



Educate for future



EDU4future

COMPARATIVE ANALYSIS

HOW ARE INDUSTRY 4.0 REQUIREMENTS
IMPLEMENTED IN THE VOCATIONAL EDUCATION
AND TRAINING SYSTEMS OF THE PARTNERSHIP'S
COUNTRIES?



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Foreword

The transformation of European economies under the influence of digitalisation, automation and robotics is becoming increasingly intense in the 21st century. This 4th industrial revolution has been known for almost a decade as Industry 4.0. Some technological trends have been further accelerated under the influence of the Covid-19 pandemic. New occupations are emerging, some that have become obsolete are disappearing, but above all most occupations are being internally transformed and absorbing new technologies and practices. It turns out that without adequately skilled professionals, digital transformation faces one of its limits. In other words, high-quality, modern, and responsive vocational education and training is one of the conditions for a successful digital transformation.

The transfer of new skills into vocational training programmes is a complex process in which different countries can learn a lot from each other through exchange of information. These processes are often difficult to capture and different in each country. The complexity of comparisons is also due to the fact that VET systems are often very different in individual European countries and different labour market actors play different roles in them. Nevertheless, we have attempted such a comparison and in the EDU4future project we are trying to answer the overarching question: How are the requirements of Industry 4.0 implemented in different European vocational education systems?

1. Methodology

To answer the above question, it was necessary (given the multitude of perspectives and actors in the vocational education and training system – VET system) to collect the essential information for each of the Partnership countries. The relevant data were compiled by the Partnership institutions in the form of 'Country reports'. It was necessary to ensure that the project partners produced their Country reports in a consistent yet comparable manner. For this purpose, a common methodology was prepared to allow the project partners to collect the necessary data in a structured way and in a uniform format.

This Comparative Analysis is the result of collecting and comparing key information provided in the Country reports. It presents the different vocational education and training systems, the procedures for involving different actors, the processes for identifying new trends, competences, and their subsequent transfer to VET.

The analysis focuses on the most important differences in VET and on the approaches of each country to ensure timely and quality transfer of labour market requirements, especially in the areas of digitalisation and Industry 4.0, into VET. The innovativeness of the Comparative Analysis lies in the focus on processes and tools for transferring labour market requirements into the structure and content of VET. The Comparative Analysis also presents the most interesting examples of good practice that have been successfully applied in the Partnership countries. Based on the results, meaningful recommendations will then be formulated.

The EDU4future project produced a total of 6 Country reports describing the situation in the following countries: Austria, Czechia, Germany, Italy (Veneto Region), Slovakia and Slovenia.

Methodological notes:

1) The national report for Italy was prepared for the Veneto Region. Therefore, where Comparative Analysis text describes Italy's situation, it is in the context of the Veneto Region, unless explicitly stated otherwise.

2) Meaning of abbreviations used in the tables:

AT – Austria, CZ – Czechia, DE – Germany, IT – Italy (Veneto Region), SI – Slovenia, SK - Slovakia

3) During the preparation of the Comparative Analysis, the individual project partners were confronted with additional questions on the content of the national reports. The Comparative Analysis in individual cases may therefore go beyond the content of the individual national reports. On the other hand, the Comparative Analysis is not a simple compilation of 6 reports. It is neither the aim nor the purpose to include all the information contained in the Country Reports. For those interested in more detailed data, we refer to the Country Reports themselves.

2. Sectors relevant for Industry 4.0

In the introduction of the national reports, the project partners were asked to mention in which sectors of the national economies changes related to Industry 4.0 were observed or investigated. The classification corresponds to the NACE nomenclature. The Manufacturing sector (C) was usually mentioned, but other sectors where Industry 4.0 technologies are manifesting themselves were also mentioned. Most partners mentioned sectors such as Energy production and distribution (D), Construction (F), Wholesale and retail trade, Transport and storage (H), and Information and communication (J). Some partners also mentioned a more detailed classification at NACE 2-digit level, but this was not the rule. The identified sectors in the highest classification category by Partnership country are shown in the table below.

Table 1: Overview of Industry 4.0 relevant sectors (NACE) in the Partnership countries

Sector	AT	CZ	DE	IT	SI	SK
A – Agriculture, forestry and fishing		●		●	●	
C – Manufacturing	●	●	●	●	●	●
D - Electricity, gas, steam and air conditioning supply		●	●	●	●	
E – Water supply, sewerage, waste management and remediation activities			●		●	
F – Construction		●	●	●	●	
G - Wholesale and retail trade		●	●	●	●	
H - Transportation and storage		●	●	●	●	
I – Accommodation and food service activities			●	●	●	
J - Information and communication		●	●	●	●	
K – Financial and Insurance activities					●	
M - Professional, scientific and technical activities		●		●	●	
N – Other miscellaneous business activities					●	
P – Education					●	
Q – Health and Social Welfare					●	
R - Arts, Entertainment and Recreation				●	●	
S – Other Activities					●	

The relevance of sectors to the needs of Industry 4.0 is only indicative. Some project partners have rightly pointed out that the skills' needs of Industry 4.0 are manifested in specific occupations that are subsequently applied in a wide variety of sectors across the national economy. In this context, it is also necessary to perceive the concept of partners from Slovakia or Austria, who identified only the manufacturing industry as a priority sector.

For example, Austrian partner ConPlusUltra reminded that Industry 4.0 requires interdisciplinary skills that are difficult to capture through NACE nomenclature. For example, given the high level of automation and increasing digitalization, a mechanical engineer must also know computer science



and software engineering. Increasingly, versatile specialists are being sought who no longer deal with just one machine, but much more with the entire machinery fleet.

There are also parallel activities in other sectors, e.g., in Germany (e.g., "Agriculture 4.0", "Mining 4.0"), but these are not analysed in detail in the German Country report. Some partners focused on selected areas within broad sectors. For example, in the Austrian Country report, the sectors C22 Plastics Technology and C25 Metal Technology were selected from the Manufacturing industry because some of the stakeholders included are active in these sectors.

3. VET systems in the Partnership's countries

Key parameters of vocational education and training

EDU4Future partner countries described several key parameters of their VET systems, with a focus on initial VET. Partners identified the **VET model that best defines their VET system in their country**. They were also asked to indicate the approximate ratio of work-based learning to school-based learning in their initial VET system. They also gave an outline description of the main types of vocational schools in their countries. In the next section, the EDU4Future partners went into detail about the laws regulating VET in their respective country. They focused on the aspects of VET that are regulated by legislation in their country.

Table 2: The prevailing VET model that best defines the VET system in the Partnership countries regarding Industry 4.0

Models of Vocational Education and Training	AT	CZ	DE	IT	SI	SK
dual system or very similar	●		●	●		●
predominantly school-oriented VET system		●		●	●	●
predominantly employer-oriented VET system						

The partner countries have different models of VET in terms of the role of the main actors involved. The VET system in the Czech Republic and Slovenia is school based, while Germany is typically a dual system. Slovakia and Italy perceive their systems as two-track, which are (depending on the chosen educational pathway) dual or school-based. Slovakia introduced a dual VET option in 2015.

Additional comments on the table:

Austria: The two most common ways to obtain vocational education or vocational training in Austria are "dual training" on the one hand, and attendance of 2 types of VET schools (BMS or BHS) on the other hand. Austrian VET system can be described as a "dualistic system" with 2 strong pillars, apprenticeship training on the one hand, and a full-time school-based sector, on the other. However, apprenticeship is still by far the most important training pathway in quantitative terms at the 10th-grade level and the most relevant for skilled workers in industry sector.

Italy (Veneto): Two options are listed, however, it is important to note that out of 300 VET (EQF3) courses, only 24 apply a dual system, so the majority are school-oriented. VET (EQF4) courses apply the dual system. There is no distinction between the different sectors since training is organized in a homogeneous way inside the region regardless of the field.



Based on desk-research and consultation with local experts, the partner organisations have estimated the approximate **ratio between work-based learning and school-based learning** (in the country's VET system).

The comparison shows that the highest share of work-based learning is found in countries with a strong dual education tradition (**Germany, Austria**). At the other end of the spectrum are countries with a stronger role for vocational schools, such as the Czech Republic or Slovenia. However, the theory-practice ratios reported by these countries do not differ significantly from those countries that have a dual VET strand in place to some extent (albeit a minority).

The vast majority of VET in **Germany** is organised in a dual system (regardless of whether the VET programmes are relevant for Industry 4.0 or not). The ratio of training in the company to school-based learning is generally 70% to 30%, which is usually defined in the framework training curricula. There is also a small number of VET programmes, which are predominantly school-based and have smaller work-based learning components. Depending on type of programme as well as school facilities these can vary from practical learning in school laboratories to several weeks work placement.

The **Czech** partner mentioned that the overall estimate is for the whole structure of secondary vocational education and varies according to the categories of VET programmes (45 % of three-year apprenticeship courses, 27 % of four-year matriculation courses with extended work-based learning and 10 % in four-year matriculation VET programmes without extended WBL). The Czech partner further clarified the term "work-based learning". In the Czech Republic, WBL may or may not take place in company workplaces. It can also be in school workshops, laboratories, etc.

The situation in **Slovakia** and **Slovenia** is similar to the one described by the Czech partners. However, it appears that the practice share is slightly lower in both countries than in the Czech Republic. For example, apprenticeships in Slovenia have a WBL rate of 33 % (34 % in Slovakia), while the similar "Czech" category has a WBL rate of 45% compared to school learning.

Austrian partner noted that precise statistics on skilled worker training in industry and special sectors compared to school-based training in the same fields could not be elicited. In 2018/2019, across all occupations in Austria, 13 % of students were in BMS, 26 % in BHS, and 37 % in dual training. "Dual training" is considered company-based education, and the ratio of training in the company to school here is 80 % to 20 %.

Italy: In Veneto Region, as well as in Italy, VET (in EQF 3) takes place mostly at school and in-company training is limited to a few months (8-13 % of WBL x 87-92 % of school-based learning). The fourth year that guarantees the EQF 4 VET qualification is very similar to the dual system and the ratio of on-the-job experience to school education is 50/50.

The individual Country reports described in detail the types of vocational schools (with a focus on secondary VET). It is clear that even at the national level, vocational education systems are often complex. There are different educational pathways even in relatively homogeneous systems, which are also adapted to different types of schools. The phenomenon is even more pronounced in countries that combine different educational models (e.g., school-oriented educational pathways and dual educational pathways). Comparing different types of vocational schools would therefore be very difficult and is therefore not part of the Comparative Analysis. The types of schools in each country of the EDU4future Partnership are available in the Country Reports.



Legislative regulation

Partner organisations indicated whether VET is regulated by law in their countries and could also describe in more detail what aspects of VET are regulated by standards. Highlights of which VET parameters are regulated in each EDU4future country - and how - are presented in the text box below.

Table 3: Regulation of VET by law

	AT	CZ	DE	IT	SI	SK
Yes	●●	●	●●	●	●●	●●
No						

Explanatory notes:

- : VET is regulated in the country through the Vocational Education and Training Act
- : VET is regulated in the country concerned through other standards

In the National Reports, the EDU4future partners have described in detail the specific aspects of VET that are regulated by the relevant legislation. Relevant information is used in other chapters of the Comparative Analysis, for example in the sections describing the roles of actors and the processes of transferring new competences into VET programmes.

4. Labour market needs for Industry 4.0

Competences needed for the Industry 4.0 work environment

Workers need specific competences to succeed in an Industry 4.0 work environment. According to Schmid (2017)¹, we divided them into 4 basic groups:

- **Technical competences**
- **Data and IT competences**
- **Social competences**
- **Personal competences.**

The partner organisations have identified and listed in their national reports the specific competences falling into these categories that, based on desk-research and consultation with local experts, are required by their labour market as necessary for success in the Industry 4.0-related labour market. A comparative overview is given in the tables below².

Technical competences are all skills that relate to basic and specialised knowledge in a particular discipline, sector or profession (e.g. process understanding, production system knowledge, process control, quality assurance.....).

Table 4: Technical competences

Overview of technical competences	AT	CZ	DE	IT	SI	SK
Quality management		●				
Ability/Strategy to intervene in the event of incidents and problems	●		●	●		
Identification of possible anomalies or operational problems				●		
Monitoring and maintaining connected systems	●		●			
Set-up, control and monitoring of complex systems	●		●			

¹ Schmid (2017), [What type of competencies will Industry 4.0 require?](#)

² Some National Reports also give examples of very specific competences relevant to specific occupations. However, it is beyond the scope of the Comparative Analysis to include them.



