

European Software
Skills Alliance.

How to design Software Professionals Curricula

FROM ESSA SOFTWARE SKILLS STRATEGY TO EDUCATIONAL
PROFILES TO EXAMPLE CURRICULA.

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About ESSA

The European Software Skills Alliance (ESSA) is a four-year transnational project funded under the EU's Erasmus+ programme. It ensures the skills needs of the rapidly evolving Software sector can be met — today and tomorrow.

ESSA provides current and future software professionals, learning providers and organisations with software needs with the educational and training instruments they need to meet the demand for software skills in Europe.

ESSA will develop a European Software Skills Strategy and learning programmes for Europe. It will address skill mismatches and shortages by analysing the sector in depth and delivering future-proof curricula and mobility solutions; tailored to the European software sector's reality and needs.

Project partners

The ESSA consortium is led by DIGITALEUROPE. It is composed of academic and non-academic partners from the education, training, and software sectors.

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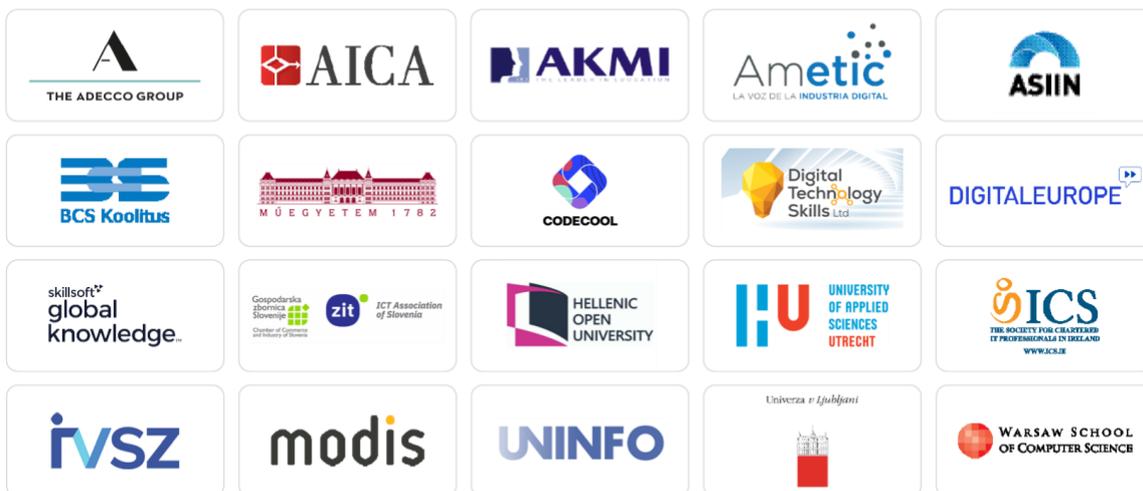


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List of abbreviations and acronyms

Abbreviation	Term
CEDEFOP	Centre Européen pour le Développement de la Formation Professionnelle
CEN	Comité Européen de Normalisation
CEN/CWA 16458-1	CEN Workshop Agreement 16458-1 European ICT Professionals Role Profiles – Part 1: 30 ICT Profiles
CPD	Continuous Professional Development
e-CF, EN 16234-1	European e-Competence Framework, European Norm 16234 - Part 1: Framework
ECTS	European Credit Transfer and Accumulation System
EQF	European Qualifications Framework
ESCO	European Skills, Competences, Qualifications and Occupations
ESSA	European Software Skills Alliance
EU	European Union
ICT	Information and Communication Technology
ICT BoK	ICT Foundational Body of Knowledge
LLL	Lifelong Learning
LO	Learning Outcome
PLO	Programme Learning Outcome
VET	Vocational Education and Training
WP	Work Package

1 Executive Summary

1.1 Introduction

This report “Software Professionals Curricula Design” is a deliverable related to the project’s Work Package 3. It translates the ESSA role profiles, namely Developer, DevOps expert, Solution designer, Test specialist, and Technical (software) specialist (as defined in the [ESSA Software Skills Strategy for Europe](#)), into [educational profiles](#) which result in curricula equipping people with the skills and competences needed in those roles.

1.2 Objective

The objective of this document is to describe **how the ESSA role profiles and ESSA Software Skills Strategy lead to effective skilling, upskilling, and reskilling curricula**. The definition of educational profiles ensures comparability of curricula designed based on these profiles and the ESSA principles, which support mobility.

1.3 Approach

This document reflects the process of developing the educational profiles and how to design example curricula. The first step in that process is to formulate learning outcomes based on the ESSA role profiles. This was done in an iterative process with experts of partners. After this, the rest of the educational profiles, including the descriptions, assessments, etc., were developed in a similar iterative process with partners.

The educational profiles approved by the partnership are the input for the design of example curricula. The first step in that design is to ensure that a proposed example curriculum covers the learning outcomes of the educational profile, which was done again in an iterative process with partners. Each partner matched one or two potential curricula with an educational profile and based on that, designed a first tentative example curriculum. The drafts were discussed, and the feedback was processed, which led to agreeing on further developing the example curricula for piloting in 2023.

1.4 Results

The development of the educational profiles resulted in **nine educational profiles covering the five ESSA roles** defined in the ESSA Software Skills Strategy on relevant **EQF levels ranging from 4/5 to 7**.

Defined are profiles for developers on three levels (junior EQF 4/5, EQF 6 and senior EQF 7), profiles for DevOps experts and solution designers (both on EQF 6 and EQ7 level) and two profiles exclusively on EQF 4/5 level: test specialist and technical (software) specialist.

There are twelve **example curricula** under development. All are designed by **matching the learning units and the learning outcomes** of the corresponding educational profile. The description of each curriculum will contain general information, for example, the goal, target group, and the learning outcomes covered. Besides this, it will also contain a description of the structure of the curriculum and an overview and details of the learning

units including the assessments. **Some profiles will be covered by more than one example curriculum** to show how a different educational approach, local situation, or target group can lead to a different curriculum, but still, cover the same learning outcomes. Thus, equipping a software professional with the same competences. The example curricula will be further specified and finetuned in WP4 in an iterative process that will e.g., involve developing learning materials and detailing the assessments. It is also possible to add other curricula following the procedure and template that are described in this document.

Besides curricula that are specific to a certain situation, there are **common parts of the curricula** identified that will be relevant in (almost) every situation. These are learning units focused on learning outcomes on personal and interpersonal soft skills for software professionals and profession-related skills for ICT professionals.

1.5 Conclusions

The defined **ESSA educational profiles serve as a foundation for the design of curricula and consequently for the delivery of effective learning programmes** for skilling, upskilling, and reskilling people into in-demand software roles.

The overviews of example curricula can be used as starting point for the ESSA pilots. Materials can be collected and developed to deliver these curricula and the programmes can be run based on the information in the curricula.

The identified common parts of the curricula can be the starting point for collaboratively developing learning materials that can be used in all the learning programmes.

1.6 Use of this document

This document presents the educational profiles and how to use them to design curricula. It can therefore be used by any learning provider to design ESSA-compliant curricula.

2 Introduction

Defining general curricula that provide efficient (up- and re-)skilling is almost contradictory to the fact that the most efficient way to skill people is to develop individual learning pathways tailored to the situation.

The challenge for ESSA is therefore to provide an approach that, on the one hand, considers the importance of mobility of people and thus, the comparability of competences, and, on the other hand, considers the individual differences, i.e., the need for individual learning pathways to develop those competences.

In this chapter, the translation of the ESSA Software Skills Strategy into curricula will be discussed, as well as the steps to design effective curricula.

2.1 Translating the ESSA strategy into curricula

The ESSA Software Skills Strategy is the starting point: the document describes an integrated approach to overcome the skills gap, considering the current and emerging skills and roles needed for software professionals. The strategy links European policies to concrete actions and outputs. One of the strategic objectives is to design and develop harmonised curricula across the EU.

The Strategy outlines the key aspects of the design of these curricula. They should be focused on EQF 4 to 7 levels, adhere to European standards, and take into account market demand for specific skills.

2.1.1 Learning programmes

The way for ESSA to reach its goals is to develop innovative **learning programmes** designed to match specific occupational profiles in software. This means that the learning programmes should educate for roles, competences, knowledge, and skills that are indicated as central to this project. Furthermore, there should be learning programmes on EQF 4/5 level, but also on EQF 6 and EQF 7 levels.

The educational programme or training must be directly related to and prepare for the occupational field. On the higher EQF levels, extra attention must be paid to the fact that the programme is a VET programme or training and not a scientific or general education one.

The aim is to educate or train learners to achieve learning outcomes, leading to qualifications that are recognised by national education authorities (or equivalent). Therefore, ESSA is focused on formal learning, especially in the context of this document. At the same time, ESSA recognises the importance of non-formal and informal learning in skills development.

2.1.2 European standards and specific skills

The foundation for the design of the educational profiles and, by extension, the curricula, is found in the **European ICT Professional Role Profiles** (CEN/CWA 16458-1)¹, combined with relevant competences, skills, knowledge, and attitude from the European e-Competence Framework (“e-CF”, EN 16234-1)². From the 30 CEN ICT Professional Role Profiles, ESSA selected five software-related profiles that require software development and operations skills as an essential part of their profile: Developer, DevOps expert, Solution designer, Test specialist, and Technical specialist.

The **European Skills, Competences, Qualifications and Occupations** (ESCO) taxonomy³ is another important input. The ESCO classification identifies and categorises skills, competences, qualifications, and occupations relevant to the EU labour market and education & training. It also systematically shows the relationships between the different concepts.

2.1.3 Other aspects

Another important aspect to consider in the design of curricula for software professionals is the market demand for **T-shaped and π-shaped professionals**. These are professionals that possess the skills to work together with other disciplines, hence the horizontal bar. Their technical specialisation is represented by the vertical bar. The π-shaped professionals have two specialisations, hence the two vertical lines.

