

European Software
Skills Alliance.

Accreditation Standards and Criteria for Software Professionals' Education

ENSURING LEARNING PROGRAMMES MEET
THE ESSA QUALITY STANDARDS

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ESSA



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ESSA “Accreditation Standards and Criteria for Software Professionals’ Education”, 2022, DRAFT version.

Deliverable D.20: “Accreditation standards and criteria”

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About ESSA

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

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

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

Project partners

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

View all project partners: [ESSA Partners](#) | [ESSA Associated Partners](#)



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List of abbreviations and acronyms

Abbreviation	Term
CEPIS	Council of European Professional Informatics Societies
e-CF	e-Competence Framework
EQA	External Quality Assurance
EQANIE	European Quality Assurance Network for Informatics Education
EQAVET	European Quality Assurance in Vocational Education and Training
EQF	European Qualification Framework
ESG	Standards and Guidelines for Quality Assurance in the European Higher Education Area
ESSA	European Software Skills Alliance
PLO	Programme Learning Outcomes
QA	Quality Assurance
SSC	Subject-Specific Criteria
WP	Work Package

1 Executive Summary

1.1 Introduction

ESSA report “Accreditation Standards and Criteria for Software Professionals' Education” is a deliverable related to Work Package 3. It presents general criteria and procedural guidelines as well as subject-specific criteria (SSC). The latter builds on the ESSA's [educational profiles](#) covering 5 software roles at different qualification levels (EQF 4-7). The rationale of the two sets of criteria (general and subject-specific) is to provide a quality assurance (QA) scheme for learning programmes that are developed following ESSA's educational profiles, notably within Work Package 4 and beyond.

1.2 Objective

The report introduces a QA scheme for the learning programmes in selected software-related areas such as, but not limited to, Software Development, Software Design, and DevOps. The proposed accreditation scheme aims to provide the procedural principles and learning outcome definitions needed to assess whether the study programmes fulfil the requirements of levels 5 to 7 of the European Qualification Framework for Lifelong Learning (EQF). The two accreditation documents in the annexes encompass both the general and subject-specific framework standards as well as the procedural guidelines to be applied in the accreditation process of selected ESSA programmes.

1.3 Approach

The process of defining and formulating the accreditation standards and criteria has been undertaken in the second year of the project under the responsibility of ASIIN, which disposes of extensive experience in the field of accreditation of third-cycle and further education learning programmes. The development of the SSC greatly benefitted from the partners' contributions related to the definition of relevant educational profiles for five software professional roles. In between and at the end of the process, several feedback loops were implemented. In the final stage, the WP co-leaders provided essential input on the drafts. The efforts put to obtain all project partners' consent on the final draft of the criteria allowed for further improvements.

1.4 Results

This document outlines ESSA's accreditation standards and criteria. It describes — in general terms — their structure as well as the process of how they were defined and formulated as well as the actors who participated in the process. The document summarises how these standards and criteria are to be used in practice and how the actual accreditation process will look like. In this regard, it also focuses on how the accreditation procedure can be carried out as time- and cost-effectively as possible for all project partners.

1.5 Conclusions

In line with the expectations of this Work Package, the proposed accreditation scheme for learning programmes educating future software professionals in selected professional roles

will ensure the adequate qualification level of these programmes. For this purpose, it is based on two sets of general and subject-specific standards.

1.6 Use of this document

The documents elaborated under Work Package 3 form the basis for a considerable number of piloting accreditation procedures in the framework of the project and anticipate implementation of EQA procedures for similar learning programmes beyond the scope of the ESSA project.

The execution of the pilot accreditation procedures will provide important insights into whether the two sets of criteria fully satisfy the expectations in ensuring the quality of the learning programmes and whether the procedural rules are adequate for the reviews.

