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European Software  
Skills Alliance.

# A Software Skills Strategy for Europe.

HOW TO BRIDGE THE SOFTWARE SKILLS GAP  
WITH TRAINING, EDUCATION, AND VALIDATION

**Draft version**



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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 Vocational Education and Training 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

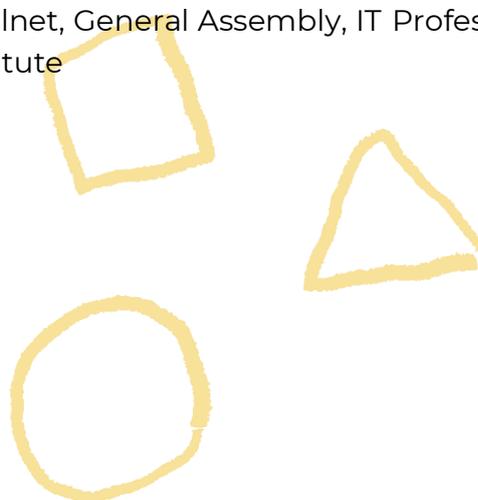
The ESSA consortium is composed of 26 partners from the academic and non-academic sectors involved in the education, training and software sectors.

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## Table of Contents

<b>1</b>	<b>Executive Summary.....</b>	<b>13</b>
1.1	Scope and starting points .....	13
1.2	Key skills.....	13
1.3	Skills training .....	14
1.4	Software role profiles.....	14
1.5	Educating for roles .....	14
1.6	Validation.....	15
1.7	Activities and outputs.....	15
<b>2</b>	<b>Introduction.....</b>	<b>17</b>
2.1	Mission.....	17
2.2	Scope.....	18
2.2.1	Software services .....	18
2.2.2	Role profiles and competences (skills, knowledge, attitude) .....	19
2.2.3	Education and training.....	21
2.2.4	Organisations with software needs.....	21
2.2.5	(Future) professionals.....	22
2.2.6	Learning providers .....	22
2.3	Starting points.....	23
2.3.1	EU initiatives and focal points .....	23
2.3.2	Frameworks.....	23
2.3.2.1	e-CF.....	24
2.3.2.2	ICT professional role profiles.....	25
2.3.2.3	ESCO.....	25
2.3.3	Research.....	25
2.3.3.1	ESSA software skills Needs Analysis.....	25
2.3.3.2	CEDEFOP .....	26
2.4	Elements of the software skills strategy .....	26
<b>3</b>	<b>Key skills .....</b>	<b>28</b>
3.1	Hard software skills.....	28
3.1.1	Programming skills.....	28
3.1.2	Other hard skills.....	28
3.2	Profession-related skills.....	29
3.2.1	(Agile) project skills .....	29
3.2.2	Security skills.....	29
3.2.3	Software lifecycle skills.....	29
3.2.4	Sustainability skills.....	29
3.2.5	Ethical awareness skills.....	30
3.3	Soft skills .....	31

3.3.1	Interpersonal soft skills .....	31
3.3.2	Personal soft skills.....	31
<b>3.4</b>	<b>Skills overview .....</b>	<b>32</b>
<b>4</b>	<b>Skills Training .....</b>	<b>34</b>
<b>4.1</b>	<b>Staying up to date .....</b>	<b>34</b>
4.1.1	Ways of skills development .....	34
4.1.2	Organisations and learning providers together .....	36
4.1.3	Up to date training.....	37
<b>4.2</b>	<b>Flexible training .....</b>	<b>38</b>
4.2.1	Self-paced.....	38
4.2.2	Modular training .....	39
4.2.3	Innovative methods of delivery .....	39
<b>5</b>	<b>Software role profiles .....</b>	<b>42</b>
<b>5.1</b>	<b>T-shaped and <math>\pi</math>-shaped professionals.....</b>	<b>43</b>
5.1.1	Specialisation(s) to stand on .....	43
5.1.2	Broad reach through (profession-related and soft) skills.....	43
<b>5.2</b>	<b>Improved role profiles .....</b>	<b>44</b>
5.2.1	ESSA adjustment proposals to software role profiles .....	44
5.2.2	Soft skill set.....	45
5.2.3	Profession-related skill set.....	45
5.2.4	Developer .....	46
5.2.5	DevOps expert.....	46
5.2.6	Solution designer .....	46
5.2.7	Test specialist.....	47
5.2.8	Technical (software) specialist.....	47
<b>5.3</b>	<b>European educational profiles for software roles .....</b>	<b>47</b>
5.3.1	The educational profile .....	47
5.3.2	Starting points for educational profiles for software roles .....	48
<b>6</b>	<b>Educating for roles.....</b>	<b>51</b>
<b>6.1</b>	<b>Skilling and reskilling.....</b>	<b>51</b>
6.1.1	Initial educational programmes .....	51
6.1.2	Reskilling programmes .....	52
<b>6.2</b>	<b>Mobility.....</b>	<b>53</b>
6.2.1	Cross-border mobility .....	53
6.2.2	Localisation.....	53
6.2.3	Language skills.....	54
<b>6.3</b>	<b>Modularity.....</b>	<b>54</b>
6.3.1	Easier to exchange/ update parts.....	54

6.3.2	Exemptions for previous learning .....	55
<b>6.4</b>	<b>Individualised pathways .....</b>	<b>55</b>
<b>6.5</b>	<b>Recommendations outside the direct scope of ESSA.....</b>	<b>56</b>
<b>7</b>	<b>Validation .....</b>	<b>58</b>
7.1	Assessment .....	58
7.2	Certification.....	59
7.3	Accreditation .....	60
<b>8</b>	<b>Overview.....</b>	<b>62</b>
8.1	Overview of strategy statements .....	62
8.1.1	Training .....	62
8.1.2	Education .....	62
8.1.3	Validation.....	63
8.2	Outputs.....	63
8.3	Activities & milestones .....	64
8.3.1	Activities & milestones 2022.....	64
8.3.2	Activities & milestones 2023.....	65
8.3.3	Activities & milestones 2024.....	66
<b>9</b>	<b>References and resources.....</b>	<b>67</b>
<b>10</b>	<b>Annexes .....</b>	<b>69</b>
	<b>Annex 1: Software professional role profiles .....</b>	<b>69</b>
	Improved role: Developer .....	70
	Improved role: DevOps expert.....	71
	Improved role: Solution designer .....	72
	Improved role: Test specialist .....	73
	Improved role: Technical (software) specialist .....	74

## List of Figures

Figure 1	European ICT professional role profiles and ESSA scope .....	20
Figure 2	Relation role profile, e-CF competences and knowledge.....	20
Figure 3	Overview of e-CF competences .....	24
Figure 4	Elements of the Software Skills Strategy.....	26
Figure 5	Skills overview .....	32
Figure 6	The position of the educational profile.....	48

## Glossary

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

Term	Definition
<b>Accreditation of an education or training programme</b>	A 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.
<b>Accreditation of an education or training provider</b>	A 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.
<b>Assessment</b> (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.
<b>Associate degree</b>	Qualification awarded after successful completion of the so-called short cycle in the Qualifications Framework of the European Higher Education Area (EQF). The short cycle fits within or is linked to the first cycle (or bachelor's level). The degree requires approximately 120 ECTS credits.
<b>Bachelor's degree</b>	Qualification awarded after successful completion of the first cycle in the Qualifications Framework of the European Higher Education Area (EQF). The degree usually requires a minimum of 180 and a maximum of 240 ECTS.
<b>Certification</b> (of learning outcomes)	The process of formally validating knowledge, know-how and/or competences acquired by an individual, following a standard assessment procedure. Certificates or diplomas are issued by accredited awarding bodies.
<b>Competence</b>	Demonstrated ability to apply knowledge, skills, and attitudes for achieving observable results.
<b>Digital badge</b>	A 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.
<b>Doctorate degree</b>	Qualification awarded after successful completion of the third cycle in the Qualifications Framework of the European Higher Education Area (EQF). The degree usually requires a three to four years of study, mostly as a period of research.
<b>e-Competence Framework (e-CF)</b>	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. The standard "EN 16234-1:2019 e-Competence Framework (e-CF) – A common European Framework for ICT Professionals in all sectors - Part 1: Framework" is published as a European Norm and has been prepared by the Technical Committee CEN/TC 428 "ICT professionalism and digital competences".
<b>Educational credential</b>	Documented statement that acknowledges a person's learning outcomes.
<b>EQF level 4</b>	is defined by [...] a range of cognitive and practical skills required to generate solutions to specific problems in a field of work or study [...]

<b>EQF level 5</b>	is typically related to the associate degree or equivalent degrees and is defined by [...] a comprehensive range of cognitive and practical skills required to develop creative solutions to abstract problems [...]
<b>EQF level 6</b>	is typically related to the bachelor degree or equivalent degrees and is defined by [...] advanced skills, demonstrating mastery and innovation, required to solve complex and unpredictable problems in a specialised field of work or study [...]
<b>EQF level 7</b>	is typically related to the master's degree or equivalent degrees and is defined by [...] specialised problem-solving skills required in research and/or innovation in order to develop new knowledge and procedures and to integrate knowledge from different fields [...]
<b>EQF level 8</b>	is typically related to the doctorate degree or equivalent degrees and is defined by [...] the most advanced and specialised skills and techniques, including synthesis and evaluation, required to solve critical problems in research and/or innovation and to extend and redefine existing knowledge or professional practice [...]
<b>European Qualification Framework (EQF)</b>	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. The levels 4 until 7 are the most relevant levels for this project.
<b>European Skills, Competences, Qualifications and Occupations (ESCO)</b>	The multilingual ESCO classification identifies and categorises skills, competences, qualifications, and occupations relevant for the EU labour market and education and training. It systematically shows the relationships between the different concepts.
<b>Formal learning</b>	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.
<b>Formal recognition (of learning outcomes)</b>	Process of granting official status to learning outcomes knowledge, skills and competences either through: <ul style="list-style-type: none"> <li>• validation of non-formal and informal learning;</li> <li>• grant of equivalence, credit units or waivers;</li> <li>• award of qualifications (certificates, diploma or titles).</li> </ul>
<b>Hard skills</b>	Strictly job-specific, closely connected with knowledge, easily observed, measured and trained skills. They constitute the core occupational requirements of a job.
<b>Higher or upper VET</b>	Composed of: a) post-secondary level VET, offered outside higher education; b) higher-level continuing VET (CVET) offered within or outside the formal education system (usually after entry into working life); qualification here often gives access to nationally recognised qualifications but the target is adult learners; qualifications are often based on professional experience and examinations (competence tests); c) higher-level CVET provided outside the formal education system (by adult education centres, public employment services or private companies), which do not fall into the above categories. Higher VET relates to EQF levels 5 to 8.
<b>ICT Body of Knowledge (ICT BoK)</b>	Structured set of information including, terminology, concepts, models, and theories which represent the accepted and agreed upon core knowledge base required by the ICT profession.
<b>ICT Professional Role Profiles</b>	Provide a broad picture of the activities performed by individuals engaged in the multitude of positions that make up the ICT profession. 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. ICT Professional Role Profiles are key components of ICT jobs, as described in the report of the CEN Workshop Agreement “CWA 16458-1 European ICT Professionals Role Profiles - Part 1: 30 ICT Profiles”.
<b>ICT sector</b>	The sector that fulfils or enables the function of information processing and communication by electronic means, including transmission and display. The ICT sector is composed of economic activities related to ICT Manufacturing and ICT Services.
<b>Informal learning</b>	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.
<b>Information and Communication Technology (ICT)</b>	Digital computers and internet (communication) systems, including software, hardware and networks.
<b>Initial education</b>	Formal education of individuals before their first entrance to the labour market, i.e., when they will normally be in full-time education. It thus targets individuals who are regarded as children, youth, and young adults by the society to which they belong. It is typically provided by educational institutions in a continuous educational pathway.
<b>International Standard Classification of Education (ISCED)</b>	Global reference classification for education systems and it provides a comprehensive framework for organising education programmes and qualification by applying uniform and internationally agreed definitions to facilitate comparisons of education systems across countries.
<b>Knowledge</b>	Theoretical or practical understanding and awareness of phenomena such as facts, terminology, concepts, models, or theories that are related to a field of work or study. Knowledge is the outcome of the assimilation of information through learning and is theoretical and/or factual.
<b>Learning</b>	Process by which an individual assimilates information, ideas and values and thus acquires knowledge, know-how, skills and/or competences. Learning occurs through personal reflection, reconstruction and social interaction. It may take place in formal, non-formal or informal settings.
<b>Learning outcome</b>	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.
<b>Lifelong learning</b>	All learning activity undertaken throughout life, with the aim of improving knowledge, skills/competences and/or qualifications for personal, social and/or professional reasons.
<b>Master's degree</b>	Qualification awarded after successful completion of the second cycle in the Qualifications Framework of the European Higher Education Area (EQF). The degree usually requires a minimum of 90 ECTS, of which at least 60 ECTS at master's level.
<b>Microcredentials</b>	Sub-unit of a credential that could accumulate into a larger credential or degree or be part of a portfolio. Microcredentials 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.

