

**04-T3: Blueprint for the integration of ML skills requirements into sectoral competence frameworks and EU/national certification and standardisation schemes**



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## 1 ABBREVIATIONS

|                |  |
|----------------|--|
| <b>CEDEFOP</b> | European centre for the development of professional training |
| <b>EQAVET</b>  | Quality assurance in vocational education and training       |
| <b>EQF</b>     | European qualifications framework                            |
| <b>ESCO</b>    | European skills, competences, and occupations                |
| <b>ECTS</b>    | European credit transfer and accumulation system             |
| <b>ECVET</b>   | European credit system for vocational education and training |
| <b>EURES</b>   | European cooperation network of employment services          |
| <b>ISCED</b>   | International standard classification of education           |
| <b>ISCO</b>    | International standard classification of occupations         |
| <b>NQF</b>     | National qualifications framework                            |
| <b>NSC</b>     | National skills classification                               |
| <b>QA</b>      | Quality assurance  |
| <b>VET</b>     | Vocational education and training                            |

## 2 INTRODUCTION

This blueprint contains a series of recommendations regarding the integration of ML skills in the national education and professional training systems. It is important to consider that each national system has a different level of maturity, organizational structure, through therefore, the recommendations contained in this document are general and indicative being able to be adapted by the educational and professional training entities in each country, depending on their specificity. Regarding the integration of ML skills in the European qualification frameworks, the recommendations refer to the principles that must be the basis of this process, as well as the guiding component elements of this integration. In this context, the present blueprint contains a series of recommendations regarding the integration of the program developed through the Machina project “Machine learning skills for ICT professionals” into the already existing education and training systems. Thus, the main objectives of the "Blueprint" are:

- contribution to the improvement of education and professional training systems
- improving the processes of training and evaluation of skills in the field of ICT;
- the implementation of a methodological framework for correctness at the level of the EU member states.

The plan for integrating ML skills requirements into national qualification systems will lead to social recognition of MACHINE learning outcomes. This recognition means the design of the ML specifications in the national qualification systems.

Integrating ML skills requirements into sectoral skills frameworks is necessary to integrate ML skills requirements into the e-Competence Framework, ESCO and ECQA classification systems, as well as national certification and standardization systems.

The EU Skills Panorama presents quantitative and qualitative information on short- and medium-term skills needs, as well as skills supply and skills mismatches in the European Union. Currently, the top five skills shortage occupations in the EU are: ICT professionals; doctors; science, technology, engineering and mathematics (STEM) professionals; nurses and midwives and teachers.

However, the picture varies from country to country. There are member states (with the exception of Finland) that do not have ICT professionals, while others such as Belgium, Greece, Hungary, Latvia, Lithuania, Luxembourg, Portugal, Spain and the United Kingdom do not have the same problem.

### 3 TERMS AND DEFINITIONS

Terms and definitions are key notions in education and professional training as well as in the process of certification of competences. In this sense, the main terms and their related definitions are provided below.

|  |  |
|--|--|
| <p><b>Assessment of learning outcomes</b></p>    | <p>Process of appraising knowledge, know-how, skills and/or competences of an individual against predefined criteria (learning expectations, measurement of learning outcomes). Assessment is typically followed by certification.</p> <p>Source: Cedefop, 2004.</p>   |
| <p><b>Competence</b></p>                         | <p>Ability to apply learning outcomes adequately in a defined context (education, work, personal or professional development).</p> <p>or</p> <p>Ability to use knowledge, skills and personal, social and/or methodological abilities, in work or study situations and in professional and personal development.</p> <p>Comment: competence is not limited to cognitive elements (involving the use of theory, concepts or tacit knowledge); it also encompasses functional aspects (including technical skills) as well as interpersonal attributes (e.g. social or organisational skills) and ethical values.</p> <p>Source: Cedefop; European Parliament and Council of the European Union, 2008.</p> |
| <p><b>Recognition of competences</b></p>         | <p>All learning activity undertaken through life, which results in improving knowledge, know-how, skills, competences and/or qualifications for personal, social and/or professional reasons.</p> <p>Source: Cedefop, 2008.</p>  |
| <p><b>Certification of learning outcomes</b></p> | <p>The process of formally validating knowledge, know-how and/or competences acquired by an individual, following a standard assessment procedure. Certificates or diplomas are issued by accredited awarding bodies.</p> <p>Source: Cedefop, 2008.</p>  |

|   |   |
|---|---|
| <p><b>Vocational education and training</b></p>   | <p>Education and training which aims to equip people with knowledge, know-how, skills and/or competences required in particular occupation or more broadly on the labour market.</p> <p>Source: adapted from European Training Foundation, 1997.</p>  |
| <p><b>Educational and training programmes</b></p> | <p>There are considerable differences in the approach to education and training depending on whether it takes place before or after entering the workforce. The distinct types of education and training programs are characterized by the following two concepts:</p> <ol style="list-style-type: none"> <li>1. Initial education and training: general or vocational education and training carried out in the initial education system, usually before entry into working life. Some post-employment training may be considered initial training (such as retraining). Initial education and training can take place at any level of general or vocational education (full-time school training or alternative training) or apprenticeship pathways.</li> <li>2. Continuing education and training (lifelong learning (LLL)): education or training after initial education and training – or also training after entry into working life, aimed at helping people to: <ul style="list-style-type: none"> <li>improve or update their knowledge and/or skills; acquire new skills for a career move or retraining;</li> <li>to continue their personal or professional development. LLL can include any kind of education (general, specialized or vocational, formal or non-formal, etc.).</li> </ul> </li> </ol> <p>Source: CEDEFOP- Terminology of European Education and Training Policy, 2014</p> |
| <p><b>Qualification</b></p>                       | <p>An official record (certificate, diploma) of achievement which recognises successful completion of education or training, or satisfactory performance in a test or examination;</p> <p>and/or the requirements for an individual to enter, or progress within an occupation.</p> <p>Source: Cedefop, 2003</p>  |

## 4 AN OVERVIEW OF DIGITAL SKILLS IN THE EU

According to Skills Panorama, 4 out of 10 European citizens lack basic digital skills and most employers are having difficulty hiring digital specialists. In this sense, there is a need to develop new programs that meet the current requirements of the labor market. This material aims to support structural changes in VET systems in order to increase the responsiveness of VET to the changing needs of the labor market.

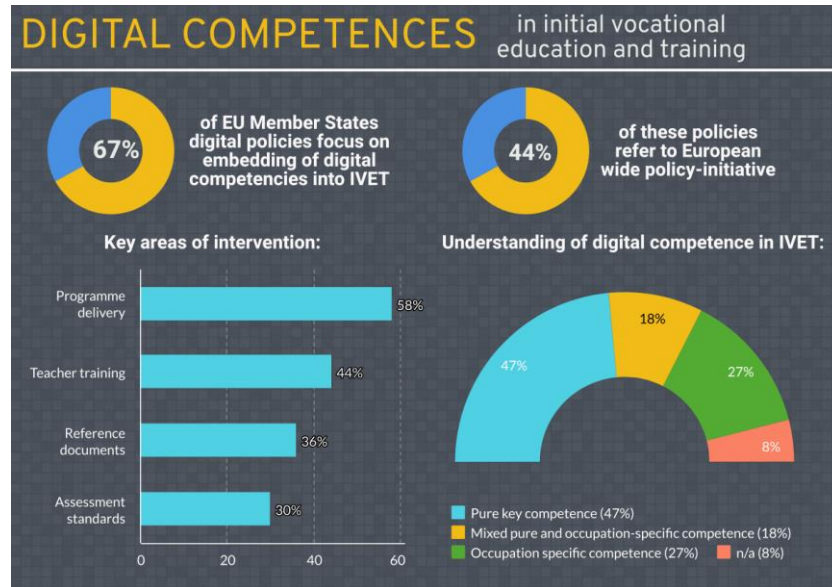
Regarding the Panorama, Cedefop estimates the risks of automation in particular for occupations that have a significant share of tasks that can be automated and with a low reliance on communication, collaboration, critical thinking and customer service skills.