The horizontal bar is composed of certain skills that are relevant to all the five selected software roles. These are two types of skills: profession-related and soft skills, both at personal and interpersonal levels. These types of skills are considered highly essential to professionals working in the software industry. Therefore, they will be explicitly addressed in and central to the ESSA curricula.

2.2 Common ground

Educational providers all have different backgrounds, institutional settings, kinds of learners and educational approaches. It would be unrealistic to expect them to define curricula that overcome all these differences.

¹ CEN/CWA 16458-1 (2018) European ICT Professionals Role Profiles, available at:

<https://itprofessionalism.org/about-it-professionalism/competences/where-to-buy-the-e-cf-standard/>

² CEN - European Committee for Standardization/ TC 428 (2019). European norm EN 16234-1:2019. e-Competence Framework (e-CF) – A common European Framework for ICT Professionals in all sectors - Part 1: Framework. Brussels: CEN-CENELEC. General information about the e-CF, available at ITPE:

<https://itprofessionalism.org/about-it-professionalism/competences/the-e-competence-framework/> Formal information, available at CEN & CENELEC:

https://standards.cenelec.eu/dyn/www/f?p=205:110:0:::FSP_PROJECT:67073&cs=15E62ED24D608A5F10D6BEE8E6D50FA10

³ ESCO, available at: <https://esco.ec.europa.eu/select-language?destination=/node/1>

Also, these general, overall curricula would not tackle the issue of the recognition of non-formal and informal learning. There are national and regional factors that influence the recognition of non-formal and informal learning, such as demography, the labour market, human capital development, and formal education and training systems⁴.

The European Council stresses the importance of the recognition of these forms of learning⁵:

“The validation of learning outcomes, namely knowledge, skills and competences acquired through non-formal and informal learning can play an important role in enhancing employability and mobility, as well as increasing motivation for lifelong learning, particularly in the case of the socio-economically disadvantaged or the low-qualified.”

This paragraph describes the common ground that is needed as a starting point to overcoming these differences.

2.2.1 Focus on learning outcomes

There are plenty of educational methods and techniques available and used to get a learner to the level needed to obtain a learning outcome. These methods and techniques differ based on, amongst others, target group, location, institutional setting, and personal preferences. The thing that they have in common is that they are all aimed at ensuring that a learner obtains a specific set of learning outcomes. For example, a set of learning outcomes to become a junior developer, includes application design, application development, skills related to the ICT profession in general and soft skills.

Since 2004, the learning outcome principle is explicitly promoted in the EU policy agenda for education, training and employment⁶. The application of learning outcomes is considered important in the implementation of tools such as the EQF. At the national level, the use of learning outcomes supports the building of national qualification frameworks and influences the definition and writing of qualifications and curricula as well as the orientation of the assessment, teaching, and training. The application of learning outcomes in educational practice has several advantages for different stakeholders⁷:

⁴ OECD (2010). Recognition of nonformal and informal learning outcomes. Available at: <https://www.oecd.org/education/skills-beyond-school/44600408.pdf>

⁵ European Council (2012). Council recommendation on the validation of non-formal and informal learning. 2012/C 398/01. Available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32012H1222%2801%29>

⁶ <https://www.cedefop.europa.eu/en/projects/learning-outcomes>

⁷ Cedefop (2022). Defining writing and applying learning outcomes: A European handbook - second edition. Luxembourg: Publications Office of the European Union. Available at: <https://www.cedefop.europa.eu/en/publications/4209>

Learning outcome statements clarify what a learner is expected to know and be able to do and understand, having completed a learning sequence, a module, a programme, or a qualification.

- **For individual learners**, an overview of learning outcomes can support the initial choice of education and training; they can help to orient the learning process itself, and they can clarify what to expect during the assessment or validation.
- **For the teacher and/or instructor**, the learning outcomes approach helps to orient teaching, to select methods and support the individual learner throughout the learning process.
- **For the assessor**, the learning outcomes should clarify the criteria for success/failure and performance.
- **For the education and training institution**, learning outcomes provide an important instrument for developing as well as reviewing programmes and qualifications. The approach also provides the basis for systematic dialogue with labour market and society stakeholders on the evolving skills needs. The perspective helps to determine the purpose and orientation of a course, programme, or qualification and to clarify how it relates to and/or overlaps with other courses or programmes and qualifications. Learning outcomes provide an important reference point for quality assurance and close dialogue with end-users.
- **For the labour market and societal stakeholders**, learning outcomes provide a common language allowing different stakeholders in education and training, as well as the labour market and society at large, to clarify skills needs and to respond to these in a relevant way.

Using this common language and taking learning outcomes as a starting point ensures the comparability of different learning experiences. By focusing on the end result, the route towards it becomes more or less irrelevant, as long as the learner can prove that the end result as described in the learning outcome is obtained.

Focusing on learning outcomes simply means that results obtained in the learning process are not dependent on the exact design of that learning process.

2.2.2 Micro-credentialling & certification

An important aspect of a learning outcome-based system is assessment. This should be an assessment based on predetermined standards. These standards play a critical role in deciding the orientation of the learning outcomes. Assessment criteria must relate directly to the learning outcome. They fine-tune the learning outcome and are usually more detailed. The assessment must assess what the learning outcome states. Therefore, aspects like content and construct validity are important to take into account⁸.

⁸ Cedefop (2022). Defining writing and applying learning outcomes: A European handbook - second edition. Luxembourg: Publications Office of the European Union. Available at: <https://www.cedefop.europa.eu/en/publications/4209>

A certificate can be awarded after the successful assessment of one or a set of learning outcomes. The certificate must be awarded based on an actual assessment. It cannot be based on, for example, the proof of attending a course or training — something that is, unrightfully, sometimes also referred to as a certificate.

Certificates and micro-credentials are both types of credentials. Micro-credentials are considered to be an important tool for the recognition of all kinds of learning. Micro-credentials certify the learning outcomes of short-term learning experiences, for example, a short course or training. They offer a flexible, targeted way to help people develop the knowledge, skills, and competences they need for their personal and professional development⁹.

The European approach to micro-credentials for lifelong learning and employability states that¹⁰:

“Micro-credentials could help certify the outcomes of small, tailored learning experiences. They make possible the targeted, flexible acquisition of knowledge, skills and competences to meet new and emerging needs in society and the labour market and make it possible for individuals to fill the skill gaps they need to succeed in a fast-changing environment, while not replacing traditional qualifications. They can, where appropriate, complement existing qualifications, providing added value while not undermining the core principle of full degree programmes in initial education and training. Micro-credentials could be designed and issued by a variety of providers in different learning settings (formal, non-formal and informal learning settings)”.

The challenge now is that micro-credentials have no quality controls and can be issued by anyone. There is no guarantee that learning outcomes are really achieved and currently micro-credentials in the form of digital badges are sometimes handed out for just going over some training material and answering some questions, without any quality control. A lack of transparency is one of the main barriers to the recognition of micro-credentials; another is trust¹¹. Adherence to the European **Europass framework** for digitally signed credentials is therefore important¹².

⁹ A European approach to micro-credentials. Available at: <https://education.ec.europa.eu/education-levels/higher-education/micro-credentials>

¹⁰ The Council of the European Union (2022). Council Recommendation on a European approach to micro-credentials for lifelong learning and employability. 2022/C 243/02. Available at: [https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32022H0627\(02\)](https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32022H0627(02))

¹¹ Higher education consultation group (2020). Final report: A European approach to micro-credentials. Luxembourg: Publications Office of the European Union. Available at: <https://education.ec.europa.eu/sites/default/files/document-library-docs/european-approach-micro-credentials-higher-education-consultation-group-output-final-report.pdf>

¹² Europass framework for digitally signed credentials. Available at: https://ec.europa.eu/futurium/en/system/files/ged/europass_background-info_framework-digitally-signed-credentials.pdf

2.2.3 Accreditation

Accreditation is an important instrument when it comes to quality assurance for a programme or institution. Accreditation is even more important when speaking of micro-credentials.

As mentioned briefly above, the challenge that micro-credentials face is a lack of transparency and trust. To build trust, it is important to have full transparency over three interrelated aspects: the quality of the credential itself (authenticity and technology), the content of the learning experience, and the provider. Trust in the provider of the credential is a crucial element for trusting the credential itself¹³.

In the higher education sector, this transparency and trust are ensured by quality assurance processes, internally by the institution in question as well as externally, e.g., accreditation, audit, and review. External accreditation can be programme-based and institution-based. This has to be done by an officially recognised and independent accreditation institute, that adheres to certain quality standards. The accreditation of an institute is becoming more important when focusing on individualised learning paths and micro-credentialing. Also, alternative ways of accreditation are considered by accreditation institutes, such as accrediting a certain certification level of a specific institute, instead of single certifications¹⁴. In this way, it is possible to create an efficient certification system, also in the case of micro-credentials and individual learning paths.

2.3 Steps towards effective learning programmes

Designing an effective, well-balanced learning programme is not an easy task. The process must be well structured and take all relevant aspects into account. This means that some well-conceived steps have to be taken. This is already true for a single learning programme developed for a single educational provider operating in a local context, let alone for several coherent learning programmes developed for different providers operating across Europe. Also, these steps need to be orchestrated well and in a logical sequence; each step being the logical consequence of the former.