	A micro-credential is a proof of the learning outcomes that a learner has acquired following a short learning experience. These learning outcomes have been assessed against transparent standards.
<b>Non-formal learning</b>	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.
<b>Post-secondary, non-tertiary education</b>	Encompasses qualifications that are considered to be beyond secondary education but are not included in the tertiary sector. Post-secondary non-tertiary education provides learning experiences building on secondary education, preparing for labour market entry as well as tertiary education. Students entering will have usually completed upper secondary education. Programmes usually have a full-time equivalent duration of between 6 months and 2 years. Post-secondary, non-tertiary education relates to EQF levels 4 and 5 and ISCED level 4.
<b>Prior learning</b>	The knowledge, know-how and/or competences acquired through previously unrecognised training or experience.
<b>Profession-related skills</b>	Skills related to the broader ICT-sector that are necessary to do software related roles well.
<b>Qualification</b>	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.
<b>Qualification system</b>	All activities related to the recognition of learning outcomes and other mechanisms that link education and training to the labour market and civil society. These activities include: <ul style="list-style-type: none"> <li>• definition of qualification policy, training design and implementation, institutional arrangements, funding, quality assurance;</li> <li>• assessment and certification of learning outcomes.</li> </ul> Comment: a national qualifications system may be composed of several subsystems and may include a national qualifications framework.
<b>Reskilling</b>	Training enabling individuals to acquire new skills and knowledge giving access either to a new occupation or to new professional activities.
<b>Short cycle tertiary education</b>	Programmes at this level are often designed to provide participants with professional knowledge, skills, and competences. Typically, they are practically based, occupational-specific and prepare students to enter the labour market. However, these programmes may also provide a pathway to other tertiary education programmes. Short cycle tertiary education relates to EQF level 5 and ISCED level 5.
<b>Skilling</b>	Training enabling individuals to acquire new skills and knowledge giving access either to an occupation or to professional activities.
<b>Skills</b>	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).
<b>Skills gap</b>	Situation where an individual does not have the kind and/or level of skills required to perform their job adequately.
<b>Soft skills</b>	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).
<b>Software skills</b>	Particular or specialised skills necessary to perform tasks that lead to the design, development, deployment and/or maintaining of software.
<b>T-shaped professionals</b>	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.
<b>Tertiary education</b>	Third level education that encompasses bachelor, master and doctorates or equivalents. Vocationally oriented education and training at tertiary qualifications level means education and training that can contain aspects of both academic and vocational areas typically with the majority of vocational aspects (e.g., Universities of applied sciences, Polytechnic institutes). It is usually located at levels equivalent to EQF levels 6 to 8 and ISCED levels 6 to 8.
<b>Transferable skills</b>	Skills learned in one context that are useful for another. They can serve as a bridge from study to work and from one career to another, as they enable subject and research-related skills to be applied and developed effectively in different work environments.
<b>Upper-secondary education</b>	Encompasses educational institutions that focus on general or vocational education. Programmes at this level are typically designed to complete secondary education in preparation for tertiary education, or to provide skills relevant to employment, or both. Pupils enter this level typically between ages 14 and 16. Upper secondary education relates to EQF levels 3 to 5 and ISCED level 3.
<b>Upskilling</b>	Training enabling individuals to acquire new skills and knowledge for a certain occupation, often to keep up to date with market developments or legislative changes.
<b>Validation (of learning outcomes)</b>	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.
<b>Vocational Education and Training (VET)</b>	Education and training which aims to equip people with knowledge, know-hows, skills and/or competences required in particular occupations or more broadly on the labour market. Vocational Education and Training covers upper-secondary, post-secondary, non-tertiary, and tertiary levels of education.
<b>Work-based learning</b>	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.
<b>Π-shaped professionals</b>	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.

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The authors would like to thank all ESSA partners who provided their valuable input during the process and are, to this extent, the co-authors of this Software Skills Strategy.

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**01.**

# **Executive Summary**



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## 1 Executive Summary

The Software Skills Strategy wants to bridge the current and emerging skills gaps via Vocational Education and Training (VET) programmes. It is aligned with the overall mission of the European Software Skills Alliance (ESSA): offering the learning instruments to skill, reskill, and upskill individuals into high demand professional software roles in Europe.

### 1.1 Scope and starting points

The strategy translates the results from the [ESSA's Needs Analysis](#) in a structured way and with a specific focus on **skilling, reskilling, and upskilling**. It focuses only on professionals involved in the development, implementation, and operation of software. The 5 CEN European ICT Professional Role Profiles selected are Developer, DevOps expert, Solution designer, Test specialist, and Technical (software) specialist.

Besides **VET programmes** to train these professionals, a **certification framework** will be developed to validate acquired competences and skills. This framework and the VET programmes will be aligned with standards like the **e-Competence Framework (e-CF)**.

This strategy is relevant for organisations with software needs, learning providers on VET level, and of course (future) professionals working in software roles.

### 1.2 Key skills

The ESSA Needs Analysis report showed that there are three important skills categories for professionals in software roles:

- **Hard software skills:** These are primarily programming skills like for example Java, SQL and Python, but also other skills like testing and debugging, algorithm skills, and DevOps skills.
- **Profession-related skills:** These are skills related to the ICT professional field in general like project skills, security skills, software lifecycle skills, sustainability skills, and ethical awareness skills.
- **Soft skills:** These are interpersonal soft skills like teamwork skills and communication skills and personal soft skills like critical thinking & analysis, problem solving, and self-management.

### 1.3 Skills training

The training of skills takes place in many forms and in **formal, non-formal** and **informal** learning settings. It requires **cooperation** between organisations with software needs and learning providers like work-based learning opportunities.

In general, training should be **flexible** to widen access to many professionals. **Self-paced** learning and concepts like **microlearning** will support this. As well as the use of **innovative methods of delivery** to increase the attractiveness and quality of training such as flipped classroom, gamification, and peer learning.

### 1.4 Software role profiles

**T-shaped** and **π-shaped professionals** are needed in the software sector. These are professionals that will not only be able to programme and maintain software, but also have a broad range of skills to function well in multidisciplinary teams. **π-shaped** professionals are especially in demand because they have a second specialism besides software, so they can understand the business and ICT side of things very well.

The software-related ICT role profiles were adjusted to emphasise the importance of these kind of professionals. **Two skill sets** were added to all the profiles:

Soft skill set	Profession-related skill set
A set of skills that is transferable to other fields and that include teamwork, communication, critical thinking, problem solving, self-management, and English language.	This skill set includes skills related to the field like skills involving security, (agile) project management, software development lifecycle, sustainability, and ethical awareness.

The adjusted role profiles will be translated in educational terms by using the **educational profile**, ensuring this way that learning programmes are adapted to market needs.

### 1.5 Educating for roles

The education of software professionals is about skilling and reskilling people. **VET curricula** will be formulated based on educational profiles and subsequently **learning programmes** developed to train people.

The reskilling of individuals into software professionals will take place by using **flexible learning paths** in the modular VET programmes. **Modularity** is key in creating flexibility in VET programmes since it also makes exemptions for previous learning possible.

Two other important aspects are cross-border **mobility** and **localisation** to help close the skills gap between demand and supply.

## 1.6 Validation

**Assessments** can validate the achievement of learning outcomes and, to formalise these achievements, certification is important. The creation of a **certification framework** based on the principles of **micro-credentialling** and using **digital badges** will make the supply of software professionals and their skills more visible. The accreditation of programmes assures that software professionals are educated or trained to meet the ESSA standards.

## 1.7 Activities and outputs

The outputs of this Software Skills Strategy will be developed in the coming years in respective work packages. Starting off with **curricula, qualification / certification** frameworks, **accreditation** standards and a **mobility** programme. After that **VET programmes and materials** will be developed and pilot training programmes conducted. These programmes will include a **work-based learning component** and there will also be a **train the trainer** programme.

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**02.**

# **Introduction**



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## 2 Introduction

We are proud to present the **European Software Skills Strategy** — a document that defines actions to bridge the software skills gap via Vocational Education and Training (VET) programmes. This Software Skills Strategy is part of the work conducted in ESSA's Work Package 2 (WP2).

The Work Package is composed of three main outputs as follows:

- Profiles, competences, and skills Needs Analysis based on current EU initiatives/sources, and primary research among industry stakeholders,
- An innovative new European Software Skills Strategy to bridge the current and emerging skills gap via VET programmes,
- A strategy review process to update the European Software Skills Strategy.

### 2.1 Mission

The traditional role of a software professional is changing. New tools and technologies are emerging. The way software is developed is changing with organisations adopting agile methodologies in addition to a significant drive towards cloud-based application development and secure and sustainable development practices. All of these require the development of new ways of working, new skills, and competences. In addition, how and who developers work with is evolving, requiring more collaboration and teamwork as different roles and different professional fields within and outside the software life cycle work together to achieve the end result.

As the arena of software development is constantly changing, the market demand for software skills is also changing. Education and training to fulfil this changing market demand are essential.

Therefore, the **overall mission of the ESSA project** is:

*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.*

It is imperative that the ESSA project results are sustainable. With a changing software arena and fluctuating skills, it is important to formulate a Software Skills Strategy that is resilient in that it includes core fundamentals and is also flexible enough to respond to future changes.

The Software Skills Strategy is in line with the overall mission of the ESSA project and provides a further finetuning of it, in line with the description in the ESSA grant proposal. According to this grant proposal, the Strategy should describe “concrete actions, and a clear set of activities, milestones, and well-defined outputs that will address sector skills gaps”. Furthermore, the Software Skills Strategy should bridge these “current and emerging skills gaps via VET programmes”.

The Software Skills Strategy:

- Translates the results from the Needs Analysis in a **structured approach** with specific actions
- Is focused on **education** and **training**
- Uses **VET programmes** to close the software skills gap
- Describes how ESSA will **deliver the outputs** related to education and training as listed in the project plan
- Provides the foundation for the development of **educational profiles**, that are the basis for the development of the **VET curricula**, the **certification** framework, and the **education and training materials**.
- Covers **skilling, reskilling, and upskilling** practices
- Encourages **cooperation** between organisations and learning providers
- Creates European-wide **recognised programmes** by use of (European) frameworks, standards, and policies
- Is **flexible** so that project results can maintain relevance in the future.

## 2.2 Scope

The demarcation that follows from the Software Skills Strategy as described above is outlined in detail below.

### 2.2.1 Software services

The European Commission (2021) proposed a [Digital Compass](#) to translate Europe’s Digital Decade ambitions into concrete targets. Part of the first of four cardinal points is to have 20 million ICT specialists in the EU by 2030. These ICT specialists are referred to as highly skilled digital professionals.

A subgroup of these ICT or digital professionals are professionals working in software services. These professionals are working on the **development, implementation and operation of software**.

In this strategy, software skills refer to the skills these software professionals need to perform their tasks. Software skills in this strategy are not to be understood as

the generic skills people need to effectively use software. It is also not focused on other ICT professional sub-domains, like data analysis, IT security, and so on.

## 2.2.2 Role profiles and competences (skills, knowledge, attitude)

Role profiles (occupational profiles) and competences are an important aspect of the scope of this Strategy. Competences are a mixture or a combination of skills, knowledge, and attitudes that enable someone to successfully perform a task or an activity within a given context. They are also part of role profiles as required competences for a particular role.

In any professional field a certain set of competences is relevant and each of these competences will have associated skills and knowledge. This automatically implies that a certain skill set and a certain set of knowledge are relevant to a field if a certain set of competences are relevant. This means that when looking at specific roles within that professional field, a selection of those competences (skills and knowledge) has to be made of only those competences that relate to the specific roles.

The CEN defined [European ICT Professional Role Profiles](#) (CEN/CWA 16458-1) based on the competences of the [European e-Competence Framework](#) (“e-CF”, EN 16234-1). ESSA adopts the European ICT Professional Role Profiles as a reference framework. These role profiles cover the whole ICT field and therefore a selection was made of the roles and competences that deal directly with the development and operation of software. The findings from the Needs Analysis endorse this selection.