2 General accreditation criteria

The ESSA general accreditation criteria for learning programmes for software professionals are based on the Standards and Guidelines for Quality Assurance in the European Higher Education Area (ESG). While the ESG explicitly refer to academic settings and higher education institutions, they can also be adapted to alternative providers of (further) education and training. Moreover, the ESSA general accreditation criteria also comply with the European Quality Assurance Reference Framework for Vocational Education and Training (EQAVET).

In the framework of this project, the criteria provide an accreditation scheme for training programmes of EQF levels 4/5 to 7 and can be applicable to all areas of further education and training. They are therefore also tailored to accredit all qualification profiles for software professionals, which have been defined in the ESSA project's framework.

To fully assess whether learning programmes related to the ESSA role profiles are meeting defined quality standards in the field, the general criteria have to be applied in combination with the respective subject-specific criteria (SSC) (see annexes). They will be validated in pilot accreditation procedures of selected programmes.

A successful accreditation confirms that the (intended) learning outcomes for an educational programme or individual learning unit can be achieved based on the contents, resources, and structural framework outlined during the accreditation procedure. Hence, the criteria should enable experts to assess whether the contents of a learning programme or a learning unit are leading learners to achieve the programme learning outcomes (PLO). Likewise, they focus on whether the didactical and examination methods do reasonably relate to the PLO. Additionally, they ask whether administrative and counselling services as well as personal and material resources figure as supportive structures for achieving those learning outcomes. This is reflected in the following structure of the ESSA general criteria:

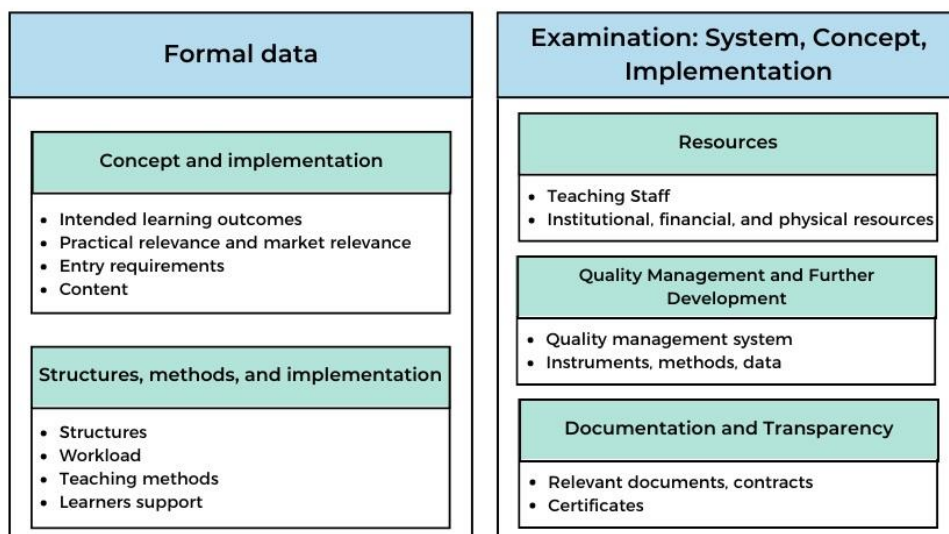


Figure 1: Structure of ESSA General Criteria

These learning outcomes should transparently reflect the qualifications profile and level obtained by graduates after successful completion of the respective programme or module. Learning outcomes are instrumental in fostering mobility between academic education and vocational education and training (VET), while supporting the transfer of credits between academic and working experience. Ultimately, the accreditation of an educational offering based on achieved learning outcomes will promote diversity in (further) education and training and, at the same time, guarantee the quality, transparency, and comparability of achievements as well as of the required processes and resources. Transparency in this sense is also ensured through the alignment of the ESSA accreditation criteria with the EQF and respective competence levels, which will be indicated in the respective accreditation seal.