Overview of technical competences	AT	CZ	DE	IT	SI	SK
Communication with machines and interconnected systems	●		●			
Network technology/mechatronics	●					
Precision engineering	●					
Materials		●				●
Professional documentation and records		●				
Planning and organisation		●		●		
Processes (their knowledge, management and innovation, including production processes)	●	●	●		●	●
Machines and tools (preparation, use, monitoring, care)		●		●		●
Technical, customer and user support		●				
Economics of the organisation		●			●	
Interdisciplinary development of production systems			●			
Checking parameter values of materials, intermediate products, final products and services		●				
Quality control/assessment of materials, intermediates, final products and services	●	●	●		●	
Operate and evaluate dashboards of cyber-physical systems and perform corrective measures	●		●			
Data-driven decision-making and implementation of corrective actions	●		●	●		
Communicating mathematical information				●		
Measurement and subsequent evaluation of the obtained results		●		●		
Numerical calculations				●		●
Statistics				●		
Use mathematical tools and equipment				●		
Orientation in materials and their properties		●				
Assessment and selection of materials		●				
Reading and interpreting drawings and schematics		●				●
Interpreting data in technical documentation		●				
Understanding of logistics requirements and delivery conditions	●		●			
Archiving and safe keeping of technical documentation		●				
Checking, identifying and correcting errors and inconsistencies in technical documentation		●				
Orientation in material and technical standards		●				●
Compliance with technical imaging standards		●				
Receiving and transmitting technical documentation in accordance with organisational processes and standards		●				
Preparation of technical drawings and sketches		●				●
Coordinating resources and planning		●				
Prioritising activities		●				
Production chain management		●				
Systems (knowledge, monitoring)	●	●	●			
Preparation and operation of machines and tools		●				
Customer relationship analysis and management		●				
User documentation and individualisation		●				
Understanding one's own territory and historical-cultural and working context				●		
Performing routine and emergency maintenance on systems, networks, equipment and user terminals.				●		
Automated production control systems CAD/CAM						●



EDU4future partners reported a wide range of technical competences, yet a cross-cutting match was found on many of them and mentioned by multiple organisations. In the table, the technical competences that were mentioned by at least half (i.e., at least 3 out of 6 partner organisations) are colour-coded. Thus, the focus is on technical competences related to process and systems management, the ability to intervene adequately in the event of incidents and technical problems, the control of relevant machines and tools, quality control and assurance, and finally data-driven decision making.

However, we cannot forget the repeatedly mentioned competences directly linked to the Industry 4.0 concept, such as operating and evaluating dashboards of cyber-physical systems, communication with machines and interconnected systems, or Interdisciplinary development of production systems, which respond to the interdisciplinary nature of the new technologies and processes associated with Industry 4.0. These competences were emphasized by partners from Germany or Austria.

Data and IT competences are all skills related to data collection, analysis, and protection, as well as monitoring, use and maintenance of data systems (e.g., documentation, cloud computing, use of analytical and digital tools, programming, software development), artificial intelligence, 3D printing, IT support, UX design....).

Table 5: Data and IT competences

Overview of Data and IT competences	AT	CZ	DE	IT	SI	SK
Digital technologies and communication in general	●			●		●
Browsing, searching, and filtering digital data				●		
Programming, software development	●		●		●	
Setup and maintenance of hardware and related equipment		●		●	●	
Using and interfacing specialized hardware		●		●	●	
Use of specialized programs, advanced databases and applications		●		●	●	
Computer networks					●	
Enter, process, transmit, receive, and analyse data	●		●	●		
Digitisation and softwarization of production processes						●
Quantitative data management				●		
Create order-related and technical documents with the aid of standard software			●			
Use assistance, simulation, diagnostic or visualisation systems			●	●		
Identify anomalies and irregularities in IT systems and take measures to eliminate them			●	●		
Evaluating data outputs		●				
Use of relevant computer, graphical and spreadsheet systems		●				●
Recording data in technical documentation, reading data from documentation	●	●				
Maintain, exchange, save and archive data and documents			●			●
Processing, maintenance, and transfer of data managed by digital archives				●		
Graphic software		●				●
Online communication and data presentation		●		●	●	
Videoconferencing systems					●	
Management of computer-controlled machines and equipment					●	
Comply with company guidelines on the use of data carriers, electronic mail, IT systems and Internet sites			●			
Industrial robots/cobots and manipulators (programming, troubleshooting)		●				●



Overview of Data and IT competences	AT	CZ	DE	IT	SI	SK
Digital biomimetic production						●
The ethics of digitalisation						●
Industrial Internet of Things		●				●
Modelling and simulation of manufacturing machines, processes and systems		●				●
Remote device management		●				
Predictive analytics and maintenance		●				●
Advanced Process Control (APC)		●				
Intelligent Networks		●				
Collaboration software	●		●			
IT-supported troubleshooting	●		●	●		
Data management and analysis (Big data, Business Intelligence)		●				
Augmented Reality		●			●	
Virtual reality		●			●	●
Digital twin		●				
Cybersecurity (availability, integrity, confidentiality and authenticity)	●	●	●	●		●
Artificial Intelligence	●	●	●		●	
Cloud computing/Architecture	●	●	●			
UX analysis and design	●	●				●
Building Information Management (BIM)		●				
Geographic Information Systems (GIS)		●				
3D printing		●	●			
3D scanning		●				
Automated storage		●				
Autonomous warehouse vehicles (AGVs)		●				
Warehouse management system (WMS)		●				
Warehouse Control System (WCS)		●				
Autonomous driving and driving systems		●				
E-commerce		●				
On-line marketing		●				
Critical use of decision and analysis tools	●					
Application of digital tools	●					
Application of knowledge of documentation systems	●					
Data, network, cloud and process competences	●					
Search for information in system or network maintenance documentation and logs				●		
Using data transfer protocols				●		

The digital and IT competences listed by the partner organisations are quite broad and have different definitions. This also applies to sectoral definitions. For example, the Czech organisation TRIXIMA also listed digital competences from sectors such as construction and facility management (BIM) or logistics.

The table highlights digital and IT competences that have been listed by at least 3 partner organisations. The highest level of agreement was recorded for cyber security, which is widely perceived as one of the basic conditions for the functionality of cyber-physical systems that are at the core of the Industry 4.0 concept. Artificial Intelligence follows in order of number of launches. Further, competences from areas such as virtual reality, 3D printing, UX analysis and design, cloud computing and architecture or competences that are more cross-cutting in nature were repeatedly mentioned.



However, competences that are mentioned by fewer partners or even only one of them cannot be overlooked. This may be because, for example, some broader competences may implicitly contain more sub-competences listed elsewhere (e.g., Internet of Things as a prerequisite for predictive analytics and maintenance). Another reason could be, for example, the somewhat broader view of digital competences that some of the partners have taken in identifying them. An inspiring example is Digital ethics, presented by the Slovak partner SOPK. Digital ethics applied in areas such as machine learning/artificial intelligence algorithms is an important but sometimes somewhat overlooked topic in the context of Industry 4.0.

Social competences are all skills that relate to communication and collaboration activities (e.g., interdisciplinary and intercultural collaboration, translation and transfer competences, user-oriented engagement, motivation to innovate and perform...).

Table 6: Social competences

Overview of Social competences	AT	CZ	DE	IT	SI	SK
Effective communication	●	●	●			●
Cooperation/collaboration and teamwork	●	●	●	●	●	●
Planning and organisation of work		●				●
Problem solving and optimisation	●	●	●			●
Customer orientation	●	●				
Interdisciplinary cooperation/knowledge	●		●		●	
Intercultural competences	●		●		●	
Translation and mediation skills	●		●			
Management and leadership (incl. employee leadership)	●		●	●	●	●
Encouraging innovation, loyalty, and performance	●		●		●	●
Process management as cross-divisional networking	●					
Management and project control skills	●				●	
Ability to transfer knowledge and skills - mentoring					●	●
Finding niche markets					●	

As with the previous types of competences, we particularly note the social competences that were agreed upon by at least half of the 6 national reports.

There was 100% agreement across EDU4future partners for cooperation and teamwork. Team management and leadership skills also appear to be important. This competence was mentioned by 5 countries. This is followed by competences such as Effective communication, Problem solving and optimisation, and Supporting innovation, loyalty, and performance. The last-mentioned competency could be seen as part of leadership. However, as this competency was mentioned separately by some Country reports, we consider it appropriate to present it separately here as well.

Personal competences are related to personal dispositions and abilities (e.g., willingness to continuously improve, lifelong learning; holistic, analytical and creative thinking; problem solving; self-learning, recognition of transferable skills; tolerance of ambiguity; flexibility...).

Table 7: Personal competences

Overview of Personal competences	AT	CZ	DE	IT	SI	SK
Analytical thinking	●	●	●		●	●
Interdisciplinary thinking and interdisciplinary problem solving	●		●			
Self-organisation/Self-management	●		●			●



Overview of Personal competences	AT	CZ	DE	IT	SI	SK
Anticipation						●
Conceptual/systemic thinking		●	●			●
Lifelong learning/willingness to learn	●	●	●	●	●	
Flexibility/Adaptability		●	●		●	●
Ability / willingness to innovate			●		●	●
Ability to argue and justify						●
Creativity (creative thinking and creative work)	●	●	●	●	●	●
Critical thinking						●
Entrepreneurship				●	●	
Processing qualitative information				●		●
Stress and workload management	●	●	●			
Dealing with complexity (complex situations, problems)	●		●		●	
Transferability of competences	●		●			
Proactive approach		●				●
Reaction speed	●		●			
Independence		●				●
Performance		●				
Methodological approach	●		●			
Holistic thinking			●			
Dealing with unpredictable situations	●		●			
Bringing together different disciplines and mediation	●		●			
Mobility	●		●			
Tolerance of ambiguity	●		●			
Personal responsibility	●					●
Developing and maintaining physical and emotional well-being				●		●
Tolerance					●	●
Empathy					●	●

The many studies available on the impact of Industry 4.0 on the workforce suggest that people will need to strengthen competences that are a competitive advantage over machines and algorithms. This applies to both social competences and personal competences. However, the price for staying in the digitalised labour market is that the demands on the complexity of the work performed are increasing.

Most of the competences on which the partners generally agreed correspond to this assumption. All partners agreed on Creativity: the ability to think and work creatively. The majority mentioned the ability for Lifelong learning, Flexibility and adaptability or the Ability and willingness to innovate. The same is true for recurring competences such as Managing stress and workload or the Ability to deal with complex situations and problems.

In addition, other types of personal competences were also highlighted, but these themselves increase the chances of staying in the labour market, regardless of the general trend towards digitalisation of work. Here, for example, the Ability to self-manage or the Ability to think conceptually/systematically can be mentioned.

Labour market requirements

This part of the Comparative Analysis summarises the most important labour market requirements related to Industry 4.0 that have been identified in each of the Partnership countries. The summary includes the most interesting findings and inspiring examples of approaches and needs identified.



The **German** partner stated that from the perspective of Industry 4.0, the local labour market requires mainly skilled workers in the manufacturing industry, specifically metalworking and electrical engineering. The German dual education system is set up in such a way that it already prepares highly qualified professionals at the secondary vocational education level. The expertise of these workers is equivalent to bachelor's degree graduates in other countries. Ensuring a certain cross-cutting mix of knowledge and skills that enable workers to adapt to new technologies is seen as an essential theme in Germany, as well as in Austria. The emphasis is on the ability to combine theoretical knowledge with the ability to apply it in practice. There is a growing demand for skilled workers who have both practical skills and in-depth knowledge of production and work processes, as well as the scientific and reflective skills to contribute to innovation, added both German and Austrian partner.

According to the **Austrian** partner ConPlusUltra, the survey among companies showed that employers place emphasis on generic competences, especially understanding of processes, operational and interdisciplinary context, in addition to specialist knowledge and skills. Social and personal competences, such as problem-solving skills, collaboration, and creativity, are also important. Among the cross-cutting competences, the Austrian partner highlighted the topics of data protection and privacy, the processing of big data, the willingness and know-how for interdisciplinary cooperation and designing innovations. Specific key technologies with labour market implications were mentioned as mobile devices and web 2.0, the Internet of Things and cyber-physical systems, additive manufacturing processes (e.g., 3D printing), robotics and knowledge in wearable electronics (e.g., data glasses). In addition, digital technologies, communications and network technologies, mechatronics, and precision engineering, as well as cybersecurity and data analytics.

The **Czech** partner chose a very broad approach - TRIXIMA presented key technologies (or processes, materials) that define the current and future needs of the labour market in 11 sectors: electromobility, energy, chemistry, cyber security, gaming, logistics, e-commerce and internet marketing, modern industrial production, food, construction, and agriculture. For example, game development was chosen because of the application of technologies such as virtual reality or artificial intelligence, which are mainly mentioned in the Industry 4.0 concept in the context of smart factories. The automation of production and warehouse logistics is growing strongly, logistics processes are being automated and autonomous handling technology is being deployed. The digitisation of sales and marketing is manifested, for example, by 3D modelling, the deployment of big data analytics or the automation of customer communication. The digitisation of the construction industry is manifested by the dynamic development of Building Information Management, the use of augmented reality on construction sites, 3D printing, the digitisation of the process of preparing and permitting buildings, etc.