The selected role profiles that have software development and operation as an essential element of their role are:

- Developer
- DevOps expert
- Solution designer
- Test specialist
- Technical (software) specialist

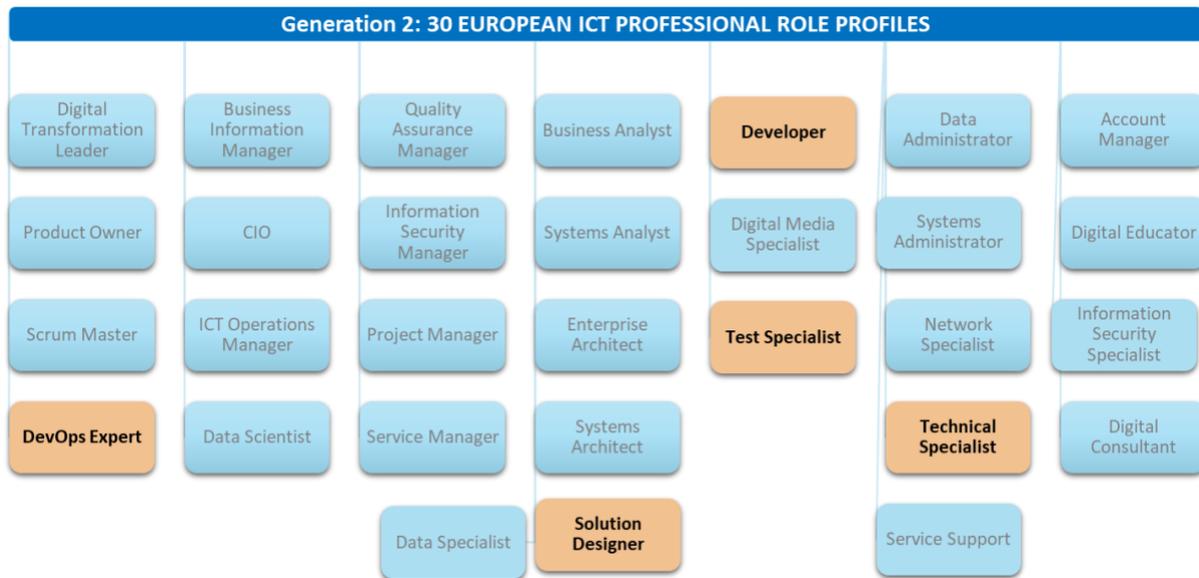


Figure 1 European ICT professional role profiles and ESSA scope

These Role Profiles are also at a fairly high level of abstraction so normally require organisations to add more detail to suit their particular needs. These selected role profiles are improved and expanded, based on the findings in the Needs Analysis. These selected and improved role profiles will include the related competences from the European e-Competence Framework (“e-CF”, EN 16234-1), and underlying knowledge and skills. They are discussed further in chapter 5.

As competences are typically composed of certain skills, knowledge and attitude, these are automatically included in the selection as well.

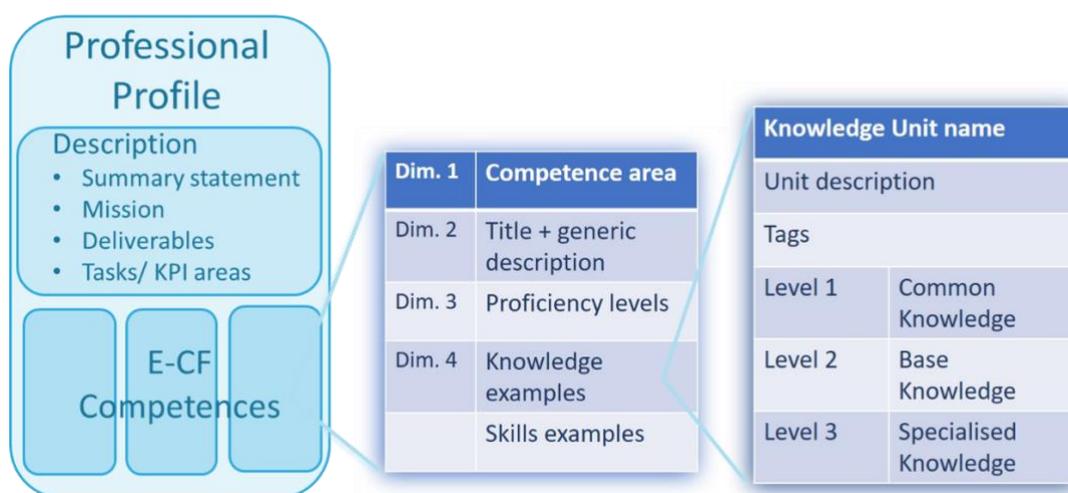


Figure 2 Relation role profile, e-CF competences and knowledge

### 2.2.3 Education and training

The approved and funded ESSA project description states that the main way for ESSA to reach its goals is by developing innovative **VET programmes** designed to match specific occupational profiles in software. This means that the VET programmes should educate for roles, competences, knowledge and skills that are indicated as central to this project. This implies that the European ICT Professional Role Profiles (CEN/CWA 16458-1) will be used, combined with relevant competences, skills, knowledge, and attitude from the European e-Competence Framework (“e-CF”, EN 16234-1), as discussed in the former paragraph. Furthermore, the VET programmes should be on VET or higher VET level, incorporating upper secondary VET (EQF3/4), post-secondary/ tertiary VET (EQF 4/5), and higher VET (EQF 5/7).

The educational programme or training must be directly related to and prepare for the occupational field. Especially on the higher EQF levels extra attention has to be paid that the programme is *really* a VET programme or training and *not* a scientific or general education.

The aim is to educate or train learners to obtain learning outcomes. Therefore, ESSA is focused on formal learning in a formal learning setting.

At the same time ESSA recognises the importance of non-formal and informal learning in skills development.

Besides VET programmes, a **certification framework** will be developed, that validates competences and skills, in a learning path independent manner. This implies that results from any form of learning, formal, non-formal, and informal learning can be officially recognised. In relation to software developers this is important, as they often use non-formal and informal ways of learning to upskill themselves.

### 2.2.4 Organisations with software needs

Important actors in this strategy are the organisations that will make use of the educated and trained software professionals. These **organisations with software development and operations needs** can be categorised into two main groups:

- IT organisations (large and SME) that develop & operate software
- Other organisations with their own software development & operation needs

Organisations that use off-the-shelf software solutions are not targeted in this strategy since they do not employ software professionals.

## 2.2.5 (Future) professionals

The **software professionals** that have to fulfil the needs of organisations can be categorised in three groups:

- People following/ wanting to follow initial education in software roles (to **skill**)
- Professionals working in software roles (to **upskill**)
- Professionals in other roles that want to work in software roles (to **reskill**)

Software professionals from all these groups will be needed to fill the software related ICT vacancies in the coming years. Given the fact that women make up only 22-35% of software developers in all EU countries, a key objective of the European Commission is to break down the barriers that prevent women entering software education and working in the profession, so this strategy will include ways to make software education and training more appealing and accessible for women.

## 2.2.6 Learning providers

The group of formal learning providers consists of three subgroups that also have related partners in their eco-system that are important for the success of this strategy. These groups are:

- VET providers (in the case of standardised programmes: education policy makers are representing the VET providers)
- Higher VET providers
- Training providers (incl. certification bodies and internal training departments within organisations)

Training providers include departments of large organisations that provide training to personnel and in some cases clients as well. These are in most cases called academies.

Part of the eco-system of training provision are certification bodies that validate the learning outcomes by assessment (e.g., exams).

## 2.3 Starting points

### 2.3.1 EU initiatives and focal points

The European Commission (2021) declared this decade “[Europe’s Digital Decade](#)”. The foundation of this is the [Digital Strategy](#) the Commission announced in 2020. To reach the goals of this Digital Strategy a [Digital Compass](#) is developed to translate the ambitions in concrete terms. Part of the first of four cardinal points in this Digital Compass is about highly skilled digital professionals. The projected need for ICT specialists is 20 million by 2030 and given the current amount of specialists (7.8 million by 2019) and annual growth rate (4.2%) this demand cannot be met without actions and massive investment. An important observation the Commission makes is that only one in six ICT specialists is a woman at the moment so women make up a large potential, and currently underused, source of skilled labour for the software profession.

To train Europeans to be ready for the digital world and to expand the talent pool, the EU is investing in programmes. These programmes include:

- [European Skills Agenda](#): a five-year overarching plan to help individuals and businesses develop more and better skills and to put them to use.
- **Pact for Skills**: The first of the flagship actions under this Agenda, which is a shared model for skills development in Europe, translating engagement of different stakeholders into concrete commitments on upskilling and reskilling.
- [Digital Skills and Jobs Coalition](#): tackles the digital skills gap by bringing together Member States, companies and organisations to develop localised responses to improving digital skills.
- [Digital Education Action Plan](#): a renewed European Union (EU) policy initiative to support the sustainable and effective adaptation of the education and training systems of EU Member States to the digital age.

### 2.3.2 Frameworks

The Erasmus+ requirements and the project plan specify that the ESSA project uses European standards in order to be recognisable and have a broad support across the wider European community.

The use of these European standards ensures a common language and point of reference when talking about specific software roles, competences, and skills. This optimises the process of the development of curricula through enabling communication with relevant stakeholders using a common reference point.

**2.3.2.1 e-CF**

Regarding ICT competences, specifically the [“EN 16234-1” e-Competence Framework \(e-CF\)](#) - A common European Framework for ICT Professionals in all sectors - Part 1: Framework” is an important input for the ESSA Strategy. EN 16234-1 “e-CF” as a European norm, is a neutral standard, developed and maintained through an EU-wide balanced multi-stakeholder agreement process, under the umbrella of the European Committee for Standardization. The standard is also a key component of the European Digital Agenda for ICT Professionalism. The e-Competence Framework (e-CF) (EN 16234-1) identifies 41 competences related to the ICT professional field.

Dimension 1 5 e-CF areas	Dimension 2 41 e-Competences identified	Dimension 3 5 e-Competence proficiency levels				
		e-1	e-2	e-3	e-4	e-5
A. PLAN	A.1. Information Systems and Business Strategy Alignment					
	A.2. Service Level Management					
	A.3. Business Plan Development					
	A.4. Product/Service Planning					
	A.5. Architecture Design					
	A.6. Application Design					
	A.7. Technology Trend Monitoring					
	A.8. Sustainability Management					
	A.9. Innovating					
	A.10. User Experience					
B. BUILD	B.1. Application Development					
	B.2. Component Integration					
	B.3. Testing					
	B.4. Solution Deployment					
	B.5. Documentation Production					
	B.6. ICT Systems Engineering					
C. RUN	C.1. User Support					
	C.2. Change Support					
	C.3. Service Delivery					
	C.4. Problem Management					
	C.5. Systems Management					
D. ENABLE	D.1. Information Security Strategy Development					
	D.2. ICT Quality Strategy Development					
	D.3. Education and Training Provision					
	D.4. Purchasing					
	D.5. Sales Development					
	D.6. Digital Marketing					
	D.7. Data Science and Analytics					
	D.8. Contract Management					
	D.9. Personnel Development					
	D.10. Information and Knowledge Management					
	D.11. Needs Identification					
E. MANAGE	E.1. Forecast Development					
	E.2. Project and Portfolio Management					
	E.3. Risk Management					
	E.4. Relationship Management					
	E.5. Process Improvement					
	E.6. ICT Quality Management					
	E.7. Business Change Management					
	E.8. Information Security Management					
	E.9. Information Systems Governance					

Figure 3 Overview of e-CF competences

Being related very closely to the e-CF, the European standards [Foundational Body of Knowledge for the ICT profession](#) (ICT BoK) and the [Guidelines for developing ICT Professional Curricula](#) as scoped by EN16234-1 “e-CF” will also play a role in the development of this Strategy.

### 2.3.2.2 ICT professional role profiles

Besides the EN 16234-1 “e-CF”, the “[CEN/CWA 16458-1 European ICT Professionals Role Profiles](#) - Part 1: 30 ICT profiles” also forms a key input for the ESSA project.

The European ICT Professionals Role Profiles as described in CEN/CWA 16458-1 are based on and therefore closely related to EN 16234-1 “e-CF”. They incorporate the competences of the e-CF as a main component within each profile. In total there are 30 ICT Professional Role Profiles distinguished that provide a generic set of typical roles performed by ICT Professionals in any organisation, covering the full ICT business process. The profiles are meant as “a flexible tool for ICT professional development and profile construction. They are not intended to represent a rigid standard. The role profiles were built as a foundation and inspiration, for the flexible creation of more context-specific profiles in a broad variety of areas”.

In chapter 5, Software role profiles, the profiles relevant to the ESSA Strategy are discussed in more detail.

### 2.3.2.3 ESCO

The [European Skills, Competences, Qualifications and Occupations \(ESCO\)](#) is another important input. The ESCO classification identifies and categorises skills, competences, qualifications, and occupations relevant for the EU labour market and education & training. It also systematically shows the relationships between the different concepts. Unlike e-CF, ESCO makes no distinction between skills and competences.

## 2.3.3 Research

Relevant research related to the gap between the market demand for software skills and the supply is also an important foundation for the ESSA Software Skills Strategy.

### 2.3.3.1 ESSA software skills Needs Analysis

First of all, the report “[Europe’s Most Needed Software Roles and Skills](#)”, in short: “Needs Analysis” that was conducted within the first part of the ESSA project is an important foundation to build the Strategy upon. In this Needs Analysis, the current and the future needs for software skills in Europe and the nature of the skills gap that needs to be filled were investigated by the ESSA partnership. The research led to a set of concrete conclusions to build the Software Skills Strategy upon.

