a). In addition, although there has been an increase in the number of ICT and STEM (science, technology, engineering, mathematics) graduates, the skills gap still remains (European Commission, 2017a). These facts provide relevant insights for the future of the EU. Quoting the EC, coping with technological changes "*will require a massive investment in skills and a major rethink of education and lifelong learning systems*" (European Commission, 2017b). In other words, the EU needs to invest in creating educational systems that work synergistically with the changes happening at the industry.

The Commission, the Council and other institutions are aware of this challenge. In fact, in a recent communication the EC describes as "of outmost importance" the need of investing in digital skills education in a context where digitalisation of work and business processes keeps increasing with the rise of the industry 4.0. While there are no specific actions or programmes directly connecting education and Industry 4.0 at a European level, the EU is trying to facilitate the transition to this new paradigm of production through several measures in the educational field. For this, the EU is using existing mechanisms like the 8 Key Competences for Lifelong Learning but is also launching new strategic tools such as the New Skills Agenda, the Digital Education Action Plan, the Digital Skills and Jobs Coalition and funding programmes like Erasmus +. These initiatives are supposed to guide and encourage Member States to create efficient educational systems and to prepare European citizens for the changes that the industrial revolution will bring. However, as seen in the report on the educational system of the EU, this depends largely on national and regional governments.

Over the last decade, European institutions have put an especial emphasis on the development of digital competences, a requirement for the effective implementation of Industry 4.0. In fact, these were included as one of the eight Key Competences for Lifelong Learning, which define crucial competences that European citizens should have in order to adapt to the new society. Digital competences were defined as those involving the confident and critical use of Information Society Technology (IST) for work, leisure and communication (European Parliament, 2006). However, this definition has been recently updated in order to keep up with the fast-changing nature of technological environments.

This change came within the framework of the Recommendations launched by the Council in 2018. Through these recommendations, there are key points and measures connected to the Industry 4.0. These include the determination of the EU in boosting digital competences including programming, cybersecurity, robotics and artificial intelligence aspects; raising levels of achievement in digital basic skills and supporting the development of and the interest in science, technology, engineering and maths (STEM) competence and making STEM careers more attractive (European Commission, 2018b).

In order to clarify how digital skills can be measured, the European Commission has created the Digital Competence Framework 2.0, known as DigComp 2.0. This framework includes five competence areas, which are in line with the new definition of digital skills provided by the EU. The EC has also developed a practical guide for Member States and European institutions or organisations who might be interested in applying this framework.

Figure 1: The digital competence framework 2.0
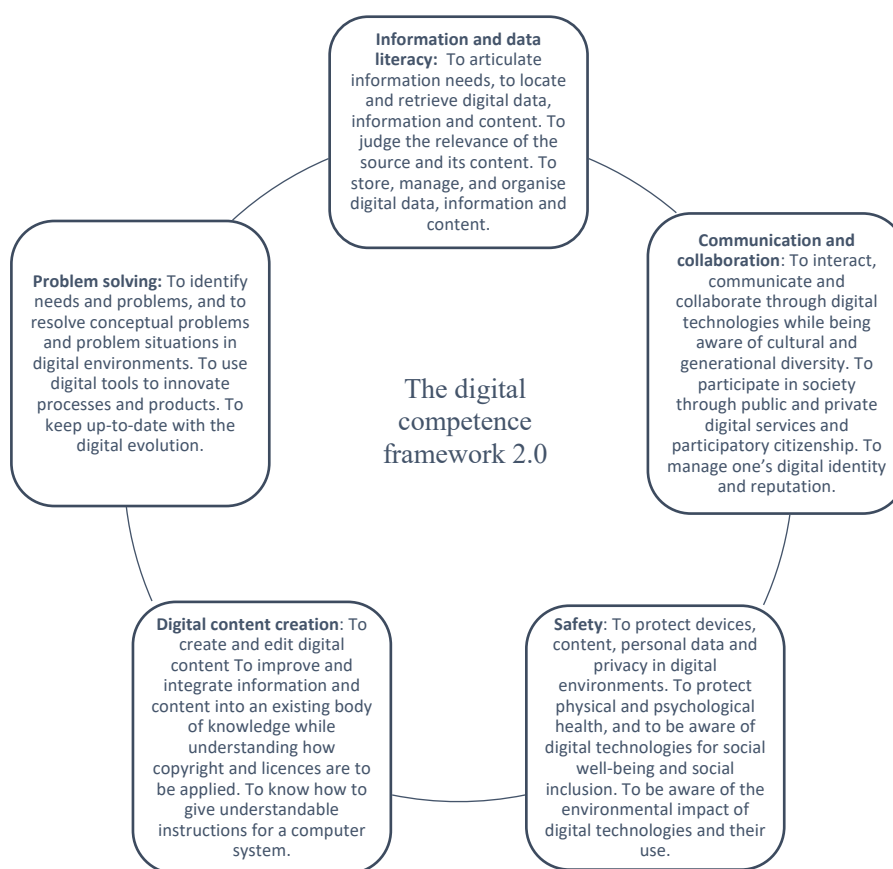
Source: The European Commission, 2018; Retrieved from: https://ec.europa.eu/jrc/en/digcomp/digital-competence-framework

As can be noticed, this definition of digital competences is more complete than that provided in 2006. In terms of other competences related to the Industry 4.0, the Commission highlighted that the ability to adapt to change resilience, creativity, critical thinking, entrepreneurial and STEM competences also need to be strengthened.