In the Veneto Region of **Italy**, a regular survey is being conducted to map employers' requirements for various competences, including those relevant to Industry 4.0. It shows that competences related to mathematical methods, programming, and the application of digital competences in general are essential for businesses. More than half of employers require these skills. A third of enterprises require competences for the application of "Technology 4.0" in process innovation.

The **Slovak** partner pointed to labour market needs that affect access to initial education. In Slovakia, it is considered essential to strengthen pupils' mathematical and digital competences, STEM competences or creative production. The Sector Skills Councils' analysis of labour market needs in Slovakia revealed trends such as 3D technologies and materials; next generation communication networks; artificial intelligence; virtual and augmented reality; automation; big data; distributed ledger and blockchain technologies; information and cyber security; drones; gamification; internet of things; robotics; information technology development; smart technologies; alternative fuels and propulsion.



The **Slovenian** partner also highlighted the labour market requirements related to the growing need for IT competences. In particular, artificial intelligence technology was mentioned. The Slovenian national plan, aimed at strengthening the teaching of digital competences, responds to these demands. In addition, the emerging national tool for forecasting short, medium and long-term labour market requirements (matching supply and demand, competences) responds to the need to identify labour market trends better.

Fair opportunities

Some EDU4future partners also added the most interesting examples of initiatives aimed at addressing inequalities in relation to Industry 4.0. The programmes identified could focus on gender inequalities or address changing demographics (especially with regard to age). Most of the good practice examples presented are based on the fact that Industry 4.0 trends are science and technology based, corresponding to STEM qualifications (Science, Technology, Engineering and Mathematics). However, STEM careers are still significantly more often preferred by men than women. Many national and local initiatives are therefore trying to balance this ratio.

The German and Czech partners have introduced the [Girl's Day](#) programme: an interactive open day for girls to learn about a wide range of STEM fields and professions. Every year in April, the doors of technical universities, companies and research centres are opened to girls for one day.

Czech partner also presented [CZECHITAS](#): an NGO that aims to educate and inspire women and children in IT and build a community interested in IT. CZECHITAS thus increases gender diversity in the IT environment and offers an alternative to formal IT education in schools. The workshops teach interested women the basics of web development, programming, graphics and data analysis. They also organise IT events for children aged 8 to 18. In 2016, their work with the community was recognised by the European Union with the European Citizen Prize.

Austria presented the FiT initiative - Women in Trades and Technology. "[FiT Centres](#)" are located all over Austria. They provide qualification opportunities for women in occupations that are not very typical for women. FiT centres introduce women and girls to non-traditional career fields. Through this, they acquire basic technical and craft skills and acquire or renew vocational knowledge. The effectiveness of the programme is monitored and evaluated, so that there is an overview of the proportion of female graduates who have gained employment (tracking employment at 3 months, 6 months and 12 months after graduation).

"[Protagonists of change - tools for people and organisations](#)" was an umbrella initiative of the Veneto Region, co-funded by the ESF. A total of 61 projects were implemented in the period 2019-2020 for a total value of 5.5 million euro. The projects focused, among others, on strengthening digital competences, on women in digital professions with the aim of reducing the gender gap in digital professions. The projects were tailored to strengthen the specific technical competences and soft skills of unemployed women in order to facilitate their integration and retention in the labour market.

The Slovenian partner said that the new Slovenian adult education strategy for 2020-2030 will aim, among other things, to ensure equal opportunities for everyone, at every stage of their lives. In addition, the national programme will also offer counselling services available to employees who need further education, qualifications, or training in relation to labour market and workplace needs.

Another type of exemplary initiative was presented by the Slovak partners. In 2019, a conference entitled "[From Industry 4.0 to Inclusive Society 4.0 - Challenges for citizens, advisors, economy and policy makers](#)" was held in Slovakia under the auspices of IAEVG (International Organization for Educational and Vocational Guidance). The conference addressed topics such as:



- The role of career guidance in the Industry 4.0 era
- the context of social changes associated with the emergence of Industry 4.0
- the role of teachers, career counsellors and career education in preparing the young generation for the demands of the 4.0 labour market.

5. Actors involved in VET reform processes

Decision-making bodies

The following table presents the key actors involved in VET reform processes in each of the Partnership countries. VET reform here refers to the modernisation of the structure and content of the different VET programmes in the process of transferring Industry 4.0 competences into VET, or more generally the new needs of the labour market into VET. The decision-making bodies are selected and ranked according to their level of responsibility in these processes. The lowest numerical value indicates the highest level of involvement, in the opinion of project partners and externally consulted experts.

In some Partnership countries, it was difficult for partners to estimate the order of importance according to the responsibility of each actor for changes in VET. This was because, for example, even externally approached specialists differed in assigning the order of importance to different organisations. Therefore, the Austrian partner only chose to indicate whether the relevant actor is connected to the process or not. Slovenia and also the Slovak partner have chosen a form of clustering multiple organisations into one group, indicating essentially equal importance within one group.

Table 8: Decision-making bodies: involvement and level of responsibility

Decision-making bodies: involvement and level of responsibility	AT	CZ	DE	IT	SI	SK
Ministry of Education (Federal/National level)	●	1	1	2	1	1
Ministry of Education (Regional level)	-	-	5	-	-	-
Ministry of Industry and Trade	●	-	5	3	2	2
Ministry of Labour/Employment	-	-	-	-	2	2
School Councils	-	-	-	3	5	2
Trade Unions	●	-	3	3	-	2
Association of Employers	●	4	-	2	5	1
Employment Office	●	-	-	2	4	3
Federal Institute/The Advisory Commission for VET/apprenticeships	●	-	4	-	-	-
Teachers' Association	-	-	-	3	5	3
Representation of students and pupils	-	-	-	3	-	-
VET providers - schools	●	2	-	1	2	1
VET providers - employers	●	3	-	1	2	1
Industry/economy (representatives)	●	5	2	2	3	1
Academies and other research institutions	-	-	-	-	3	-
International stakeholders (EU Commission, EU Regional Development Fund, UE Enterprise Network, Digital Europe)	-	-	-	-	4	-
Regional Governments	-	-	5	-	-	-
Teachers	-	-	-	2	-	-
Other ministries	-	-	-	-	-	2
School Inspectorate	-	-	-	-	-	3
Regional Advisory Body	-	-	-	-	-	1



It is clear from the comparison that the Ministry of Education has the highest level of responsibility. This decision-making body was mentioned by all 6 countries and also assigned generally the highest degree of responsibility in the process. Of the ministries, the Ministry of Economy/Industry/Trade was also mentioned by 5 partners (the names vary from country to country in the Partnership), but e.g., Germany gave it the lowest level of responsibility and the Czech Republic did not mention it at all.

Employers play a strong role in most countries, either as associations or as representatives of industry or the economy. All project partners mentioned them. However, it is evident that countries such as Germany, Austria, or Slovakia (i.e., countries with a legislatively anchored role for employers in the VET system), or Italy, attribute a higher responsibility to employers than is the case in Slovenia or the Czech Republic.

According to most partners, local level actors, i.e., specific VET providers (vocational schools, employers), also play an important role. Partners from Italy and Slovakia assigned the highest level of responsibility to these actors.

Trade unions are perceived as an important actor by most of the 6 partner countries. It should be noted, however, that they were included among the relevant actors by countries that have established VET management tools that take into account the role of trade unions in VET. This is also why trade unions are not mentioned, for example, in the Czech national report.

Cooperation between different actors

The Partnership countries further detailed various aspects of cooperation between actors in the VET modernisation processes. They listed the key strengths and achievements from their country's perspective. They also listed the main challenges and obstacles to any further improvements and presented suggestions and/or recommendations for improvement.

Strengths or achievements identified by partner organisations based on desk-research and consultation with external experts in terms of cooperation and/or communication between the different actors involved in VET reform processes:

The corporatist structure has been a key stabilising factor because employers' associations and trade unions generally agreed on the main organisational principles of the dual model in **Germany**. The social partners are involved at all levels of decision-making (national, regional, sectoral, and firm) and social dialogue and co-determination shape the implementation of VET reforms. The basic configuration of the participants in the regulatory process (Federal Government, States, social partners) shows that VET regulations must necessarily be an expression and result of successful consensus talks, since in addition to the educational and cultural authorities from the Federal Government and the States, key organisations of the employers and the trade unions are also involved.

Also in **Austria**, the success and further development of vocational training are ensured by the (social) partnership-based cooperation of many institutions and facilities at different levels.

At the local level, there are many examples of high-quality and long-term cooperation between VET schools and employers in **Czechia**. There is a growing awareness among employers of the need to work with vocational schools and to invest in the training of pupils. New tax incentives to support the provision of work-based learning in employers' workplaces are also increasing their interest. The requirement to develop cooperation with employers in specific areas has been reinforced in existing school legislation. The project "Kompetence 4.0", which is examining new labour market requirements in 10 pilot sectors, has succeeded in involving experts from the National Institute of Education, who are taking suggestions for adjusting the set of VET programmes and their content.



Voluntary cooperation between actors in the regions has started to develop in recent years (regional employment pacts).

In **Italy**, cooperation was considered indispensable for innovation and change and there's a better functioning in the bottom-up networks, as the actors recognize themselves in more evident common objectives. Companies are realising that there is increasing lack of staff and that their role in training is essential to overcome this situation. The relationship between companies and the training centres who have been working together for years has consolidated and has been well defined by now, giving birth to a strong informal local cooperative network.

In **Slovakia**, the cooperation of VET providers, employers, regional government and the state is formalized. Companies are actively cooperating with VET providers and formulating educational programmes. Companies materially support schools. Employers' organizations have divided competences in education according to economic sectors. There are a number of foundations supporting education and innovation. Representatives of companies are member of School Councils, advisory board of Regional governments or Sectoral Working groups.

The social partners are involved in four national expert councils in **Slovenia**, which have an advisory role to the Ministry of Education:

- a) Expert Council for Vocational and Technical Education;
- b) Council of Experts for General Education;
- c) Expert Council for Adult Education;
- d) Council of the Republic of Slovenia for Higher Education.

Following the relevant law, schools implement initial vocational and professional education programmes in cooperation with companies.

Challenges or obstacles in terms of cooperation or communication between the different actors involved in VET reform processes

In **Czechia**, the VET system is strongly school-oriented, and the position of employers and other social partners is weak, especially at the national and regional level. The current school legislation does not address the management of the VET system with an appropriate role for social partners. The Education Act sets out certain requirements for employers' involvement in the system at national level, but these are often only formal procedures with insufficient time limits for making suggestions and comments. Social partners are involved late and insufficiently in national education development strategies. For example, they are not approached at the initiation stages of the strategies, when key challenges need to be identified. Employers have so far been only minimally involved in the modernisation of VET programmes. The relevant working groups are dominated by representatives of vocational schools. This may lead to insufficient reflection of new labour market needs.

In **Germany**, the recommendations and implementation guidelines issued by the main committee of the Federal Institute for Vocational Education and Training do not have a legal character. The formulated criteria for the recognition and continuation of training occupations and their essential characteristics offer a wide scope for interpretation, which is left to the judgement of all involved participants. It can be assumed that a multitude of objectives are being pursued at the same time. Differences and alignment of interest between the actors exist during, but also before, the opening of the procedure and can lead to long consultation loops and thus to delays in the process. The influence of the different perspectives ensures the relevance and acceptance of a revised training occupation in professional practice but is based on a very general formulation of objectives.

Austria offers a very similar perspective. What on the one hand can be seen as a strength, namely the cooperation of many institutions and facilities, is on the other hand also a weakness, since a consensus must be found and there is a high need for coordination. Under certain circumstances, the



process is lengthy and possible consensus solutions do not always achieve the most optimal results for all representatives.

Institutional or top-down networks often work less in **Italy**, due to stereotypes and poor recognition between actors. Communication problems may be found on local level: different actors usually have different knowledge and skills in the field where they have to collaborate, and sometimes it is difficult to find a common goal that goes beyond the interests of individuals. VET centres sometimes find it difficult to communicate and collaborate with labour consultants or human resources managers, who often do not seem to cooperate and have adequate or updated information on the possibilities of collaboration. Sometimes companies do not consider the importance of training because they do not want to allocate time for it. They lack awareness and knowledge of training centres and the potentiality of cooperation, simply because the labour market "works". This situation creates a comfort zone that slows down the change.

In **Slovakia**, the Ministry of Education's role in coordinating the regions needs to be strengthened. Better coordination is needed in optimising the network of vocational schools, subject focus and number of classes based on labour market needs. Better use of labour market information is needed to avoid delays in optimising labour market supply and demand in different sectors. The network of educational counsellors and their communication with schools, pupils and their legal representatives and companies should be improved. The processes of creation and adaptation of VET programmes in Slovakia at the level of initiation (schools, companies, associations), optimization (Ministry of Education, sector councils etc.) and approval (regional VET councils, government council, ministry of education) should be more systemic. Cooperation in technology-oriented education between teachers at secondary school, employers, associations, and chambers must be intensified.