The accreditation approach aims at supporting educational providers to continuously improve their learning programmes/units. Once accredited, improvement measures should never be postponed until the next accreditation date. On the contrary, for a renewed accreditation, it is essential to be able to convincingly provide evidence of continuous improvement efforts. The general accreditation criteria can be found in [Annex 1](#) of this document.

3 Subject-specific accreditation criteria

The SSC are a supplementary set of quality standards designed during the project and to be validated during the pilot accreditation procedures of selected programmes. They are complementary to the general accreditation criteria and thus should be applied by the expert groups as an additional layer of QA. SSC are essentially derived from the ESSA educational profiles which form the starting point for the development of the ESSA learning programmes.

The SSC will make sure that PLOs are not only just defined for the piloted learning programmes and well-served by the personal and material resources (“input”) of the ESSA piloting organisations, but also ensure they are in line with the sought educational profile and respective qualification level.

To this end, ASIIN will prepare and support the piloting partner institutions in aligning their offers to the defined standards. Selected programmes will eventually be accredited in pilot procedures, where the standards and criteria herein will serve as the basis for an assessment. The subject-specific accreditation criteria can be found in [Annex 2](#) of this document.

4 The accreditation process

The consortium has developed a process to ensure the quality of learning programmes. It verifies that they fulfil the general accreditation criteria and are aligned with the SSC mentioned above. The activities and timeline for the different procedural steps of an accreditation procedure can be found in [Annex 1](#): General accreditation criteria under “Procedural principles”.

The accreditation procedure reviews the logic and effectiveness of the teaching and learning process of a given learning programme/learning unit, with respect to three core dimensions:

1. **Definition of (intended) learning outcomes:** The learning outcomes to be achieved by learners (in each learning programme/unit) are the main focus. For learning programmes, the focus will also be on the plausible and consistent relation between the overall intended learning outcomes and the objectives of its individual units.
2. **Implementation:** The focus in this stage will be on organisational processes, instruments, and resources needed for the implementation of a programme/module (input) and the achievement of the intended objectives (outcome).
3. **Evaluation of the results and further development:** The focus will be on internal quality assurance, which should positively feed back into the system, leading to a continued improvement of the learning programme/unit.

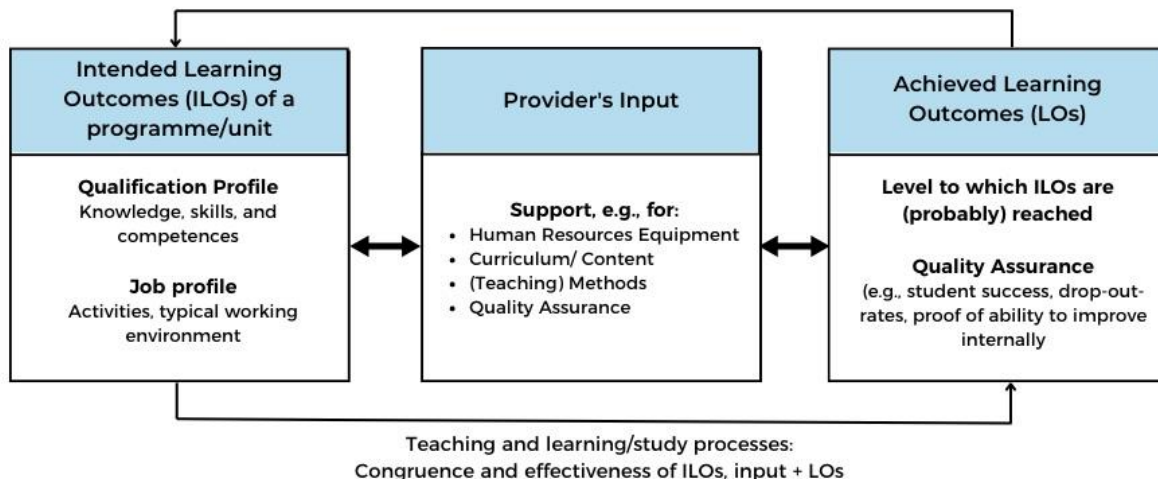


Figure 2: The review approach: a process-orientated approach

It is important to acknowledge, that accreditation procedures require considerable efforts in terms of personal, material, and financial resources. In line with many similar initiatives in the European and international QA community, the ESSA consortium has also considered and adopted a variety of additional procedural schemes that are at the same time cost-efficient and effective, without compromising on the underlying understanding of quality. Next to a full-scale accreditation procedure as described in [Annex 1](#), the following alternatives may be considered:

- a) **Downstream procedures:** One of the key aspects of the downstream procedure is the recognition of previously acquired accreditations and thus the underlying idea that the same criteria should not be checked twice. Therefore, if a provider has already obtained an accreditation or undergone an evaluation, all criteria that had already been assessed will not be double-checked during the accreditation procedure taking place in the framework of ESSA. Nevertheless, it must be assured

in advance that the set of criteria used in the previous accreditation procedures complies with the ESSA accreditation criteria.

For former accreditation decisions or evaluation results to be considered, it is conditional, however, that the respective accreditations are still valid and that its findings are not outdated (usually they should not be older than a maximum of five years). In addition, the results of such EQA procedures can only be regarded as a downstream procedure, as far as they directly address the applicable accreditation criteria.

- b) **Focused review/targeted review:** As a subcategory of alternative a), a shortened accreditation procedure can be executed in the form of a “focused review”, addressing and concentrating on those issues which may have been critically addressed in a preceding review. Similarly, the procedure could focus on predefined, indispensable quality aspects with respect to the accreditation criteria (“targeted review”).
- c) **Institutional accreditation with the award of self-accrediting status of the provider:** A grand solution for the indicated cost-efficiency and effectiveness issue of quality assurance could be the self-accrediting status of the educational provider. This type of institutional accreditation does not deal with the quality management system as such but rather focuses on the programme-related aspects of this system. Central would be exclusively that part of the quality management system, which is strictly related to the learning programme/unit design, conduct, monitoring and further development of the learning programmes/units. This includes, most crucially, the procedures of ensuring the continued compliance of the learning programmes/units with the accreditation criteria (including a cyclical external review component). As a result, this alternative programme accreditation route could lead to a self-accrediting status, which authorises the institution for a specified time to (re-)accredit its learning programmes and learning units by itself. Half-time random samples of external (re-)accreditation of some learning programmes/units by the authorising agency may be an additional option to sustainably ensure the quality of educational services.

5 Methodology

In the second project year and initial phase of the development of the ESSA accreditation criteria, the ESSA partners have been introduced to the general EQA approach and the basic methodological principles underlying the criteria design. In addition, ASIIN created a comprehensive information video as well as a corresponding handout for the project partners, in which the approach and methodological principles were summarised in detail once more. Subsequently, the ASIIN circulated a survey aimed at collecting feedback on the information video. All partners were invited to fill in the survey, comment, and give feedback on the accreditation approach and criteria design strategy. To make sure that the project partners had enough feedback opportunities and that ambiguities and questions were clarified, a so-called “Q&A document” has been produced, in which questions and/or concerns of the partners were collected and detailed explanations and answers provided. This document was distributed to all project partners. With these feedback loops, the partners have been included in the criteria development process.

The next phase (end of the second project year) was reserved for the development of the criteria. Once the ESSA general criteria had been defined, these were extended by a catalogue of SSC. As already mentioned, these SSC build on the educational profiles elaborated jointly by the ESSA partners. The matching with the educational profiles and other existing frameworks (in particular the e-CF) played an important role in defining the SSC.