### 2.3.3.2 CEDEFOP

[CEDEFOP](#), being the European Centre for the Development of Vocational Training, has a lot of experience and knowledge that can be used to develop and maintain a software skills strategy. Although they are not specialised in software professionals and skills, their knowledge about education in general and about ICT education and training, helps provide an overview of the current situation and the needs required to be ready for the future.

## 2.4 Elements of the software skills strategy

The remainder of this strategy report will focus on the training of skills, educating for roles and validating. This will be addressed in the following chapters:

- **Key skills:** The ESSA Needs Analysis indicated the most important skills for software professionals. These are hard skills, profession-related skills, and soft skills which are becoming increasingly important.
- **Skills training:** Training in these key skills is the primary strategy of closing the skills gap between the skills that software professionals currently have, and the skills they should have according to the market needs.
- **Software role profiles:** The ICT professional role profiles relevant for software are adjusted to fit the market needs. There is a need for a lot of extra software professionals in the coming decade and they need to be skilled and reskilled, based on the profiles organisations need
- **Educating for roles:** The challenge is to educate new software professionals with VET programmes that are relevant and meeting market demand and are also attractive to follow for initial students and reskillers
- **Validation:** To establish whether somebody is an up-to-date software professional, it is important that learning is validated with certification. This increases mobility of software professionals and the professionalism of the software field. It also supports lifelong learning.

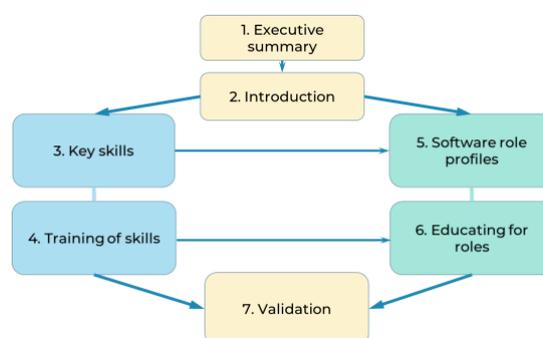


Figure 4 Elements of the Software Skills Strategy

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# **Key skills**



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## 3 Key skills

The needs analysis showed that several skills are important to perform well in a software role. These are certain hard software skills, but also other profession-related skills and more generic soft skills. Training in these skills is therefore essential to obtain properly skilled software professionals. These skills should also be the central part of skilling and reskilling programmes.

### 3.1 Hard software skills

Hard software related skills are primarily focused around programming skills, but besides these there are also other related hard skills that are relevant in software roles. The hard skills are job-specific technical skills that are directly related to the production and maintenance of software.

#### 3.1.1 Programming skills

The needs analysis revealed that there is no gap in programming skills in terms of content as there is a large availability of programming courses. The most requested programming languages by organisations, like Python and Java, are widely taught in VET programmes and all kinds of training programmes are available to learn these languages. Learners can choose between online, in-class and hybrid forms of education and training and can also learn for example by the numerous books and all kinds of online materials that are available. The most needed **programming languages** at the moment are: Java, Javascript, SQL, HTML, PHP, C++, C# and Python.

A lot of people learn these languages, but many of them do not actually pursue a career in software. The result is that there are enough software professionals that use these programming skills as a professional.

It is to be expected that in the (near) future other programming languages will become more important, which will lead to the need for upskilling and adjustments in skilling and reskilling programmes. It will help to speed up and ease these processes if software professionals have a strong foundation in **general programming principles**.

#### 3.1.2 Other hard skills

Besides programming skills, other important hard skills related to software production and maintenance are:

- Testing and debugging
- Algorithm skills
- DevOps skills

The findings in the Needs Analysis show that the ability to work with algorithms is also very important, besides programming skills. Organisations have a substantial need for people with skills in this area. There is also a substantial need for skills related to testing and to DevOps, both are considered almost equally important. DevOps skills somewhat more than testing skills.

## **3.2 Profession-related skills**

Profession-related skills are needed to perform well as a software professional, but also many other professionals operating in the field of ICT need these kinds of skills. So, these skills are related to the field of the software professional, but also to the ICT professional in general. They may be considered essential for functioning in this kind of role. The needs analysis revealed that the most relevant skills are (agile) project skills, security skills, software lifecycle skills, sustainability skills and ethical awareness skills.

### **3.2.1 (Agile) project skills**

A software developer does not work alone, but is working together with other people and different experts in projects and teams. Project skills are important in general and agile project skills, in particular, are becoming increasingly important since more and more projects and teamwork are organised in this way. Specific agile project skills are therefore also required.

### **3.2.2 Security skills**

Security is an issue that is already important and is gaining more relevance. Security is now an integral part of the whole cycle of designing, developing, deployment and maintenance.

### **3.2.3 Software lifecycle skills**

Having a deep understanding of the whole development lifecycle is considered important for all software professionals. It is also useful to have an awareness and understanding of the broader context of one's activities and tasks as a software professional is necessary.

The ability to actively apply and integrate different methods and techniques within the whole of the software lifecycle is especially important when it comes to continuous integration and continuous deployment.

### **3.2.4 Sustainability skills**

Sustainable development in a general sense is a core principle of the Treaty on European Union (operative from 1993) and a priority objective for the Union's

internal and external policies. The [United Nations 2030 Agenda](#) includes 17 Sustainable Development Goals (SDGs) intended to apply universally to all countries. One of those SDG's relates to Technology and states that

*“...the research, development, deployment, and widespread diffusion of environmentally sound technologies in the context of a Green Economy is also closely linked to other core elements and means of implementation, including innovation, business opportunities and development, ...”*

In relation to these ambitions of the EU and growing importance of the topic, it is expected that in the future sustainability management and sustainable software development will become important. This is also strongly supported by the European expert group that was held during the Needs Analysis.

Sustainable software development takes into account technical, operational and environmental aspects of software. Technical Sustainability covers the decisions related to traditional software engineering activities that are made for the system to produce the desired results. These include decisions related to hardware and software as well as e.g., systems latency and testing requirements. Operational Sustainability refers to any aspect of the system which requires human maintenance such as the deployment process and incident volumes. Environmental Sustainability refers to the impact the system has on the environment. This is typically based on carbon emissions but manifests itself through measurements like Power Usage Effectiveness (PUE) and Compute Utilization Factor (CUF) within data centres.

### **3.2.5 Ethical awareness skills**

There is evidence from the research literature and the general media of an increasing disquiet from the public and some governments over the potential of software to cause harm, either through malicious misuse or the inadvertent negative effects of lack of due care. This is most notable in terms of newer software with a high public profile, such as AI, but the design of algorithms in general is no longer assumed to be an ethically neutral activity. For current and future software professionals it is likely to become increasingly important that they have the skills to critically evaluate, discuss and when necessary, report and mitigate any ethical concerns regarding the software they are developing. This will also soon be a regulatory requirement as developments on regulating data analysis and AI become more established and is increasingly seen by companies as an important reputational issue. It is also a strong area of interest for ICT professional bodies and many of the larger computing professional associations, for example the ACM, insist on some ethics content for computing courses they

accredit. Professional ethics is also a building block of the European Commission ICT professionalism programme.

### 3.3 Soft skills

The skills needed in software roles are certainly not restricted to hard software skills and other profession-related skills. There is the growing importance of soft skills that are needed to be successful as a software professional. These skills already are called “essential” and they are becoming increasingly more important skills for a software professional to be able to perform tasks well. The skills themselves are transferable and are also useful and necessary in other professional fields.

#### 3.3.1 Interpersonal soft skills

People in software roles need interpersonal soft skills since almost all activities in these roles nowadays require working together. The most relevant are teamwork and general communication skills. **Teamwork skills** include skills like, for example, working together in virtual teams and **communication skills** include skills on communication in virtual meetings. In most cases teamwork and communication skills are already part of educational programmes, but they need to be the focus of more attention, especially in relation to working in a business environment.

English is important in a lot of jobs, so **English language skills** are important and may even be a foundational requirement especially in relation to mobility. At the same time a limiting factor for mobility is that in many cases it is also required to be able to speak the local language.

#### 3.3.2 Personal soft skills

Personal soft skills are becoming increasingly important for people in software roles. The most important are **critical thinking & analysis, problem solving** and **self-management**. This is confirmed not only by the findings in the ESSA Needs Analysis, but also in many other (EU) reports and studies. The skill self-management has become even more important during the COVID-19 pandemic, because a lot of professionals had to work (even) more autonomous than before the pandemic.

Personal soft skills, especially the three mentioned, are important for people in any working environment and certainly for software professionals.

### 3.4 Skills overview

The relevant skills can be summarised in a short overview:

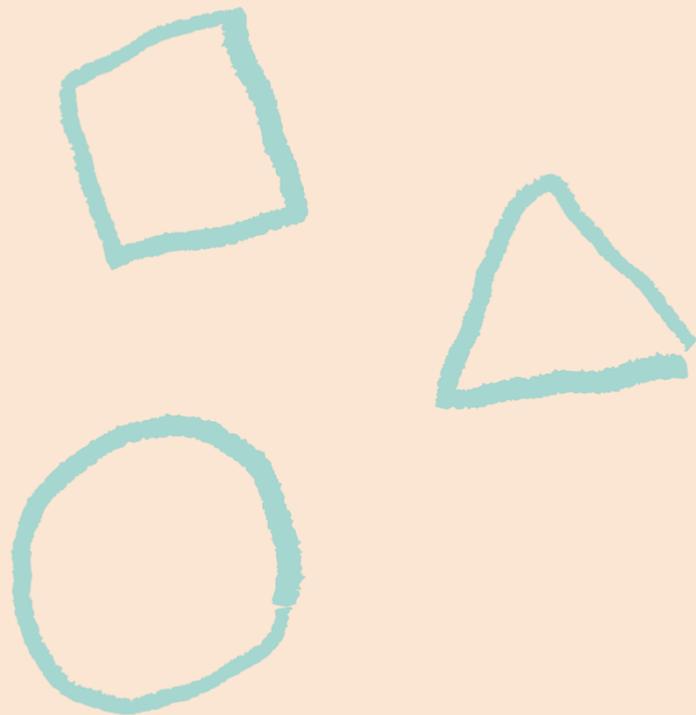
Hard software skills	Profession-related skills	Soft skills
Programming skills	(Agile) Project skills	Teamwork skills
Testing and debugging	Security skills	Communication skills
Algorithm skills	Software lifecycle skills	English language skills
DevOps skills	Sustainability skills	Critical thinking skills
	Ethical awareness skills	Problem solving skills
		Self-management skills

Figure 5 Skills overview

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# **Skills training**



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## 4 Skills Training

Skills training is the foundation for upskilling software professionals. A skill can also be the topic of a learning unit (course, module, etc.) in a modular skilling or reskilling programme.

Software professionals must be up to date to meet the labour market's demand. The problem is that people in software roles — often also people that want to reskill — have little time for training. Currently, there is somewhat of a “Catch-22” in that more skills are needed but software professionals currently working are very challenged to find the time to upskill, precisely because they are in scarcity and teams are very stretched.

People wishing to reskill are likely to have commitments that also require flexibility in the delivery of the training. Flexible methods of training are therefore of paramount so that individuals can learn whenever they have time to do so. Flexible training is also particularly important to widen access to the provision of training for people with disabilities and for those living in more remote regions.

### 4.1 Staying up to date

Software professionals can only perform well if their skills are up to date. This, of course, also implies that the training itself needs to be up to date and meet the market's needs.

#### 4.1.1 Ways of skills development



ESSA acknowledges that informal and non-formal learning play a key role in the skills development of software professionals. ESSA will develop ways of recognition for these acquired skills.

The world is constantly changing, and the digital transformation is fast paced. Professionals must keep up with these changes to stay relevant for organisations. Lifelong learning is therefore essential for lifelong employability.

In most cases, it is quicker and easier for organisations to upskill software professionals than to reskill other professionals or to wait for young professionals to be skilled. Therefore, organisations and employees both benefit when employees are engaged in lifelong learning.

Learning takes place in three basic forms (OECD, 2021):

- **Formal learning:** This is intentional learning in a designated learning setting. Organised training is, by definition, formal learning because it is a setting created to learn.
- **Non-formal learning:** This is intentional learning in settings that are not designed for formal learning. Typically, the training is not formally designed nor assessed.
- **Informal learning:** This is unintentional learning, taking place in everyday (working) situations. People learn things that were not initially intended or planned.

Experts believe that a big part of software professionals' learning is by informal and non-formal learning. This can be true, but it is impossible to design curricula and training based on these two components. Mainly because non-formal and informal learning are, by definition, not part of formal learning programmes and training.

Having said this, informal learning is taking place all the time and therefore will also occur during education and training that is formally focused on other things. This kind of learning contributes to the skill level of a software professional.

Non-formal learning also contributes significantly to the skill level of professionals like improving programming skills in a certain language by learning from a more experienced colleague during a project.