Despite the goals set in **Slovenia**, there are not enough activities and incentives to implement the targets. Occasionally there is a lack of understanding of school or company management who are unwilling to invest in knowledge transfers and new IT skills. There is a lack of initiative in schools to involve companies, and on the other hand, companies do not even have enough staff to connect with schools.

Suggestions and/or recommendations to improve cooperation and/or communication between the different actors involved in VET reform processes, formulated by partner organisations on the basis of desk-research and consultation with external experts

In **Germany** and **Austria**, there is general satisfaction with the model of cooperation and communication between the different actors. No suggestions or recommendations for improvement have been made.

The **Slovak** partner pointed to the need to improve cooperation between different actors aimed at promoting girls' interest in choosing STEM careers that better fit the environment of the digitalised labour market. New, inclusive social programmes focusing on new technologies (e.g. for physically disadvantaged pupils) will require cooperation between employers, vocational schools, parents and civic associations. Improving the availability of skilled workers for Industry 4.0 will require a reduction in the administrative burden of training, the abolition of outdated VET programmes and better conditions for the creation of new VET programmes in response to labour market developments. New trends need to be made visible through the mass media to make them more easily accessible to pupils and their parents.

The **Italian** partner recommends the continuous cultivation of mutual cooperation, especially in the case of institutionalised networks. Here, unlike informal partnerships growing from below, there is a



risk of self-interest taking precedence over the common objectives of the network. It is necessary to set clear objectives that match the motivations of the participants. It may be useful to organise activities to facilitate cooperation between local actors, for example, aimed at identifying new areas/opportunities for cooperation.

Another suggestion is to provide adequate information to companies and career counsellors. Employers' associations could contribute in this sense by organising training events for career counsellors.

Czech partner mentioned that it is necessary to find a solution for partnership-managed VET in the **Czech Republic** that will be long-term, sustainable, and stable.

It is necessary to set up a process of continuous reforms of VET so that it is constantly in line with developments in the labour market. A suitable solution would be to anchor the management of the VET system in the Czech Republic legislatively, including the strengthening the position of the social partners in the Czech VET environment.

The VET management system with the partnership status of the social partners needs to be resolved at the national but also at the regional level so that local labour market needs can be better addressed in a subsidiary way.

It is necessary to establish operational rules for the modernisation of the national standards of individual VET programmes, for example in the form of regular revisions (e.g. over a period of several years), including stronger involvement of the social partners (employers, unions). This will ensure that the current revision properly reflects the changing needs of the labour market.

Processes for initiating new VET programmes should be established.

For **Slovenia**, it is essential to increase interest from companies to get involved in cooperation with schools, adding IT and Industry 4.0 content to the curriculum by the Ministry. There can also be more training for teachers in these areas, more frequent checking of how teachers use what they have learned in their work, involvement of state institutions in support of teachers and the organisation of cooperation and projects, between secondary schools, institutions and companies.

6. Processes

Furthermore, the national reports described the actual processes used in each country to shape and adapt VET. Here the project partners explained:

- what mechanisms are used to revise existing VET programmes
- how the process of monitoring and revising VET programmes is set up
- how the process of introducing completely new VET programmes is set up.

Revision and reform processes

In the context of EDU4future, revision and reform processes are linked to the revision of existing VET programmes and their modification, as well as processes linked to the creation of new VET programmes. The table below provides an overview of the actors for the Partnership countries that are driving innovation (e.g., stimulating change and proposing VET reforms) in each Partnership country. Approximate percentages are assigned to the actors, indicating their levels of involvement.



Table 9: Actors as drivers of innovation in VET (%)

	AT	CZ	DE	IT	SI	SK	Σ
Industry/economy (representatives)	20	20	30	10	15	30	125
Ministry of Education	5	10	5	9	35	10	74
Association of Employers	15	30	-	9	10	5	69
VET providers - employers	20	10	-	10	8	15	63
Ministry of Industry and Trade	15	10	10	9	10	5	59
VET providers - schools	5	10	5	7	5	14	46
Trade Unions	10	-	25	7	2	1	45
Federal Institute for Vocational Education and Training	-	-	25	-	-	-	25
Ministry of Employment and Social Affairs	-	10	-	10	5	-	25
Employment Office	-	-	-	3	5	5	13
School Councils	-	-	-	3	2	5	10
Regions	-	-	-	10	-	-	10
National Agency for Active Employment Policy	-	-	-	10	-	-	10
Research associations	10	-	-	-	-	-	10
Teachers' Association	-	-	-	3	2	-	5
Other ministries	-	-	-	-	-	5	5
Regional Advisory Body	-	-	-	-	-	5	5
Representation of students and pupils	-	-	-	-	1	-	1
In total	100	100	100	100	100	100	

Table 8 provided an overview of the actors that have the highest responsibility for the implementation of the processes described in the VET systems of the partner countries involved. A different insight into the description of the situation was provided by the answer to the question which actors are considered as promoters of the necessary changes and modernisation of VET (“drivers of innovation”) in each country. In this context, most partners perceived the role of ministries of education as significantly less than their importance in terms of responsibility for promoting change.

All partners also mentioned the Ministry of Industry and Trade, but its role does not appear to be very significant, at least compared to other stakeholders. Industry and employers' organisations are perceived as far more important innovators.

Of the local actors, VET providers are mentioned, with training providing enterprises mostly seen as stronger promoters of innovation than vocational schools. All this shows that actors representing the labour market are considered by EDU4future partners as the main drivers of VET innovation.

Table 10: Periodicity of reviews of VET programmes in the Partnership countries

Partnership country	Periodicity
Austria	Ongoing, at least once every 5 years
Czechia	Ad hoc
Germany	ongoing
Italy (Veneto)	Every 3 years
Slovenia	Every 5 years
Slovakia	Ad hoc (content of programmes) Every 3 years (system of programmes)



Mechanisms in place in the Partnership countries to review existing VET programmes

The **Czech** mechanisms are set out generally in the Education Act as follows:

- National Frameworks of VET Programmes (RVPs) can be changed in serious cases (however, the law does not specify the reasons for the changes, nor does it elaborate on the procedures for securing them)
- The curriculum must correspond to the latest findings of the scientific disciplines whose foundations and practical application are supposed to be mediated
- The development and review of the RVPs is carried out by the relevant ministries through experts in science and practice, including pedagogy and psychology.

There are no set intervals for the review of national standards of VET programmes. Programmes are reviewed on an ad hoc basis. Secondary schools must adhere to the basic requirements set by the national standard of the specific programme, but they have a relatively large scope to specify the curriculum and to target it to the requirements formulated by the cooperating employers. This allows in many cases a better transfer of the requirements of labour market into VET without changing the content of the national standards.

Revision processes in **Germany** are ongoing and ensured via various mechanisms, i.e. committees representing key stakeholders (e.g. German Employers' Organisation for Vocational and Further Training, BIBB, Confederation of German Trade Unions).

The initiation of new or revision of existing occupations is tied to the development of parameters defining training occupations; generally, these are created by the social partners headed by German Employers' Organisation for Vocational and Further Training and usually the Confederation of German Trade Unions.

Proposals for the introduction of new or revision of existing parameters can emerge in different ways:

- out of preliminary talks held by the social partners (employers and trade unions),
- from the findings of research projects conducted or advisory opinions drafted by the Federal Institute for Vocational Education and Training (BIBB),
- from instructions issued by the responsible ministry.

The push for new professions to be introduced or existing ones to be modified usually comes for the employers' associations. Once all the parties involved – especially the trade unions – have been heard, the competent minister (in most cases the Federal Minister for Economic Affairs and Energy) coordinates with the states (which have jurisdiction over the vocational schools) and decides whether the initiative is to be implemented.

Both in **Slovenia** and **Austria**, the VET standards are revised every five years. From 2020, the Austrian Vocational Training Act stipulates that existing vocational training programmes must be assessed and revised as necessary after at least 5 years. This measure is part of the quality management of the Austrian VET system. Up to now, apprenticeship occupations and their training content have been reviewed and revised for current requirements, but partly irregularly, usually at the suggestion of an industry. In order to systematize vocational training development more strongly in the medium and long term and to orient it on the basis of evidence, the new regulation aims at a mandatory regular analysis of all occupational profiles in a five-year cycle. This is intended to ensure that all apprenticeship occupations meet the latest professional and technical standards.

VET programmes' revision should be done every three years in **Italy**. Currently, the responsibility of the different actors is being discussed. Veneto Region is monitoring the working placement of those who graduated recently. The analysis results help the region to understand the efficiency of certain study paths related to the needs of the geographical area. Veneto Region allocates funds based on the results of these analyses, which help to understand which and how many courses should be initiated in a specific area.



The revision of educational programmes in the **Slovakia** as well as the revision of their content can be implemented in two ways:

- Top-down process (Initiation by the Ministry of Education and Sector Skills councils to revise the National standard of VET programme(s))
- Bottom-up process (Initiation by Secondary Vocational Schools, employers, employers' associations in cooperation with the school founder)

The Government Council for VET is an advisory body to the Government in the field of VET. It consists of representatives of the state, regions, industry organisations and trade unions. Similar bodies also exist at the level of regions in Slovakia. Government Council among others:

- assesses analyses and forecasts of labour market developments,
- discusses sectoral concepts of vocational education and training,
- discusses regional strategies of education in secondary schools,
- discusses and recommends to the Ministry of Education the inclusion of a new field of study, focus of the field of study, field of study or focus of the field of education
- discusses National standards of VET programmes

The central methodological role in the process of revision educational programmes is played by government agency "State Institute Vocational Education" (ŠIOV), which acts on behalf of the Ministry of Education.

The Employers' Council for the Dual VET: Members in the relevant areas initiate or approve new or adapted educational programmes.

The overall system of VET programmes is revised every 3 years, with regard to quantitative labour market needs (with a high prevalence of supply or demand). The revision of VET programmes' content is ad hoc based.

Processes for reviewing and revising existing VET programmes. Here, partners could describe how revisions are considered, submitted, and implemented, how long the process takes, and on what basis the conditions are set (e.g., by law or other procedures).

The process of VET programmes' review in **Czechia** is following:

- An organisation established by the Ministry of Education called the National Pedagogical Institute of the Czech Republic (NPI CR) is responsible for the organisation and actual implementation of VET programmes' revisions.
- The designated NPI expert will set up a working group to check the relevance of the existing VET programme.
- Where a need is identified, adjustments to the relevant framework curriculum are proposed and determined by the working group.
- The requirements for the composition of the working group are not defined. Usually, the working group is composed of teachers from secondary vocational schools offering the relevant field and, depending on availability, representatives of employers, usually the proposer of the relevant change to the standard.
- The duration of the programme review itself is not specified.
- The revised programme shall be discussed by the relevant ministries with the relevant central trade union bodies, the relevant employers' organisations with a national scope and the regions before being issued.



- The earliest the change will take effect is the start of the following school year (1st of September). Vocational schools have up to two years to incorporate the changes into their (school) curricula.

In **Germany**, the procedure is systematic and involves the federal and state governments, employers, trade unions and the VET research community. As a rule, the initiative for updating the content or structure of a training occupation or for developing an entirely new occupation comes from industry associations, from the top-level employers' organisations, from trade unions or the Federal Institute for Vocational Education and Training. After hearing the views of all the parties concerned, the responsible federal ministry decides in consultation with the Länder governments whether to proceed. If so, the process consists of 3 steps, preceded by a research phase aimed at identifying needs. The 3 stages are:

1. Definition of training regulation parameters (e.g., including designation of profession, length of training, structure of topics; list of skills, knowledge, and competences).
2. Drafting and coordination (development of training regulation and corresponding framework curriculum)
3. Issuing the training regulation (approved training regulation and curriculum, then the different German states adopt the framework curriculum or adapt to local curricula).

No more than 1 year should elapse between the start of the process and the completion of the revision work. The work of the experts on the content review should take up to 8 months. The revised programme goes into effect at the beginning of the new school year following the publication of the programme regulations in the Federal Register. In most cases, however, the whole process can take several years, as an important part of it is to reach a consensus between employers, trade unions and the state. Given the speed of change in the labour market, this may be a problem in the future.

A very similar procedure as in Germany can also be found in **Austria**.