¹³ Higher education consultation group (2020). Final report: A European approach to micro-credentials. Luxembourg: Publications Office of the European Union. Available at:

<https://education.ec.europa.eu/sites/default/files/document-library-docs/european-approach-micro-credentials-higher-education-consultation-group-output-final-report.pdf>

¹⁴ Zanville, H. & Travers, N. (2021). Is Incremental Credentialing Compatible with Institutional Accreditation? (Part 3). Available at: <https://evollution.com/programming/credentials/is-incremental-credentialing-compatible-with-institutional-accreditation-part-3/>

2.3.1 Establishing educational profiles

The first step towards effective learning programmes is to define **educational profiles** in which market needs are translated into educational terms including learning outcomes. Educational profiles serve as a¹⁵:

- **Translation tool for curriculum designers:** It serves as an aid to translating a professional profile, a (set of) competence(s), or other inputs, into a profile in educational terms that can be used as a blueprint for curriculum (re)design.
- **Legitimation tool:** It underpins the choices that are made in the curriculum design; showing compliance to a profile is well regarded, e.g., towards accreditation committees.
- **Guide to learners/students:** It links the professional profile to the curriculum elements. In this way, it helps learners or students to choose their learning path and make decisions on their direction.
- **Communication tool:** It communicates in a clear, concise manner the foundation of a programme, which is useful information to several stakeholders. For example, potential students/learners in their decision to enrol in a certain learning programme or not.
- **Positioning tool:** Its independence from the learning path makes it easier to compare the programme with other programmes within an institute, or externally, with the programmes of other institutions. This is useful both to students and educational providers themselves. It will stimulate the mobility of students and learners across institutes and boundaries.
- **Tool for a flexible, demand-driven education and training offer:** The educational profile is focused on results. It acknowledges a diversity of learning paths while the requirements regarding qualifications are guaranteed. As such, it is an instrument that supports the validation of prior learning and is in line with lifelong learning policies. It also enables a modular learning programme or curriculum design that can be adapted to different needs and flexibly offered in smaller and larger 'portions', without losing coherence or logic.

At the heart of the educational profiles are the learning outcome statements. The strength of these profiles is that they embed the learning outcomes and link them to other characteristics — in a way that is independent of the actual implementation in a concrete situation. This means that educational profiles can be applied in many different contexts.

¹⁵ CEN/TS 17699 (2022). Guidelines for developing ICT Professional Curricula as scoped by EN 16234-1 (e-CF).

Available at:

https://standards.cenelec.eu/dyn/www/f?p=205:110:0:::FSP_PROJECT:72363&cs=1825944F2586B5DDEE73CE814B769E7AD

2.3.2 Define target groups and context

The next step is to define the target group(s) of the programme and relevant conditions in the local context (regional, national) that have to be considered.

Target groups can be differentiated based on characteristics like age, needs, or income. Is the learning programme, for example, focused on the skilling of young people for their first job? Does it aim to reskill professionals from one job to the other? Or is the focus on upskilling?

Contextual factors can be many things, e.g., national policies and regulations related to education or economic factors, and the needs of local companies. Anything in a local situation that may influence the educational offer.

2.3.3 Design effective curricula

Effective curricula in the context of ESSA are curricula that fulfil market needs, not only content-wise, but also in the way the educational offer is shaped. They should be attractive to initial students and working professionals alike. They should be flexible in the sense that learners can follow only those parts that fit their needs and not necessarily follow a predefined path and they should allow for skilling, but at the same time, also allow for shorter reskilling and upskilling learning trajectories. To create such an effective, flexible curriculum, certain design criteria must be applied that shape a programme that is attractive to learners and addresses market needs at the same time.

To be flexible, the curriculum/learning programme must be composed of relatively **small learning units**, somewhere ranging between 1 ECTS and 7 ECTS (or even less than 1 ECTS). A learning unit should be designed as an independent unit and form a coherent whole, internally and externally. Internally, in the content that it offers and externally in the sense that it is aligned with clear learning outcomes and a kind of assessment in the end. In this way, a **modular curriculum** can be designed.

By having these small, modular units, learners will achieve a result much faster and also for example able to prove their successful learning process in the form of a certificate. This appeals very much to the needs of, in particular, working professionals, as this lowers to a great extent the entry barrier to starting a reskilling or upskilling trajectory.

Working professionals may have specific needs for the knowledge and skills they want to obtain. Some already have a certain domain-related knowledge and skills base and need only a specific addition to that. Some have experience in another field and want to broaden their knowledge and skills. To address these specific needs, the educational provider should offer them the possibility to **select and combine the learning units** that fulfil their needs and create their **individual learning paths**. This is possible when a programme or curriculum is designed in a flexible way with small units and with **multiple levels of aggregation**. This design is also attractive to initial students, allowing them to combine the study paths they are following more easily with other learning units of other knowledge domains of their interest. Especially when it comes to the study of ICT-related topics, this is

a very valuable approach that allows students of different knowledge domains and fields to gain knowledge of the field of ICT. And the other way around, students or learners in the field of ICT can gain more easily knowledge and skills in other fields. A combination most wanted by the market, addressing the need for the T-shaped and π -shaped professional, in line with the trend of “hybridisation” of roles.

If this flexible approach is combined with learning taking place in **real-life situations**, with work-based elements in the programme, a more hybrid situation is created between the institute and the practical context. Thus, initial students will become even better prepared to start their professional careers. Also, professionals coming from that practical context, with real-life experience, should be able to redeem that previously acquired knowledge and skills and receive the relevant certificate quite easily. To consolidate this approach the educational institute may seek **cooperation with organisations** at this point and may even co-create certain learning units.

This modern approach to curriculum design addresses national and European practices and policies related to continuous professional development (CPD) and lifelong learning (LLL). Many EU policy documents stress the importance of this, for example:

“There is a need for high-quality education content to boost the relevance, quality and inclusiveness of European education and training at all levels. Education institutions have an increasingly important role as providers of lifelong learning.”¹⁶

If well-communicated the educational institute can use its innovative approach and educational offering as a strong marketing tool, attracting more students/learners to position itself firmly in the “education market”. Also, the institute will be able to communicate the fact that it adheres to European policies while addressing many aspects considered highly relevant by national and European policymakers alike, such as offering lifelong learning possibilities, opportunities for reskilling and upskilling, access to education for a broad and varied group of learners, and addressing detected skills gaps especially related to the field of ICT. If an educational institute implements this approach, it will not only improve its current position and image but also become an institute that is future-proof.

3 Educational profiles

The design and development of harmonised curricula that reflect software roles in a consistent and market-oriented way are crucial. To design and develop these kinds of curricula, a translation of market needs to educational concepts must be made. This can be done by using educational profiles. **The CEN technical specification on Guidelines for ICT**

¹⁶ European Commission (2020). Digital Education Action Plan 2021-2027. Resetting education and training for the digital age. Available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020DC0624>

Curricula¹⁷ provides guidance on how to translate market demands to learning programmes making use of educational profiles. **ESSA follows these guidelines to develop educational profiles for roles in the software services sector.**

Using educational profiles means that curricula and other learning programmes are lifted out of their specific implementation context. Educational profiles provide, in a curriculum-independent manner, a tool for communication and transparency to all stakeholders and flexibility regarding the (re)design and maintenance of curricula. It also leads to more transparency of learning programmes within and across educational institutions on a national and international level. In so doing, it also stimulates student and learner mobility across institutions and countries.

3.1 Elements of educational profiles

An educational profile consists of three main elements: a general description, a set of learning outcomes, and a set of assessments. The general description provides relevant information about the profile in general terms so that a reader knows what the profile is aimed at, what competences it addresses, and to what further professional and educational perspectives it leads. The set of learning outcomes is composed of clear descriptions of the knowledge and skills the profile is composed of. The assessments are related to the learning outcomes and describe the way these learning outcomes are accomplished. The educational profiles template can be found in [annex 3](#).

3.1.1 General description

The general description of the **educational profile** consists of the following elements:

Item	Description
Goal	The overall focus of the profile in terms of results.
Description of characteristics	<ul style="list-style-type: none"> • Scope: an indication of the knowledge domain or specialism • Competences: a short indication of the professional e-CF competences involved • Level of complexity, e.g., in relation to the EQF and/or other (national) qualification standards • Deliverables: outputs or 'work outcomes' that students or learners should master
Perspective	<ul style="list-style-type: none"> • The possible options for the learner after completing a learning programme based on this educational profile: • Professional perspective: the possible professional functions and/or roles a person may fulfil • Educational perspective: the possible further education or training a person can take

¹⁷ CEN (2022), CEN/TS 17699 Guidelines for developing ICT Professional Curricula as scoped by EN 16234-1 (e-CF). Available at: https://standards.cencenelec.eu/dyn/www/f?p=CEN:110:0:::FSP_PROJECT,FSP_ORG_ID:72363,1218399&cs=169E9940F2911D404FAE0D4872E5D2630

3.1.2 Learning outcomes

The learning outcomes are described **at two aggregation levels:** programme learning outcomes and unit learning outcomes.

Unit learning outcomes are clear statements that describe a measurable result of a learning experience. They are formulated independently from a specific learning path. This implies that learning outcomes can be achieved by different learning paths in different settings, not necessarily a setting at an educational institute.

To check whether a learning outcome is achieved, the learning outcome must be described in measurable terms. This can be done by using action verbs related to the taxonomy of Bloom¹⁸. The unit learning outcomes together cover the programme learning outcome(s).

Programme learning outcomes are a list of clear statements of what a person, after successful completion of a learning programme, based on the profile demonstrably knows, understands, and is capable of doing. Like unit learning outcomes, programme learning outcomes are described in terms that do not refer to the actual curriculum, learning units, or learning methods. Programme learning outcomes have a broad scope that encompasses the underlying learning outcomes.

3.1.3 Assessments

The set of assessments indicates how to determine learning outcomes are obtained. In the educational profile, each learning outcome is directly linked to an assessment. These assessments consider the scope and the levels of cognition and complexity of the learning outcomes they assess. They equal the scope and level of cognition and complexity of the learning outcome. The formulation of the learning outcome and the verbs used in that formulation should be taken carefully into consideration when determining the assessment method.

3.2 The ESSA educational profiles

The ESSA educational profiles are based on market needs as determined by the ESSA needs analysis and described in the ESSA Strategy, but also the adapted ESSA software professional role profiles, the e-CF, and other related reports. The educational profiles will serve as a blueprint to develop the curricula and to determine the contents of the programme learning outcomes (PLOs) and learning outcomes (LOs). A template is developed to describe the profiles in a structured manner. This template can be found in annex

¹⁸ Bloom, B. S. (1956). *Taxonomy of Educational Objectives, Handbook I: The Cognitive Domain*. New York: David McKay Co Inc. *And also:* Anderson, L. W., Krathwohl, D. R., & Bloom, B. S. (2001). *A taxonomy for learning, teaching, and assessing: A revision of Bloom's Taxonomy of educational objectives*. Longman.