Another particularly important strategic tool is the Digital Education Action Plan, which provides specific guidelines on how the EU can assist Member States and social actors to adapt educational systems and policies to the current context of rapid digital change. The plan is composed by eleven specific actions, which seek to enhance the development of digital competences and the use of technology in education. It has three main priorities: *providing tools to help educators and trainers to make better use of technology including better internet connectivity; targeted action to develop relevant digital competences and reinforced and new efforts to improve education via better evidence and analysis* (European Commission, 2018a). This Plan puts special emphasis on basic education and specifically addresses schools, VET and higher educational centres.

It is also focused on creating innovative learning environments and on fostering the use of digital infrastructure in the educational centres, where learning takes place. Amongst the actions carried out

so far, we can find the creation of SELFIE (Self-reflection on Effective Learning by Fostering the use of Innovative Educational Technologies), a tool designed to help schools embed digital technologies into teaching, learning and student assessment (European Commission, 2018c) or funding opportunities to increase connectivity within schools.

The EC also launched the Digital Skills and Jobs Coalition, which aims to bring together different social actors (businesses, NGOs, educational centres, national governments etc.) to tackle the low levels of digital skills within the EU. With this initiative, the EC seeks to benefit a variety of groups, including unemployed, VET students, recent graduates, teachers, children or ICT specialists. Regarding the types of learning opportunities promoted, these also take many forms, ranging from MOOCs, trainings, traineeships or simply fostering the share of good practices. The EC has also encouraged the creation of Coalitions at a national level, gathering relevant stakeholders to collaborate on the strengthening of digital skills.

Other specific initiatives include the Europe Codeweek or the Digital Opportunity traineeships, which will benefit 6.000 students who will have the opportunity to carry out traineeships in companies in the fields of big data, cybersecurity, quantum technology or machine learning. These traineeships are being financed by Horizon 2020 and implemented by means of the programme Erasmus +.

These two programs represent important funding instruments through which the EU is expanding learning opportunities in topics related to Industry 4.0. In fact, the promotion of innovative pedagogies and methods for teaching, learning and assessment that support educators and learners to use digital technologies in creative, collaborative and efficient ways is a horizontal priority for projects funded by Erasmus + in 2019 (European Commission, 2018). In this aspect, public and private organisations are developing numerous projects focused on this field, such as InVET. The Parliament has recently highlighted the important role of the partnerships developed in the framework of Key Action 2 of Erasmus +, especially in the development of start-ups working in the technological sector and the promotion of ICT skills. Finally, the European Social fund, InvestEU and Digital Europe are other channels through which the EU finances projects related to Industry 4.0.

In the field of European educational policies connected with Industry 4.0, the Joint Research Centre (JRC) provides support to European institutions by generating knowledge in the field of educational research. The JRC is focused on making a better use of ICT for *"rethinking learning, for innovating education and training and for addressing new skills requirements"* (European Commission, 2019b).

There are several conclusions that can be drawn from this analysis. Firstly, as national policy reforms aimed at fostering innovation in educational systems are intrinsically complex, EU's role to provide institutional support becomes necessary. In this aspect, it seems that in the educational field, the EU has opted for supporting the acquisition of new skills related to the industry 4.0 through four main actions. These include setting common goals, sharing good practices, implementing policy cooperation and tools for funding. Moreover, following the Riga conclusions, the EU has strategically

chosen to put especial emphasis on the development of VET education and the strengthening of lifelong learning opportunities. These two areas are essential to tackle the skills mismatch caused by the rapid development of technology and the change of paradigm that the European industry is experiencing.

Secondly, according to a panel of experts from the European Parliament, the Digital Education Action Plan represents a first step towards a cohesive and common educational policy. However, current initiatives, despite being promising, have a limited impact and come from different general departments in the EU. In addition, if the EU aims to tackle the shortage of professionals to support the transition towards the fourth industrial revolution and to prepare citizens for the changes it will bring, Member States will also have to address numerous challenges.

In this regard, although Industry 4.0 is already a reality, the set of competences needed to live and deal with this new paradigm is still vague. Thus, more research in this area is essential in order to cope with the uncertainty of rapid technological development. Moreover, a needs analysis of other actors such as teachers, companies and educational centres might also be needed. According to an official report on education on the digital era, Member states first need to be able to create successful policies to build the necessary capacities in teachers (Commission of Culture and Education, 2018).

Another clear challenge is the inequality characterising Member States in terms of digital skills and technological infrastructure. According to the European Parliament, a common policy is needed in order to reverse this situation. Connected to this, inequities are also present amongst social groups and learning gaps occur depending on socioeconomic backgrounds or gender[1]. In a recent communication the Parliament placed special emphasis on this topic and stated that "*digital technologies should not aggravate the existing inequalities but should be used to close the digital gap between students from different socio-economic contexts and regions of the EU*" (European Parliament, 2018).

IMPLEMENTATION OF INDUSTRY 4.0 IN THE EDUCATIONAL SYSTEM IN SPAIN

Spain has prioritised the modernisation and flexibilisation of its education system. The Government is promoting a new VET (in Spanish "Formación Profesional" or FP) that is more modern, flexible, innovative and international, with the purpose of being able to respond quickly and to anticipate the needs of the productive model (Gobierno, 2018).