1. Preparation

- The Ministry of Economy, the social partners or companies take the initiative for the creation or modernization of an apprenticeship occupation
- Clarification of the framework conditions is carried out by the Ministry of Economy and the social partners
- Consideration of international developments and solutions in other countries

2. Creation of training regulations and framework curriculum

- Development of new occupational profiles by educational research institutes with experts from the sectors concerned
- Involvement and opinion of the Federal Vocational Education Advisory Board for the Ministry of Economic Affairs
- Development of a framework curriculum corresponding to the training regulation by a group of experts under the direction of the Ministry of Education
- Preparation of the drafts for Austria-wide evaluation

3. Enactment of the regulations

- Referral to all stakeholders in a review process
- Evaluation of the statements
- Entry into force of the new training regulations of the Ministry of Economics and the framework curricula of the Ministry of Education

4. Follow-up measures, e.g.

- Preparation of supplementary materials to support the training companies
- Information of the training companies by the apprenticeship offices
- Training of the trainers in the companies and the teachers in the vocational schools

A new occupation/vocational training can be fully designed and in force within one year,



depending on the urgency of implementation, but it usually takes longer.

As of 2019, all programmes are being redesigned to take into account digitalisation and new economic developments.

In **Italy**, on the other hand, the specific procedure is not precisely defined and is currently under discussion. The following can be said about the current procedures:

At regional and national level, the process of evaluation and review of VET programmes requires cooperation between different actors. It is not a simple and linear process. Consultations take place between the regions, the Ministry of Education, the Ministry of Employment, and the Ministry of Economy. The region can rely on the identification of training needs, their monitoring and evaluation, as well as suggestions based on experience with courses offered by the province. The regulations stipulate that a review of the VET field should be conducted every three years.

The top-down review process in **Slovakia** is aimed at updating the national curriculum and is being carried out at the level of the Ministry of Education, Sector councils and the Government Council for Vocational Education. These revisions have an impact at the national level.

The bottom-up revision process is (and if a general consensus is reached) aimed at updating the national curricula. In addition to vocational secondary schools, the involvement of employers' associations and enterprises plays an important role in this process.

In the case of curricula at the vocational school level, school teachers, employers and other organisations (school founder, consultants) are involved in the revisions. The revised VET curriculum is approved by the school principal after consultation with the school council, the pedagogical council, employers/employers' organisations/chambers, the school founder. The programme shall be submitted to the Government Council for VET.

VET standards in **Slovenia** are developed in social dialogue. The employers and sector experts involved in formulating the knowledge and skills requirements that a qualified professional must have. Professional standards are also forward-looking to enable qualification holders and employers to better adapt to future labour market challenges.

A proposal for a new professional standard is submitted to the CPI (Slovenian Institute for VET) by a natural or legal person. The proposal should include information on labour market needs, a study on the comparability of relevant standards in the EU Member States, and compliance with EU rules and regulations.

If the CPI score is positive, the proposal is submitted to one of the ten sectoral committees (POs) set up by the Ministry of Labour. It involves experts from chambers, ministries, and trade unions. The Sectoral Committee approves and classifies professional qualifications and appoints experts who will develop a draft professional standard with the methodological support of the CPI.

Based on the professional standard, the CPI develops a VET programme. When the professional council approves the programme, it is submitted to the Minister of Education for approval.

The programme can be implemented at the beginning of the next school year when the procedure is completed. The process takes different lengths but is usually completed within 1 to 2 years.

Processes of introducing new VET programmes

Partners from **Slovenia, Germany, Czechia, and Italy** reported that the procedures governing the introduction of new VET programmes are broadly the same as those for the revision of existing programmes.

In **Slovakia**, a test phase is being applied before the utterly new VET programme is deployed. However, the preparation, testing and evaluation phase is quite long, which is not perceived positively



(3-4 years of preparation, 3-4 years of experiment, 1 year of evaluation). After successful pilot testing, the programme can be rolled out to other VET providers.

During the experimental validation, other schools cannot enter the testing. In addition, the curriculum and the full curriculum may not be published during the experimental validation until it has been evaluated.

The process of establishing a new VET programme in **Austria**:

Proposals for new programmes can be developed by the Chamber of Commerce, the Federal Ministry for Digitalisation and the Economy (BMDW), ibw Austria - Research and Development in VET, employee organisations (AK/ÖGB) and the Federal Advisory Board for Vocational Training (BBAB).

The Federal Ministry for Digitalisation and the Economy is, among other things, responsible for the training regulations for apprenticeships.

The Federal Advisory Council for Vocational Training (BBAB) is a social partnership body and serves as an advisory body to the Federal Ministry. According to the Vocational Training Act (BAG), the BBAB is responsible, among other things, for the development and assessment of new vocational training courses and for the revision of existing courses.

The Austrian Federal Economic Chamber and the Employees' Party delegate experts to this body. Discussions on the content of the programmes are always held with the participation of experts from professional organisations and trade unions.

Institute ibw: ibw Austria - Research and Development in Vocational Education and Training is a research institution close to the Austrian Federal Economic Chamber.

General review procedure:

The BMDW will send the proposal to all social partners, federal ministries, federal states, schools, universities, etc., which may comment on the proposal within a period of approximately two months. In the light of the comments received, the circulated draft is then revised. A further round of discussion may take place, in particular with those affected by the proposal.

Once the proposal has been approved by the Federal Minister for Economic Affairs, the standard is published in the Federal Law Gazette.

What is taken into account in VET review and reform processes

The partner organisations have identified aspects that are taken into account in the VET review and reform processes in their respective countries. The result is presented in the following overview. The criteria chosen by at least 3 countries are highlighted in colour.

Table 11: Aspects that are taken into account when transferring the needs of the economy to VET

	AT	CZ	DE	IT	SI	SK
Technology	●	●	●	●	●	●
Industry/Labour market needs	●	●	●	●	●	●
Staff Competences	●	●		●	●	●
Evidence-based research	●	●	●	●		●
Local/regional/national policy	●	●	●	●		●
VET providers needs	●	●		●		●
Staff Availability	●	●		●		●
Wording of Job Descriptions	●	●		●		
International standards (e.g. ESCO, ISCO)	●		●	●		
Staff needs	●			●	●	
Infrastructure	●	●				●
European trends	●	●		●		
Learners' needs	●			●		
International trends	●			●		

All partner organisations agreed on criteria such as "Technology" or "Labour market needs". In most participating countries, the availability and competence of workers, related data, policies set at different levels or European trends are also taken into account.

3 most and 3 least important aspects

For a better overview, a shortlist of the 3 most important aspects on which countries pay the most attention has also been made. Similarly, the 3 aspects that receive the least attention from the range of items have been listed.

Table 12: The 3 most important aspects that are taken into account when transferring the needs of the economy to VET

	AT	CZ	DE	IT	SI	SK
Industry/Labour market needs	●	●	●	●	●	●
Technology		●	●		●	●
Staff Competences	●	●			●	●
Evidence-based research			●			
International trends	●					
Wording of Job Descriptions				●		
Staff Availability				●		

In the case of the shortlist of the three most important aspects, a high degree of consensus across the Partnership countries emerged. The criteria "Staff Competence" and "Technology" were repeatedly mentioned. The aspect "Labour market needs" emerged as the most important, being ranked in the "Top 3" by all 6 partner organisations.

Table 13: The 3 least important aspects that are taken into account when transferring the needs of the economy to VET

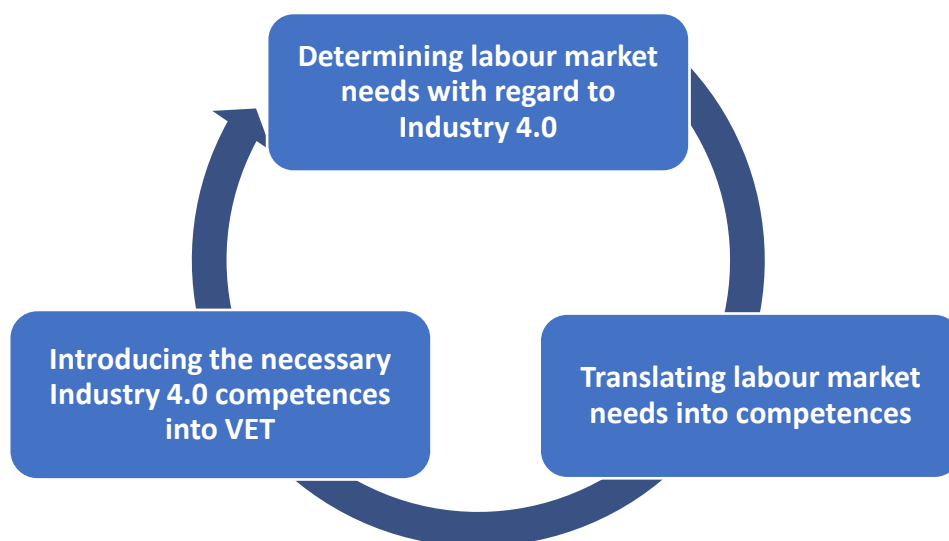
	AT	CZ	DE	IT	SI	SK
Staff needs		●	●	●		●
International standards (e.g., ESCO, ISCO)	●	●				●
International trends		●	●			
Infrastructure			●	●		
Staff Availability					●	●
Local/regional/national policy	●			●		
Evidence-based research					●	
Learners' needs					●	
Wording of Job Descriptions	●					

When it comes to the three least important aspects, the differences between countries are greater. At least half of the partners ranked "International classifications (e.g., ESCO, ISCO)" and "Staff needs" as the least important criteria.

Mechanisms for transferring labour market needs with regard to Industry 4.0 to VET

The following illustration describes the process that the Comparative Analysis addresses in the following sections. Its 3 sub-stages are:

- Identifying labour market needs with regard to Industry 4.0
- Translating labour market needs into competences
- Introducing the necessary Industry 4.0 competences into VET



Identifying labour market needs with regard to Industry 4.0

In the Country reports, the EDU4Future project mapped what (if any) mechanisms each country uses to identify labour market needs with respect to Industry 4.0. We identified the key actors responsible for the relevant mechanisms and described the relevant mechanisms. These could be general mechanisms (used to identify labour market needs in general) and specific mechanisms (if available) that may have been developed in a given country to identify labour market needs specifically with regard to I 4.0.

Table 14: Overview of the actors mainly responsible for the mechanisms in place in the Partnership countries to identify labour market needs

	AT	CZ	DE	IT	SI	SK
Association of Employers	●		●	●	●	●
VET providers – school-based	●			●	●	●
VET providers – work-based	●			●	●	●
Industry/economy (representatives)	●			●	●	●
Ministry of Industry and Trade	●			●	●	
Ministry of Labour and Social Affairs		●		●		●
Research Institution	●				●	
Ministry of Education	●					●
Trade Unions	●		●			
Employment Office	●		●			
Education Directorate	●					
Federal Advisory Council on VET	●					
School Council						●
Other ministries						●
Regional Advisory Body						●

Employers' associations are the most frequently cited actor responsible for the mechanisms put in place (if any) in the Partnership countries to identify labour market needs. In most national reports, actors such as VET providers (whether schools or enterprises) and industry/economic representatives were mentioned. Of the governmental actors, ministries responsible for the economy and for employment were mentioned by at least half of the partners.



General mechanisms to identify labour market needs in the Partnership countries

Monitoring and evaluating the situation on the **Czech** labour market is part of the state employment policy as defined by the Employment Act. This Act requires the Ministry of Labour and Social Affairs (MLSA) to prepare analyses and forecasts of labour market developments and to take measures to create balance between the resources and needs of the labour force. The MLSA publishes an annual quantitative analysis of the labour market situation in the Czechia. It maps the employment and unemployment situation in a given year according to various parameters (e.g. the structure of the unemployed, the structure of offered jobs). A deeper, qualitative analysis of supply and demand on the Czech labour market was carried out in 2016. It notes that one of the causes of the mismatch is the low or outdated qualifications of the unemployed, which do not match the requirements for the performance of the offered job. According to the report, the initial VET system provides better conditions for preparation for technical occupations (in comparison with re-training courses). The MLSA also maintains the National Occupational Catalogue ([NSP](#)) by law and is responsible for updating it in accordance with developments in the Czech labour market.

As part of the ongoing revisions of the VET sector in **Germany**, institutions like the Federal Institute for Vocational Education and Training and Public Employment Agency establish current labour market needs (in terms of skilled workers' shortages).

In addition, employers' organisations and trade unions publish reports on the needs of their sectors in terms of workers' skills or trained workers in general.

Austrian labour market needs are surveyed by various public agencies. This is usually done by commissioning studies (for example, [Qualitative Surveys of Labour Market Needs for the AMS Qualifications Barometer](#)).

The Union of Chambers of Commerce, Industry, Crafts and Agriculture (Unioncamere) has created the **Italian** Information system for employment and training, which provides forecast data on the progress of the labour market and on the professional needs of companies. The survey is based on CAWI technique and is performed on a monthly basis. Data is collected for example on employment situation, contract activation and/or any terminations expected in the quarter following the month of the survey.

Veneto Lavoro (regional agency for employment) is responsible, among other tasks, for observation on the labour market and management of information systems for the labour market.