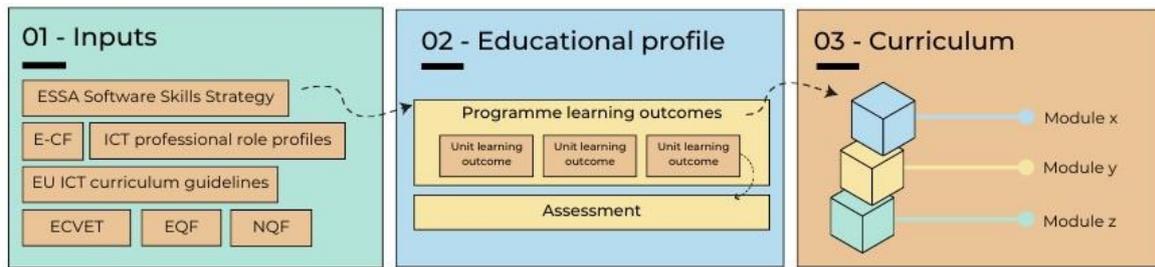


Figure 1: From strategy to curriculum

In the process of creating the profiles, the following aspects were kept in mind:

- Different educational profiles should be developed for **the different software professional roles with different levels of complexity**
- The set of educational profiles together **should offer a complete scheme**. They will be offered in a structured way and possible learning paths relating to skilling, reskilling and upskilling will be indicated
- **ESSA Educational profiles** should be developed **for the whole of the EU**, however, there will be room for contextualising the profile to local conditions
- There should be **one generic set of PLOs and LOs related to the transferable soft skill set and profession-related skill set** as described in the ESSA Strategy. These generic sets should be part of every educational profile that is focused on a full professional role
- The common ICT knowledge as described in the **European Foundational Body of Knowledge for the ICT profession**¹⁹, that applies to all ICT professionals, should **be part of every educational profile that is focused on a full professional role**
- **Learning outcomes** should be described **in a standardised way**, according to defined principles²⁰
- The educational profiles should be formulated **in a vendor-neutral way**. Depending on the specific market demand in a specific local context, the learning provider can select certain vendors and specific certificates
- The educational profiles should provide enough information and detail to develop learning programmes upon, and at the same time will be generic enough, so that **flexible interpretations at local levels are possible**

¹⁹ CEN - prEN 17748-1 Foundational Body of Knowledge for the ICT Profession (ICT BoK) - Part 1: Body of Knowledge. Brussels: CEN-CENELEC, available at: https://standards.cenelec.eu/dyn/www/f?p=CEN:110:0:::FSP_PROJECT,FSP_ORG_ID:71369,1218399&cs=1037FF415D2B146EA5B76090895FB7FDD

²⁰ Principles as provided e.g. by Cedefop (2022). Defining, writing and applying learning outcomes: a European handbook - second edition. Luxembourg: Publications Office. <http://data.europa.eu/doi/10.2801/703079>

3.2.1 The 9 ESSA educational profiles in brief

The ESSA Software Skills Strategy selects five important software roles. These are developer, DevOps expert, solution designer, test specialist and technical (software) specialist. The ESSA role profiles, following the CEN ICT professional role profiles, do not differentiate between different complexity levels in the role that occur. For example, a starting junior developer will not have the same competence level as an experienced senior developer. Something which is reflected in the different levels of education and training needed for the role. Given the CEN role profiles and the complexity of the roles in the marketplace, which was confirmed in the ESSA needs analysis, most roles can be educated and trained at more than one level.

This results in 9 ESSA educational profiles. The developer roles are [junior developer EQF 4/5](#), [developer EQF 6](#) and [senior developer EQF 7](#). There is also defined a [junior DevOps expert EQF 6](#) and [DevOps expert EQF 7](#). The [solution designer EQF 7](#) has a [junior solution designer EQF 6](#) profile in the same way. The last two profiles are roles on EQF 4/5 level being [technical software specialist](#) and [test specialist](#).

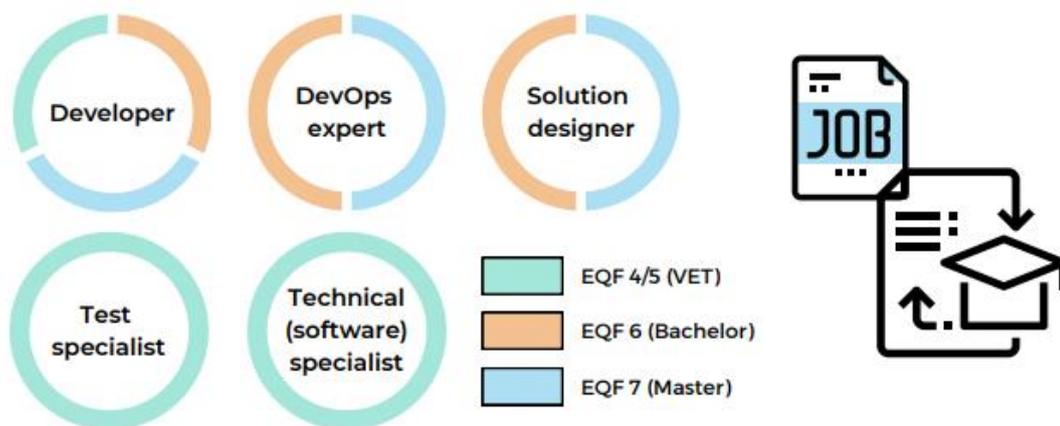


Figure 2: ESSA Educational Profiles for Software Roles at EQF levels 4/5, 6, 7

3.2.2 Programme learning outcomes

The programme learning outcomes can roughly be divided into role-specific software-related outcomes and more generic outcomes that need to be obtained to be able to use the software-related outcomes within societal and organisational settings.

These generic programme learning outcomes relate to personal and interpersonal soft skills, such as problem-solving and teamwork, and skills related to the ICT profession in general, such as security and ethical behaviour. They are based on the soft skill set and the profession-related skill set that apply to all software-related roles as described in the ESSA Strategy and the ESSA Needs Analysis.

3.2.3 Framework of educational profiles

The core element of educational profiles is the (programme) learning outcomes. Programme learning outcomes may overlap between different educational profiles, especially when educating for roles in the same domain. This means that the same programme learning outcome can be part of more than one profile.

Another aspect is that educational profiles provide a description that relates to a certain role, but this is done on multiple complexity levels. This means that e.g., for the role of developer, there are educational profiles for a junior developer at level EQF 4/5 as well as a profile for a developer at level 6 (bachelor) and one for level 7 (master).

These elements are the input for an overview that shows for each ESSA profile and for each complexity level which programme learning outcomes belong to which profile. The complexity levels are indicated by the EQF level of the learning experience that would lead to obtaining the learning outcomes. A distinction is made between EQF 4/5, EQF 6 and EQF 7 levels of complexity.

The level and profile combinations that do not exist or are not relevant in the context of the ESSA project are of course empty. This leads to the below overview in which the names of the profiles are entered into the framework. The detailed overview of all the programme learning outcomes (PLOs) for all profiles can be found in [Annex 2](#). This overview clearly shows which PLOs are shared by multiple profiles.

European Qualification Framework (EQF)	EQF 7	ESSA Senior Developer	ESSA DevOps expert	ESSA Solution designer		
	EQF 6	ESSA Developer	ESSA Junior DevOps expert	ESSA Junior Solution designer		
	EQF 4/5	ESSA Junior Developer			ESSA Test specialist	ESSA Technical specialist
		Developer	DevOps expert	Solution designer	Test specialist	Technical (software) specialist
		Software Role				

Figure 3: ESSA educational profiles for software roles per EQF level

4 Curriculum descriptions

The educational profiles provide, in combination with the ESSA Software Skills Strategy and the specific context and target audience, the pointers necessary to design curricula.

A curriculum can be seen as an:

“Inventory of activities related to the design, organisation and planning of an education or training action, including definition of learning objectives, content, methods (including assessment) and material”²¹

A curriculum is focused on the design, organisation and planning of learning activities and a learning programme is the implementation of these learning activities²².

The first step in the process of designing the learning activities is to identify the design criteria followed by the actual definition of learning objectives, content, and methods including assessment and material. In this chapter, a template will be presented to guide this definition, followed by examples of curricula that are designed based on the ESSA educational profiles.

4.1 Design criteria

To create a curriculum that addresses the individual needs of the learner, it must be flexible. In the context of ESSA, where the focus is on overcoming the software skills gap, the needs that must be addressed are very diverse. ESSA’s target groups can be initial students and working professionals alike, meaning that there is a need for skilling, but also for reskilling and upskilling. People that are already employed do not have much time besides their jobs for learning, meaning that an efficient combination of working and learning is essential, so that the educational offer should not cost too much of their valuable time. They may also have very specific needs for more advanced knowledge and skills. There are also people that may be unemployed, seeking a job, but lack essential software skills. And there is a group of initial students that must be convinced of following an education in the field of software.

All these diverse needs call for a curriculum design that is flexible and efficient. This can be achieved if the curriculum is composed of small learning units if learners can select and combine these units according to their individual needs, if skills and knowledge already mastered are also valued and if learning can be merged with workplace practices in forms embedded in the curriculum.

²¹ CEDEFOP (2014). Terminology of European education and training policy. A selection of 130 key terms. Second edition. Available at: <https://www.cedefop.europa.eu/en/publications/4117>

²² CEDEFOP (2014): «The term programme of education of training refers to the implementation of learning activities whereas curriculum refers to the design, organisation and planning of these activities».