The improvement will be based on the social commitment of working for a VET that combine technical and professional skills, and also others of personal and social nature (usually named as soft skills) that help the integration of students as active, critical and committed citizens.

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[1] The percentage of men working in the digital sector is 3.1 times higher than the percentage of women and only 19% of workers in the ICT sector have a woman as supervisor, compared to 45% in other sectors (European Parliament, 2018).

The aim is to promote, where necessary, the approval and application of strategic VET plans, like the 5th Plan of VET for the Vasc Country [cited as Planning Vasc VET], on each Spanish region.

As the New Skills Agenda for Europe states, "we need to further invest in the modernisation of VET and higher education, and fully exploit their potential as drivers for regional development".

Particular attention will be given to innovation in pedagogy; this will include supporting flexible curricula, promoting interdisciplinary and collaborative approaches within institutions, and supporting professional development to enhance innovative teaching practice, including ways of using and bringing digital tools into the classroom and stimulating entrepreneurial mindsets.

In a survey hold by the Engineering College of the University of Navarra (Tecnun, 2018), 80% of respondents said that operators and supervisors will require another type of qualification (of which they lack nowadays). All its respondents believe that the importance of management competence and ability to train and develop its employees will increase with the 4.0 economy.

- As for the <u>line operator</u>, the most important technical competences will be: the ability to interact with modern interfaces and competence in information technologies, and also in security and data protection. On the other hand, the most important personal competences (soft skills) for the operator will be: teamwork and cooperation, adaptability and flexibility in the face of change, creativity and entrepreneurship. The personal competences (or soft skills) that are most likely to be affected by Industry 4.0 are creativity and decision making.

- <u>For the supervisor</u>, all competencies (except maintenance and repair of electronic equipment) will be important. They emphasize the ability to interact with modern interfaces, the need to have knowledge in organization and processes and, above all, the ability to analyze data. The following competencies will be particularly affected (due to the consequences of Industry 4.0): implementation of 4.0 technologies, information security and data protection.

- Interviewees affirm that personal competences for middle-level management will be even more important in the future. Supervisors have to improve in all, but especially in creativity, entrepreneurship, communication and teamwork.

Right from the basic vocational education, it will be necessary to develop individuals who can think on their feet and act independently. This also means that trainers and vocational schools face a completely new set of tasks (ITA, 2015).

Industry 4.0 requires people who are capable of inter- and transdisciplinary collaboration (i.e. across different subject areas, and with other departments, companies, customers and/or civil society). Again, this is an ability that must be fostered from the initial training onwards.

At the same time, this collaboration with others, and above all with other stores of knowledge and experience, is the vehicle for acquiring a capacity for systemic thinking.

There is no doubt that the demand for systemic thinking and interdisciplinary collaboration will increase. Not everyone will have to be capable of programming and modelling, but more employees will need an understanding of IT and data structures. We will therefore need more formal qualification and training in data handling – but without giving up on know-how about production technology.

For that regard, universities in Spain have already start new programs and studies, like for instance the Polytechnic University of Valencia2. Also, the "Instituto Nacional de Tecnologías Educativas y Formación" (INTEF) provides a series of updated courses3, mainly for teachers.

Educational institutions around the world have realized the urgent need to prepare their students for a complex and uncertain society as well as a competitive labour market. They have accepted that soft skills are a considerable privilege for the future employees, although there is still a significant confusion over how soft skills should be defined and implemented. Employers have begun to give priority in behavioural over technical skills, and individuals who have the pertinent soft skills are preferred over those who perhaps have more technical skills.

There is no better source of creativity and innovation than the person who thinks. Students should become protagonists in an education that works efficiently in the cultural, scientific and technological fields, because our professionals have to improve their level of preparation by acquiring in their training a balance between these components4.

In this new era, the new generations will need to acquire a wide spectrum of skills, attitudes and experiences, both digital and in innovation and creativity. The social challenge is to stimulate the development of these competences and not only to focus on technical skills. Today more than ever it is necessary for people to question the why of things and be able to ask themselves questions. We need knowledge that makes possible to improve the skills and abilities related to empathy, resilience, adaptability, commitment and solidarity. Also skills such as attention to detail, analytical thinking, problem solving, working with digital interfaces, and managing information and knowledge, are fundamentals for the future in environments 4.0

We want to insist on this because it is important to teach how to make a good use of technology. We all have already seen how social networks and smarts phones may be misused, and how they bring bad consequences to people and society. In the case of the Industry 4.0, there is also a risk of losing some human aspects. If we assume for instance that Artificial Intelligence is developed only based on terms of "efficiency", then we are reducing it to what can be quantified and refined (like processes in which all possibilities are controlled). But this also migth bring some behavioral consequences, like

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2 https://www.upv.es/titulaciones/GCD/menu_1023060c.html , and
http://www.upv.es/titulaciones/MUIARFID/menu_1014203c.html
3 http://www.educacionyfp.gob.es/servicios-al-ciudadano-mecd/catalogo/general/educacion/201533/ficha/201533-2019-1.html
4 Planning Vasc VET, http://www.euskadi.eus/gobierno-vasco/-/plan-gubernamental/11-v-plan-vasco-de-formacion-profesional-2018-2021/

pretending to avoid risks having everything under control, and then losing courage in order to dare with the uncertainty (or said with other words, to keep ourselves within our comfort zone). Everything will be easier there, but it will make more difficult the option of personal growth and development. This aspect connects with the formation of character, especially the "management of fear", which is foreseen to be one of the more needed competence in the near future.