Every three months Veneto Lavoro publishes "a [compass](#)" : the overview with the transformations of the market in terms of hiring, terminations, contractual transformations and balances of the employment positions of workers in the various provinces and sectors. Veneto Lavoro then carries out, in collaboration with ISTAT, Unioncamere and other statistical centres, specific reports.

The [Atlas of Employment and Professions](#) contains all the professions and related skills.

The new **Slovenian** strategy emphasizes the importance of including digital competences, developing specialized and in-service training programmes, better quality of work-based learning and career guidance.

The Ministry of Education, Institute for VET, in cooperation with companies and schools, developed new training programmes for employed graduates of various levels of education to meet employers' needs for skills and competences.

The state regulates the scholarship system. The aim is to support the deficient professions, attract more students to STEM education, provide appropriate staff according to the needs of the labour market and encourage enrolment in fields of education that enable faster employability. The



scholarship policy includes lists of professions in demand/deficit professions (updated annually), and a list of relevant VET programmes.

The 2015 reform of VET in **Slovakia** led, among other things, to the creation of the National Council for Vocational Education and Training. The body operates on a statutory basis and, among other things, assesses labour market forecasts or lists VET programmes where the number of graduates is insufficient to meet employers' needs. It also deals with sectoral VET concepts. The Council currently has 19 sectoral working groups. Labour market needs are therefore transferred through specific working groups organized within general regulatory framework of VET.

Furthermore, the government coordinates the initiatives (projects) focused on areas like labour market needs (analysis and predictions).

Ministry of Employment also maintains the [National Occupational Register](#) and is responsible for updating it in accordance with developments in the Slovak labour market.

Specific mechanisms used to identify labour market needs with respect to Industry 4.0 in the Partnership countries

There are no specific mechanisms for identifying labour market needs focused on Industry 4.0 in **Czechia**. Thematic studies and projects are currently designed for this purpose. Examples:

- Studie [Práce 4.0](#), s doprovodným akčním plánem (most of the measures formulated in Action Plan were delayed or not implemented at all)
- The project „Labour Market Forecasting – [KOMPAS](#)“ aimed to create a system of labour market forecasting and monitoring in the Czech Republic, which should reflect the significant impact of technological trends on the Czech labour market
- The project „[Kompetence 4.0](#)“ is aimed at mapping future competences that respond to changing requirements with regard to Industry 4.0 technologies.

A similar approach as in Czechia has been identified in **Germany** or **Austria**. Also in these countries, labour market needs specifically in the topic of Industry 4.0 are addressed through various studies, surveys or platforms, such as the Austrian "[Industrie 4.0](#)", designed for discussion between policy makers, businesses, academic and research institutions, chambers and trade unions, NGOs and other institutions. Among other things, there is an Expert group on qualifications and competences, which addresses the requirements that Industry 4.0 and digitalisation place on education, training and further education in Austria.

Unioncamere's survey of **Italian** employers to identify the skills required by workers included the competency "applying 'technologies 4.0' to innovate processes".

Slovenia's policy focuses mainly on the overall improvement of competences in cloud technologies, the Internet, extensive data management and analysis, machine communication, teleworking, and remote administration. However, there is a deficit in the use and understanding of Industry 4.0 related areas. With the support of the Jožef Stefan Institute, one of the leading centers in Industry 4.0, much has been achieved, especially in higher education.

In **Slovakia**, several strategies targeting Industry 4.0 have been prepared (or in preparation). Examples:

- "Learning Slovakia": detailed thematic challenges for education in the field of new technologies
- Slovakia's Digital Transformation Strategy 2030
- Comparison of Industry 4.0 strategies in Slovakia and abroad
- "Work 4.0" strategy (in preparation)



Translating labour market needs into competences

The next stage of the process described above is the translation of the identified labour market needs into competences. We identified which actors are mainly responsible for the processes of translating labour market needs into key competences for VET in each Partnership country. We described the processes that regulate or organise the "translation" of labour market needs into competences. These can be general processes (without taking into account the specific needs of Industry 4.0) or specific processes developed with regard to the competences needed for Industry 4.0.

Table 15: Overview of actors mainly responsible for the processes of translating labour market needs into key competences for VET in the Partnership countries

	AT	CZ	DE	IT	SI	SK
VET providers - schools	●		●	●	●	●
VET providers - employers	●			●	●	●
Ministry of Education	●	●	●			●
Ministry of Industry and Trade	●		●		●	
Association of Employers	●				●	●
Industry/economy (representatives)	●		●			●
Federal Institute/Advisory Council for VET	●		●			●
School Council	●					●
Trade Unions	●		●			
Ministry of Labour/Employment					●	
Teachers' Association	●					
Examples from other schools and systems				●		
Regional Advisory Body						●

Most partners identified VET providers (schools and employers) as responsible actors. Employers are another important player, representing the employer sector individually or as employer organisations. Among the state representatives, the Ministry of Education and the Ministry responsible for economy/industry management were repeatedly mentioned.

Processes generally regulating or organising the "translation" of labour market needs into competences in the Partnership countries

The organisation of the "translation" of labour market needs into competences in **Czechia** is mainly ensured through the administration and continuous modernisation of the National Occupational Catalogue ([NSP](#)) under the responsibility of the Ministry of Labour and Social Affairs. The competences required for individual occupations are stored in the Central Competence Database ([CDK](#)) with almost 27,000 professional competences, general skills, soft skills and digital competences.

The CDK forms a common competence base with another important catalogue: National Register of Qualifications ([NSK](#)). The composition of vocational qualifications in the NSK system can be used by vocational schools in structuring the school curricula of the VET courses offered.

In **Germany**, the translation of labour market needs to competences is integral part of the overall 3-step revision process. However, there is no specific or centralised mechanism ensuring a standardised (or uniform) translation of labour market needs to specific competences, which has also been confirmed in the stakeholder feedback. Federal as well as industry funded research initiatives have developed varied understandings of "Industry 4.0" competences.



In **Austria**, these mechanisms are also an essential part of the overall process of shaping the structure and content of VET programmes. If the respective VET programme is regulated by law, the competences formulated and regulated there are implemented by the in-house trainers in the company and teachers in the vocational school. The same applies to curricula at vocational schools. These will be implemented by the teachers in theory and practice. They are supported in this by external and internal work-related further training as well as further training courses offered by the Ministry of Education.

The **Italian** [Atlas of Employment and Qualifications](#) organizes the needs of the market into specific skills by professional figure, managed by the National Institute for Public Policy Analysis (INAPP). The main actors involved in this process are, however, those at the local level, which, thanks to their synergy contribute in a more or less formal way to translating the needs of the local market into skills. Despite national standards, therefore, it is with bottom-up cooperation that this process takes place. Training centres try to create alternative and innovative paths based not only on the demands of the local market in a specific sector, but also on what is seen by other regions, and nations.

Translating labour market needs into competences is an integral part of the process of formulating qualification standards in **Slovakia**. On the national level there are National Occupational Catalogue ([NSP](#)) and National Register of Qualifications ([NSK](#)). On local level, labour market representatives could transform their needs for competences through negotiations with VET providers on initiating changes to school education programmes in the dual pathway. Up to 30% of the government's VET framework can be modified in this way.

The **Slovenian** partner stressed the importance of anticipating labour market needs. The Ministry of Labour and the Ministry of Education play a key role in anticipating key skills activities. The Employment office, labour market intermediaries and employers' organizations related to skills anticipation are also active. The Slovenian government has invested resources and work to develop skills anticipation activities and improve appropriate tools.

The Ministry of Labour has prepared a project for a competency forecasting platform in 2021 to identify short-, medium- and long-term gaps in occupations and competences in the labour market.

Implementing the necessary Industry 4.0 competences into vocational education and training

After the phases of identifying labour market needs and translating them into the language of competences, the phase of implementing competences in VET begins. In the EDU4Future project, we investigated which actors in the Partnership countries are mainly responsible for the processes regulating or organising the implementation of key competences in VET. We described the relevant processes regulating or organising the implementation of new competences in VET practice), either at a general level or (if they exist) specifically with regard to the implementation of competences needed for Industry 4.0.

Table 16: Overview of the actors mainly responsible for the processes regulating or organising the implementation of key competences in VET in the Partnership countries

	AT	CZ	DE	IT	SI	SK
Ministry of Education	●	●	●	●	●	●
Ministry of Industry and Trade	●				●	●
Ministry of Labour and Employment				●	●	●
VET providers - schools	●				●	●
VET providers - employers	●				●	●



	AT	CZ	DE	IT	SI	SK
Industry/economy (representatives)	●				●	●
Association of Employers	●					●
School Council					●	
Trade Unions	●					
Regions				●		
Education Directorate	●					
Other ministries						●
Regional Advisory Body						●
School Inspection						●

Unsurprisingly, the Ministry of Education was the only actor responsible for processes regulating or organising the implementation of key competences in VET that was mentioned in all the Country Reports. However, other actors were also mentioned. Half of the partners mentioned other ministries with responsibility for the economy and for employment. VET providers (schools and enterprises) and industry/economic representatives were also mentioned.

Processes generally regulating or organising the implementation of new competences in VET

The **Czech** Education Act requires that VET programmes should correspond to the latest knowledge of the scientific disciplines whose foundations and practical application education is intended to convey. The methods and organisation of education are then to be in line with the latest findings in pedagogy and psychology and adapted to the age and level of development of pupils.

However, the more specific procedures by which the new competences are implemented in the national standards are not specified.

New education policy requirements that are more general in nature (e.g. in mathematics, financial literacy or digital competences) appear across the board in the standards. In general, there is a greater emphasis on providing a broader educational base in order to make graduates more employable in the labour market and in civic life, this also applies to VET programmes.

In **Germany**, this happens in the drafting and coordination phase of introducing or revising new training regulations. The Federal Institute for VET (BIBB) asks the top-level employers' and trade union organisations to nominate representatives of company-based training practice who, acting as experts for the federal government (since company-based vocational training falls within its purview), work jointly with BIBB to develop new training regulations or revise existing training regulations.

Proceeding in concert with the work done by the federal government's experts, the experts delegated by the Länder develop a draft curriculum for instruction at vocational schools. At the end of the drafting phase, the two groups of experts meet to discuss the two drafts and bring their respective content and timetables into alignment.

Also, BIBB initiated the modernisation / revision of the standard occupational profile elements. These are contents that are anchored in the respective occupational profile and WBL plan in addition to the skills, knowledge and competences that determine the occupational profile. All companies providing training must ensure that these are taught and include them in the WBL plan. They are also subject to examinations.

The item "digitalised workplace" was included as a completely new standard. It deals with the handling of digital media and data, the consideration of data security and data protection as well as the ability to obtain and check information. In addition, communicative and social competences in the digital work environment are also taken into account with regard to social diversity and mutual appreciation.

VET standards in **Italy** define the professional figures and training standards that must be achieved in each region. The document is drawn up in agreement between the State and the Regions. Here are



collected the skills necessary to achieve the VET qualification. New skills are introduced during the revision of the programmes, in ways that are still under discussion, but which should take place every three years.

Individual centres providing VET courses cooperate with local companies, organize internships, and modulate their training courses based on the needs of the local market while meeting the skills of the minimum standards. Local companies share their needs in terms of required skills.

Most of the processes in **Slovakia** are formalized by a law framework as described in previous parts. To be more specific we can identify roof processes (impact on whole country/sector), as well as local processes.

Roofing processes:

- Initiation based on government policies
- Strong involvement of employers in sector groups and the Council of the Government of the Slovak Republic for VET

Local processes:

- Participation of employers in the Dual Education System
- Cooperation of employers with VET providers (within the school education system)
- Involvement of employers in VET advisory groups within regional governments
- The role of the trade union representing the interests of employers
- Ad hoc partnership between employer and VET provider
- Transfer of good practice through international projects of VET providers.

Specific processes regulating or organising the implementation of competences needed for Industry 4.0 in VET practice in the Partnership countries

All Partnership's countries noted that no specific processes have been established to regulate or organise the implementation of the competences needed for Industry 4.0 in their VET systems.

The modernisation of VET programmes and their addition of new content has taken place, but attention has been paid to the new requirements of the fields, regardless of whether these were technologies typically associated with the Industry 4.0 phenomenon. However, it is clear that many of the newly added elements of education are indeed directly related to Industry 4.0.

It seems that in Slovakia, the dual pathway is more focused on a technological basis and tailored to industry needs than the school-oriented VET pathway.

The operation of VET Centres of Excellence could have higher potential for implementing the needs of I 4.0 in VET practice in Slovakia. The operation of a VET centre of excellence is also formalised by the VET Act.

The **Austrian** partner, like the **Italian** partner above, mentioned the importance of implementing the new competences at local level. The necessary skills are transferred by company trainers and teachers. In this context, they stressed the need for further training of trainers from companies and teachers from schools. Continuing education opportunities are supported by both companies and schools. Companies are essentially the innovators of the competences needed in the market. The Austrian partner also pointed out that the digitisation process is accompanied by various support measures from the federal and state governments.