The challenge of informal and non-formal learning is to make the acquired skills visible. For instance, how can a potential new employer be sure that somebody possesses a specific skill? The professional can mention it in their CV and/or talk about it, but there is no unequivocal proof of it. The most independent way of establishing if a person is equipped with a specific skill would be to run some kind of assessment.

This is in line with the concept of lifelong learning that acknowledges that learning is not limited to a single, specific phase in life but happens in different contexts, over the course of a lifetime. The concept of lifelong learning is also supported by the European Union, with its strategic framework for [European cooperation in education and training, ET2020](#). It is stated that:

*“Members have supported stronger links between education and employment. These include training schemes that combine apprenticeships with education in vocational schools and improved mobility options in Erasmus for young people in*

*vocational education. Equally important is the **development of tools** that make it possible to **validate and recognise the outcomes of non-formal and informal learning** rapidly. Parliament has called for the European quality framework to be better aligned with society's needs and the full use of its potential to facilitate student and worker mobility."*

In line with the EU policy, ESSA wants to develop ways to recognise and validate the outcomes of non-formal and informal learning.

#### 4.1.2 Organisations and learning providers together



ESSA will include work-based learning into the upcoming VET programmes.

ESSA's recent report, the Needs Analysis, showed that there is an imbalance between the software skills needed by organisations and the skills (future) software professionals possess. Organisations have a good understanding of the skills they need, and it is evident that learning providers can train those skills. Organisations can also help training those skills. For example, through on-the-job training of personnel and students.

Cooperation between organisations and learning providers is therefore necessary to ensure a better and sustainable match between software skills demand and supply.

Cooperation between organisations and learning providers can take many forms, but good options include:

- **Organisational academies:** More and more organisations have their own academy to train personnel. Learning providers can assist these organisations by professionalising these academies.
- **A dialogue/roundtable to clarify and share expectations:** On the one hand, the organisations' needs are not always clear to learning providers and, on the other hand, learning providers' provision and what they can expect from graduates and certified learners is not evident for organisations. Cooperation can help to better match demand and supply. The use of recognised frameworks like e-CF can ensure both parties can understand each other and the basis of competences and skills.

- **Co-creation of work-based learning (WBL) opportunities:** One of the most common forms of industry-academia cooperation is the student internship. Organisations can offer internships and other work-based learning opportunities like working on real-life scenarios, access to laboratories, and so on. Learning providers can integrate WBL into their programmes, for instance, via a capstone project at the end of the year. In this way new software professionals are better prepared for work and have a higher employability potential towards employers

This strategy focuses on the content of learning programmes and therefore some kinds of collaboration are more relevant than others. The most direct and valued collaboration form between organisations and learning providers is WBL opportunities which ESSA will include in the VET programmes to be developed. Collaboration is needed by making this an integral part of the qualification of software professionals.

### 4.1.3 Up to date training



ESSA will provide up-to-date training materials and mechanisms to facilitate continuous and easy updating after the project's end.

In a field like software development and operation, it is inevitable that training (materials and methods) will need to be updated on a regular basis. The collaboration between organisations and learning providers will also provide insights on the extent to which the provided training materials are up to date. Here are three important points of attention:

1. **Methods and materials must be up to date to start with:** Given the actual software skills gap, we can assume that a large part of the methods and materials currently used are outdated. New methods and materials should be reviewed by organisations to confirm whether they will educate and train the desired skills.
2. **Training of soft skills:** It is tempting to train transferable skills in a generic way — for all kinds of (future) professionals, i.e., a “one-fits-all” approach. Software professionals though encounter specific challenges in soft skills. For example, they need to learn to explain complex, technical innovations to the rest of the organisation. Thus, the development of soft skills should be tailored to their specific needs.
3. **Keep the training up to date:** Because of the time and effort invested, it is very tempting for educators and training providers to keep the methods

and materials stable for (at least) a couple of years. But this can result in out-of-date training, so mechanisms must be put in place to identify emerging needs and facilitate updating methods and materials when needed. It requires a system of continuous improvement and delivery to stay up to date in education and training provision.

## 4.2 Flexible training

An important finding of ESSA's Needs Analysis Report is that people in organisations have little time to up- or reskill. To deal with this issue, solutions like short, flexible training and alternative ways of delivering training must be considered.

### 4.2.1 Self-paced



ESSA will promote the idea of self-paced training when possible and instructor-paced learning when needed.

Training that can be followed at a suitable time and at a pace that is manageable for the learner will drastically increase the opportunities to undertake training. It will lead to more professionals being upskilled and reskilled. It is also an effective way to widen access to initial education for working students or potential students that have other commitments.

It must also be recognised that teachers and instructors have added value in the learning process. A lot of delivery methods in education depend on the teachers and their expertise. Expertise, in our case, consists of software skills and pedagogy. Therefore, there must be a balance between self-paced and instructor-paced learning. To ensure the optimal amount of flexibility, self-paced learning is preferable with the use of instructor-paced learning only when from a learning perspective it is needed to ensure the quality of learning.

## 4.2.2 Modular training



ESSA will promote the concept of microlearning in situations where this learning approach is possible.

Dividing training into small modules makes it more flexible. It is for most people easier to free up short moments to study than, for example, complete days. The concept of microlearning is based on this principle. Microlearning is learning in small units which takes a learner about ten minutes to complete. The advantage of this concept is of course its flexibility, but the disadvantage is that it is not applicable to everything. Some things cannot be broken up in units this small simply because they are, for example, too complex or just take more time. Microlearning can help to make learning more flexible and therefore more accessible, but only in situations in which this does not impede or damage the learning process.

## 4.2.3 Innovative methods of delivery



ESSA will encourage the use of innovative and engaging ways of delivering training.

New methods of delivering training can help to improve the quality of learning. All of them shift the centrality from the teacher to the student, from the transmissive lesson to activities through which the learners construct their own knowledge and develop skills and competences. All these methods are based on the theory of “pedagogical activism”:

- **Flipped classroom:** The flipped classroom is a method aimed at increasing learner engagement, understanding and retention by reversing the traditional classroom teaching approach: learners receive learning materials - generally videos - before class which they should then study in advance so that the class time can be used for discussions and other active and collaborative activities.

- **Project-based learning:** This is a cooperative teaching-learning strategy. Project team members work on a complex topic according to a plan, and the result is a real product or a performance. This works best if the learners autonomously choose a project to be developed that responds to a real need for them or for others, or if they receive a real project task from a partner company.
- **Research-based learning or inquiry-based learning or discovery-based learning:** This cooperative teaching-learning strategy is based on the stimulus of learners' curiosity. Learners need to solve a real-life problem, form groups, ask questions, and find answers to questions. Learners build on their own knowledge based on information available from various sources. This approach helps students learn about hypothesis generation and testing. The emphasis is on discovering facts or developing a higher understanding of the topic.
- **Gamification or game-based learning:** Game-based learning means learning achieved through the use of games or video games. Learning is stimulated by the characteristic aspects of the game: challenge, levels, achievement of objectives through scores and prizes.
- **Peer learning:** In peer learning, learners help each other by providing feedback or support. It makes learning more flexible because learners are less dependent on instructors.

These are some examples of popular innovative ways of delivering training, but other methods are also possible. The use of these methods depends on the situation.

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# **Software role profiles**



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## 5 Software role profiles

One of the aspects of the ESSA project is to analyse, review, and if necessary, adjust occupational profiles. The European ICT Professional Role Profiles (CEN/CWA 16458-1) incorporate the competences of the European e-Competence Framework (“e-CF”, EN 16234-1) and are used as a foundation and starting point.

From the 30 ICT Professional Role Profiles, ESSA selected software-related profiles and analysed them. This resulted in a list of roles that require software skills as an essential part of their profile, as well as, some relevant aspects related to the contents of those selected role profiles.

The selected role profiles that have software development and operation as an essential element of their role are:

- Developer
- DevOps expert
- Solution designer
- Test specialist
- Technical (software) specialist

Although in other roles software-related aspects may play a role to a certain extent, these roles are out of the scope of the ESSA strategy, as the software aspect is neither essential to that role, nor does it comprise the largest portion of skills, knowledge, competences, and tasks related to that role. People in other roles like Data Specialist, Service Support, or Information Security Specialist may need software skills to a certain extent to perform their jobs, but their jobs are not defined or characterised by software skills. In these cases, other skills are often more essential, and even with limited software skills it is possible to perform the role.

In other roles it can also be helpful to have some software skills, but it is not critical for the execution of the role to have specific software skills. These professionals will need basic, general software knowledge and skills, but are out of the scope of this project.

The 5 abovementioned occupational profiles were analysed in ESSA’s Needs Analysis Report. The results are used to improve the current software-relevant profiles. One of the main conclusions is the overall importance of soft skills and their relevance to all selected role profiles. Another important development that is to be noted is the rise of T-shaped and  $\pi$ -shaped professionals.

## 5.1 T-shaped and $\pi$ -shaped professionals

Many software professionals were — and (probably) still are — I-shaped professionals. These professionals have deep and thorough knowledge and skills in one specific area represented by the “I” vertical line. These are very valuable professionals, but it is hard to work with them in multi-disciplinary teams. This is because they don’t possess the right skills to work together with people and they particularly struggle to work in diverse teams with people from other disciplines.

T-shaped and  $\pi$ -shaped professionals are professionals that possess the skills to work together with other disciplines, hence the horizontal bar. The  $\pi$ -shaped professionals have two specialisations, hence the two vertical lines. There are also other variations called m- and comb-shaped professionals indicating 3 or more specialisations, but the principle is the same as the  $\pi$ -shaped professional.

### 5.1.1 Specialisation(s) to stand on

Within both the concepts of the T-shaped and  $\pi$ -shaped professional, the vertical specialisation part is equally important as the horizontal broad part. The broad part refers to a skill set and attitude that form a base for potential cooperation with other kinds of specialists from other fields. This means that professionals should have deep knowledge of one subject, but also need to have skills to work with others from other fields.

Professionals with two specialisations that can be combined will be needed. These kinds of professionals can be of great value to an organisation, as ICT has become an integral part of many organisations and not just a standalone function. Having an expertise in software development and in a different professional field creates an added value. A good example is the combination of marketing and ICT. Reskilling people from other fields will create these professionals.

### 5.1.2 Broad reach through (profession-related and soft) skills

With ESSA’s Needs Analysis Report, it became clear that certain skills are relevant to all of the 5 selected software roles. These are two types of skills: one type of skills is profession-related, and the other are soft skills, at a personal and interpersonal level.

Profession-related skills are relevant to the broader ICT sector, such as skills in the areas of security and project management. The soft skills have an even broader range and are not only relevant in the software profession but are also relevant in other professional fields and domains.

Both types of skills enable people to develop specific hard skills easier, but also to work together in a team with different disciplines, to communicate with others and understand different perspectives from different fields easier. Furthermore, possession of these skills provides people with a broad reach, allowing people to switch between jobs and are essential for reskilling.

These are the skills of which the horizontal bar of the T- and  $\pi$ -shaped software professional is composed of. In this Strategy, they are referred to as “(software) profession-related skills” and “soft skills”.

## 5.2 Improved role profiles

The 5 selected professional role profiles are evaluated given the current market needs and improved when relevant. For the finetuning of these software role profiles, we considered:

- The underpinning of (eventually) proposed adjustments lies in ESSA's Needs Analysis Report
- The essence of a role profile is not adjusted
- The focus lies on adding elements that are clearly missing at the moment (based on the findings), not on specific wording or phrasing
- The knowledge and skills elements that are related to a certain competence in the e-CF are considered when evaluating a role with that certain competence
- Single knowledge elements, i.e., “small pieces of knowledge” are rather part of a competence than of the description or mission of a role profile
- The existence of a soft skill set and a profession-related skill set that is added to all the role profiles (meaning that in some cases adding additional tasks, skills, or competences won't be necessary anymore)
- The relation between skill and competence is considered carefully. This relates to the question whether a person in a certain role should possess a full competence or whether “just” a skill or a single knowledge element suffices.

### 5.2.1 ESSA adjustment proposals to software role profiles

The most important adjustments to all role profiles are based on the acknowledgement of the importance and relevance of certain soft skills and certain profession-related skills for all software role profiles.

It is strongly suggested to add a transferable skill set of soft skills and a software profession-related skill set to all the selected software role profiles.

With this important addition, it is not necessary to make further adjustments to the role profiles, apart from:

- Adding certain competences to the DevOps expert, Solution designer, and Technical (software) specialist roles
- Add an additional task to the Solution designer role

You can view the improved role profiles in the Annex 1, see:

- [Developer role](#)
- [DevOps expert role](#)
- [Solution designer role](#)
- [Test specialist role](#)
- [Technical \(software\) specialist role](#)

## 5.2.2 Soft skill set

Given the importance of the T-shaped and  $\pi$ -shaped professional combined with the need for soft skills across all roles, it becomes clear that it is possible to define for all software roles the same base of soft skills.