Other papers mention that "it is absolutely imperative to focus not only on the instruction of technical skills but also on teaching young people how to show up their skills on time, how to work in teams collaboratively, and how to take the supervision of their skills" (iED, 2016), or "teaching practices concerning the development of soft skills in students of VET education entering the labor market is extremely important".

These kinds of recommendations are also found in the official web page of VET studies in Spain, with a list of the main soft skills need for a good professional[5], and in The Future of Jobs report[6].

The 5th Plan of VET for the Vasc Country states some principles in order to adapt VET studies for the upcoming years. Among those, we highlight these two:

PRINCIPLE 3
**Facing new
contexts of uncertainty
and complexity**

Our biggest challenge as a society is to generate effective capacities in people to face the changing, uncertain and complex reality in the information age. We want to lead people towards the formulation of new alternatives that manage the complexity of our environment responding to the conditions of evolution of society.

PRINCIPLE 4
**Promoting
collaborative learning**

We believe that cooperative efforts guarantee long-term success. Our learning dynamics should enable the exchange of ideas, the development of social skills, the interaction with others, and consequently, the achievement of goals through participation and shared responsibility.

The central element on which this model is articulated is Collaborative Learning based on Challenges, leading to a learning process that favors the development of the technical and specific competences of each cycle, and also others like personal, digital, communication, creativity, teamwork and entrepreneurial competences.

Among the lines of action are mentioned:

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[5] http://todofp.es/orientacion-profesional/itinerarios-formativos-profesionales/conoce-tus-habilidades/Competencias-para-el-empleo/competencias-complementarias.html
[6] http://www3.weforum.org/docs/WEF_Future_of_Jobs_2018.pdf

- Adapt the workshops and laboratories of VET centers towards intelligent spaces 4.0, incorporating sensorization, communication and management of the different equipment

- Work through augmented reality and virtual reality

- Incorporate the Internet of Things (IoT) environment in its different applications

- Experiment in the field of 3D printing in four priority areas: industry, health, food and textile

- Put at the service of companies, especially SMEs (Small and Medium size Enterprises), the capacities of the centers through strategic alliances

- Move from the current departmental model to new organizational models capable of learning, adapting and addressing complexity

- Develop research skills among VET teachers

- Promote autonomous centers, which define and manage their strategy in order to accomplish changes with agility and efficiency

- Form technologically very qualified professionals, versatile, communicative, empathetic, analytical and in constant learning

- Create a multidisciplinary forum for the exchange of knowledge and experiences in collaboration with companies and technology centers

VET centers should be examples of flexibility and agility in the design of content and experiences of meaningful learning, focused on people, and considering the emerging needs of the productive sector and society in general.

These centers must be innovative and flexible organizations with agile response capacity, forming part of networks with other centers and companies, to develop joint projects both nationally and internationally.

The New Skills Agenda for Europe also notice that "in addition to practical training, any VET student should have a general education, related with the concept of culture, values, participation in society and critical thinking; it is important to learn to be people and citizens, not just workers".

Therefore, it is required a new type of centers in which innovation and know-how of people are perceived as their main value, with great autonomy and in an environment of freedom and trust.

As part of the government actions, it has set up a website called "Industria Conectada 4.0"[7] where some exit cases, events, work groups and the current state-of-the-art in each Spanish region are shown. For this regard, the latest document is from the 25th of October 2018, and it is called "Estrategias para

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[7] http://www.industriaconectada40.gob.es/Paginas/index.aspx#inicio

el fomento de la Industria 4.0 en España"[8]. It outlines a schematic vision of how this concept is being implemented in Spain, such as the Digital Innovation Hubs (DIH) and how to get financial support.

The government web page for promoting the Industry 4.0, offers an on-line tool to get the current implantation in an enterprise, and a programme advising the SMEs[9]

Also, the national organism in Spain for standardization (called UNE), has published a document called "Estandarización para la Industria 4.0, Informes de Normalización"[10], which aims to establish a forum related with the standardization needs about the Industry 4.0, with aspects like cibersecurity.

With respect to the support provided by technological enterprises, we can mention Indra, which is a company that traditionally has worked in strategic areas for the Spanish government. It has a specific branch focused on the digital transformation of the society, which is called Minsait. And Telefónica is also involved on that, both as network operator and as a service provider.

In this line, we have to mention that Spain has always been at the forefront of the technological changes, both fostered by the government and also for our society. For instance, Spain was the first country to provide 3G licenses for the telecoms operators in order to roll out their mobile networks. And is one of the countries where mobile phones and internet usage are more extended. One example is that the integration of digital technologies in public administration (e-governance and e-administration) in Spain is above the EU average. Today, 77 per cent of households have access to fast broadband connections of at least 30 Mbps, although there are considerable differences between regions, as well as between urban and rural areas.

And then, it is also expected that the forecoming 5G system will boost the use of the Industry 4.0 vision, providing the infrastructure and security needed for its proper development.