The risk of automation is further accentuated in occupations where employees report little access to training programs that could help them cope with changes in the labor market. Information on the digital skills indicator is derived from the European Union Survey on ICT Use in Households and by Individuals, which assesses individual digital skills capabilities in four areas:

- information (eg moving and copying files);
- communication (for example, sending and receiving emails);
- troubleshooting (for example, installing software);
- software (eg, using software to edit photos, videos or files).

In VET, digital skills are mostly seen as key (or transversal) skills (47% of programmes), which means that digital literacy is considered to be the focus. In 27% of programs, digital skills are seen as occupation-specific. In these situations learning often focuses on building in-depth knowledge about specific tools and application areas (such as CAD, robotics, etc.). The methodology of the digital skills indicator was substantially changed in 2021 to reflect the Digital Skills Framework 2.0. Thus, 2021 is the beginning of a new chronological series and it is no longer possible to compare it with the data published in previous years. The use of digital skills provides an indicator (i) for all individuals (essentially a measure of the potential supply of digital skills); (ii) for people aged between 25-34 (a measure of the supply of new skills); and (iii) all employees (employees, self-employed and family workers).

Fig. 1: Digital competences in initial vocational education and training (IVET) policies



Source: <https://www.cedefop.europa.eu/en/data-insights/digital-skills-challenges-and-opportunities>

The data for the digital skills indicator is derived from the European Union Survey on the use of ICT in households and by individuals, which assesses individual digital skills capabilities in five areas:

- information (for example, moving and copying files);
- communication (for example, sending and receiving emails);
- troubleshooting (for example, installing software);
- software (for example, using the software to edit photos, videos or files)
- security (managing access to personal data or preventing or limiting the use of cookies).

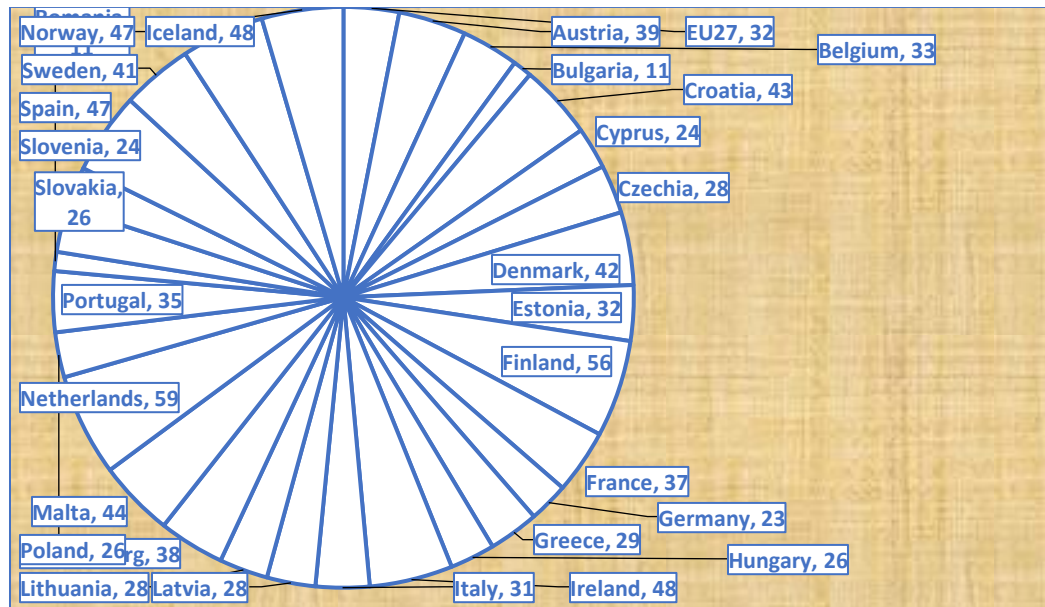
The average use of digital skills in 2021 is estimated at 34.5%.

The lowest value is 11% for Bulgaria and Romania, while the highest value is 59% for the Netherlands.

The COVID-19 pandemic has expanded the use of technology on an unprecedented scale in education and training; makes education and training systems fit for the digital age. In EU Member States, 67% of policies promoting digital competence have the explicit objective of integrating IT skills in VET.



Fig. 2 All European employment in 2021 with above basic digital skills in European countries



Source: <https://www.cedefop.europa.eu/en/tools/skills-intelligence/digital-skills-use?year=2021#1>

Due to technological changes in the economy, the development of digital skills - or ICT - has been a priority in recent years ([Link](#)). Strengthening digital skills is a priority area for both EU member states and candidate countries. At the VET level there are many activities that focus on learners, but still much remains to be done in the VET system. In order to reduce the digital skills gap of adults, the member states must have a unified approach regarding qualification frameworks and the implementation of digital skills in these frameworks. The training of teachers and trainers in digital skills is a priority for the participants in the training programs. Technological innovation and digitization represent a major economic potential that can fundamentally transform learning by improving access to learning and developing skills policies for people with low or no digital skills. In the year 2022, the results of Cedefop's European Skills Index (ESI), which evaluates the performance of European skills systems and the improvements made over time, show that skills development systems seem to be converging in Europe, even if there is still a long way to go. until full convergence is achieved. The European Skills Index also highlights areas to which each country should pay further attention and is based on three investigative indicators:

- skills development;
- activation of skills;
- matching skills.

These three indicators are divided into six sub-indicators and then into 15 measurable indicators that are closely related to the monitoring of Member States' policies. The performance of the general skills system is represented by these indicators.

The European e-Competence Framework (e-CF) classifies 40 competencies for ICT professionals. This establishes a common language for competences, skills and proficiency levels across Europe. Competences in e-CF are organized according to five areas of ICT activity and are linked to the European Qualifications Framework (EQF). e-CF is developed by experts and stakeholders under the umbrella of the CEN ICT Skills Workshop. Thus, e-CF is an important source for the development of ESCOs and, in particular, has been used by the ICT service activities of the Sectoral Reference Group. The Commission published the European Digital Competence Framework for Citizens (DigComp) with the overall aim of contributing to a better understanding and development of digital competence in Europe. The digital competence framework consists of 21 competences divided into the following five competence areas: information and data literacy

- communication and collaboration
- digital content creation (including programming)
- safety (including digital well-being and competences related to cybersecurity) and
- problem solving.

In 2021, there were 2.79 million employed persons with an ICT education, 3.3% more than in 2020. Men represented 84.1% (2.35 million) of the EU's total workforce with an ICT educational background, an increase of 1.3% from the previous year (2.20 million in 2020), while the number of women in employment with an ICT education declined. In 2021, women represented 15.9% (442 800) of the ICT workforce compared with 17.2% (463 800) in 2020.

Looking at the EU Member States, Czechia (92.6%), Slovenia (90.8%), France (89.7%), Belgium (89.2%) and Poland (89.1%) had the highest shares of men in the total number of employed persons with an ICT education.

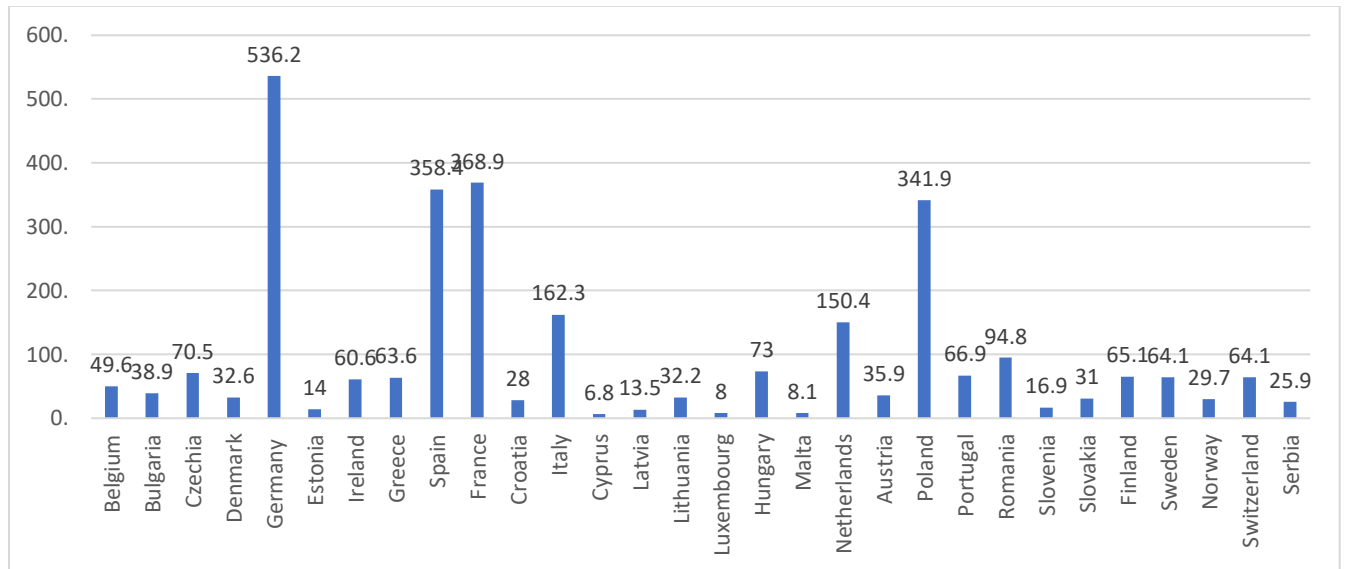
Women accounted for more than a quarter of employed persons with an ICT education in Bulgaria (36.6%), Greece (29.4%), Denmark (28.0%), Romania (27.2%) and Cyprus (26.9%).