This soft skill set is composed of **interpersonal soft skills** — especially the ability to work in a **team** as well as **communication** skills. Besides these, proficiency in the **English** language is important.

Equally important are **personal soft skills**, like **critical thinking & analysis**, **problem solving** and **self-management**. There is a very substantial need in organisations for people with these skills.

The possession of the above-mentioned personal and interpersonal soft skills is considered highly important, and in many cases, there is a substantial need indicated for them.

These types of skills are truly transferable as they allow people to change between different jobs more easily, and between different professional fields and domains, but also to communicate with others from different disciplines and work together in multi-disciplinary teams.

## 5.2.3 Profession-related skill set

Besides the highly valued soft skills, some profession-related skills stand out. The most important skills are those related to **security, (agile) project management**, and **software development lifecycle skills**.

Skills related to **sustainability** and raising **ethical awareness** in software development require special attention because although these topics are not

highly ranked by organisations at the moment, according to experts and reports it will become much more important in the near future. The awareness of the importance of sustainability management and sustainable software development should therefore be raised as well as some awareness of the impact of software development on society.

#### 5.2.4 Developer

The role of developer stays the same in its essence. Granted, there are a lot of new titles for all kinds of developers, but the principles remain the same. It is translating a design into code. These can be all kinds of code in all kinds programming languages (e.g., Python, Java, C++) for all kinds of purposes (e.g., AI, data analytics, blockchain).

A developer that possesses foundational programming logic skills, can become a specialist in any kind of software application. Specialised training and experience will help them to become a better specialist in a certain area, but foundational programming logic is the starting point.

#### 5.2.5 DevOps expert

The DevOps expert implements processes and tools to successfully deploy DevOps techniques across the entire solution development lifecycle. There is one useful suggestion that can be made based on the findings in the Needs Analysis. As the person in this role is involved in the whole of the solution development lifecycle, it is suggested to add competence **B.6. ICT Systems Engineering** to this role profile.

#### 5.2.6 Solution designer

The Solution Designer provides the translation of business requirements into end-to-end IT solutions and in line with the technical architecture he proposes and designs solutions.

He needs to have a thorough knowledge and skill set relating to architecture design, so it is suggested to add **A.5. Architecture Design**. In order to make correct and balanced decisions regarding sustainable solutions **A.8. Sustainability management** is a relevant competence.

More specialised skills and knowledge in the area of risk would also be necessary. Therefore, competence **E.3. Risk Management** is also suggested to add to this profile.

Furthermore, the following main task can be added to this profile: “Uphold the architectural governance principles and good implementation design for architectural deliverables”.

### 5.2.7 Test specialist

The test specialist ensures that delivered or existing products, applications or services comply with technical and user needs and specifications. Given the added soft skill set and profession-related skill set, no other elements have to be added to this profile.

### 5.2.8 Technical (software) specialist

An important remark regarding the technical specialist role is that this role can be implemented differently in different contexts. Of course, this is true for all roles, however with regard to the technical specialist, the focus on software development and operation, i.e., the software aspect of this role, may not be that prominent in all situations. This is unlike the other roles mentioned above, where software skills are under all circumstances an essential part. In the ESSA project, therefore, the technical specialist role is interpreted as a role to which software skills are essential also.

The technical specialist maintains and repairs hardware, software and service applications. A logical and useful addition to this profile is competence **C.5. Systems Management**.

## 5.3 European educational profiles for software roles

### 5.3.1 The educational profile

CEN has described a method to translate relevant market demands (in this case represented through the Needs Analysis by this Software Skills Strategy, the e-CF and related reports like the software professional role profiles and ICT Foundational BoK) into structured learning programmes. This method is described in the report **Guidelines for developing ICT Professional Curricula as scoped by EN16234-1 “e-CF”**, to be published in 2022.

The method is the Educational profile: “a structure that enables a competence-oriented curriculum 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.”

The Educational profile translates occupational profiles and competences in learning programmes by formulating a set of programme learning outcomes, learning outcomes and assessments. Besides this, also a description is added with characteristics of the profile, independent of detailed design aspects of a concrete learning programme.

This description contains elements like scope of the educational profile, related competences, and its level of complexity and autonomy. In this way an educational interpretation in the form of a model of the market demand or a blueprint which represents the market demand in educational language, and this can form the foundation to develop learning programmes.

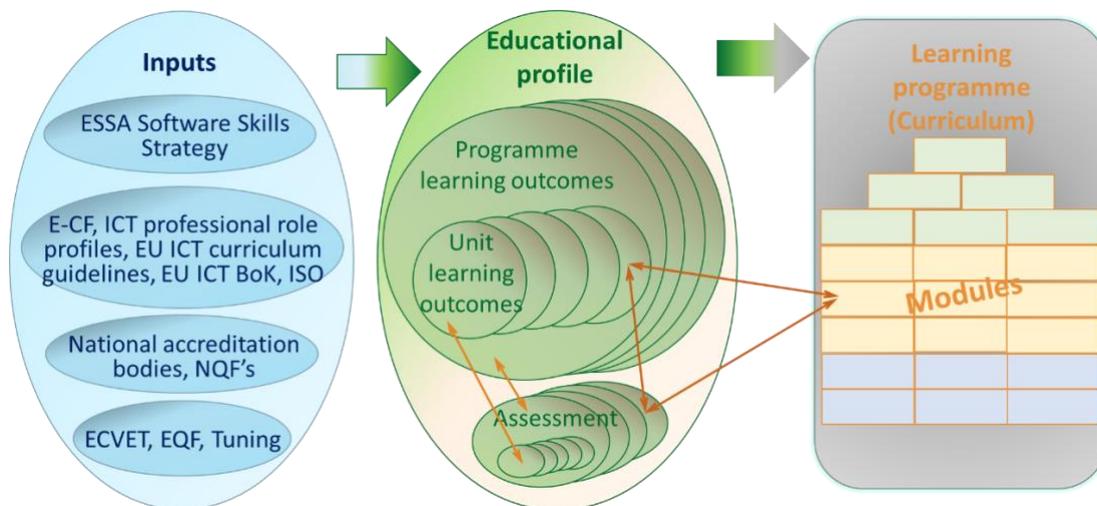


Figure 6 The position of the educational profile

### 5.3.2 Starting points for educational profiles for software roles

ESSA will develop educational profiles that will be the basis of development of the VET curricula and programmes for software skills.

Market needs (software professional role profiles, e-CF, ESSA Strategy) are used to determine the contents of the programme learning outcomes (PLOs) and learning outcomes (LOs). The market needs are reflected in this Software Skills Strategy which means that all aspects mentioned in this Strategy, like modularity and flexibility, will be taken into account. Market needs are further reflected by the improved software professional role profiles and the e-CF and related documents.

Recently work has been done to extend the e-CF with the ICT Foundational Body of Knowledge (ICT BoK). In this ICT BoK a set of knowledge units is distinguished that is relevant to all professionals working in ICT, regardless of job function.

Related to the level of complexity and autonomy, qualification frameworks like the EQF, ECVET and national qualification frameworks will be used as inputs to determine the right level for positioning the PLOs and LOs upon.

These inputs are used in developing educational profiles keeping the following in mind:

- Different educational profiles will be developed for the different software professional roles with different levels of complexity
- The set of educational profiles together will 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 will be developed for the whole of the EU, however there will be room for contextualising the profile to local conditions. It will be explained how this can be done
- There will be one generic set of PLOs and LOs related to the transferable soft skill set and profession-related skill set as described above. These generic sets will 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, that is applicable to all ICT professionals and will be part of every educational profile that is focused on a full professional role. More advanced knowledge that is part of this ICT BoK and relates to the ESSA software roles will be considered when developing learning outcomes for a specific role
- Learning outcomes will be described in a standardised way, according to defined principles
- The educational profiles will 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 will 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

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**Educating for  
roles**



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## 6 Educating for roles

The focus of educating for complete roles is on the skilling of people via initial education and on reskilling people from other professions. Software professionals who want to upskill themselves will probably only need some training in specific areas so they are not the main target group when looking at educating for roles.

There are several aspects that are important when looking at educating for roles like mobility and modularity which directly link to individualised pathways.

ESSA has a focus on VET programmes, but there are of course other actions that could lead to more and higher quality software professionals. For this reason, we will also provide advice on other aspects that are formally speaking not part of the project.

### 6.1 Skilling and reskilling

Central for creating more software professionals is the skilling and reskilling of people. This consists of initial educational programmes that skill new, young professionals and of reskilling programmes to reskill professionals to software professionals.

#### 6.1.1 Initial educational programmes



ESSA will develop educational profiles for the relevant role profiles on the relevant levels that form the foundation for the VET programmes to be developed by ESSA.

Software professionals are skilled in formal, initial education at VET level, but mostly on higher VET level given the increased complexity of the profession. Research and the Needs Analysis reveal that it is necessary to educate broad professionals that on the one hand can keep up with changes in the field, but also can operate within a business environment and have the (soft) skills to work together with other professionals within an organisation or project.

Educational profiles that translate these market needs into educational terms like learning outcomes will need to be developed. They must translate the ICT professional role profiles that are part of this strategy and make sure that working

in a business environment and soft skills are an integral part of the educational profiles.

Based on these educational profiles, VET curricula can be formulated and developed.

## 6.1.2 Reskilling programmes



ESSA will facilitate the training of  $\pi$ -shaped professionals who will be professionals in their original field and software professionals.

Reskilling professionals from other fields to become software professionals will create  $\pi$ -shaped professionals that can bridge two fields which can be of much added value in a business environment.

Working with educational profiles makes clear what learning outcomes somebody must demonstrate to be a software professional. It does not matter whether somebody obtains these learning outcomes by training or by previously acquired competences. Modular programmes in which a module is targeting only one or a few unit learning outcome(s) will make it possible to develop tailor-made learning paths for professionals that want to reskill.

The professional can either start as an I-shaped or a T-shaped professional, but both will be trained as a  $\pi$ -shaped professional. The learning path will depend on their background and already acquired skills.

The advantage of reskilled  $\pi$ -shaped professionals is of course that they already know the business domain. It is also a logical choice for organisations in times of digital transformation. The expectation is, for example, that a lot of the work of accountants will be automated.

On the other hand, these organisations will need software professionals to program and maintain the software that will take over the work. Reskilling accountants instead of making them redundant, would then be a good solution, because they will have  $\pi$ -shaped professionals with skills related to their field and software.

## 6.2 Mobility

The mobility of software professionals is very important because it increases the possibilities for matching supply and demand when, for example, one country may have good supply of software professionals who cannot get work and another country may have high need and not enough software professionals. ESSA is dedicated to facilitate cross-border mobility as much as possible.

### 6.2.1 Cross-border mobility



ESSA will support cross-border mobility by developing a European mobility programme using existing EU tools and platforms.

The cross-border mobility will be improved by the fact that educational profiles with learning outcomes will be receiving European recognition. One way of doing this is to define profiles and learning outcomes that are formulated in such a way that they can be matched with nationally accredited programmes. This makes it far easier to validate skills and competences of people educated in one country in another country.

In the project plan ESSA already announced and defined a project outcome on a European mobility programme. This is not strictly focused on education and training but viewed as an important aspect for the success of ESSA.

### 6.2.2 Localisation



ESSA will develop educational profiles and corresponding curricula in such a way that local needs can be fulfilled, while ensuring they are generic enough for European wide recognition.

The learning outcomes defined in the educational profiles will be formulated in such a way that it is possible to meet specific local demands and still be in line with the profile. It also means that learning outcomes will be defined with existing national curricula in mind. By formulating learning outcomes in such a way that

they encompass national defined learning outcomes (or learning goals/ objectives if they work with those) the European recognition will rise.

Examples of local needs can be a specific programming language that is often used in a certain region or in a certain important industry. It can also be that a specific profession-related skill or soft skill is extra important given the national or regional situation.

### 6.2.3 Language skills



ESSA will support cross border mobility by paying attention (in the European mobility programme) to the issue of local languages and by incorporating English language skills in its programmes.

A specific point of attention that came forward during the needs analysis is that English is asked for a lot, but also for the local language of the employer. This causes mobility issues, because it is not feasible for all software professionals to learn a very wide variety of European languages. It is of course possible to incorporate English language skills for software professionals in the educational profiles.

Local languages in general will be a point of attention in the mobility programme and can be the topic of upskilling training.

## 6.3 Modularity

The modularity of educational programmes is an important tool for efficient, up to date skilling, reskilling and upskilling.

### 6.3.1 Easier to exchange/ update parts



ESSA will support flexibility in educational programmes by designing modular programmes.

The first advantage of modular programmes is that it is easier to replace or update parts of the programme without having to redesign the whole programme. Educational profiles will be formulated in a way that they will remain stable in most cases. In a profile, for example, there will be no specific programming language prescribed, so that it won't change when a new programming language is becoming more popular. A learning provider can decide to replace a module in an educational programme and replacing one programming language by another.