IMPLEMENTATION OF INDUSTRY 4.0 IN THE EDUCATIONAL SYSTEM IN AUSTRIA

IMPLEMENTATION OF INDUSTRY 4.0 IN THE EDUCATIONAL SYSTEM IN THE CZECH REPUBLIC

It´s often said, that the educational system in the Czech Republic should prepare an answer on the Industry 4.0 initiative. That´s so called Learning 4.0, but by many is rather Learning 2.0 at most… One of the most characteristic features of Learning 2.0 is to change the role of a teacher to guide the

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[8] http://www.industriaconectada40.gob.es/Documents/Catalogo-I40-CCAAAGE.pdf

[9] https://www.eoi.es/es/empresas/industria-40

[10] https://www.une.org/normalizacion_documentos/Estandarizacion-para-la-industria-4_0.pdf

pupil through a world of education and a source of knowledge. It´s kind of pretty simple sentence but the real consequences can only be imagined in pedagogical practice by just a few.

The fact is, that the Digital Education Strategy of the Czech Republic 2020 is not really connected with Industry 4.0. Digital Education Strategy focused mainly on setting up the conditions for development of digital skills in regional education, Industry 4.0 initiative is mainly about setting up new branch of industry rather than thoughts about the conditions for teaching this new theme. In the document Industry 4.0 there are mainly just a general recommendation for Ministry of education, youth and sports.

One of the most contradictory question is, that there is a pressure to focus just on technical oriented school subjects. The truth is, that implementing Industry 4.0 will affect ordinary live of all people! In the school the consultants should know, that girls can be better in IT than boys etc. There is very long way in front of us, because educational system can be change very heavily and slowly in connection with not such a big thing, which Industry 4.0 is. In this very moment, there is not any implementation of the Industry 4.0 on the high school level (not even on the technically oriented schools).

Only implementation we can see in the tertiary level, just because it´s much easier to prepare new course, or much bigger thing as a set up new faculty than make a bigger change in the high school curriculum.

Technically oriented university, such as ČVUT, TUL, VUT did a good work and a big move in this area, but it is still not enough. University needs well prepared students from high school, so educational system has to change from the ground, if we don´t want to be somewhere in the back and just sadly looking that we missed our shot.

For the adults, there are many trainings on the market, but there is not very much people to train. Low basic knowledge, low implementation, low motivation of companies, low support from the state administration create a perfect cycle which we have to break to achieve some results. There is a huge potential, but it has to be supported, it has to be the highlighted way from the administration to make things happened.

IMPLEMENTATION OF INDUSTRY 4.0 IN THE EDUCATIONAL SYSTEM IN ITALY

The plan for Industry 4.0 was approved in 2017 Budget Law which included early stage private investments, support to venture capital and also training programmes for schools and universities in order to take part to the fourth industrial revolution.

For the Plan of Industry 4.0 in Italy, 2018 was the year of transition from industry 4.0 to enterprise 4.0 and the year of downsizing. The transition from industry 4.0 to enterprise 4.0 aims to allow the small and medium enterprises to be trained and developed in order to keeping up with changing technology.

The government guidelines are:

- Operate in a technological neutrality logic;

- Implement horizontal actions avoiding vertical or sector-based ones

- Operate on enabling factors

- Steer existing instruments to promote technological leap and productivity

- Coordinate key stakeholders without acting as a controller or decision maker

The National plan provides some strategic measures such as the spread of I 4.0 culture through "Digital School" and "Work related learning" programs; the strengthen and development of the Italian Vocational Schools skills through vocational training; special funding for the Technological Clusters and Industrial PhDs; creation of competence of the Centres and Digital Innovation Hubs.

The Target of this National Plan as far as school/university is concerned, includes the growth of the number of academic students and managers qualified on topic I 4.0 as well as doubling students attending vocational schools on I 4.0 topics.

The project "Industry 4.0" for technical and vocational schools wants to create a closer relationship with the industrial world in order to develop all the technical -professional levels as to help the growth of the enterprise.

This project involves some Technical and Vocational schools that should deal with Made in Italy products.

Some examples are in Florence, Treviso, Perugia, Bologna, Pavia and Viterbo.

- *"Computer Tomography 3D"*: Technical Secondary School M.I.T.A New Technology for Made in Italy Fashion System in Florence has combined the ancient handcrafted Italian tradition with the modern diagnostic tools, using 3D tomography on raw material or leather in textile industry in order to find the non-visible defects of the product.

- *"Agricultural decisional support for the phytosanitary defence of the vineyard and the other agricultural crops"*: Technical Secondary School for Made in Italy Agricultural-Food and Wine System in Treviso has developed an Application which gives an instant and quick phytosanitary support according to the collected agrometeorological data, the weather radar data and the wine report.

- *"Digital and Industrial 4.0 Manufacture"*: Technical Secondary School Umbria Made in Italy Innovation, Technology and Development in Perugia has started a partnership with several enterprises where students can give solution and project in the production sector.

- "*Steering to the Top":* Technical Secondary School Maker in Bologna has developed a prototype of a steering wheel in order to better the driving system of a one-man car of the SAE team Unipr, which is an international competition among university students.

- *"LumenTILE"*: Technical Secondary School in Pavia for New Technology in Made in Italy has created a tile with intelligent sensor. At the beginning it was devised only for Home Entertainment, then it became useful for security measures such as showing the safer way out in the event of a fire or an earthquake.