4.1.1 Modular

A curriculum should be modular to increase the potential for individual learning paths. This means that the curriculum has to be composed as much as possible of relatively small learning units, somewhere ranging between 1 EC and 7 EC (or even less than 1 EC). The exact level of modularity depends on the specific context like the target group and the delivery method. A modular part of a curriculum is called a learning unit.

A learning unit is a combination of different elements that together form a certain whole, this can be as small or as large according to needs. Learning units are independent and self-contained, in the sense that they offer coherent content and are aligned with clear learning outcomes and a kind of assessment in the end.

4.1.2 Multiple levels of aggregation

Multiple levels of aggregation of learning units increase flexibility and structure a curriculum more clearly. Small learning units can be combined resulting in more overarching units and those can be combined again into logical sets when relevant. Learning units can be seen as building blocks that can be stapled and combined flexibly in different ways.

4.1.3 Relation between learning outcomes and learning units

The learning outcomes of a curriculum are the comparable end results of a learning process and are defined in the educational profile that is the starting point of the design of a curriculum. In most cases, it is possible to create learning units that correspond directly to a learning outcome, but there are a lot of reasons why this could be not the case.

Elements that may lead to a certain learning unit, can be taught in several learning units. It is therefore very well possible that a learning outcome is covered in more than one learning unit. The learning outcome should be fully covered by those learning units in total together so that after finishing those learning units successfully with assessments, the learning outcome is obtained.

The other way around is also very well possible: in a learning unit, more than one learning outcome can be covered. Partly or even completely. In short, the relationship between learning outcomes and learning units is a many-to-many relationship. Assessments play an essential role here; they serve as formal proof that a learning outcome is obtained. Therefore, care should be taken that the assessment really “measures” what the learning outcome states.

If these three key elements — learning outcomes, learning units with learning activities, and assessments — are well-balanced, a curriculum is designed that is transparent, with well-

organised and visible goals, so that students and teachers alike know what is expected from them²³.

4.1.4 Tailored for context and target groups

A curriculum is specific for a certain context and target group(s). The content, methods, assessments and material depend on for example the approach of the educational provider and for example whether the target group are initial learners, upskillers or reskillers. Also, the region or the local environment can influence the design of the curriculum. A curriculum should (and usually is) be tailored for these specific aspects to be able to deliver the most effective learning programme.

One way to contextualise a curriculum is to incorporate real-life situations in it, in which the students or learners work in an organisation and conduct assignments or tasks. This also supports students in achieving the much sought-after skill of functioning in an organisation.

Incorporating these real-life situations, with work-based elements in the programme, creates a more hybrid situation between the institute and the practical context and, initial students will become even better prepared to start their professional careers. Also, professionals coming from that practical context and can show they possess already real-life experience should be able to redeem that previously acquired knowledge and skills and receive the relevant certificate quite easily.

To consolidate this approach the educational institute may seek cooperation with companies and other organisations, creating more sustainable relationships with organisations operating at local, regional or national levels, thus tailoring the curriculum to the local or national context. The extent to which may of course vary but can go as far as the educational provider and the company co-creating certain learning units.

4.2 Curriculum description template

The ESSA curricula are described using a standard template to increase comparability. The curricula description template can be found in [annex 4](#). The following paragraph explains the constitutive elements of this template.

²³ This is the principle of constructive alignment as described by: Biggs, J. Enhancing teaching through constructive alignment. High Educ 32, 347–364 (1996). <https://doi.org/10.1007/BF00138871>

4.2.1 General information

The first part describes the general information of a **curriculum**:

Item	Description
Name	The name of the curriculum, which for ESSA in most cases will be the name of the corresponding educational profile, with sometimes an extra addition to indicate the specific context.
EQF-level	This is the level of complexity of the final level in the curriculum. It is for example common that the first parts of a four-year bachelor programme, are at EQF-level 5 (which can lead to an Associated Degree) and only the last parts on EQF-6. The level that must be indicated in this example is level 6.
Goals	This part briefly describes the goal(s) of the curriculum. For example, training people to become starting junior software developers to address the shortage of developers at local software development organisations.
Scope	The scope is mainly about the target group(s). The curriculum can for example be aimed at reskillers and therefore focus on the technical competences needed for the role. The curriculum will in that case for example have entry requirements for learning outcomes related to soft skills and working in organisations. Those entry requirements can be stated here as well.
Programme learning outcomes (PLO)	This is a short overview of the PLOs that are addressed in the curriculum. These can be copied from the related educational profile — since those are the outcomes that need to be achieved by an ESSA curriculum.

4.2.2 Description of the structure

The description of the structure indicates how the curriculum will be delivered.

It contains a general overview of the method(s) that is/are used, like project-based learning, inquiry-based learning, classroom-based learning, etc. It also explains the overall structure of the learning activities, for example 4 courses in each trimester or a set of learning units that can be completed by the learner in their preferred order, but all have to be successfully finished before moving to the next set of learning units. The connection between learning units and/or sets of learning units is explained, so the structure of the curriculum becomes clear in relation to achieving the learning outcomes of the curriculum.

In short, this paragraph describes how the learning outcomes are achieved through a structured set of learning units.

4.2.3 Overview of learning units

A curriculum needs to be modular to ensure flexibility and increase the possibilities of individual learning paths. The programme should therefore be divided into learning units.

The table provides a general overview of the learning units in the curriculum. It mentions the name of each learning unit, the size of the learning unit, complexity level and assessment.

The size of the learning unit is expressed in ECTS. In this EU standard,²⁴ a credit stands for 25-30 hours of learning and there are 60 credits in one-year full-time of study.

A learning unit can have all sizes, but most learning units are defined ranging from 3 to 10 ECTS. It is possible to use larger learning units, but that requires an explanation in the description of the structure of how the curriculum is still tailored to deal with different backgrounds and needs of learners. It is also possible to have smaller units, but in that case, the list of learning units will become very long in most cases, which decreases the understandability of the curriculum in most cases. In the case of a smaller unit that is less than an ECTS or a unit that is defined in hours, it is possible to use partial ECTS, but for clarity, it is advised to round to 1 decimal.

The level of complexity is expressed in EQF²⁵. Not all the learning units have to be on the final level of complexity of the curriculum, so indicating the level of the learning unit helps to gain insight into the complexity of a learning unit.

The last element in the overview is how a learning unit is assessed. For example, an exam, a practical assignment or a report. There can be one or more assessments in a learning unit. In this overview, it is enough to just mentioned the assessment method(s) since in the details of the learning units the assessment will be described in more detail.

4.2.4 Details of learning units

Each learning unit is described in more detail in this section of the template. It starts with a short description of the learning unit. After that, the related programme learning outcomes and the related unit learning outcomes are listed.

4.2.5 Learning units vs learning outcomes matrix

The relationship between learning units and learning outcomes is a many-to-many as explained before. How exactly in a specific curriculum the learning outcomes are related to the learning units, an overview can be created that shows these relationships at this detailed level, so that this is immediately visible at a glance.

4.3 Example curricula

There are many possible curricula applying a specific context and target group to the ESSA educational profiles. Starting point is that such a curriculum should be effective and efficient in skilling, re-skilling or up-skilling a specific target group in a specific situation.

²⁴ European Commission (2015). ECTS Users' Guide. Luxembourg: Publications Office of the European Union. Available at : <https://op.europa.eu/en/publication-detail/-/publication/da7467e6-8450-11e5-b8b7-01aa75ed71a1/language-en/format-PDF/source-search> and https://ec.europa.eu/education/tools/ects_en.htm

²⁵ European Commission – Education and Culture (2008). The European Qualifications Framework for Lifelong Learning (EQF). Luxembourg: Office for Official Publications of the European Communities. <https://europa.eu/europass/en/europass-tools/european-qualifications-framework>

Preferably with possibilities for individualised learning pathways, so the curriculum can even be tailored to a specific learner.

This paragraph presents an overview of **example curricula under development** tailored for different target groups and contexts. These example curricula are under development and will be further specified and finetuned in WP4. Elements like specific learning materials, delivery methods, and assessments will be decided on and will complement the descriptions. There will also be the possibility to develop additional curricula starting from the criteria and template defined above. This will lead to a set of curricula that can be piloted.

4.3.1 Curriculum Junior developer EQF 4/5

This first curriculum junior developer provides participants with the knowledge and skills necessary for software development. Programming languages, techniques and practices for frontend and backend development are covered in-depth. It also pays attention to soft and profession-related skills. The curriculum consists of 14 modules that result in 200 contact hours which translates into a total workload of 24 ECTS. It is aimed at people who intend to become software developers and who are motivated to participate in an intensive course for reskilling in the software services field.

4.3.2 Curriculum Junior developer - EQF 4/5

This curriculum junior developer gives students a broad overview of and practical experience with IT technologies from the very basics, through frontend and backend technologies until enterprise solutions, and the required soft skills as well. There is a big focus on learning how to learn in order to prepare students for new technologies in a company environment. It is an intensive full-time yearlong programme of 55 ECTS for people that want to skill or reskill themselves.

4.3.3 Curriculum Junior developer of web applications - EQF 4/5

The aim of this curriculum is to provide basic knowledge and skills of web application development being a specification of the junior developer role. The curriculum provides learners knowledge and skills to create a simple working software component or application. The curriculum has different target groups, with different levels and previous experiences, but are currently unemployed. It is a short programme that focusses on the essential learning outcomes to get started in the field of software services.

4.3.4 Curriculum Developer - EQF 6

The aim of this curriculum is to give students a broad overview and practical experience of IT technologies from the very basics, through frontend and backend technologies until enterprise solutions, and the required soft skills as well. There is a big focus on learning how to learn to prepare students for new technologies in an organisational environment. Target groups are people who want skilling or reskilling. Specific micro-credentials will be offered for obtained micro-competencies, in areas where a student requires an upgrade of

competencies. The full programme is divided into three years, or six semesters with 30 ECTS study obligations each.