Two examples of such support measures are given by the **German** partner.

“Industrie 4.0” (Industry 4.0 [I40]) is a national strategic initiative from the German government. It aims to drive digital manufacturing forward by increasing digitisation and the interconnection of products, value chains and business models. I40 has become institutionalised with the Platform



Industrie 4.0 (Platform I40) that now serves as a central point of contact for policy-makers. Five working groups ensure the thematic work on training, as well as reference architecture and standardisation, research and innovation, security or legal framework.

The national initiative “Berufsbildung 4.0” (VET 4.0) is an initiative launched by the Federal government in 2016. One of the key elements is the new research initiative “Skilled Worker Qualifications and Competences for the Digitised Work of Tomorrow”. In dialogue with companies, the jobs affected by digitalisation are being examined in selected occupations with regard to work processes, activities and qualification requirements. The aim is to identify the changing requirements for the qualifications of skilled workers at an early stage, to record the quantitative and qualitative effects and to establish an early identification system. The initiative is also investigating the importance of digitally supported education and digital competences of trainees and trainers.

7. Examples of good practice

Another objective of the Country Reports was to provide examples of good practice that partner organisations themselves know intimately or have identified through desk-research. The examples focus on the field of upper secondary education (ISCED level 3, equivalent to EQF level 3-4). For example, we have been looking at the specific ways in which initial VET programmes have recently been modernised in the light of new technologies and digitalisation. We also investigated whether completely new VET programmes have recently been developed in the Partnership countries to respond to labour market needs related to Industry 4.0.

Revision of existing VET training programmes

Here we investigated how specifically (if at all) the new needs and demands of the labour market in the context of Industry 4.0 have been reflected in changes to existing VET programmes over the last 5-7 years. In the overview below, the most interesting examples of modernisation of VET programmes with regard to technological innovations mentioned by EDU4future partners are presented. The selection has been made so that the examples cover as wide a range of sectors as possible. More detailed information is available in the individual Country reports.

Table 17: Examples of newly added elements in already existing VET programmes

Country	VET programme(s)	New element(s) - examples
AT	Mechatronic (focus on Automation engineering or Electrical machinery engineering)	Additive manufacturing/3D printing (module)
AT	Electrical engineering: automation and process control engineering	Network and Communication Technology (e.g., data transmission and storage, integration of computer systems)
CZ	Electrician	Intelligent wiring Security systems
CZ	Electrical mechanic for equipment and instruments	PC-based measuring systems Remote measurement of electrical and non-electrical quantities Industrial robots Industrial networks Sensors of non-electrical quantities
CZ	Applied Chemistry	Automation - the basics of robotics



Country	VET programme(s)	New element(s) - examples
CZ	Construction	BIM method BIM information model BIM graphic programs
CZ	Multimedia production	Digital models and spatial visualisations
DE	Electronics technician	Energy and building technology (<i>specialisation</i>) Automation and systems technology (<i>specialisation</i>)
DE	Vehicle interior mechanic	Connectivity Networked systems and production High-tech seats 3D printing of equipment parts
DE	IT Specialist for Application Development	Digital networks Data and process analytics IT security and data protection
DE	Metal industry and electronics (10 VET programmes)	Digitisation of work, data protection and information security
IT	Industrial automation technician	Programming and application language for robotics Reprogramming techniques Programming the PLC in relation to automation and robotics process
SK	Specialist in computer networks	Elements of Artificial intelligence

Notes:

Extensive revision and creation of new employment standards is currently underway in **Slovakia**. The process of adaptation to industry I 4.0 has begun in the following sectors:

- Chemistry and pharmacy
- Electrical engineering
- Information technology and telecommunications
- Automotive and mechanical engineering
- Textiles, clothing, footwear and leather processing
- Crafts and personal services

Slovenia: Due to the 2017 law, VET programmes revisions will be carried out for the first time only after 5 years. In 2022 that will be 5 years after the law's adoption, which means that changes the debate's changes will not occur until next year.

New VET training programmes

The partners of the EDU4Future project also investigated whether completely new VET programmes with a particular focus on Industry 4.0 have been created in their countries in the last 5-7 years. Examples of newly created programmes are given in the following box.

In **Germany**, a new programme called "*Electrician for building systems integration*" has been created. This new apprenticeship was prepared to meet the demand for skilled workers, especially in the market segments of smart home, smart building, energy management and building system integration.

The **Austrian** partner presented an example of the newly defined specialisations in the field of "IT with specialisation in technology". It is now possible to obtain qualifications in two specialisations: „*IT with specialisation in production technology*“ and „*IT with specialisation in system technology*“.



In 2018, "*Application development - coding*" programme was introduced in Austria. The programme concerns the digitalization of work processes and the increased need for planning and development of software applications for computers and IT systems (e.g., also for smartphones and tablets), specific industry software and browser applications. Another new programme is "*Mechatronic*" from 2015: The apprenticeship with the main modules automation technology and IT, digital system, and network technology, as well as the special modules robotics and PLC technology meets the increased use of computer-controlled programmes and components through the digitalization in production companies. In 2018, the "*E-commerce trader*" programme was introduced. Digitalization means that many more products are being sold online via online stores or web stores. E-commerce traders are responsible for looking after these online stores or Internet sales platforms. They also know exactly the distribution and logistics chains and plans the respective products.

A [complete overview](#) of the changes for the period 2015-2021 in the structure and content of VET courses in Austria is published on the website of the Ministry of Digitalisation and Economy.

In **Italy**, they have also responded to the growing demand for digitalised occupations, for example by creating the "*IT and Telecommunications Operator*", replacing the outdated "Electronics and Telecommunications Operator". The aim of the creation of the field was to provide skilled workers to digitise different types of processes or manage data.

In addition, new specialisations of technicians have been created in Italy in sectors related to Industry 4.0 (e.g. "*Logistics Services Technician*" or "*Modelling and Digital Production Technician*").

Slovakia is represented by the new programme "*Intelligent and Digital Systems Manager*". The programme is intended to provide skills related to programming, configuration and diagnostics of devices using IoT Internet of Things (Smart Home, Smart City, Smart Factory), implementation and operation of infrastructure for digital communications and cloud services. Another new field is "*Plastics Processing Technician*", which shall equip graduates with competences in the following areas: CNC machines prepared for I 4.0, knowledge of chemical and physical properties of materials, requirements for production automation, requirements for robotics and special forms of surface treatment, 3D printing, new types of materials.

No new secondary VET programmes were established in **Czechia** and **Slovenia** during the period under review.

Other projects and initiatives

In EDU4Future, we also looked for examples of other national, regional or sectoral VET projects and initiatives. These included, for example, initiatives aimed at identifying or strengthening competences relevant to Industry 4.0 or analysing new labour market requirements with regard to Industry 4.0. Selected examples are described in more detail, while others are briefly described with a reference where available. More detailed descriptions of other examples of good practice can be found in the national reports.

Slovakia

Name: [Dual Academy](#)

Description: Companies-based VET provider both in dual and school education system. Dual employers are: Volkswagen Slovakia, Faurecia, Slovnaft, Magna, Siemens, ŠKODA AUTO Slovakia. The school introduces various forms of skills acquisition, for example based on gamification.

Italy

Name: Operative Manual



Description: All skills and qualifications are translated in a more “practical” version, to facilitate companies in their understanding. The manual is not only useful to facilitate the entry of VET learners into the world of work, but also to make the training experience in the company more effective.

Germany

Name: [Digitalisierung@SPE](#)

Description: Siemens identified 25 key digitisation competences and analysed 50 typical Industry 4.0 use cases. On this basis, Siemens education experts recorded around 20,000 competence entries in a database and identified all relevant competence shifts per SPE training course, which were then transferred to develop the teaching content. Siemens Training is now adapting the training plans for 15 VET programmes. Learning methods, learning material and the training of trainers and lecturers were also conceptually integrated by the experts. The first teaching sequences developed - on 3D printing, for example - have already been integrated into the training plans and are being implemented. A wide variety of educational products are being developed to train the young people accordingly.

Czechia

Name: [Kompetence 4.0](#)

Description: Nationwide project aiming on identification of new competences related to new technologies in 10 selected sectors. The very first attempt in Czechia to systematically identify new trends, technologies and resulting new competences in selected sectors and occupations. Includes new competency model (testing the "competence pyramid" model). The project is mapping the possibilities of transferring the newly identified competences to vocational training through competence pyramids.

Austria

Name: [Expert group “Qualification and Competences”](#)

Description: The Industry 4.0 Platform has investigated the requirements that Industry 4.0 and digitization will place on education, training, and continuing education in Austria. The results paper on qualifications and competences was developed in a broad process. A total of 81 recommendations were derived.

Slovenia

Name: POKIT

Description: Initiative focused on developing digital competences of teachers and learners. Project is enabling better knowledge of technology by teachers, who then transfer knowledge and skills to learners. In addition, POKIT brings knowledge of using various IT tools to facilitate work and data retrieval, perform database analysis, and use basic software packages for everyday work.

More good practice examples

[Dual Education and improving appeal and quality of VET](#) (Slovakia): Implementation of the dual education system on the national and regional level in cooperation with employers. Highly relevant for sectors influenced by I 4.0.

[Pedagogical Clubs](#) (Slovakia): The clubs focused on personal and professional development, recommendations for the activities of teaching staff. One of the clubs is focused on Industry 4.0 and Work 4.0.

[Online Job Market Guide](#) (Slovakia): The integrated online platform provides various functions to support the online multi-level counselling model adopted by national employment services. Promotion of all disciplines, including those covering I 4.0.



[Vocational education and training centres](#) (Slovakia): The aim is to concentrate the resources of schools and companies in order to support VET, including lifelong learning. Focused on technologies used in I 4.0

[Festo Lernfabrik](#) (Germany): The learning factory of Festo company is an integrated training facility and an integral part of a technology factory in Scharnhausen.

[Berufenet](#) (Germany): Berufenet offers specific section on trends and digitalisation topics in relation to respective occupations (demonstrates future trends and potential relevance of occupation).

[Competences for automation and robotization in Pilsen Region](#) (Czechia): The Regional Employment Pact initiated a debate between VET schools and employers on changes in VET with regard to automation and robotics.

[Dual Academy](#) (Austria): Specialized in-depth training and teaching of future competences. The target group includes VET high school graduates who are not immediately pursuing a degree, but also students without a degree or career changers.

[Internship abroad for apprentices](#) (Austria): The internship abroad is a mandatory part of the training at the Dual Academy. The aim is to give trainees an insight into the work processes and procedures of other countries in the chosen industry/area.

Study “[Employment and Industry 4.0](#)” (Austria): The study analyses the requirements of the labour market with regard to Industry 4.0 by 2030 in Mechanical engineering and mechatronics, Automotive, Wood processing, Logistics and industry-related services.

[AEIQU study](#) (Austria): Analysis of Industry 4.0 qualification requirements and their impact on the Austrian education landscape, including options for a desirable development of training offers for Industry 4.0.

E-competent VET schools (Slovenia): The project includes students of computer science, engineering, and mechatronics, who transfer knowledge to high school students. Relevant topics of I 4.0 are Artificial intelligence, Robotics, Multimedia.

MegaVET (Slovenia): Project focused on gamification, training to use a computer in learning by playing, knowledge of functional platforms and Android applications.

E-education (Slovenia): Project focused on the use of IT technology in teaching and the development of skills in the use of IT tools in practice, in the fields of Virtual reality, 3D modelling and animation.

8. Conclusions

In the Country Reports, EDU4Future partners summarised the findings that they had gathered during the development of the Country Reports. They described the positive elements they found in their countries (e.g., what conditions and processes regarding their countries they considered to work well, as described in the previous chapters of the Reports). On the other hand, they could indicate areas for improvement and describe how improvements could be achieved. They also commented on whether some aspects of the implementation of changes in VET are not adequately addressed in the country. They summarised the key changes in VET and indicated where they felt it was difficult to put them into practice. The descriptive texts have been summarised in the tables below for ease of reference. More detailed descriptions are available in the individual Country reports.



Table 18: Quality and functional conditions and processes in terms of their effectiveness

	AT	CZ	DE	IT	SI	SK
Local networks enable to innovate training courses from the bottom up				•		
Functional local cooperation between enterprises and vocational schools		•		•		
Strong value base and individual motivations guarantee diversity, enabling the fulfilment of local needs, national and regional standards				•		
VET schools' flexibility to tailor the National standards of VET programmes to local conditions		•				
Legal requirement for schools to cooperate with employers		•				
Improving cooperation between labour market and VET actors at regional level		•				
Multiple perspectives considered thanks to involvement of many actors			•			
Structured regulations brings clearly defined/detailed processes and responsibilities	•		•			•
Effective cooperation/dialog between all involved actors	•		•			•
Training companies are usually familiar with newer equipment, work processes etc., then ready for new programmes			•			
Employers in Sector councils and sectoral groups play an important role in description of qualifications						•
New measures set in national strategies, focused on digital and STEM skills						•
Involvement of social partners in VET system					•	
System of VET is flexible about changes in society, economy and individual needs					•	
Functional scholarship system, revised every 5 years					•	
Financial incentives for VET training companies					•	
Career counselling is supported: every school employs at least one career counsellor					•	

The conditions set out by each partner vary considerably. A large degree of agreement was found by partners with a dual VET system, where laws have well addressed the involvement of different social partners and set up appropriate processes (see Germany, Austria, Slovakia). Czechia and Italy agreed on functional cooperation between employers and vocational schools at local level.