- *"Factory 4.0"* Technological Secondary School in Viterbo has created a double project, i.e. the elaboration of communication instrument to widespread the topics linked to industry 4.0 (big data, 3D print) and the trial of an intelligent safer helmet in cooperation with GS Net Italy.

The limitations of the Italian education system, in terms of skills and training related to advanced technologies, are another major concern. Italy's robotics industry has complained that there are not enough specialised professionals and technical experts. According to the Ministry of Economy and Finance, Italy is considerably below the European average as far as its workforce having digital competence 29 per cent, as compared to 37 per cent for Europe as a whole.

Participation in 4.0 training courses in Italy, at 8.3 per cent, is also well below the European average of 10.8 per cent. In this respect, Italy also ranks far behind France, at 18.8 per cent, and the United Kingdom, at 14.4 per cent. The gap is, unsurprisingly, even wider compared to digital leaders such as Sweden, Denmark and Finland, where more than a quarter of the workforce is educated in aspects of digital technology. However, in the 2018 budget Italy's government put forward a plan to invest €10 million in 2018, and €35 million by 2020, to develop technical institutes. The goal is to train an additional 200,000 university students, 20,000 technical institute students, 3,000 managers and 1,400 PhD holders/candidates, all with a specific focus on Industry 4.0 topics.

CONCLUSIONS

Through this report, the partnership of InVET has explored issues related to how industry 4.0 is present on the educational systems of the partner countries and in the EU.

In this sense, the EU has opted for supporting the acquisition of new skills related to industry 4.0 through four main actions. These include setting common goals, sharing good practices, implementing policy cooperation and tools for funding. Amongst all the initiatives, the Digital Education Action Plan represents the most important step towards a cohesive and common educational policy that places considerable emphasis on the development of technical as well as soft skills needed to deal with the new technologies and to face the changing, uncertain and complex reality of the information age.

In the case of Spain, the country is following the guidelines of the New Skills Agenda for Europe and is investing in the modernization and flexibilization of the VET system. Some ways through which industry 4.0 is being introduced in the educational system are, for instance, including the use of digital tools into the classroom, stimulating entrepreneurial mindsets or offering university and VET studies in topics related to industry 4.0. In this sense, the strategic plans of each community will also play a key role in the introduction of industry 4.0-related skills in the educational system.

Regarding the Czech Republic, it can be stated that its Digital Education Strategy 2020 is not really connected with Industry 4.0, as it is focused mainly on setting up the conditions for development of digital skills in regional education. Although there are some technical initiatives in the country, the initiatives lack of a holistic perspective, needed to exploit the huge potential of the Czech educational system.

In Italy the educational initiatives related to industry 4.0 came within the scope of the Plan of Industry 4.0 in Italy, 2018. This program included some strategic measures such as the spread of industry 4.0 culture through "Digital Schools" and "Work related learning" programs, the project "Industry 4.0" for technical and vocational schools or special funding for the Technological Clusters and Industrial PhDs. Additionally, many resources have been invested in the development of public technical institutes.

As demonstrated, each country has opted to develop different strategies to prepare citizens to adapt to the new reality. However, it is important to note that there are still many challenges and barriers that should be overcome to ensure a successful transition towards the fourth industrial revolution in the European Union. Given this scenario, there is no doubt that the demand for both, technical and soft skills to deal with industry 4.0 will increase and that national and European institutions will have to continue striving to achieve more effective educational systems.

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CURRENT STATUS OF INDUSTRY 4.0

SUMMARY REPORT

INDUSTRY 4.0 for VET

Erasmus+ - KA2 - Cooperation for Innovation and the Exchange of

Good Practices

Strategic Partnerships

Project Number: 2018-1-CZ01-KA202-048179

CONTENTS

INTRODUCTION

During the first intellectual output of INVET project, the consortium has analysed the European and national situation of the countries involved with regards to Industry 4.0.

More concretely, the partnership has gathered, analysed and compared information regarding the law and government support available with respect to Industry 4.0., and how the educational systems are responding to the increasing needs of learning and training that this new wave is requiring. The implementation of Industry 4.0. has also been studied by the consortium, looking for the differences and possibilities of improvement in each of the countries involved.

From the results obtained in each of these topics, a stand-alone report has been created by the partnership. The current report compiles the main conclusions and outcomes obtained from those previous four reports.

REPORT 1: LAW SUPPORT

Studying how law supports Industry 4,0, in each country has been useful to get a better understanding of the legislative approaches adopted by the governments of Italy, Spain, Austria, the Czech Republic and the EU with regard to industry 4.0.

A general conclusion that can be drawn is that, despite the importance that this topic has for the successful transition of the European Union towards an industry 4.0 model, this aspect has gone commonly unnoticed or even neglected by many national governments and legislators. In this regard, the discussions and debates focused on this issue in the partner countries are just beginning and consequently, specific jurisdiction related to industry 4.0 is still rare (e.g.: Spain or Italy) or almost non-existent (e.g.: Austria and the Czech Republic). This contrasts with the fact that the four countries have launched national initiatives to support industry 4.0 technologies.

Another common characteristic is that the European legislation plays an important role in the legal national frameworks of the four countries analysed. In all the cases it has incentivised changes and urged national governments to adapt their jurisdiction to technological advancements, which confirms the value that European initiatives have to trigger and to address certain aspects that national governments could not achieve unilaterally.