### 6.3.2 Exemptions for previous learning



ESSA will support efficiency in reskilling programmes by enabling exemptions based on already acquired skills for modules in these programmes.

Another advantage of modular programmes is that people that already possess relevant competences, skills or knowledge, can have exemptions from certain parts of the programme. This facilitates efficient reskilling because the use of well-designed exemptions reduces needless and tedious repetition. This speeds up the completion of the programme and makes it more attractive for students and employers. Modularity makes it easier to have an optimised process for exemptions.

### 6.4 Individualised pathways



ESSA will promote the use of individualised learning pathways

People do not only learn in formal learning situations and there is no one learning method that suits everyone. Learners will therefore benefit from individualised learning pathways although they still need to achieve the same learning outcomes.

Exemptions are a tool to create individualised pathways. Prerequisite for that is assessing whether somebody already obtained a certain learning outcome. ESSA will develop assessment criteria to facilitate individualised pathways.

Another perspective is to develop more than one way to achieve a learning outcome. Some learners learn, for example, better if they listen to the material while others prefer reading or visual information. It is also easier for some people to train a certain skill in their real-life working environment while for others this is not possible. ESSA will provide examples in the programmes on how to achieve the same learning outcome using different learning methods.

## 6.5 Recommendations outside the direct scope of ESSA



ESSA will advise relevant actors on topics that are not in the scope of ESSA but still relevant for the quality of software professionals like programming principles in primary school and financial resources for reskilling.

ESSA and this Software Skills Strategy focus on closing the software skills gap using VET programmes, but there are of course other things that can contribute to closing that skills gap. Topics that are not in the scope of ESSA, but relevant for the quality of (future) software professionals.

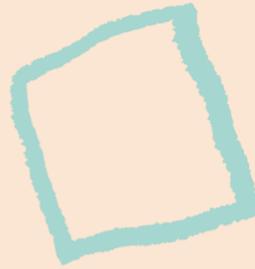
An example is to skill young people in programming principles starting in primary school. Another example is providing information about financial resources for reskilling so that individuals know how to fund their reskilling.

ESSA will bring these issues to the attention of the relevant stakeholders so, for example, educational policy makers regarding programming principles in primary school and funding possibilities via an ESSA promotion campaign.

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# **Validation**



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## 7 Validation

Learning is not only about formal learning and official qualifications. People learn all the time through non-formal and informal learning. The issue is that it is hard to verify whether somebody possesses a certain skill if there is no formal recognition of it. People can state it in their resume or during a job interview, but that is no objective assessment and, most of the times, it is hard to verify.

Objective validation is therefore important for the recognition and mobility of software professionals.

### 7.1 Assessment



ESSA will support cross-border mobility by achieving recognition of learning outcomes at the European level.

Assessments are a way to validate whether somebody achieved a learning outcome. These assessments can be in the context of an education or training, but also be part of the selection of candidates for a vacancy. This last version is relatively expensive for an organisation and can be inefficient especially when it is about skills like programming skills that should be clear from certifications. Also, for job seekers it is quite demanding because they could be required to do an assessment on the same topic several times when applying for multiple jobs.

ESSA will focus on independent assessments of learning outcomes using professional assessment organisations. This is because it is, for example, challenging for organisations or learning providers to assess workplace experience and professional assessment organisations will have more situations and people to compare to.

The fact that the achievement of learning outcomes will be assessed, means that when the learning outcomes are internationally recognised also the assessments will be internationally recognised. This will promote cross border mobility.

## 7.2 Certification

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ESSA will create certifications for software skills based on the principles of micro credentialling making use of digital badges.

People who successfully complete a training or course can be certified for this. This does not include certificates of participation, because, in that case, there is no proof that the learning outcomes are achieved. There must be an assessment that proves whether the intended learning outcome is achieved.

Traditionally, certificates covered a lot of knowledge and skills that was assessed at once. This was cost-effective and people needed only one paper certificate to prove knowledge or a skill. This has changed in the digital age. It is now possible, using micro credentialling and digital badges, to recognise relatively small (parts of) skills and knowledge. These can be linked to only ten minutes of learning material (microlearning) but they are typically covering a bigger unit (like e.g., 1 ECTS/ 28 hours of learning).

The ESSA certification framework will entail several levels so a combination of badges on the level of the smallest unit will together lead to a higher-level badge and so on. The final level is a badge indicating that somebody has acquired the competences related to a complete role profile.

The system of digital badges also prevents problems like the authentication of paper certificates. This is especially valuable for upskilling. Professionals can learn a new skill in the field and add it to their digital resume. They can do that at their own pace, for example: one small badge every month, a few at once, or a whole group of badges at once. The framework will also connect to the **European Digital Credentials for Learning** tool of [Europass](#) and consider already existing vendor certifications for the selected role profiles.

Certification is also a useful tool in complete skilling or reskilling programmes. A number of learning outcomes can be assessed, and certificates awarded. The most common example is a module or course in a programme that is completed by an exam of an independent institute. First of all, certification by independent institutes increases in most cases the value of the programme. It is learning path independent testing which means that the result does not (partly) depend on course dependent activities like attendance or in-class group work. Learning path

independent testing also provides the opportunity for people to have individualised learning pathways, but still achieve the same learning outcome validated by the same certificate.

## 7.3 Accreditation



ESSA will develop an accreditation system for programmes that are meeting the criteria ESSA will formulate.

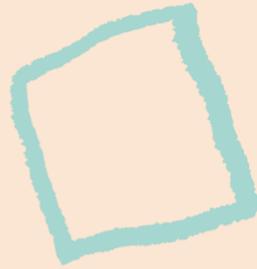
It is tempting for employers just to look at the desired hard skill at that moment and forget about other important skills like soft skills or broader profession-related skills needed to stay relevant as a software professional. A software professional is not somebody though that only can programme in one or two languages, but it is a professional with certain competences that include a specific skill set and knowledge. To be sure that somebody is a software professional that meets an ICT professional role profile, a professional should possess a degree obtained from an accredited programme. It is established that such a programme leads to obtaining the learning outcomes defined in the educational profile and therefore educates a software professional.

This holds of course for complete skilling programmes, but also for reskilling programmes. Also upskilling training can be accredited when it is proven that the training leads to a learning outcome that is part of the educational profile.

In all cases there must be an assessment whether the learning outcome is indeed achieved. Preferably by independent organisations or at least through learning path independent testing.

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**Overview**



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## 8 Overview

The ESSA Software Skills Strategy statements result in activities and milestones that will lead to outputs and outcomes — most of which are already defined in ESSA's project description.

The ESSA Software Skills Strategy is focused on Vocational Education and Training (VET), so the activities and outputs mentioned below are only the ones related directly to VET. Other ESSA activities and outputs that, for instance, have to do with the alliance, the quality and sustainability of ESSA's results are not included.

### 8.1 Overview of strategy statements

The three chapters on training, education, and validation contain the strategy statements that are the starting points of the activities. Find below the list of these statements that set the direction of the work ahead.

#### 8.1.1 Training

1. ESSA acknowledges that informal and non-formal learning play an important role in the skills development of software professionals. ESSA will develop ways to get recognition for these acquired skills.
2. ESSA will include work-based learning into the upcoming VET programmes.
3. ESSA will provide up to date training materials and mechanisms to facilitate continuous and easy updating after the project's end.
4. ESSA will promote the idea of self-paced training when possible and instructor paced learning when needed.
5. ESSA will promote the concept of microlearning in situations where this learning approach is possible.
6. ESSA will encourage the use of innovative and engaging ways of delivering training.

#### 8.1.2 Education

1. ESSA will develop educational profiles for the relevant role profiles on the relevant levels that form the foundation for the VET programmes to be developed by ESSA
2. ESSA will facilitate the training of  $\pi$ -shaped professionals that will be professionals in their original field and software professionals
3. ESSA will support cross-border mobility by developing a European mobility programme using existing EU tools and platforms

4. ESSA will develop educational profiles and corresponding curricula in such a way that local needs can be fulfilled, while ensuring they are generic enough for European-wide recognition
5. ESSA will support cross-border mobility by paying attention (in the European mobility programme) to the issue of local languages and by incorporating English language skills in its programmes
6. ESSA will support flexibility in educational programmes by designing modular programmes
7. ESSA will support efficiency in reskilling programmes by enabling exemptions based on already acquired skills for modules in these programmes
8. ESSA will promote the use of individualised learning pathways
9. ESSA will advise relevant actors on topics that are not in the scope of ESSA, but still relevant for the quality of software professionals like programming principles in primary school and financial resources for reskilling

### 8.1.3 Validation

1. ESSA will support cross border mobility by achieving recognition of learning outcomes at the European level
2. ESSA will create certifications for software skills based on the principles of micro credentialling making use of digital badges
3. ESSA will develop an accreditation system for programmes that are meeting the criteria ESSA will formulate

## 8.2 Outputs

The directions formulated with the strategy statements must be reached by incorporating them into the outputs that ESSA will deliver during the project's lifetime. The outputs related to this ESSA Software Skills Strategy are mentioned in the below table:

Description	in plan	Due
Software Skills Curricula for VET and Higher VET	Output 7	Nov. 2022
Recognised qualifications/certifications	Output 8	Nov. 2022
European mobility programme	Output 9	May 2023
VET training programmes & materials	Output 10	July 2023
Pilot training programmes	Output 11	June 2024
Work-based learning component	Output 12	July 2023
Train the trainer programme	Output 13	July 2023
Development of sustainable learning programmes	Output 20	Nov. 2022

## 8.3 Activities & milestones

The operational aspect of this Software Skills Strategy falls under the responsibility of the leads of WP3, WP4, and WP6.

WP3 is responsible for activities relating to outputs 7, 8, and 20 and WP6 for output 9. After those are delivered WP4 will take over for activities related to output 10, 11, 12, and 13.

The Software Skills Strategy itself will be reviewed and updates based on the Software Skills Strategy Review Process (output 6) and will fall under the responsibility of WP6.

### 8.3.1 Activities & milestones 2022

The activities in 2022 are necessary to deliver the outputs 7, 8, and 20 of WP3 and output 9 of WP6. At the end of 2022, the activities of WP4 will start, but they will end in 2023 and 2024 and are therefore mentioned in those years.

Description	WP	Due date
Formulate educational profiles for VET and for higher VET for each of the five role profiles (taken into account all relevant input like this strategy, e-CF, EU ICT curriculum guidelines, EU ICT BoK, ISO standards, NQF's, EQF, Tuning and ECVET)	3	May 2022
Present a coherent framework of educational profiles including guidelines that forms a clear foundation for developing programmes.	3	May 2022
Design standard, general curricula on EU level for all educational profiles, each consisting of a set of modules that together cover the learning outcomes defined in the educational profile.	3	July 2022
Formulate example learning programmes for all educational profiles on national level for all countries in the pilot, based on the EU level learning programmes.	3	Nov. 2022
Formulate example learning programmes for upskilling and reskilling that are flexible parts of the educational profiles.	3	Nov. 2022
Formulate a certification framework based on the concept of micro credentialing and digital badges. The framework must cover certification of people verifying the learning outcomes of the educational profiles.	3	July 2022
Formulate a qualification framework incorporating the certification framework and relating new ESSA qualifications to the educational profiles (especially the learning outcomes) and to existing qualifications.	3	July 2022

Define standards and criteria for learning programmes creating a benchmark.	3	Nov. 2022
Defining an accreditation policy for the accreditation of programmes that meet the ESSA standards.	3	Nov. 2022

### 8.3.2 Activities & milestones 2023

The activities in 2023 are necessary to deliver the outputs 10, 12 and 13 of WP4. Also activities related to output 11 will start, but have a due date in 2024 and therefore be mentioned there.

Description	WP	Due date
Develop VET programmes to implement the defined curricula. This entails programmes for VET and for Higher VET for the five role profiles in all pilot countries including sub-programmes suited for flexible up- and reskilling.	4	July 2023
Design and produce all related up to date learning materials and delivery methods to execute the programmes. The delivery methods will be self-paced when possible, using the concept of microlearning when possible. It will make use of innovative ways of delivery as much as possible.	4	July 2023
Localising of training materials and delivery tools into each of the languages of the partner countries in preparation for pilot testing.	4	July 2023
Embed a work-based learning component into the learning programmes. Relating realistic, professional deliverables to these work-based learning components which are directly connected to the learning outcomes formulated in the educational profiles.	4	July 2023
Design practical "real life" training scenarios related to each role to implement in a work environment or to use in a training environment when actual on the job training is not feasible.	4	July 2023
Develop trans-national learning experiences to support work-based learning.	4	July 2023
Design and support a Train-the-Trainer Programme. This programme will focus on transferring knowledge about the programme, the related educational profile and how to deliver the content in the most effective way ensuring high quality programmes.	4	July 2023

### 8.3.3 Activities & milestones 2024

This last year of the ESSA project will have several activities, but in relation to this Software Skills Strategy only activities on output 11 of WP4.