Table no. 1 - Employed persons with ICT education

| <b>Countries</b> | <b>Year</b> | <b>Thousand</b> |
|------------------|-------------|-----------------|
| Belgium          | 2021        | 49.6            |
| Bulgaria         | 2021        | 38.9            |
| Czechia          | 2021        | 70.5            |
| Denmark          | 2021        | 32.6            |
| Germany          | 2021        | 536.2           |
| Estonia          | 2021        | 14.0            |
| Ireland          | 2021        | 60.6            |
| Greece           | 2021        | 63.6            |
| Spain            | 2021        | 358.4           |
| France           | 2021        | 368.9           |
| Croatia          | 2021        | 28.0            |
| Italy            | 2021        | 162.3           |
| Cyprus           | 2021        | 6.8             |
| Latvia           | 2021        | 13.5            |
| Lithuania        | 2021        | 32.2            |
| Luxembourg       | 2021        | 8.0             |
| Hungary          | 2021        | 73.0            |
| Malta            | 2021        | 8.1             |
| Netherlands      | 2021        | 150.4           |
| Austria          | 2021        | 35.9            |
| Poland           | 2021        | 341.9           |
| Portugal         | 2021        | 66.9            |
| Romania          | 2021        | 94.8            |
| Slovenia         | 2021        | 16.9            |
| Slovakia         | 2021        | 31.0            |
| Finland          | 2021        | 65.1            |
| Sweden           | 2021        | 64.1            |
| Norway           | 2021        | 29.7            |
| Switzerland      | 2021        | 64.1            |
| Serbia           | 2021        | 25.9            |

Source: <https://ec.europa.eu/eurostat/web/products-eurostat-news/-/ddm-20221011-1>

Fig. no. 3 Employed persons with ICT education in 2021



Source: <https://ec.europa.eu/eurostat/web/products-eurostat-news/-/ddm-20221011-1>

The previously mentioned are also reflected in ESCO, where in subgroup 25 of group 2 there are specialists in information technology and telecommunications. In this subgroup there are 58 occupations intended for ICT specialists. These occupations are presented in the following table. However, as the labour force market is constantly changing, it is expected that new occupations will appear. All these existing occupations are intended for people with higher education, level 6 qualification.

Table no. 2: ICT occupation according with ESCO

| ICT ROLES                     | ESCO Code |
|-------------------------------|-----------|
| Computer scientist            | 2511.1    |
| Computer vision engineer      | 2511.2    |
| Data analyst                  | 2511.3    |
| Data scientist                | 2511.4    |
| Embedded system designer      | 2511.5    |
| Enterprise architect          | 2511.6    |
| Green ICT consultant          | 2511.7    |
| ICT business analysis manager | 2511.8    |
| ICT business analyst          | 2511.9    |
| ICT consultant                | 2511.10   |



|                                   |         |
|-----------------------------------|---------|
| ICT intelligent systems designer  | 2511.11 |
| ICT research consultant           | 2511.12 |
| ICT system analyst                | 2511.13 |
| ICT system architect              | 2511.14 |
| ICT system developer              | 2511.15 |
| ICT system integration consultant | 2511.16 |
| Integration engineer              | 2511.17 |
| IT auditor                        | 2511.18 |
| User experience analyst           | 2511.19 |
| Cloud engineer                    | 2512.1  |
| Software analyst                  | 2512.2  |
| Software architect                | 2512.3  |
| Software developer                | 2512.4  |
| User interface developer          | 2512.5  |
| Digital games developer           | 2513.1  |

|   |        |
|---|--------|
| Search engine optimization expert             | 2513.2 |
| User interface designer                       | 2513.3 |
| Web content manager                           | 2513.4 |
| Web developer                                 | 2513.5 |
| ICT application configurator                  | 2514.1 |
| ICT application developer                     | 2514.2 |
| Industrial mobile devices software developer  | 2514.3 |
| Numerical tool and process control programmer | 2514.4 |
| Data quality specialist                       | 2519.1 |
| ICT auditor manager                           | 2519.2 |
| ICT change and configuration manager          | 2519.3 |
| ICT disaster recovery analyst                 | 2519.4 |
| ICT quality assurance manager                 | 2519.5 |
| ICT test analyst                              | 2519.6 |
| Software tester                               | 2519.7 |
| Database administrator                        | 2521.1 |
| Database designer                             | 2521.2 |
| Database developer                            | 2521.3 |
| Database integrator                           | 2521.4 |
| Data warehouse designer                       | 2521.5 |

|                                    |        |
|------------------------------------|--------|
| ICT system administrator           | 2522.1 |
| ICT capacity planner               | 2523.1 |
| ICT network architect              | 2523.2 |
| ICT network engineer               | 2523.3 |
| Chief ICT security officer         | 2529.1 |
| Digital forensics expert           | 2529.2 |
| Embedded systems security engineer | 2529.3 |
| Ethical hacker                     | 2529.4 |
| ICT resilience manager             | 2529.5 |
| ICT security administrator         | 2529.6 |
| ICT security engineer              | 2529.7 |
| ICT security manager               | 2529.8 |
| ICT knowledge engineer             | 2529.9 |

Source: ESCO

Because the EQF covers all types and all levels of qualifications, and the use of learning outcomes clearly shows what a person knows, understands and is able to do, it will be used as a reference within this Blueprint. A comparison between the training requirements related to the national qualification frameworks of the countries involved in the project for level 5 is presented in the following table:

Table no. 3: Comparison of training requirements

| Romania  | Germany  | Grecia  | Italy   | France   |
|--|--|---|---|--|
| Short cycle higher education certificate (Certificat de absolvire) - short cycle higher education post-graduate university studies<br>Post-secondary certificate and Descriptive supplement (Certificat de calificare) | IT specialist<br>Service technician<br>Advanced vocational training pursuant to § 54 of the Vocational Training Act (level 5)<br>Other advanced vocational training pursuant to the Vocational Training Act or Crafts and Trades | Vocational post-secondary school 'degree' for graduates of EPAL apprenticeship class, level 5 (post-secondary level)<br>Vocational training diploma (post-secondary level) (vocational training institute)<br>(IEK) Vocational training diploma | Higher technical education diploma - Diploma di tecnico superiore | Undergraduate technician certificate<br>Undergraduate technician certificates in agriculture<br>Undergraduate certificates in technology<br>Mastercraftsman qualifications |

| Romania   | Germany                   | Grecia   | Italy | France  |
|---|---------------------------|--|-------|---|
| si suplimentul descriptiv al certificatului) - post-secondary non-higher tertiary education | Regulation Code (level 5) | (post-secondary level) Post-secondary and not higher education diploma or 'degree' |       | Professional qualifications level 5<br>Other vocational qualifications level 5 "by law" |

Source: [https://europa.eu/europass/en/compare-qualifications?field\\_location\\_selection\\_target\\_id%5B6082%5D=6082](https://europa.eu/europass/en/compare-qualifications?field_location_selection_target_id%5B6082%5D=6082)

The learning outcomes for qualification level 5 are described in terms of knowledge, skills, responsibilities and autonomy in the following table.