Amongst the legal initiatives analysed in the EU, the GDPR, the e-Privacy Regulation and the Cybersecurity Act stand out due to their important implications for industry 4.0. In this sense, the Digitalising European Industry Strategy has played a key role in the development of the European initiatives reviewed, but despite all the advances, it could be said that we are at the beginning of a long process.

Connected to the previous idea, in the majority of the contexts studied the legal initiatives aim to develop a digital-friendly regulation -which is a necessary step– but do not directly address the issue of industry 4.0 from a holistic perspective. In this case, Italy would be, to some extent, an exception.

When looking at the national contexts, despite sharing some characteristics, the legislative support in each of the countries differ.

In the case of Spain, the context represents a fertile ground for the creation of new legislation. The government seems to be proactive to integrate industry 4.0 in the Spanish legislative framework, there is a national initiative focused on industry 4.0 and social actors such as labour unions are demanding a revision of the current law. However, only minor changes have been implemented so far. In this sense, the general and regional political elections of April 2019 will determine the future of the law support in Spain.

In Austria, most of the laws reviewed are directly linked to the European legislation, while others date back from the 2000s. Since then, there have not been any substantive changes aimed at regulating certain aspects of industry 4.0. The most relevant ones would be the e-government Act, the

Telecommunications Act and the General Administrative Procedure Act, which refer thematically to industry 4.0 but are connected to the topic in an indirect way.

Similarly, in the Czech Republic there are no laws connected to industry 4.0 except those from the EU. This is striking, given the huge weight of the industrial sector in the country and the recent political narrative based on the idea that the Czech Republic should produce goods with added value. This negative scenario could be potentially reverted due to the role of social actors such as trade unions.

Finally, when compared with Spain, Austria and the Czech Republic, Italy seems to have taken more significant steps in this field. In this country, the Budget Law (2017) represents the most important initiative in terms of legislation related to industry 4.0. This law includes several articles dedicated to the topic of industry 4.0 through which the Italian government aims to incentivize the acquisition by companies and SMEs of capital goods related to technological transformation by means of several financial mechanisms.

These are, in summary, the most important ideas that can be drawn from the report. Apart from that, this analysis also serves to prove that there is still a lot of work to do. In this sense, this will not be an easy journey due to several barriers, including the fast development of technological innovation, the fast-evolving scenario of the labour market or the slow-paced nature of legislative changes. However, overcoming these barriers is an essential requirement to develop a legal-friendly environment that allows different social actors to benefit from industry 4.0.

REPORT 2: GOVERNMENT SUPPORT

This overview of the national and European support to industry 4.0 has allowed us to gain a general understanding of the specific realities of each country, as well as to reach important conclusions.

At the European level, the Digital Single Market Strategy and the Digitalising European Industry Strategy represent the most comprehensive frameworks for industry 4.0 support. The political relevance of these initiatives and the efforts and resources invested demonstrate that industry 4.0 implementation is one of the main objectives of the EU. This is strategically important to achieve the general goal of strengthening the industrial value of the EU in order to be up to the level of other regions of the world. After reviewing the most important actions implemented under the scope of these strategies, it can be concluded that the EU aims to work synergistically with current national initiatives on the industry 4.0 to secure a coherent European approach and to ensure that all the countries strive to reach the same collective objectives. Initiatives such as the DIHs or the partnerships demonstrate how this emphasis on international collaboration amongst countries could be materialised.

Additionally, Italy, Spain, Austria and the Czech Republic are four of the 15 EU countries that have launched large-scale initiatives for digitalising their industries, making clear that the adoption of industry 4.0 is a priority for their future development. These are "Industria Conectada 4.0" in Spain, "Plattform Industrie 4.0" in Austria, "Průmysl 4.0" in the Czech Republic and the "Piano Industria 4.0" in Italy. While these initiatives converge in many aspects, they also show clear differences.

For instance, the four programmes have common goals and targets. These are mainly economic, such as enhancing the competitiveness and modernization of their industries, but also social, such as the focus on education of the Czech Republic or on the labour market in Austria. Another common pattern is that the four initiatives do not show specific focus on certain aspects or technologies related to industry 4.0. Instead, they could be applied to multiple sectorial areas.

On the opposite side, each of them differs in terms of their design, funding structure, participatory approach and main forms of support, characteristics that are commonly aligned with other overarching national strategies.

In the case of Spain, Industria Conectada 4.0 is particularly focused on supporting SMEs and micro enterprises by providing them personalised services based on their needs. Although the program is adapted to the national territory, it also works in line with the strategy of the EU. So far, its focus on SMEs and on unlocking the potential of digital enablers are two key aspects of its success, but the outcome of the elections of April 2019 will mark the future of this initiative.

In Austria, all governmental efforts have been initiated by the Austrian Ministry of Transport, Innovation and Technology, who launched the connected network named "Plattform Industrie 4.0". This association differs from the others in the sense that it is a major coalition of diverse actors that function around working groups. This platform also works alongside with other initiatives such as the

Austrian Program on Technologies for Sustainable Development, which demonstrates that research is also a primary form of support of industry 4.0 in Austria.