4.3.5 Curriculum Developer - EQF 6

The aim of this curriculum is to educate people to build and implement software components and applications based on specifications and designs by using programming languages, tools, and platforms. It is a reskilling programme targeting people without prior knowledge of the software services field.

4.3.6 Curriculum Senior developer - EQF 7

The curriculum at EQF7 level aims to qualify engineers with solid scientific and technical knowledge related to the professional field of Information Technology who are competent in the design of IT systems and tools and the development and integration of IT systems. People with a bachelor's degree in computer engineering can enter the programme directly. People with a bachelor's degree in a related field must complete additional learning units in parallel.

4.3.7 Curriculum Junior DevOps expert - EQF 6

The aim of this curriculum is to educate people to implement processes and tools to successfully deploy DevOps techniques across the entire solution development lifecycle. It is a reskilling programme targeting people without prior knowledge of the software services field.

4.3.8 Curriculum DevOps expert - EQF 7

This 90 ECTS EQF7 level curriculum provides participants with the opportunity to understand not only the technical, but also the business and human factors at play during the high pressure demands of modern software delivery processes, which is essential in the modern discipline of DevOps. Participants will learn how to implement processes and tools to successfully deploy advanced DevOps techniques across the entire solution development cycle. This curriculum is aimed at those who have an existing undergraduate (Bachelors) degree in a related technology discipline.

4.3.9 Curriculum DevOps expert - EQF 7

This curriculum also provides participants with the opportunity to understand not only the technical, but also the business and human factors which are essential in the modern discipline of DevOps. Participants will learn how to implement processes and tools to successfully deploy advanced DevOps techniques across the entire solution development cycle. This curriculum is also aimed at those who have an existing undergraduate (Bachelors) degree in a related technology discipline. The goal and target group of both DevOps EQF 7 curricula are the same. Also, the programme learning outcomes are of course the same, but the difference is that both institutions have different approaches, learning units and delivery methods.

4.3.10 Curriculum Solution designer - EQF 7

This 90 ECTS EQF7 level curriculum prepares students to become technology professionals who support the development of new programs and devices in a variety of businesses. The main aim is to help IT Professionals to acquire skills in the design, development, and execution of integrated architectures that meet the business's current and future needs. Learners will evaluate current computer systems, design and develop new technology solutions, and integrate software and hardware to fit a company's digital systems through hands-on experiences. This curriculum is aimed at those who have an existing undergraduate (Bachelors) degree in a related technology discipline.

4.3.11 Curriculum Solution designer - EQF 7

This curriculum aims to equip established and aspiring IT architects with an informed, common, industry-aligned understanding of their role. They will gain knowledge of a set of frameworks, approaches, practices, and tools for executing architecture-related tasks. They will develop the ability to communicate effectively with a range of stakeholders and to understand technology initiatives from a broad business perspective. In such a way that they will be equipped to make strategic technical decisions and obtain internationally certified and validated academic recognition. It is a 100 ECTS part-time curriculum

4.3.12 Curriculum Test specialist - EQF 4/5

This programme provides participants with the skills useful to perform software testing operations: an essential activity for the development of any software platform and application. In addition to the technical skills, the programme provides also project management skills essential for the management of a digital project, as well as soft skills focused on team collaboration, essential for interacting effectively with colleagues and project stakeholders.

5 Design of common parts of curricula

The curricula based on the ESSA educational profiles all have the same learning outcomes, so it is logical that they could also share parts of the curricula. Content like knowledge elements and skills development are likely to be similar or even the same and also even the delivery of the content can be similar or the same.

The basic starting point is that partners share existing and new parts of curricula as much as possible. This means for example that new and existing learning materials are shared.

The degree of exchangeability depends on several aspects like target group, approach to learning and institutional requirements, but also on the kind of programme learning outcome. Some kinds of learning outcomes are more generic than others. To provide a first direction for, e.g., the actual development and sharing of learning materials, possible common parts of curricula are defined by identifying four kinds of programme learning outcomes. These are role-specific learning outcomes, soft skills for software professionals,

profession-related skills for ICT professionals and functioning in organisations for software professionals.

5.1 Role-specific learning outcomes

The role-specific learning outcomes are mainly focused on competences relevant to a small number of roles. These are mostly focused on technically oriented competences such as programming, testing, and designing. They cover the hard skills of software professionals. These technical learning outcomes can be obtained in very many different ways and there is already a lot of education and training available on most of these learning outcomes. It is therefore not a focal point for the project.

There is for example no added value in developing a special ESSA Java programming course since there are already a lot of ways someone can obtain this skill. This can be a course in the curriculum of a partner, but also online self-learning courses.

This does not mean that these parts of curricula cannot be shared. It is still very well possible to share parts between different educational profiles and between learning providers.

The framework of educational profiles shows that some programme learning outcomes are shared between profiles. For example, both the developer and the solution designer on EQF 6 level share the PLO application design on e-CF 3 level. This means that the part of the curriculum that prepares a learner for obtaining this PLO can be the same in a curriculum for developer and the one for solution designer.

It is also possible to share parts between learning providers. It might be that certain topics are covered in one curriculum in a way that another learning provider can and wants to use it in their own curriculum as well. This sharing makes it more efficient to develop up-to-date curricula.

This potential sharing is facilitated by sharing information about each other's curricula in the phase before and during the actual development and delivery of the programme. There will be no explicit emphasis though on these role-specific learning outcomes and there will be for example no centrally coordinated development of materials, given the beforementioned availability on the one hand and specific use for limited roles on the other.

5.2 Soft skills for software professionals

Soft skills for software professionals do receive little explicit attention in most existing software curricula in comparison to hard skills. It was established in the ESSA Software Strategy that this is a very important topic for employers and therefore should receive more explicit attention in the training of software professionals.

This would entail attention to the knowledge about soft skills and of course, training them. In most cases, the part of training soft skills is already embedded in programmes for example in the form of working in teams on an assignment or delivering a presentation at the end of a course on the results achieved. What should be added to this to achieve the

defined learning outcomes is the knowledge component and some basic training, before putting it into practice.

These basics are very relevant for upskillers, when they are technically trained specialists that need a broader skillset as organisations indicate. These basics are also relevant for initial learners that don't have or have little experience with these skills in an organisational setting.

The knowledge and basic training part of soft skills are relatively generic and could be used in every curriculum for software professionals. This means it can be considered to harmonise this part in the context of the ESSA project and develop one set of learning units to be used in all programmes. This will be further discussed and determined when developing learning materials in the context of WP4.

5.3 Profession related skills for ICT professionals

The ESSA Software Skills Strategy emphasises the importance of a broader skillset for software professionals including skills that are relevant to all ICT professionals. Most of these topics are part of courses within educational programmes but have in most cases no explicit own part in the curriculum. It includes skills like basic IT security skills, software lifecycle skills, sustainability skills, ethical awareness skills, skills for dealing with new technologies and skills in using basic common ICT knowledge.

The basics of these skills would be very useful for reskillers to get a good general understanding of the profession they are going to work in. These basics are of course also relevant for initial learners that are also new to the profession.

These basics of these skills are relevant for each ICT professional and are generic, so seem to be well suited to be developed and used centrally within the ESSA project. The feasibility of this will be further discussed and determined when developing learning materials in the context of WP4.

5.4 Functioning in organisations for software professionals

The last set of learning outcomes that are part of the ESSA educational profiles is the set of learning outcomes that deal with functioning in organisations. These are skills related to functioning in (agile) project environments and skills related to working in an organisational environment. Most upskillers and reskillers will have those skills, but reskillers do not always from an ICT or software perspective. For example, reskillers who are not familiar with the basics of agile projects or do not know anything about the alignment between business and IT. The practical aspect of these skills will be covered in the work-based learning element within ESSA and it could be relevant to add a generic, more theoretical part to this to make sure that also concepts on these topics are known. This will be further analysed in WP4 task work-based learning component.

6 Methodology

The ESSA educational role profiles and example curricula are designed based on the starting points formulated in the ESSA Software Skills Strategy. The basis of this design process is that the educational profiles provide a way to make educational offerings comparable and that the uniqueness of each learning situation makes it impossible and irrelevant to define a uniform curriculum that meets everybody's learning needs. This led to the inputs, design process and production of the output described in this chapter.

6.1 Input for the curricula design

The input for the design of the educational profiles consists of the ESSA Software Skills Strategy and in particular the ESSA role profiles that are defined in this document. These were in return based on the CEN ICT professional role profiles²⁶ and the e-Competence Framework (e-CF)²⁷. Guidelines outlined in CEN Technical Specification for developing ICT Professional Curricula²⁸ were also applied.

The example curricula will be designed based on the formulated educational profiles in combination with existing curricula for the selected roles on the different EQF levels.

6.2 The design process

The development of the ESSA educational profiles started with translating the competences defined in the ESSA role profiles into programme learning outcomes. This was done by experts of the WP lead using the Tuning principles for formulating learning outcomes²⁹ and the CEDEFOP handbook for defining, writing and applying learning

²⁶ CEN/CWA 16458-1 (2018) European ICT Professionals Role Profiles, available at:

<https://itprofessionalism.org/about-it-professionalism/competences/where-to-buy-the-e-cf-standard/>

²⁷ CEN - European Committee for Standardization/ TC 428 (2019). European norm EN 16234-1:2019. e-Competence Framework (e-CF) – A common European Framework for ICT Professionals in all sectors - Part 1: Framework. Brussels: CEN-CENELEC. General information about the e-CF, available at ITPE:

<https://itprofessionalism.org/about-it-professionalism/competences/the-e-competence-framework/> Formal information, available at CEN & CENELEC:

https://standards.cencenelec.eu/dyn/www/f?p=205:110:0:::FSP_PROJECT:67073&cs=15E62ED24D608A5F10D6BEE8E6D50FA10

²⁸ CEN (2022), CEN/TS 17699 Guidelines for developing ICT Professional Curricula as scoped by EN 16234-1 (e-CF). Available at:

https://standards.cencenelec.eu/dyn/www/f?p=CEN:110:0:::FSP_PROJECT,FSP_ORG_ID:72363,1218399&cs=169E9940F2911D404FAE0D4872E5D2630

²⁹ Tuning Association (2010). A Tuning Guide to Formulating Degree Programme Profiles. Available at:

<http://tuningacademy.org/publications>

outcomes³⁰. The level of complexity of the learning outcomes was checked against the EQF³¹.