Table no. 4 The learning outcomes for qualification level 5

|  | <b>Knowledge</b>   | <b>Skills</b>   | <b>Responsibility and autonomy</b>   |
|--|--|---|--|
| Level 5<br>The learning outcomes relevant to Level 5 are | Comprehensive, specialised, factual and theoretical knowledge within a field of work or study and an awareness of the boundaries of that knowledge | A comprehensive range of cognitive and practical skills required to develop creative solutions to abstract problems | Exercise management and supervision in contexts of work or study activities where there is unpredictable change; review and develop performance of self and others |

Source: EQF recommendation, 2017

## 5 THE MACHINA QUALIFICATION

Machine Learning (ML) is a subset of Artificial Intelligence (AI) that has gained substantial prominence in diverse economic & social realities, having become the basis for a series of technological developments such as automated translation systems, medical image analysis, and virtual assistants. ML was born from pattern recognition but has evolved to refer to the use of data & learning algorithms to produce models, predict outcomes and make decisions with minimum human intervention.

MACHINA developed a formal VET curriculum on Machine Learning for ICT professionals, to address current and emerging occupational needs, essentially improving the quality of sectoral formal and non-formal vocational training. The curriculum is referenced to the 5th EQF level and has a 2-semester duration. It comprises both theoretical & practical learning components, employing a modular structure to facilitate deployment in formal & informal C-VET environments. Each learning unit was designed to consist of a unique set of learning outcomes, defined in terms of knowledge, skills and competences, which can be assessed and validated in a consistent and coherent approach. Each unit will be also assigned with ECVET credit points to serve as a point of reference for a future, accredited qualification on Machine Learning for ICT professionals.

According to CEDEFOP VET means Education and training which aims to equip people with knowledge, know-how, skills and/or competencies required in particular occupation or more broadly on the labor market (Source: adapted from European Training Foundation, 1997).

This definition refers to both vocational education and adult education. In this sense, in order to integrate the Machine Learning program into the VET system, the structure developed within this project must be adapted to the specifics of each country, both for the VET system and for adult education. An essential element in the integration of Machine Learning is compliance with the developed program, with the requirements to ensure the quality of the training process. Integration also implies the adaptability of the program to the requirements of transferable credits.

The introduction of the present program in the VET system of each country first of all requires the integration of two essential elements:

- a. The training program
- b. The elements of quality assurance in education, training and certification of competences



## a. The MACHINA training program

The MACHINA course, consisting of six learning units, is described in this section below.

The learning units are:

- **LU1** ML essentials for ICT professionals,
- **LU2** Mathematical Foundations,
- **LU3** ML Algorithms, Programs and Protocols,
- **LU4** Deep Learning Advances,
- **LU5** Communicating the merits, challenges and implications of Machine Learning technology,
- **LU6** Legislation, Ethics, Project Management related to Machine Learning

Each learning unit is composed of several lessons and each lesson includes 2 or more learning outcomes.

| Learning Units                         | Lessons  | Duration         |
|--|--|------------------|
| ML essentials for ICT professionals    | Lesson 1: Introduction to ML   | Total: 80 hours  |
|  | Lesson 2: Where to apply ML  |                  |
|  | Lesson 3: Machine Learning and Data processing                                 |                  |
|  | Lesson 4: Example ML applications  |                  |
| Mathematical Foundations               | Lesson 1: Set, Functions, Relations  | Total: 80 hours  |
|  | Lesson 2: Linear Algebra   |                  |
|  | Lesson 3: Probability Theory   |                  |
|  | Lesson 4: Statistics   |                  |
|  | Lesson 5: Computation theory   |                  |
| ML Algorithms, Programs, and Protocols | Lesson 1: Machine Learning by linear models                                    | Total: 100 hours |
|  | Lesson 2: Supervised learning  |                  |
|  | Lesson 3: Unsupervised learning  |                  |
|  | Lesson 4: Semi-supervised learning   |                  |
|  | Lesson 5: Programming languages and frameworks for Machine Learning algorithms |                  |
|  | Lesson 6: Best practices for ML  |                  |
| Deep Learning (Advanced)               | Lesson 1: Multilayer Perception (MLP)  | Total: 80 hours  |
|  | Lesson 2: Convolutional Neural Networks (CNN)                                  |                  |
|  | Lesson 3: Recurrent Neural Networks (RNN)                                      |                  |
|  | Lesson 4: Autoencoders (AE), Restricted Boltzmann Machines (RBM)               |                  |

| Learning Units   | Lessons  | Duration        |
|--|--|-----------------|
| Communicating the merits, challenges, and implications of Machine Learning technology to customers and within own organization | Lesson 1: Introduction to communication and ML involvement   | Total: 83 hours |
|  | Lesson 2: Types, levels, components of effective communication and ways for using Machine Learning in Communications |                 |
|  | Lesson 3: The future of communication in accordance with artificial intelligence                                     |                 |
|  | Lesson 4: The effects of artificial intelligence in communication  |                 |
| Legislation, Ethics, Project Management related to ML  | Lesson 1: EU guidelines on ethics in artificial intelligence   | Total: 83 hours |
|  | Lesson 2: Data Value/Costs Model   |                 |
|  | Lesson 3: Bias in Machine Learning   |                 |
|  | Lesson 4: Software engineering for AI applications   |                 |

The curriculum is referred to the 5th EQF level and has a duration of 2 semesters. It comprises both theoretical and practical learning components, using a modular structure to facilitate implementation in formal and informal C-VET settings. The implementation mode of the program in each country will be realized taking into account the specificities of the national VET systems. There is also the possibility of developing qualification programs based on the Machine Learning structure for level 6.

#### **b. The elements of quality assurance in education, training and certification of competences**

The training program must comply with quality assurance requirements both from the point of view of professional training and from the point of view of certification of competences. Thus, the training providers must have clear procedures with the help of which they can implement the training program in good conditions. Competence evaluation in which the participants participate at the end of the professional training program must be impartial and ensure the confidence of the participants both in the training program and in the evaluation of competencies.

Quality assurance in education and competence assessment must be oriented towards the development of systems that can generate confidence in the process.

A training and competency assessment provider must comply with quality assurance requirements in accordance with international standards (ISO 9001:2015 “Quality management systems — Requirements” and ISO/IEC 17024:2012: Conformity assessment — General requirements for bodies operating certification of persons).

Quality management in education and vocational training focuses, in particular, on organization, learning infrastructure, training and teaching, and the process of learning itself. The organizations that carry out the certification of competences upon completion of a training program must comply with the quality requirements regarding the impartiality and correctness of the evaluation process. The organization must implement procedures to ensure the functionality of the system. Can implement procedures regarding document control, record control, corrective action, preventive action, non-compliant process control and internal audit. Also, for the training process, the organization must have operational procedures that describe how this process is carried out. For the competency certification activity, the organization must develop operational procedures to ensure the impartiality and correctness of the competency certification process.