The homologous initiative in the Czech Republic is Průmysl 4.0 (Industry 4.0). A differentiation factor is that, although it is led by the Ministry of Industry and Trade, it is based on a strong interdisciplinary cooperation between the ministries, social and industrial partners and academia. One of its main lines of action are grant programs aimed at co-financing industrial projects related to new technologies. However, bureaucratic barriers, flexibility and financial issues are some of the main challenges that the government will have to tackle in the near future.

Finally, in Italy the initiative "Piano Industria" stands out for its clear focus on research and development and for its emphasis on the development of new products and technologies aimed at improving manufacturing processes. This characteristic contrasts with the rest, which (with the exception of Austria) are more focused on industry 4.0 implementation.

After gaining a better understanding of the situation in Spain, Austria, the Czech Republic and Italy, it can be stated that, despite the advances, there is still a lot of room for improvement and innovation in the partner countries, as well as in the EU. In most of the countries reviewed and, in the EU, the support to industry 4.0 tends to be scattered across several initiatives or programmes and, although the EU aims to foster collaboration amongst partner countries, more systematic forms of cooperation and exchange of good practices are needed. In addition, we agree with the idea portrayed in the Digital Transformation Monitor Report of 2017, which argues that the national initiatives lack clear and measurable annual targets, as well as monitoring mechanisms.

In light of this situation, national governments and European institutions will have to continue striving to fully exploit the benefits of advanced technologies.

REPORT 3: EDUCATIONAL SYSTEMS

In summary, this report has shown that, considering the importance of education in the future of the EU, it should be a primary priority to coordinate and promote an improvement in education from the European institutions. Many European policies have been studied in this report, highlighting the importance of VET education and how it is entering the most important circles in the EU.

However, there is still work to do in this area; each of the countries analysed in this report has shown the need to make VET attractive and encourage the entrance of students in VET, as well as the need to improve the academic content provided in this part of the education. From the results obtained in Spain, the challenge remains representing VET education as an attractive option that facilitates the entrance to the labour market, especially considering this is one of the main worries of the country. Also, it has been seen how it is necessary to adapt the studies to the "technological and knowledge society", in a way that separates them in a certain way from the excessive industrial bias. That may be a way of promoting the employability of VET students, which is also one of the most relevant factors when it comes to attracting students.

On the contrary, the analysis of Austria's education system has provided a vision of a system where VET education is highly developed and divided in different areas to ensure a proper control of the education depending on the requirements of the country.

Educational system in the Czech Republic has proven to have issues referring to its flexibility to adapt to new situations, especially when preparing and motivating students, as its curriculum is currently not reflecting the modern requirements that would be interesting to the student. Also, it has been highlighted the stigma of memorizing the facts, instead of use other teaching methods, an issue that is shared among many of the countries analysed.

Italian school system, although relevant for its inclusiveness are the vocational schools, has shown that many times VET education is considered only for disengaged students, while they should be considered as a place of professional specialization. Plenty of people give their best through movement and manual activities, such as dancers, artisans and so on. There should be an implementation of such schools in order to better the national production.

To conclude this report, it is seen how most of the countries engaged in it are making efforts towards a more digitalised, structured VET that promotes the entrance of new studies and encourages the interest of students in expanding their educational horizons.

REPORT 4: IMPLEMENTATION OF INDUSTRY 4.0.

Through this report, the partnership of InVET has explored issues related to how industry 4.0 is present on the educational systems of the partner countries and in the EU.

In this sense, the EU has opted for supporting the acquisition of new skills related to industry 4.0 through four main actions. These include setting common goals, sharing good practices, implementing policy cooperation and tools for funding. Amongst all the initiatives, the Digital Education Action Plan represents the most important step towards a cohesive and common educational policy that places considerable emphasis on the development of technical as well as soft skills needed to deal with the new technologies and to face the changing, uncertain and complex reality of the information age.

In the case of Spain, the country is following the guidelines of the New Skills Agenda for Europe and is investing in the modernization and flexibilization of the VET system. Some ways through which industry 4.0 is being introduced in the educational system are, for instance, including the use of digital tools into the classroom, stimulating entrepreneurial mindsets or offering university and VET studies in topics related to industry 4.0. In this sense, the strategic plans of each community will also play a key role in the introduction of industry 4.0-related skills in the educational system.

Regarding the Czech Republic, it can be stated that its Digital Education Strategy 2020 is not really connected with Industry 4.0, as it is focused mainly on setting up the conditions for development of digital skills in regional education. Although there are some technical initiatives in the country, the initiatives lack of a holistic perspective, needed to exploit the huge potential of the Czech educational system.

In Italy the educational initiatives related to industry 4.0 came within the scope of the Plan of Industry 4.0 in Italy, 2018. This program included some strategic measures such as the spread of industry 4.0 culture through "Digital Schools" and "Work related learning" programs, the project "Industry 4.0" for technical and vocational schools or special funding for the Technological Clusters and Industrial PhDs. Additionally, many resources have been invested in the development of public technical institutes.

As demonstrated, each country has opted to develop different strategies to prepare citizens to adapt to the new reality. However, it is important to note that there are still many challenges and barriers that should be overcome to ensure a successful transition towards the fourth industrial revolution in the European Union. Given this scenario, there is no doubt that the demand for both, technical and soft skills to deal with industry 4.0 will increase and that national and European institutions will have to continue striving to achieve more effective educational systems.

BIBLIOGRAPHY

As this report is a summary of the results obtained in the previous 4 reports, the bibliography used is the same as in those.