These first versions were discussed in multiple meetings in the partnership and fine-tuned. The meetings were with experts from the partners. After two introductory meetings, the meetings were split into a subgroup of training providers (mainly focused on EQF 4/5 level) and a subgroup of universities (mainly focused on EQF 6 and 7). This ensured that both subgroup-specific needs, questions and concerns could be addressed. The WP lead with experience and knowledge of both subgroups made sure that the relevant information was shared between the subgroups.

The second phase was to define the unit learning outcomes that make up each programme learning outcome. Again, following the sources used to define the programme learning outcomes and making sure that the set of unit learning outcomes exactly makes up the programme learning outcome. Also, these unit learning outcomes were discussed and finetuned in multiple iterations in the subgroups. To further verify the learning outcomes, they were matched with existing curricula to gain insight into overlaps and missing elements. This led to a set of programme learning outcomes and sets of unit learning outcomes, that form the core of the educational profiles.

The educational profiles were completed with general descriptions that were derived from the ESSA role profiles and with an assessment overview. This assessment overview is a first setup that needs to be further refined in WP4 when the learning activities are established. The constructive alignment of Biggs³² will then be used to align in more detail the learning outcomes, learning activities and assessment. Like in the other stages the drafts were discussed within the partnership and finally approved.

In the course of this process, there were twelve (sub)group meetings held in total fully dedicated to the content of educational profiles. Besides these dedicated meetings, the topic was of continuous attention during all the meetings to follow, leading to further adjustments to the programme learning outcomes, unit learning outcomes, assessments and the general descriptions of the educational profiles.

The next step was to design example curricula based on these educational profiles. Partners were asked to select one to three profiles. For each selected profile they were asked to make the matrix in which learning units were matched with the learning outcomes. In the weekly meetings of the subgroups the progress was discussed and iterations were made. After it became clear which learning outcomes were covered in which way, the partners were

³⁰ CEDEFOP (2014). Terminology of European education and training policy. A selection of 130 key terms. Second edition. Available at: <https://www.cedefop.europa.eu/en/publications/4117>

³¹ European Commission – Education and Culture (2008). The European Qualifications Framework for Lifelong Learning (EQF). Luxembourg: Office for Official Publications of the European Communities. <https://europa.eu/europass/en/europass-tools/european-qualifications-framework>

³² Biggs, J. (1996). Enhancing teaching through constructive alignment. High Educ 32, 347–364. <https://doi.org/10.1007/BF00138871>

asked to develop the curriculum descriptions. These were also discussed in weekly progress meetings. In total there were fourteen meetings dedicated to the example curricula.

6.3 Production of the output

This delivery was produced iteratively in a collaborative way using an online environment enabling synchronous working on the document. It was also discussed in three dedicated meetings in which also the last fine-tuning took place on the educational profiles and example curricula.

Most content-related elements of this report are the result of an intensive collaboration with partners over the whole period of the work package, like described in the paragraph above. The ESSA educational profiles are published as separate documents, besides this more process-oriented report. The relevance of these profiles would have been underexposed if they had been included as an annex.

7 References and resources

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Europass framework for digitally signed credentials

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8 Annexes

8.1 Annex 1: Glossary

This glossary provides a list of key terms that are used hereinafter and their definitions. It is not meant to provide an exhaustive list of all the terms related to the subject of this study.

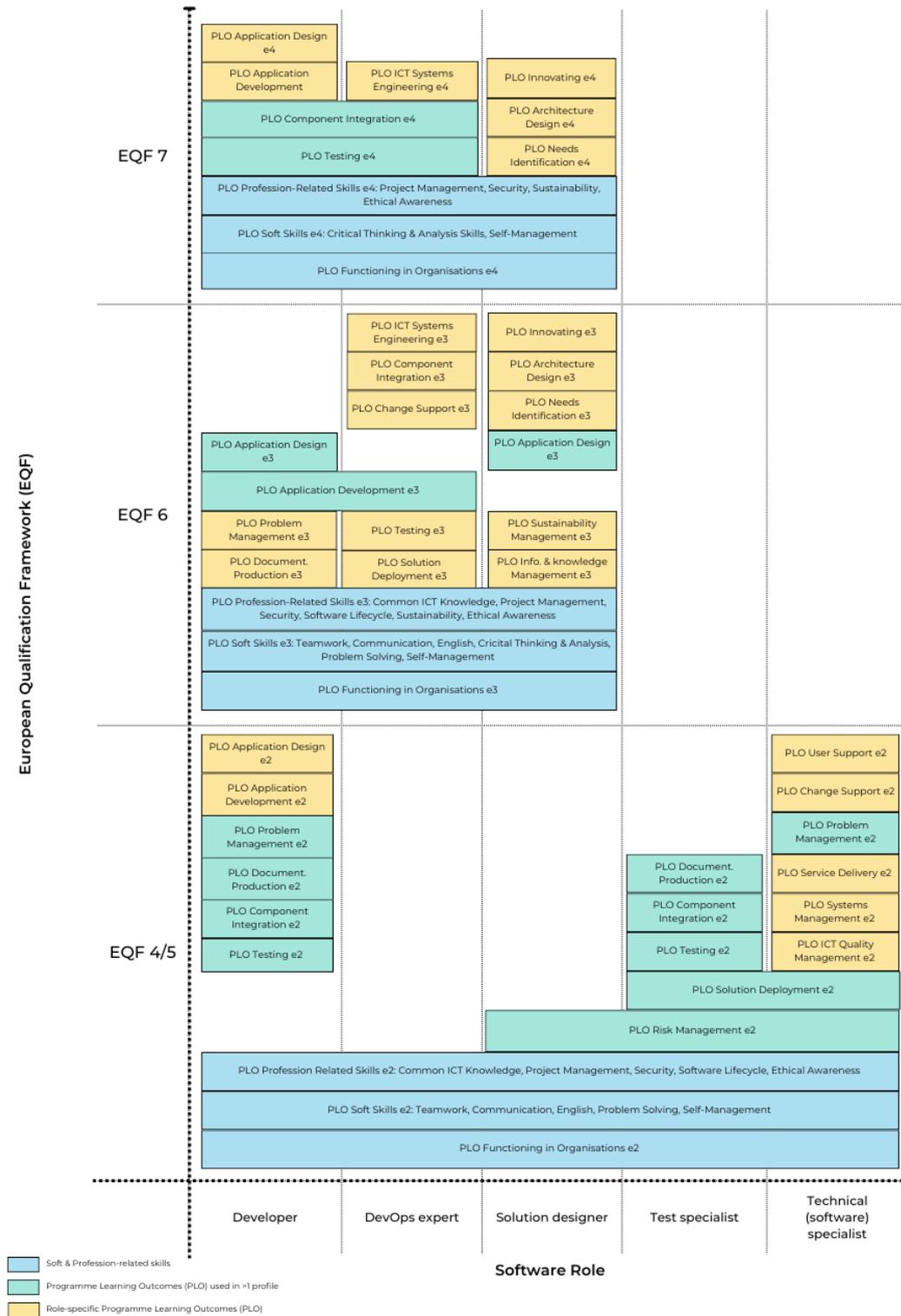
Term	Definition
Accreditation of an education or training programme	Process of quality assurance through which a programme of education or training is officially recognised and approved by the relevant legislative or professional authorities following assessment against predetermined standards. (Cedefop, 2014)
Accreditation of an education or training provider	Process of quality assurance through which an education or an education training provider is officially recognised and approved by the relevant legislative or professional authorities following assessment against predetermined standards. (Cedefop, 2014)
Assessment (of learning outcomes)	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. (Cedefop, 2014)
Certification (of learning outcomes)	Process of issuing a certificate, diploma or title formally of learning outcomes attesting that a set of learning outcomes (knowledge, knowhow, skills and/or competences) acquired by an individual have been assessed by a competent body against a predefined standard. (Cedefop, 2014)
Curriculum	Inventory of activities related to the design, organisation and planning of an education or training action, including definition of learning objectives, content, methods (including assessment) and material, as well as arrangements for training teachers and trainers. (Cedefop, 2014)
Competence	Demonstrated ability to apply knowledge, skills, and attitudes for achieving observable results. (CEN/TC 428, EN 16234-1 (2019))
DevOps	Development methodology aimed at bridging the gap between Development (Dev) and Operations (Ops), emphasizing communication and collaboration, continuous integration, quality assurance, and delivery with automated deployment utilizing a set of development practices. (Jabbari et al., 2016)
Digital badge	Validated indicator of accomplishment, skill or competences, that can be displayed, accessed, and verified online, which describes a specific performance that the recipient has done to earn it. They often represent the completion of a microcredential. (Carey, 2012)
e-Competence Framework (e-CF)	Standard established as a tool to support mutual understanding and provide transparency of language through the articulation of competences required and deployed by Information and Communication Technology (ICT) professionals. (CEN/TC 428, EN 16234, 2019)