## 6 GUIDELINES ON EMBEDDING ML SKILLS EVIDENCE INTO THE EU SKILLS PANORAMA

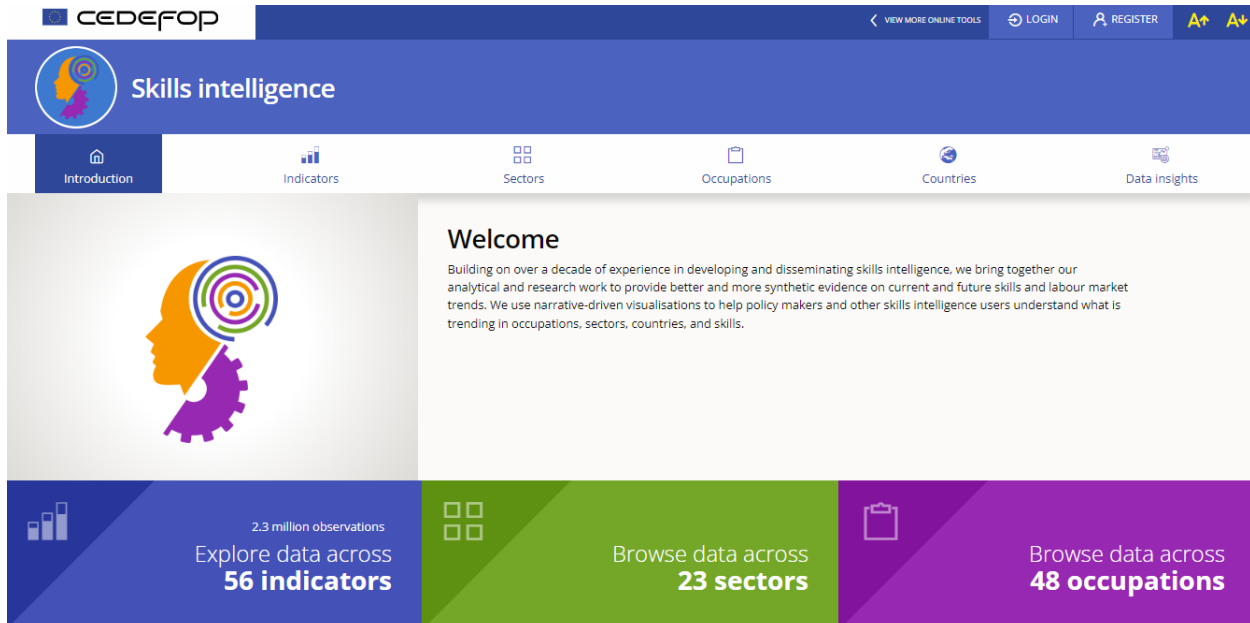
The MACHINA partnership seeks to integrate ML skills evidence into the “Skill Intelligence” Platform to achieve the following results/impact:

- Improve ML skills intelligence and document prevailing skills mismatches at the EU level.
- Contribute to the formulation of EU-wide ML occupational & educational requirements, building mutual trust and facilitating cross-border certification & professional mobility in the sector.
- Provide an informed basis for the formulation of an EU AI/ML Skills Strategy for tackling skill mismatches.
- Support the roll-out of national sectoral skills development strategies in the AI/ML field.
- Increase project’s visibility and expand sectoral collaboration through synergies with thematically-relevant initiatives.
- Push for standardized solutions and inclusive governance schemes to govern and monitor skills evolution in the sector.
- Help to achieve better match between workforce skills and labour market needs.
- Help to increase the relevance of E&T provision with labour market needs.

### 6.1 The EU skills Panorama

The EU Skills Panorama, launched in 2015 by CEDEFOP, was an interactive web portal offering skills intelligence on countries, occupations and sectors in the EU. It was designed to offer an evidence-based tool for institutional actors (policy-makers, learning providers, career counsellors, and practitioners) to monitor the evolution of skills and increase their capacity to adapt education and training systems to labour market needs and take actions to better match skill supply and demand. In terms of content, the EU Skills Panorama, drawing on evidence at EU and Member State level, provided both qualitative and quantitative information on a) skill needs, supply and mismatches, b) occupations and emerging sectors, c) current and anticipated macro-economic developments, and d) future skill trends. The portal contained information grouped by sector, profession and country to help policymakers keep up with the latest developments and make informed decisions on education, training, jobs and labour market issues.

The EU Skills Panorama, after 6 years of operation as a standalone portal, was replaced in 2021 by the “Skills Intelligence” section of the updated CEDEFOP web portal. The new “Skills Intelligence” portal ([www.cedefop.europa.eu/en/tools/skills-intelligence](http://www.cedefop.europa.eu/en/tools/skills-intelligence)) integrates content from the Panorama and other skills-related initiatives to provide more synthetic evidence on skills and labour market trends, with the mission to act as a single entry point to skills information and intelligence in the EU. In this new scheme, data-centred insights on occupations, sectors, and countries are closely interlinked with macro-level developments and EU policy prioritisation, with a particular focus on digitalization, green transition, matching of skills and jobs, and learning in work and other areas. Data is organised around indicators, sectors, occupations and countries.



The screenshot shows the CEDEFOP Skills Intelligence portal homepage. At the top, there is a navigation bar with the CEDEFOP logo, a search bar, and links for 'VIEW MORE ONLINE TOOLS', 'LOGIN', and 'REGISTER'. Below the navigation bar is a main header with the 'Skills intelligence' title and a circular icon. A secondary navigation bar contains icons for 'Introduction', 'Indicators', 'Sectors', 'Occupations', 'Countries', and 'Data Insights'. The main content area features a large graphic of a human head profile with gears and a target symbol, followed by a 'Welcome' message. The message states: 'Building on over a decade of experience in developing and disseminating skills intelligence, we bring together our analytical and research work to provide better and more synthetic evidence on current and future skills and labour market trends. We use narrative-driven visualisations to help policy makers and other skills intelligence users understand what is trending in occupations, sectors, countries, and skills.' At the bottom, there are three colored boxes: a blue box with '2.3 million observations' and 'Explore data across 56 indicators'; a green box with 'Browse data across 23 sectors'; and a purple box with 'Browse data across 48 occupations'.

## 6.2 Integration potential

The following results from the MACHINA project could be published and integrated into the new “Skills Intelligence” portal (previously the EU Skills Panorama) administered by CEDEFOP.

1. Machine Learning could be included as a standalone, distinct **sector** within the current list with industries, representing the companies with primary activity the development and provision of ML services. The sector’s dashboard will contain information about employment structure, occupational profiles, workforce characteristics, sectoral developments and mega trends, and evolution in jobs and skill, depending on the availability of relevant data.

2. ML professionals could be also added as a new **occupation** into the platform's current list with occupations (link). This occupation will represent ML jobs with similar tasks and duties as well as qualification and skills requirements. The occupation's dashboard will contain a description as well as key facts and indicators relevant to ML professionals, such as total employment and workforce characteristics, future job prospects, employment by sector and field/level of education, depending on the availability of relevant data.

3. **Data insights from the ML field**, as gathered during the project's labour market and skills intelligence activities. The partnership conducted a comprehensive needs analysis to define ML skills requirements and mismatches. Skills intelligence was collected via a) research on online job vacancies and ML use cases, b) consultation (survey) with ICT employers & field experts on skills requirements & workplace realities, and c) the analysis of existing ML related training offerings. The partnership managed to gather 154 questionnaires, 59 ML related job descriptions, 55 training offerings, 28 ML use cases, 15 cases of relevant articles and studies and 14 ML relevant EU projects. The results obtained from the market analysis were sufficient to demarcate the ML field sector from the wider ICT industry, understand ML workforce characteristics, assess the effectiveness of existing education and decipher the main ML workplace requirements. They also showed the action priorities at policy level for addressing the prevalent shortages and mismatches in the EU labour market. Finally, the report "O1-T4: Definition of MACHINA learning outcomes based on training needs analysis" summarising the main findings from research activities can be used as the main information source, as well as the 5 online registries published by the partnership with ML labour market evidence.

### 6.3 Integration process

In July 2022, CEDEFOP announced its intent to integrate sectoral skills information stemming from EU-funded projects into the platform. This foresees the publication of a catalogue with EU projects working on identifying sectoral skill needs. CEDEFOP's aim is to allow interested parties to retrieve skills-related information as drawn from project activities, and gain direct access to project websites and resources, increasing at the same time projects' visibility to a wider audience. Each project will be linked to a specific sector, and its evidence will complement existing skills intelligence and databases where available. The process for a project to publish its results on CEDEFOP comprises the following steps:

- Step 1. Expression of interest to CEDEFOP



- Step 2. Initial confirmation from CEDEFOP and formal initiation of the publication procedures.
- Step 3. Introductory meeting with the CEDEFOP Team to discuss input requirements.
- Step 4. Preparation of a “project fiche” briefly presenting the scope and objectives of the project as well as the produced results. A template is provided by CEDEFOP.
- Step 5. Review of the project fiche by the CEDEFOP Team, and feedback provision.
- Step 6. Revision of the “project fiche” based on CEDEFOP comments.
- Step 7. Approval of the project by the CEDEFOP Team.
- Step 8. Appointment of a project delegate to act as the main contact person with CEDEFOP.
- Step 9. Update of the project website with all the latest deliverables and results.
- Step 10. Ratification of a Cooperation Agreement between CEDEFOP and the partnership.
- Step 11. Publication of the project on the “Skills Intelligence” portal.