Description	WP	Due date
Run pilot training across different target groups in 7 selected partner countries ensuring a mix of VET and higher VET programmes and of skill, upskill and reskill programmes.	4	June 2024
Collect feedback from all partners and identify and implement improvements to both the educational profiles and the learning programmes as needed.	4	June 2024
Develop and package an updated set of Training Materials and Resources to support the rollout of the programme across Europe by WP5.	4	June 2024

The ESSA Software Skills Strategy will of course continue until and after the end of the project. The outputs related to this strategy however will be delivered by 2024 and it is up to WP5 and WP6 to disseminate and make ESSA sustainable. WP5 developed the ESSA Communications Strategy for the dissemination which for example in 2024 includes a European Software Skills Stakeholder Conference (output 17) and promotional campaigns (output 18 and 19). WP6 will develop a Long-Term Sustainability Strategy. Updating and continuing this ESSA Software Skills Strategy will be part of that strategy, based on the Strategy Review Process (output 6 by WP2).

## 9 References and resources

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## 10 Annexes

### Annex 1: Software professional role profiles

This Annex shows the improved role profiles. Each profile has two extra rows: i) **profession-related skills** and ii) **soft skills**. In some profiles, competences are added and in one profile a task is added; these changes are set in **bold** and *italic*.

## Improved role: Developer

Profile title	DEVELOPER ROLE		
<b>Summary statement</b>	Designs and/ or codes components to meet solution specifications.		
<b>Mission</b>	Ensures building and implementing of ICT applications. Contributes to low-level design. Writes code to ensure optimum efficiency and functionality and user experience.		
<b>Deliverables</b>	<b>Accountable</b>	<b>Responsible</b>	<b>Contributor</b>
	<ul style="list-style-type: none"> <li>Documented Code</li> </ul>	<ul style="list-style-type: none"> <li>Software Component</li> </ul>	<ul style="list-style-type: none"> <li>Software Design Description</li> <li>Test Procedure</li> <li>User Experience Design</li> </ul>
<b>Main task/s</b>	<ul style="list-style-type: none"> <li>Develop engineer and integrate components</li> <li>Follow user experience guidelines</li> <li>Aware of and address known security vulnerabilities, applying security by design</li> <li>Shape documentation</li> <li>Provide advanced, component technical support</li> <li>Resolve issues prior to and following testing</li> </ul>		
<b>e-Competences</b> (from e-CF)	B.1. Application Development		Level 3
	B.2. Component Integration		Level 2
	B.3. Testing		Level 2
	B.5. Documentation Production		Level 3
	C.4. Problem Management		Level 3
<b>Profession-related skills</b> (this set is generic for all software related roles)	The software profession-related skills are: P.1 (Agile) project skills P.2 Security skills P.3 Software lifecycle skills P.4 Sustainability skills P.5 Ethical awareness skills		
<b>Soft skills</b> (this set is generic for all ICT professional roles)	Interpersonal soft skills: ISS.1 Teamwork skills ISS.2 Communication skills ISS.3 English language skills  Personal soft skills: PSS.1 Critical thinking & analysis PSS.2 Problem solving PSS.3 Self-management		
<b>KPI area</b>	Fully functional components		

## Improved role: DevOps expert

Profile title	DEVOPS EXPERT ROLE		
<b>Summary statement</b>	Implements processes and tools to successfully deploy DevOps techniques across the entire solution development lifecycle.		
<b>Mission</b>	Applies a cross-functional, collaborative approach for the creation of customer-centric software solutions. Introduces automation throughout the software production system to deliver better software faster.		
<b>Deliverables</b>	<b>Accountable</b>	<b>Responsible</b>	<b>Contributor</b>
	<ul style="list-style-type: none"> <li>Integrated Solution</li> </ul>	<ul style="list-style-type: none"> <li>Development Process</li> </ul>	<ul style="list-style-type: none"> <li>Test Procedure</li> <li>Release</li> </ul>
<b>Main task/s</b>	<ul style="list-style-type: none"> <li>Implement and manage continuous distribution methodologies</li> <li>Design systems with high levels of availability and scalability</li> <li>Manage testing across the release lifecycle</li> <li>Facilitate cross functional collaboration and engagement</li> <li>Design and manage process automation tools</li> <li>Adopt an agile software development methodology</li> <li>Manage continuous integration tool management</li> </ul>		
<b>e-Competences</b> <i>(from e-CF)</i>	B.1. Application Development		Level 3
	B.2. Component Integration		Level 4
	B.3. Testing		Level 4
	B.4. Solution Deployment		Level 3
	<b>B.6. ICT Systems Engineering</b>		<b>Level 4</b>
	C.2. Change Support		Level 3
<b>Profession-related skills</b> (this set is generic for all software related roles)	The software profession-related skills are: P.1 (Agile) project skills P.2 Security skills P.3 Software lifecycle skills P.4 Sustainability skills P.5 Ethical awareness skills		
<b>Soft skills</b> (this set is generic for all ICT professional roles)	Interpersonal soft skills: ISS.1 Teamwork skills ISS.2 Communication skills ISS.3 English language skills  Personal soft skills: PSS.1 Critical thinking & analysis PSS.2 Problem solving PSS.3 Self-management		
<b>KPI area</b>	Reduced time to implement solutions		

## Improved role: Solution designer

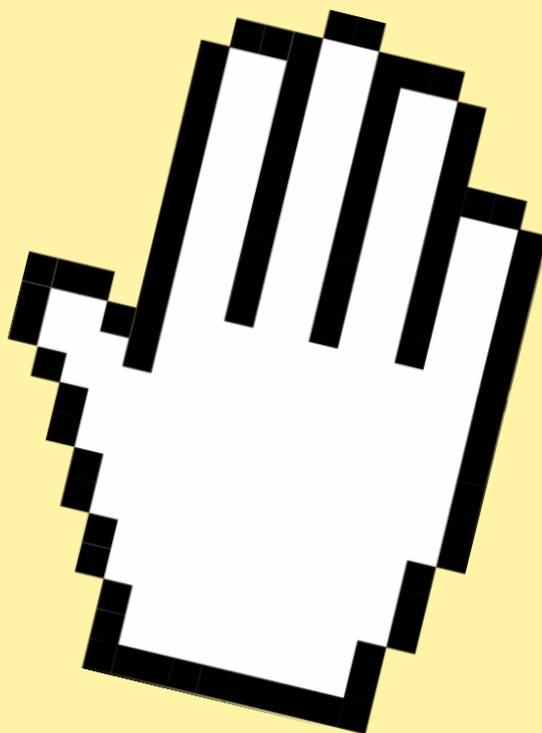
Profile title	SOLUTION DESIGNER ROLE		
<b>Summary statement</b>	Provides the translation of business requirements into end-to-end IT solutions.		
<b>Mission</b>	Proposes and designs solutions in line with technical architecture which fit business requirements and support change.		
<b>Deliverables</b>	<b>Accountable</b>	<b>Responsible</b>	<b>Contributor</b>
	<ul style="list-style-type: none"> <li>• Solution in Operation</li> </ul>	<ul style="list-style-type: none"> <li>• Solution Design Description</li> <li>• User Experience Design</li> </ul>	<ul style="list-style-type: none"> <li>• Project Portfolio</li> </ul>
<b>Main task/s</b>	<ul style="list-style-type: none"> <li>• Examine and interpret business requirements</li> <li>• Establish solution intent</li> <li>• Align solution with technical architecture</li> <li>• <b><i>Uphold the architectural governance principles and good implementation design for architectural deliverables</i></b></li> <li>• Identify potential technical design risks</li> <li>• Supervise the built in quality</li> <li>• Operate within the budgetary framework to validate the financial impact of design decisions</li> <li>• Identify opportunities for innovation</li> <li>• Plan technology roadmaps</li> </ul>		
<b>e-Competences</b> (from e-CF)	<b>A.5. Architecture Design</b>		<b>Level 4</b>
	A.6. Application Design		Level 3
	<b>A.8. Sustainability Management</b>		<b>Level 3</b>
	A.9. Innovating		Level 4
	D.10. Information and Knowledge Management		Level 3
	D.11. Needs Identification		Level 4
	<b>E.3. Risk management</b>		<b>Level 2</b>
<b>Profession-related skills</b> (this set is generic for all software related roles)	The software profession-related skills are: P.1 (Agile) project skills P.2 Security skills P.3 Software lifecycle skills P.4 Sustainability skills P.5 Ethical awareness skills		
<b>Soft skills</b> (this set is generic for all ICT professional roles)	Interpersonal soft skills: ISS.1 Teamwork skills ISS.2 Communication skills ISS.3 English language skills  Personal soft skills: PSS.1 Critical thinking & analysis PSS.2 Problem solving PSS.3 Self-management		
<b>KPI area</b>	Effectiveness of the solution		

## Improved role: Test specialist

Profile title	TEST SPECIALIST ROLE		
<b>Summary statement</b>	Designs and performs testing plans.		
<b>Mission</b>	Ensures delivered or existing products, applications or services comply with technical and user needs and specifications. For existing systems, applications, innovations and changes; diagnoses failure of products or services to meet specification.		
<b>Deliverables</b>	<b>Accountable</b>	<b>Responsible</b>	<b>Contributor</b>
		<ul style="list-style-type: none"> <li>• Test Plan</li> <li>• Test Procedure</li> <li>• Test Result</li> </ul>	<ul style="list-style-type: none"> <li>• Integrated Solution</li> <li>• Validated Solution</li> <li>• Solution Documentation</li> </ul>
<b>Main task/s</b>	<ul style="list-style-type: none"> <li>▪ Select and develop integration testing techniques to ensure the system meets requirements.</li> <li>▪ Design and customize integration tests, identify open issues.</li> <li>▪ Organise test plans and procedures for white and black box testing at unit, module, system and integration levels.</li> <li>▪ Establish procedures for result analysis and reporting.</li> <li>▪ Design and implement defect tracking and correction procedures</li> <li>▪ Write test program to assess software quality</li> <li>▪ Develop tools to increase test effectiveness</li> </ul>		
<b>e-Competences</b> <i>(from e-CF)</i>	B.2. Component Integration		Level 3
	B.3. Testing		Level 3
	B.4. Solution Deployment		Level 2
	B.5. Documentation Production		Level 3
	E.3. Risk Management		Level 2
<b>Profession-related skills</b> (this set is generic for all software related roles)	The software profession-related skills are: P.1 (Agile) project skills P.2 Security skills P.3 Software lifecycle skills P.4 Sustainability skills P.5 Ethical awareness skills		
<b>Soft skills</b> (this set is generic for all ICT professional roles)	Interpersonal soft skills: ISS.1 Teamwork skills ISS.2 Communication skills ISS.3 English language skills  Personal soft skills: PSS.1 Critical thinking & analysis PSS.2 Problem solving PSS.3 Self-management		
<b>KPI area</b>	Consistency of the test plan according to the quality plan of the project		

## Improved role: Technical (software) specialist

Profile title	TECHNICAL SPECIALIST ROLE		
<b>Summary statement</b>	Maintains and repairs hardware, software and service applications.		
<b>Mission</b>	Effectively maintains customer hardware/software. Responsible for delivering timely and effective repairs to ensure optimal system performance and superior customer satisfaction.		
<b>Deliverables</b>	<b>Accountable</b>	<b>Responsible</b>	<b>Contributor</b>
	<ul style="list-style-type: none"> <li>Solved Incident</li> </ul>	<ul style="list-style-type: none"> <li>Up to date Solution</li> </ul>	<ul style="list-style-type: none"> <li>Solution Documentation</li> </ul>
<b>Main task/s</b>	<ul style="list-style-type: none"> <li>Identify software and hardware problems and repair</li> <li>Perform regular maintenance on hardware and software components</li> <li>Install cables and configures hardware and software</li> <li>Document system addresses and configurations</li> <li>Run diagnostic programs or use test equipment to locate source of problems</li> <li>Communicate effectively with end users and customer management</li> <li>Maintain security and functionality through application of program temporary fixes</li> </ul>		
<b>e-Competences</b> (from e-CF)	C.2. Change Support		Level 2
	C.3. Service Delivery		Level 2
	C.4. Problem Management		Level 3
	<b>C.5. Systems Management</b>		<b>Level 2</b>
	E.3. Risk Management		Level 2
	E.6. ICT Quality Management		Level 2
<b>Profession-related skills</b> (this set is generic for all software related roles)	The software profession-related skills are: P.1 (Agile) project skills P.2 Security skills P.3 Software lifecycle skills P.4 Sustainability skills P.5 Ethical awareness skills		
<b>Soft skills</b> (this set is generic for all ICT professional roles)	Interpersonal soft skills: ISS.1 Teamwork skills ISS.2 Communication skills ISS.3 English language skills  Personal soft skills: PSS.1 Critical thinking & analysis PSS.2 Problem solving PSS.3 Self-management		
<b>KPI area</b>	Customer satisfaction		



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