Educational credential	Documented statement that acknowledges a person's learning outcomes. (European Micro-Credential Terminology, 2022)
Educational profile	Structure that enables a competence-oriented learning programme design and development, thus providing a link between competences needed in a professional environment and learning outcomes of education and training. It assists planning education and professional accomplishment at individual and institutional levels. (CEN/TC 428, TS 17699, 2021)
European Qualification Framework (EQF)	Overarching framework that makes transparent the relationship between European national (higher) education frameworks of qualifications and the qualifications they contain. It is an articulation mechanism between national frameworks. (Bologna Working Group on Qualifications Frameworks, 2005)
Formal learning	Learning that occurs in an organised and structured environment (such as in an education or training institution or on the job) and is explicitly designated as learning (in terms of objectives, time or resources). Formal learning is intentional from the learner's point of view. It typically leads to certification. (Cedefop, 2014)
Formal recognition (of learning outcomes)	Process of granting official status to learning outcomes knowledge, skills and competences either through: validation of non-formal and informal learning; grant of equivalence, credit units or waivers; award of qualifications (certificates, diploma or titles). (Cedefop, 2014)
Hard skills	Strictly job-specific, closely connected with knowledge, easily observed, measured and trained skills. They constitute the core occupational requirements of a job. (Dall'Amico, E. & Verona, S., 2015)
ICT Professional Role Profiles	These profiles reflect a collection of typical tasks, competences and responsibilities that are to be fulfilled and each profile is given a common use title for ease of identification. They provide a broad picture of the activities performed by individuals engaged in the multitude of positions that make up the ICT profession. ICT Professional Role Profiles are key components of ICT jobs. (CEN Workshop Agreement 16458, 2018)
Informal learning	Learning resulting from daily activities related to work, family or leisure. It is not organised or structured in terms of objectives, time or learning support. Informal learning is in most cases unintentional from the learner's perspective. Informal learning outcomes may be validated and certified; Informal learning is also referred to as experiential or incidental/random learning. (Cedefop, 2014)
Learning environment	Any environment that allows a person to learn in providing certain conditions or procedures to do so; this can be an educational institute, a training facility or a workplace, as well as a face-to-face, hybrid or a virtual environment. (CEN/TC 428, TS 17699, 2022)

Learning outcome	Statements of what a learner knows, understands and is able to do on completion of learning process, which are defined in terms of knowledge, skills and competence. (Cedefop, 2014)
Learning programme	Inventory of activities, content and/or methods implemented to education or training achieve education or training objectives (acquiring knowledge, skills and/or competences), organised in a logical sequence over a specified period of time. (Cedefop, 2014)
Learning path	Specific route that reflects a person's subsequent learning activities undertaken in a specific learning environment throughout his/her life, career or study. (CEN/TC 428, TS 17699, 2022)
Micro-credential	Sub-unit of a credential that could accumulate into a larger credential or degree or be part of a portfolio. Micro-credentials are frequently portrayed and promoted as a new way for individuals to build their own skills profile (portfolio) by collecting and “stacking” learning in flexible ways, at their own pace and according to their own priorities. Micro-credentials certify the learning outcomes of short-term learning experiences, for example, a short course or training. They offer a flexible, targeted way to help people develop the knowledge, skills and competences they need for their personal and professional development. (European Micro-Credential Terminology, 2022; Cedefop, 2021 & European Approach to Micro-Credentials, 2022)
Modular programmes	Programmes that are composed of small discrete modules or learning units that are virtually self-contained, independent, nonsequential, and typically short in duration. Modular programmes allow students to compose the content of their education in a flexible way by combining different courses or modules. (French, 2015; UNESCO, 2011)
Non-formal learning	Learning which is embedded in planned activities not explicitly designated as learning (in terms of learning objectives, learning time or learning support), but which contain an important learning element. Non-formal learning is intentional from the learner's point of view. It typically does not lead to certification. (Cedefop, 2014)
Profession-related skills	Skills that are necessary to fulfil professional tasks and are relevant for a broader range of different roles related to a certain profession. They are not related solely to one specific role. (ESSA Consortium, 2022)
Qualification	An official record (certificate, diploma) of achievement which recognises successful completion of education or training, or satisfactory performance in a test or examination; and/or the requirements for an individual to enter, or progress within an occupation. (UNESCO, 1984)
Reskilling	Training enabling individuals to acquire new skills and knowledge giving access either to a new occupation or to new professional activities. (Cedefop, 2014)

Skilling	Training enabling individuals to acquire new skills and knowledge giving access either to an occupation or to professional activities. (Cedefop, 2014).
Skills	Ability to apply knowledge and use know-how to complete tasks and solve problems. Skills can be cognitive (involving the use of logical, intuitive, and creative thinking) or practical (involving manual dexterity and the use of methods, materials, tools and instruments). (Council of the European Union, 2017)
Skills for software professionals	Skills necessary to perform tasks that lead to the design, development, deployment and/or maintaining of software. They can be grouped in hard, profession related and soft skills. (ESSA Consortium, 2022).
Skills gap	Situation where an individual does not have the kind and/or level of skills required to perform their job adequately. (Cedefop, 2014).
Soft skills	Patterns of thought, feelings and behaviours that are socially determined and can be developed throughout the lifetime to produce value. These are cross-cutting skills across jobs roles and sectors that relate to personal competences (confidence, discipline, self-management) and social competences (teamwork, communication, emotional intelligence). (Borghans, 2008; Dall’Amico, E. & Verona, S., 2015).
T-shaped professionals	Professionals who have a depth of knowledge and skills in a specific domain or field (the vertical bar on the letter T) and also have broad knowledge and skills across multiple fields or disciplines (the horizontal bar on the letter T), which enables them to collaborate across disciplines with experts in other areas. (Adapted from Gardner, 2017; Brown, 2009).
Upskilling	Short-term targeted training typically provided following initial education or training, and aimed at supplementing, improving or updating knowledge, skills and/or competences acquired during previous training. (Cedefop, 2014).
Validation (of learning outcomes)	Confirmation by a competent body that learning outcomes (knowledge, skills and/or competences) acquired by an individual in a formal, non-formal or informal setting have been assessed against predefined criteria and are compliant with the requirements of a validation standard. Validation typically leads to certification. (Cedefop, 2014).
Work-based learning	Learning that takes place through some combination of observing, undertaking, and reflecting on productive work in real workplaces. It may be paid or unpaid and includes a diversity of arrangements like apprenticeships, dual programmes, traineeships, internships, job shadowing, and other work placements used as part of school-based VET programmes. (OECD, 2016; UNESCO, 2015).
π-shaped professionals	Professionals who have a depth of knowledge and skills in two specific domains or fields (the two vertical bars of the π-shape) and have broad knowledge and skills across multiple fields or disciplines (the horizontal bar of the π-shape), which enables them to bridge the gap between the two domains or fields and also to collaborate with experts in other areas. (Adapted from Friedlein, 2013).

8.2 Annex 2: Detailed overview of ESSA educational profiles per EQF levels with PLOs



8.3 Annex 3: Educational profile template

See below the structure of the template. **You can download the Word document [HERE](#).**

EDUCATIONAL PROFILE
<Name of the educational profile>
<EQF level>

This educational profile belongs to the field of <field> and is covered by relevant references in <e-CF number> (e-CF) and ISO/IEC/IEEE <ISO number>.

<Insert general description of the professional role>

<Insert EQF level-specific description of the role on this level, e.g., junior developer>

About this profile



<Short overview: for whom is the profile (previous ICT knowledge required/not required); 3 main learning outcomes.>

The profile has an EQF X level. <No prior knowledge of the topic is required. OR Prior knowledge of the topic is required>

This level requires:

- <insert list of requirements for this EQF level>

Competences

e-CF competences (incl. e-CF level)	General competences (incl. EQF level)
<insert list of e-CF competences, e.g., A.6. Application Design [e-2]>	<insert list of general competences and EQF levels, e.g., N.T. New Technology (EQF5)>

Deliverables

Learners should master the following deliverables:

- <insert list of deliverables, e.g., Code and related documentation>

Professional perspectives

Upon completing this programme, the learner is eligible to apply for **<insert name of the role profile, e.g., junior developer> positions**, such as <insert list of job profiles, e.g., Web Developer, Computer Programmer>.

Educational perspectives

The learner may continue in a **<name of a more advanced programme> with a focus on** <include a possible focus>.

The learner also has a proper base for further training and certification such as <insert a list of possible further training and certifications, e.g., Data analytics, Software architecture, Blockchain>.

Programme Learning Outcomes (PLO)

1. PLO <Insert name of the PLO>

The learner has demonstrated capability

→ <list of capabilities>

Unit learning outcomes	<list of Unit learning outcomes part of this PLO>

2. PLO <Insert name of the PLO>

The learner has demonstrated capability

→ <list of capabilities>

Unit learning outcomes	<list of Unit learning outcomes part of this PLO>

Assessments

Unit learning outcome	Assessment method	Validation of prior acquired competences (skills and knowledge)
<number>	<method>	<type of assessment/ certification>

8.4 Annex 4: Curriculum description template

See below the structure of the template. **You can download the Word document [HERE](#).**

General information

Name	<e.g. ESSA Junior Developer>
EQF Level	<e.g. 5>
Goals	X Y Z
Scope	<about target groups: everybody, people that already have prior acquired competences only will have to do parts of curriculum>
Programme Learning Outcomes	<overview, copy from educational profile>

Description of the structure

<explain modularity; connection between (groups of) learning units etc.>

Overview of the Learning Units

Learning Unit Title	ECTS	EQF	Assessment <e.g. exam, practical, report>

Details of Learning Units

<Learning Unit Title>	...ECTS	...EQF
<short description of the Learning Unit>		
Related (Programme) Learning Outcomes(s) - PLOs		
<ul style="list-style-type: none"> • <PLO...1> • <PLO...2> 		
Unit Learning Outcomes	Assessments	
<Unit Learning Outcome(s) covered in the course> <add "(complete)" or "(partly)" depending on the ULO is covered completely in this course or that only part is covered and the rest in other learning units> <in case of partly please indicate which part is covered if possible>	<Assessment incl. short info like criteria or level/kind of assessment>	
Delivery method(s)		
<e.g., f2f or online lectures, knowledge clips, videos, quizzes practical assignment, groupwork, etc. These are proposed methods that seem the most relevant given the nature of the unit learning outcomes covered in the learning unit>		
Materials		
<What materials must be available or must be developed. Like slide desks, literature (articles, book(s)); These are first suggestions to be refined during WP4>		

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