## 6.4 Input requirements

Each project should complete a project fiche, outlining project details and presenting the main findings from skills intelligence gathering activities. The project fiche requires the following information:

- Title
- Status (ongoing / completed)
- Start and end dates
- Sector
- Abstract
- Scope of the project
- Objectives
- Short description, containing a “Read more on the project’s dedicated website” (max. 500 words)
- Key findings
- Downloads / links to key outcomes/reports

### Completion instructions

- (1) The project fiche should be written in English and its length should not exceed 2-3 pages. The aim is to provide a comprehensive overview of the project and its findings but not to cover every type of results. Project representatives should be succinct in their descriptions.
- (2) The project fiche should describe the key findings from skills intelligence activities, as well as the methodology approach employed by the partnership. It is also highly recommended to discuss any skills development strategies launched by the project. Information on WP structure, deliverables, project deadlines, any project management detail is considered irrelevant.
- (3) The project fiche should include the results already produced and the ones expected; if deemed necessary, graphs and infographics can be included.
- (4) Project representatives should have in mind that readers may not be knowledgeable about project work or even the sector in terms of skill needs and requirements. Technical terms shall be avoided.

## 6.5 Indicative project fiche for the MACHINA PROJECT

|                      |   |
|----------------------|---|
| <b>Title</b>         | MACHINA – Machine Learning Skills for ICT professionals   |
| <b>Status</b>        | Ongoing   |
| <b>Duration</b>      | September 2020 – December 2022  |
| <b>Sector</b>        | ICT   |
| <b>Member States</b> | France, Germany, Italy, Greece, Romania   |
| <b>Abstract</b>      | MACHINA seeks to tackle the ML skill deficit in the EU labour market by increasing the relevance of Continuing & Initial VET provision in the ICT sector, to assure that the existing & future ICT workforce will have the ML specific competences & transversal skills required to respond to modern workplace requirements and succeed in a competitive, fast-growing field. The project will also make available transnational educational materials in the form of OERs, to ensure wide adoption and support VET provision in a cost-effective, flexible way. |
| <b>Scope</b>         | The project forms a Strategic Partnership to strengthen key ML competences in VET provision for ICT workers, and address existing occupational skills needs & mismatches.   |



|                                 |  |
|---------------------------------|--|
| <p><b>Objectives</b></p>        | <ol style="list-style-type: none"> <li>1. Design a joint VET curriculum for ML, to empower ICT workers with sought-after technical, non-technical, meta (soft) skills.</li> <li>2. Introduce flexible, innovative training delivery methods and open access pedagogical resources to support VET provision and ML skills acquisition.</li> <li>3. Foster the recognition and integration of ML skills requirements into sectoral competence frameworks &amp; certification schemes.</li> <li>4. Improve ML labour market &amp; skills intelligence at the EU level.</li> </ol>   |
| <p><b>Short description</b></p> | <p>Machine Learning (ML) – a subset of Artificial Intelligence behind a series of important technological breakthroughs (automated translation systems, medical image analysis, virtual assistants) – is profoundly transforming “traditional” business models &amp; processes across sectors, by optimising the processing of massive data volumes and automating core tasks. The fast-paced expansion of ML uses, especially in data-driven industries (financial services, health care, retail), is rapidly pushing forward the demand for skilled ICT workers in the EU. Whereas the demand for ML skills is steadily growing, employers are facing a shortfall of suitable candidates, which is leaving thousands of positions unfilled (an estimated 769,000), threatening productivity, efficiency &amp; future growth. Besides this rapidly increasing demand, the prevalent mismatch can also be attributed to formal education and training providers’ slow and fragmented responsiveness to new workplace developments, especially when those are cutting-edge. The strengthening of both initial and continuous VET provision in the field is therefore essential so that the European ICT workforce can acquire and develop the mix of ML technical (data modelling, software engineering), non-technical (governance, business management) and meta (sense of initiative and entrepreneurship) skills required to deliver and support the uptake of tailor-made ML enabled solutions in the market.</p> <p>Read more on the project’s dedicated website: <a href="https://machina.univ-lyon1.fr/">https://machina.univ-lyon1.fr/</a></p> |
| <p><b>Key Findings</b></p>      | <p><b>MACHINE LEARNING (ML) SKILLS INTELLIGENCE</b></p> <p>The project implemented a comprehensive needs analysis, first time employed for the ML field. This comprised a mix of research activities and wide consultation with EU/national sector representatives to define ML skills</p>   |

requirements and mismatches. Skills intelligence gathering activities included i) research on online job vacancies (59 ML related job descriptions) and ML use cases (28 ML use cases), ii) consultation (survey) with ICT employers & field experts on skills requirements & workplace realities (154 questionnaires), and, iii) analysis of existing ML related training offerings (55 training offerings). The above labour market analysis led to the:

- Definition of ML workforce characteristics by age, gender, educational background, working experience, industry, employment status, type of contract, level of wage.
- Analysis of the ML educational landscape, and creation of a centralized database with available training offerings in partnership countries.
- Definition of skill requirements (divided into technical, business and transversal) and training priorities for ML roles.

### **VET CURRICULUM ON MACHINE LEARNING**

The partnership produced a comprehensive curriculum on ML to empower ICT workers with sought-after technical, non-technical, meta (soft) skills, needed for ML applications. The MACHINA VET curriculum, referenced to the 5th EQF level, is organised around 6 learning units, which are further broken down into 27 lessons. Its total duration is estimated to 509 hours.

Learning Unit 1: ML essentials for ICT professionals

Learning Unit 2: Mathematical Foundations

Learning Unit 3: ML Algorithms, Programs and Protocols

Learning Unit 4: Deep Learning (Advanced)

Learning Unit 5: Communication

Learning Unit 6: Legislation, Ethics, Project Management related to ML

To support the delivery of the MACHINA curriculum (O2-T2), the partnership created a package of prototype learning materials in ML in 6 EU languages (EN, FR, DE, IT, GR, RO), which includes:

- 122 pages of lecture notes
- 371 presentation slides
- 76 Questions & Answers



|                         |   |
|-------------------------|---|
|                         | <ul style="list-style-type: none"> <li>• 12 case studies</li> <li>• 13 practical exercises</li> <li>• 84 Multiple choice questions</li> </ul> <p><b>OTHER RESULTS</b></p> <ul style="list-style-type: none"> <li>• A Massive Open Online Course (MOOC) in 6 EU languages to act as a wide access delivery method for the MACHINA VET curriculum.</li> <li>• A complete guide for ICT trainers on how to deliver the MACHINA curriculum in formal and non-formal settings.</li> <li>• Guidelines on the introduction and integration of the developed MACHINA learning units into existing training courses for ICT Professionals.</li> <li>• Outline of an EU-wide VET qualification in ML for ICT workers</li> </ul> |
| <p><b>Downloads</b></p> | <ul style="list-style-type: none"> <li>• <a href="#"><u>REGISTRY OF MACHINE LEARNING ONLINE JOB VACANCIES</u></a></li> <li>• <a href="#"><u>REGISTRY OF MACHINE LEARNING EDUCATIONAL AND TRAINING OFFERINGS</u></a></li> <li>• <a href="#"><u>REGISTRY OF MACHINE LEARNING PRACTICAL APPLICATIONS</u></a></li> <li>• <a href="#"><u>REPORT ON MACHINE LEARNING (ML) SKILLS REQUIREMENTS AND LEARNING OUTCOMES</u></a></li> <li>• <a href="#"><u>REPORT WITH MACHINA CURRICULUM STRUCTURE</u></a></li> <li>• <a href="#"><u>MACHINA ONLINE COURSE</u></a></li> </ul>   |

## 6.6 Action plan

The partnership has already put in place an action plan for the integration of ML skills evidence into the “Skills Intelligence” platform with the partnership officially expressing its interest, and initiating communications with CEDEFOP representatives. The current plan extends beyond the project lifecycle and relies on partners’ discretion and collaborative attitude to implement the following steps. The schedule is subject to change, as strictly linked to the progression of CEDEFOP portal developments.