Table 19: Conditions and processes: opportunities and ways to improve

	AT	CZ	DE	IT	SI	SK
Satisfaction with the set VET system can lead to over-satisfaction and little willingness for critical reflection			•			
The needs of certain actors should be adequately reflected (learners, teachers, schools)			•			
Optimising processes can help improve how they work on a day-to-day basis and make them more transparent			•			
Interlocking the systems of VET and fully school-based/higher education will open the pathway from VET to higher education			•			
Conditions and processes should be improved at national and regional level		•				
Shifting paradigm: from state as a central actor in the VET system into state as a partner in the process		•				



	AT	CZ	DE	IT	SI	SK
The position of social partners in the VET system is weak and should be strengthened, ideally through law		•				
The review of VET programmes should take place on a regular basis		•				
Employers and other social partners should be involved in the development of national strategies from the outset		•				
Quality assurance of the system should be activated, through the optimisation led by Ministry of Education	•					
Making education more practical would be an asset	•					
Different requirements (industry x crafts) regarding competences should be solved through modular apprenticeships (basic, special and elective modules).	•					
The monitoring structure is not yet well established and under discussion				•		
The perception and promotion of the VET should be improved				•		
VET should be better included in national educational development initiatives				•		
Transparency of the processes on regional level should be improved						•
Better comparability of VET programmes						•
Establishment of regional thematic groups with an advisory voice - better regional dialogue between schools and companies						•
Sharing of forecasts and forward-looking visions in relation to skills needs.						•
Shared vision of VET among stakeholders should be improved					•	
The quality of teaching needs to be improved					•	
Lack of teachers					•	

Different VET systems and different starting conditions bring with them different opportunities for improvement and different ways to achieve them. The table above therefore provides an opportunity to learn about different approaches to improving VET, rather than a comparison. At the same time, it should be stressed that many of the aspects listed may also be relevant for other Partnership countries that have not directly listed them in their national reports, given the prioritisation of national needs.

Table 20: Implementation of changes in VET: inadequately considered aspects

	AT	CZ	DE	IT	SI	SK
VET institutions' needs (incl. student, teacher & staff, available infrastructure etc.) are only rarely considered in the VET revision processes, which may contribute to the mismatch between supply of and demand for particular VET offers			•			
The systemic resistance to learn from other countries is problematic. Solutions found elsewhere should be considered more.			•			
Little consideration for the specific mechanisms used to establish labour market needs and translate labour market needs to VET competences. These approaches seem unclear and somewhat arbitrary.			•			
Further education for VET trainers and teachers considering Industry 4.0 and Digitalisation competences is hardly an issue.	•					
Accelerating change: Innovations are being put into practice at an ever-increasing rate. This is an argument for introducing a real system of reviewing VET programmes to see if they are in line with technological developments.		•				
Multidisciplinary qualification requirements: new technologies often occur at the boundaries of traditional disciplines. Current narrow division of VET programmes cannot easily respond to this demand.		•				



	AT	CZ	DE	IT	SI	SK
The effectiveness of maintaining contact with former students is underestimated. This overlooks the problems they may have in employment/finding the job or during their education.				●		
More consideration should be given to the insights gained from regional/local networks and collaborations when identifying the need for change in VET.				●		
The untapped potential is in multi-institutional communication on an informal basis (e.g. brainstorming groups, identification of joint projects).						●
The education system does not specifically prepare for self-employment and the establishment of their own companies.						●
Although VET schools can adapt their school curricula up to 30 % of the national standard to meet local needs, little use is made of this option.						●
Large enterprises involved in the dual branch of VET may have a tendency to reduce the programme to their internal needs, which threatens the broad employability of the graduate.						●
Insufficient use of innovative teaching methods in VET can reduce the attractiveness of VET.						●
The overall level of digital competence is insufficient. More attention and investment are needed to strengthen them.					●	
The programmes need to be strengthened with computer science and informatics content.					●	

Here again, it is clear that each partner country comes from a different situation and perceives different aspects of the education system as a priority. Although some of the partner countries have similar VET systems, there may be a current emphasis on different elements that have not received sufficient attention to date.

Table 21: Main changes identified and the difficulty of implementing

	AT	CZ	DE	IT	SI	SK
In order to systematize VET development and to improve the evidence base, the new regulation requires regular review of all VET standards in a five-year cycle. The goal is to ensure that all VET programmes meet the latest needs.	●					
Coordination between the social partners/interest groups could be difficult procedurally and in the search for compromise in defining the training. However, the relatively rapid implementation in the last few years shows that the process basically works.	●					
A relatively large package of changes to existing VET programmes was implemented between 2018 and 2020. However, this revision did not reflect much on the requirements for general digital competences.		●				
The set schedule of revisions in practice means that it will take up to 4 years from the start of work on the revisions to the change in the teaching of first year learners.		●				
Further new changes (revisions, new programmes) can be reflected in the VET thanks to the cooperation between the National Institute for VET and the implementers of the „Kompetence 4.0“ project.		●				
Shift from a state-led VET system to a partnership model of VET governance requires political will to reform VET. This kind of reform is very complex and with uncertain outcomes.		●				



	AT	CZ	DE	IT	SI	SK
Rather than the creation of new occupational profiles, many old VET programmes have been revised and updated to suit better the new labour market requirements.			•			
Many VET institutions struggle to implement changes. The requirements cannot always be met straight away and require additional resources for infrastructure, technology and staff.			•			
VET schools are often chronically understaffed. Staff have limited capacities to engage in meaningful training to further their skills and expand their teaching repertoire. Improving teaching conditions and training to support Industry 4.0 ready VET offers are needed.			•			
New model of VET programmes (qualifications, skills) review was implemented in 2019. Its implementation was well received by the actors, but the results of this change will only be seen at the end of the 2021/2022 school year.				•		
The monitoring model (roles, and responsibilities of the various actors involved) is being discussed: this aspect requires a lot of time and negotiation between the various and numerous actors involved.				•		
Sometimes there is a strong involvement of employers who propose too narrowly focused programmes. Such targeted VET programmes can lead to unbalanced vocational training.						•
Different opinions of member of sector groups on VET priorities and content could be an issue. Final decision needs to be supported by as many authors and well ranked employers as possible.						•
VET providers are not always responsive to business initiatives. Sometimes they tend to continue with traditional VET programmes attractive to learners, but with insufficient absorption capacity in the labour market.						•
The involvement of social partners in VET is improving, as they are involved in the activities of introducing changes in many ways.					•	
The quality of work-based learning (WBL) is also improving but upgrading competences remains a challenge. Nevertheless, significant efforts have been made by investing in new training facilities (inter-enterprise training centres) and strengthening WBL in companies.					•	

Aspects that are common to several of the Partnership countries can also be found in this chapter. For example, the complications associated with managing the activities of many actors and finding the necessary compromise are mentioned by both Slovak and Austrian partners. The new model of regular reviews of VET programmes (in Austria after 5 years, in Italy after 3 years, as mentioned in another part of the Analysis) is also mentioned. However, in this case, the formulations are separated in order to make clear the differences that may be relevant for each country.



The Comparative Analysis is one of the outputs of the project "Educate for future" (EDU4future, No. 2020-1-SK01-KA202-078375). The source of the analysis was the Country Reports prepared by the individual project partners (see table below). Any additional information beyond the national reports was provided by representatives of the partner organisations.

Country report – Czechia	TREXIMA, spol. s r.o.
Country report – Slovakia	Trenčianska regionálna komora SOPK
Country report – Germany	Akademie für berufliche Bildung gGmbH
Country report – Austria	ConPlusUltra GmbH
Country report – Slovenia	G&P svetovanje Gregor Jagodič s.p
Country report – Italy (Veneto)	t2i – trasferimento tecnologico e innovazione s.c. a r. l.

Organisation responsible for the analysis, author: TREXIMA, spol. s r.o., Mgr. Marcel Navrátil



Annex: Glossary

Augmented Reality (AR): System able to superimpose some additional elements on the visual reality (attributes, explanations, schemes, internal elements not visible). It can be managed in the simplest way using the smartphone/tablet camera, but usually it requires the use of special glasses. Since this is a technique based on user experience, the quality of devices and software are essential for the diffusion of technology. (Source: [t2i Glossary](#))

Competence: Ability to apply learning outcomes adequately in a defined context (education, work, personal or professional development).

or

Ability to use knowledge, skills and personal, social and/or methodological abilities, in work or study situations and in professional and personal development. (Source: [Cedefop Terminology of European Education and Training Policy](#))

Country Report: Document that collects key data and country-specific information based on a common methodology. These can then be compared and evaluated to describe how labour market requirements are translated to VET in a given country.

Industry 4.0 refers to the fourth industrial revolution; the first industrial revolution was the arrival of the steam engine in the 1700s, the second industrial revolution was the invention of electricity and Fordism (which enabled mass production), the third was the appearance of media and computers. This most recent industrial revolution describes the current phase of transformation of industrial processes, with a strong digitization of production processes and services, the introduction of interconnected sensors, the internet of things, intelligent machines (robots), artificial vision and autonomous driving systems together with new additive manufacturing technologies, augmented reality and virtual reality. This fourth revolution is called “4.0” following the revision-numbering model used in the software to emphasize its digital nature. (Source: [t2i Glossary](#))

Internet Of Things (IoT): Literally “internet of things” refers to the connection to the internet of devices other than computers, tablets, smartphones, smart TVs such as: appliances, light bulbs, thermostats, sensors, cameras, air conditioners, cars, street lamps, or any electronic device. In this way the device will be accessible from the network and can communicate autonomously with other devices. To have IoT, a “thing” connected to the internet should have: (a) an IP address, (b) a processor capable of handling communications. The term has a certain overlap with the concept of M2M, which, however, is understood as a set of intermediate level industrial protocols, as is the case with smart meters for example. (Source: [t2i Glossary](#))

The Industrial IoT (IIoT): is a subclass of the IoT that focuses on the particular needs of industrial applications such as manufacturing, the oil sector, utilities. Although they share the same technologies (sensors, cloud, connectivity, analytics), industrial applications have demanding requirements that can be summarized in the following ten criteria: security, interoperability, scalability, precision and accuracy, programmability, low latency, reliability, resilience, automation, maintenance. (Source: [t2i Glossary](#))

Knowledge: Outcome of assimilation of information through learning. Knowledge is the body of facts, principles, theories and practices related to a field of study or work. (Source: [Cedefop Terminology of European Education and Training Policy](#))

Robot: Mechanical systems endowed with manipulative abilities (mechanical arms, systems for taking objects) and in some cases with walking ability (wheels or mechanical limbs for movement). The most



advanced robotic technologies are equipped with artificial vision systems capable of recognizing objects and possibly taking/manipulating them autonomously according to non-predefined patterns. There are wide differences in models: humanoid robots (such as the famous Japanese Pepper robot, IIT's Italian R1 or social robots), domestic robots (such as the vacuum cleaner robot), drones, logistics robots (such as Amazon's Kivas and similar wheeled cargo robots that now frequent hospitals), robot animals, robot exoskeletons and limbs, combat megabots four meters high, industrial robots (collaborative robots). (Source: [t2i Glossary](#))

Skills: Ability to apply knowledge and use know-how to complete tasks and solve problems. (Source: [Cedefop Terminology of European Education and Training Policy](#))

Stakeholder: Person or organization that has an interest in, can influence, be influenced by, or perceive itself as influenced by a decision or activity. Examples: customers, owners, people of an organization, suppliers, bankers, legislative authorities, trade unions, partners or communities that may include competitors or opposing pressure groups. (Source: [t2i Glossary](#))

Vocational Education and Training (VET): Education and training which aims to equip people with knowledge, know-how, skills and/or competences required in particular occupations or more broadly on the labour market. (Source: [Cedefop Terminology of European Education and Training Policy](#))

Virtual Reality (VR): Highly immersive visual simulation of artificially generated environments and scenarios through screens or special wraparound glasses. In the most advanced versions, in addition to sounds, it can include tactile sensations and mechanical feedback thanks to special interactive ergonomic devices. Unlike augmented reality which adds synthetic elements to real ones, in virtual reality the stimuli of the real world are completely replaced by artificial ones. (Source: [t2i Glossary](#))