| Action   | When  | Who         | Status      |
|--|-------|-------------|-------------|
| 1. Expression of interest to CEDEFOP   | 09/22 | EXELIA      | Completed*  |
| 2. Iterate interest to integrate project results into the “Skills Intelligence” Platform | 01/23 | EXELIA      | Not started |
| 3. Introductory meeting with the CEDEFOP Team to discuss input                           | 02/23 | UCBL/EXELIA | Not started |
| 4. Delivery of the project fiche   | 03/23 | UCBL/EXELIA | Not started |
| 5. Revision of the “project fiche” based on CEDEFOP comments                             | 04/23 | UCBL/EXELIA | Not started |
| 6. Appointment of a project delegate to act as the main contact person with CEDEFOP      | 04/23 | UCBL        | Not started |
| 7. Update of the project website with all the latest deliverables and results.           | 04/23 | L3S         | Not started |
| 8. Formulation of a Cooperation Agreement between CEDEFOP and MACHINA                    | 05/23 | UCBL        | Not started |
| 9. Publication of the project on the “Skills Intelligence” portal                        | 06/23 | CEDEFOP     | Not started |

\*An email was sent by EXELIA on 12 September 2022 expressing the partnership’s interest to integrate project results into the “Skills Intelligence” Platform. Stelina Chatzichristou from CEDEFOP replied “*Thank you for your overall interest in enriching CEDEFOP’s web portal with information on an additional project. MACHINA sounds indeed interesting. As we are currently undertaking the initial steps of putting online information/fiches for the Blueprint projects, please allow me to come back to you on including other projects after the launch of the new webpage.*”

CEDEFOP contact Person (1): Stelina CHATZICHRISTOU, [stelina.chatzichristou@cedefop.europa.eu](mailto:stelina.chatzichristou@cedefop.europa.eu)  
CEDEFOP contact Person (2): Christina CARKANTI, [christina.karkanti@cedefop.europa.eu](mailto:christina.karkanti@cedefop.europa.eu)

## 7 AN OVERVIEW OF VET SYSTEMS AND ACCREDITATION ARRANGEMENTS IN PARTNERSHIP COUNTRIES

### 7.1 Romania

According to CEDEFOP, Romania ranks 30th in skills development. It reaches the bottom of the rank for "high digital skills" and is third to last in "recent training" and "reading, maths & science scores (aged 15)". The best ranking achieved is 11th in "VET students", while it ranks lower than 20th for the other indicators in this pillar. Romania ranks 28th in skills activation, where it ranks between 26th and 28th position for all indicators in 2022, except for "recent graduates in employment", where it ranks 24th.

Vocational Education and Training (VET) – in Romania VET is covering both initial and continuing training. Initial vocational education and training, part of the national education system of the Ministry of Education, is provided through technological high school, technical and vocational education and training programmes with the duration of 3 years, practical stages after the X grade of high school.

Qualifications provided through the initial system of VET from the MESR are described through training standards. The training standard is specific for initial VET provided by the MESR and is the document, which specifies the units of learning outcomes (knowledge, skills, and competences) of a qualification covering one or more occupations.

Initial VET is also ensured through apprenticeship programmes, regulated by the Ministry of Labour. Continuing VET in Romania is covering vocational programs organized by the authorised training providers in accordance with the regulatory framework for adult learning, comprising programs for achieving a qualification and programs for specialisation in a particular area.

- Initial Technical and professional education is referenced at levels 2 and 3 of the ROQF.
- Continuous vocational training is referenced at levels 2-4 of the ROQF.
- Post-secondary non-tertiary education is referenced at level 5 of the ROQF.

In order to introduce the ML qualification in Romania, the related occupation must first be introduced in the Classification of Occupations in Romania and then an occupational standard must be developed.

A VET training provider to be able to deliver this training program must prove that:

- is legally constituted

- has in the constitutive act the codes related to education and training from the Classification of Activities in the National Economy - CAEN
- has the equipment necessary to implement the professional training program
- has developed procedures regarding the realization of the professional training activity
- has developed procedures regarding the performance of competence certification activities in conditions of impartiality and avoiding conflict of interests.

In this sense, the ML training program must be integrated into the authorization requirements of the VET system in Romania.

## 7.2 France

France currently has an NQF based on a five-level structure with a strong labour market focus as it does not include general education. It covers vocationally and professionally oriented qualifications, including all higher education qualifications with a vocational and professional orientation and purpose. It was established in 2002 when the national commission on vocational qualifications (Commission Nationale des Certifications Professionnelles: CNCP) and the national register of vocational qualifications (Répertoire National des Certifications Professionnelles: RNCP) were set up. Three main types of qualification are included in the RNCP:

- Qualifications awarded by the French ministries in consultation with the social partners
- Qualifications awarded by training providers, chambers and ministries but where no consultative committee is in place
- Qualifications awarded by social partners under their own responsibility

Initial vocational education and training is offered from upper secondary to tertiary education. After IVET, continuous VET (CVET) provides young people and adults with qualifications for the labour market. In initial education, each pathway prepares students for an exam to obtain a qualification. There are around 18 000 general and vocational education qualifications covered by the framework among which two thirds are awarded by public authorities and one third by training providers, chambers and social partners. The objectives of the French NQF are mainly focused on employability and all qualifications registered can be acquired through validation.

**Table 1: French Qualification type and EQF equivalence**

| French nomenclature |                 | Qualification types   | EQF level |
|---------------------|-----------------|---|-----------|
| <b>I-</b>           | <b>Doctorat</b> | Doctoral programmes   | 8         |
| <b>I-</b>           | <b>Master</b>   | Master degrees<br>Degrees in engineering<br>Qualifications on demand level 1  | 7         |
| <b>II-</b>          | <b>Licence</b>  | Bachelor programmes<br>Vocational bachelor<br>Qualifications on demand level 2  | 6         |
| <b>III</b>          |                 | Undergraduate technician certificates<br>Undergraduate certificates in technology<br>Master qualifications issued by the chambers of trades<br>Qualifications on demand level 3 | 5         |
| <b>IV</b>           |                 | Vocational baccalaureates<br>Technological baccalaureates<br>Professional certificates<br>Technician certificates<br>Qualifications on demand level 4                           | 4         |
| <b>V</b>            |                 | Secondary vocational certificates<br>Qualifications on demand level 5   | 3         |
|                     |                 | No French qualifications and certificates at these levels   | 2 & 1     |

The **EQF level 4 certification** (a three-year course called “BAC professionnel”) includes general education classes such as vocational and technical classes, as well as internships in companies (the legal number of weeks is 22 during the course). There are two options for learners; they can either attend a two-year or a three-year vocational course. By completing the two-year course, students obtain a vocational certificate, which may not allow them to pass to higher education. The three-year training course enables graduates to pursue university studies (in 2010 this category corresponded

to approximately 37% of total number of students). Learners may also enter a two-year dual learning program, which is supervised by National Education and professionals at apprenticeship school (CFA) and leads to a vocational qualification (EQF Level 3/4).

Regarding **EQF level 5 vocational certifications** (mostly 2-year courses), the following types of programmes exist:

- Undergraduate technician certificates delivered by National Education. This programme is provided by High schools.
- Undergraduate certificates in technology delivered by National Education and courses provided by Technology Institutes or university departments.

### 7.3 Germany

According to CEDEFOP, Germany ranks 10th in skills development where it attains good performance in “pre-primary pupil-to-teacher ratio” and “high digital skills” scores (ranks 5th and 9th respectively), but a performance below the average in “VET students” (ranks 16th).

Germany is characterized by fairly good activity rates (ranks 10th for both the 20-24 and 25-54 cohorts) and a polarised transition to work, with the second-highest share of “recent graduates in employment” but low performance in “early leavers from training” (rank 22nd).

Vocational Education and Training (VET) - Upper secondary VET in Germany VET is covering Upper secondary VET, Tertiary VET, Continuing VET. Apprenticeship programmes (dual system) are the pillar of upper secondary VET. They are mostly offered at EQF level 4 and cover 325 occupations. Programmes usually last 3 years and combine two learning venues, companies and vocational schools: the work-based learning share is approximately 75%. Enterprises bear the costs of company-based training and pay learner remuneration. Those passing the final examination carried out by the chambers are qualified as certified skilled professionals.

In parallel, upper secondary VET programmes are offered in vocational schools at EQF levels 2 to 4. These include: school-based VET programmes, duration 1 to 3 years, leading e.g. to a qualification in the health sector such as a nurse; general education programmes with vocational orientation, duration 2 to 3 years, leading to the general higher education entrance qualification.

Young people with learning difficulties, handicap or insufficient German language skills have the possibility to attend different transition programmes. At post-secondary level, specialised programmes are offered at EQF levels 4 to 5, lasting 1 to 3 years and leading to entrance qualifications for universities.



At tertiary level, those with vocational qualifications and professional experience can acquire advanced vocational qualifications at EQF levels 5 to 7. At EQF level 6 (bachelor professional, e.g. Meister) the qualifications entitle graduates to exercise a trade, to hire and train apprentices, and to enrol in academic bachelor programmes. Graduates can continue at EQF level 7 (master professional). These qualifications support the acquisition of middle and top management positions in companies. Preparation courses are offered by chambers or schools. Advanced vocational programmes are offered at EQF 6, lasting 1.5 to 4 years. Entrance requirements include specific vocational qualification and work experience. They lead to an advanced qualification (such as technician, educator) and give access to the relevant field of study. Dual study programmes are offered at EQF levels 6 to 7 by different higher education institutions. They provide a blend of academic and vocational training, in which in-company training is an important element (share of at least 40 to 50%). Enterprises bear the costs of company-based training and pay learners a wage. Continuing training is playing an increasingly important role in improving employability by upskilling and reskilling in line with the digital and ecological transition. It is characterised by a wide variety of training providers and a low degree of State regulation. State incentives are in place to increase participation in CVET.

## 7.4 Greece

### *An overview of the Greek VET system*

According to CEDEFOP, VET education in Greece is offered as soon as the compulsory education cycle (primary and lower secondary) up to the age of 15 is completed. It consists of a variety of different offers, in both the upper secondary and post-secondary education. It combines school-based and work-based learning to achieve both theoretical and practical results.

Following the completion of compulsory education, pupils are given a choice between general education (General High Schools - GEL) and VET (Professional High Schools- EPAL) provided in different types of institutions though following the completion of a full year in each of the two, it is possible to switch to the other. The completion of either one of the two education routes lead to an EQF level 4 qualification.

On the other hand, pupils following the completion of their compulsory education cycle up to the age of 23, can also join vocational schools (EPAS) that fall under the control of the “Public Employment Service” (DYPA) and provide apprenticeship learning with the goal of providing students with market-required skills. The completion of the 2 year-long programmes offered in these institutions leads to an EQF level 3 qualification.

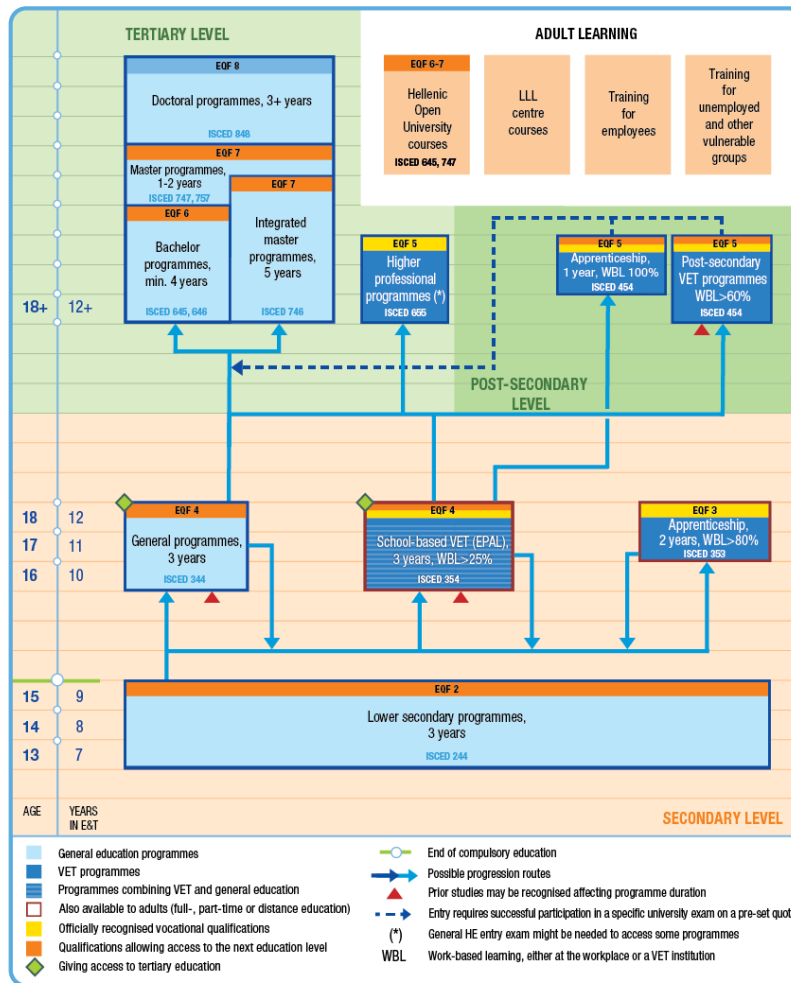
Following the completion of secondary education, students may follow two routes towards VET:

- 1-year apprenticeship programmes offered by EPAL schools in cooperation with the Public Employment Service (DYPA). These programmes are offered only to those who hold a lower secondary school leaving certificate and provide an EQF level 5 qualification;
- 2.5-year VET programmes offered by public and private vocational training institutes (IEK) to upper secondary graduates. These programmes only allow learners to obtain an attestation of completion;
- In addition, 2- to 4-year programmes are offered by higher professional schools, under the supervision of the competent ministry. Students are admitted either through general national exams or a programme-specific test decided upon by the VET-provider. The certificates awarded upon completion are equivalent to an EQF level 5 qualification, as with merchant navy academies, dance and theatre schools.

#### Main characteristics of the Greek VET system

Greece has an educational culture that greatly favours general education. Students seeking to integrate to VET may do so at the upper secondary level in the EPAL programmes. Reforms in the last decade have endorsed apprenticeship and work-based learning in IVET to enable smooth transition from education to work and contribute in reducing youth unemployment and the share of NEETs. Companies provide apprenticeships in accordance with the training regulations, developed by the education ministry with the contribution of social partners.

According to the most recent data provided by the Greek government to CEDEFOP, the total number of learners enrolled in post-secondary non-tertiary vocational education increased from 15 852 in 2014 to 82 860 in 2018. Participation in adult education and training remained stable during the previous decade (3.9% in 2019), well below the EU-28 average (10.8%). The share of young people neither in employment nor in education and training (15 to 24 years old) has been constantly falling from 20.4% in 2013 to 12.5% in 2019.



NB: ISCED-P 2011.  
Source: Cedefop and ReferNet Greece, 2022.

Vocational education and training system in Greece, Source: <https://www.cedefop.europa.eu/en/tools/vet-in-europe/systems/greece-u2>

### Incentives to join VET in Greece

The apprenticeship programmes (offered by upper secondary vocational schools, EPAL) give graduates the opportunity to upgrade their education qualifications and obtain work experience.

The main incentives used by the State to increase VET participation, include:

- EPAL graduates have access to universities, tertiary education schools and military schools regardless of their graduation field, by sitting the same examinations as general education graduates;
- Students in any VET education level have access to all education levels and may enrol to any other education level of their choice upon completion of their programme.



- The possibility for EPAL graduates to participate in a 1 year-apprenticeship. This apprenticeship programme strengthens VET attractiveness by upskilling apprentices. During said apprenticeship, participants receive a salary of 75% of the legal minimum wage and full insurance coverage.

The Lifelong learning law (Law 3879/2010) covering continuing VET provision also foresees incentives for updating the knowledge, skills and competence of the labour force (Article 18). These may include:

- Granting education leave for participation in lifelong learning programmes, especially for workers in the private sector;
- Setting up personal education accounts, with contributions from the employer and the employee (and possibly the State) to cover the worker's training needs;
- Establishing personal learning time accounts to let workers take part in continuous training programmes.

#### *MACHINA qualification accreditation*

In order to introduce the ML qualification in Greece, the related occupation must first be introduced in the Classification of Occupations and then an occupational standard must be developed.

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