To disseminate and sustainably exploit the accreditation scheme, and particularly the SSC, ASIIN collaborated closely with external experts and associations, such as its own Technical Committee for Computer Science — the European Quality Assurance Network for Informatics Education (EQANIE) — and established contact with the Council of European Professional Informatics Societies (CEPIS). These efforts are aimed at generating consent within the wider academic and professional community and thereby validate the standards framework and SSC with a view to the selected software professionals' roles/educational profiles. Moreover, ASIIN invited individual higher education institutions and other education providers outside the ESSA project to give feedback on the draft criteria.

6 List of references

European Commission. (n.d.). EQAVET - European Quality Assurance in Vocational Education and Training. <https://ec.europa.eu/social/main.jsp?catId=1536&langId=en>

European Qualifications Framework for Lifelong Learning (hereafter EQF), Official Journal of the European Union, 2008/C 111/01, 06.05.2008; available at: http://ecompetences.eu/wp-content/uploads/2013/11/EOF_broch_2008_en.pdf

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7 Annexes

7.1 Annex 1: General accreditation criteria

This annex presents an extract of the ESSA booklet “General Criteria & Procedural Guidelines for the Accreditation of Learning Programmes for Software Professionals” (2023). — [see the full booklet](#).

7.1.1 Standards for the Accreditation of learning programmes/units

The following table contains a list of the general standards for the accreditation of learning programmes/units. The table shows, which requirements have to be met to receive the accreditation seal. Accreditation seals are always based on the ESG. The table, therefore, lists analogies between the requirements to be met for the accreditation seal and the ESG.

ESSA Standards for Accreditation		Corresponding ESG
Requirements		
1	CONCEPT, STRUCTURE, AND IMPLEMENTATION	
1.1	<p>Learning outcomes The intended learning outcomes of the educational programme/unit are described briefly and precisely. The learning outcomes reflect the desired level of qualification and are feasible. They reflect currently foreseeable developments in the respective disciplinary field and adjacent disciplines.</p> <p>The learning outcomes are transparently anchored and accessible to the relevant stakeholders. Demand for graduates with the desired learning outcomes (competences) exists in the labour market or can be predicted. If applicable (e.g., in the case of short-cycle continuing education and training offers), the benefit of the learning programme for the aspired academic or professional education is demonstrated.</p> <p><i>Quality assurance</i> The intended learning outcomes are continuously reviewed and further developed, taking into consideration the development of the labour market and involving the relevant stakeholders.</p>	<p>ESG 1.2:¹</p> <p>ESG 1.8</p> <p>ESG 1.9</p>
1.2	<p>Contents and structure <i>Contents</i></p>	ESG 1.2

¹ “ESG x.y” refers to the relevant standard and corresponding guideline within the “Standards and Guidelines for Quality Assurance in the European Higher Education Area (ESG)”, European Association for Quality Assurance in Higher Education (ENQA), Yerevan, 2015; available at: https://www.enqa.eu/wp-content/uploads/2015/11/ESG_2015.pdf.

	<p><u>To be checked additionally, if necessary:</u> <i>Digital teaching</i> Applicants are informed about the e-learning and digital competences required to participate in the learning programme/unit and about the necessary technical requirements.</p> <p><i>Quality assurance</i> It is regularly reviewed whether the admission regulations ensure the required prior knowledge to a sufficient degree.</p>	
1.5	<p>Workload The estimated time budgets are realistic so that the learning outcomes of the learning programme/unit can be achieved at the desired level in the designated time. The workload of the learners can be estimated by interested persons even before registration. If credit points (ECTS/ECVET) are allocated, the allocation is transparent and adequately reflects the learners' workload.</p> <p><i>Quality assurance</i> It is regularly checked whether the actual workload of the learners corresponds to the estimated workload and whether it allows the achievement of the learning outcomes in the designated time. If necessary, adjustments are made to the content or to the time budget/the allocated credits.</p>	<p>ESG 1.2</p> <p>ESG 1.9</p>
2	EXAMINATIONS: SYSTEMS, POLICY, AND IMPLEMENTATION	
	<p>The achievement of the learning outcomes is assessed individually and comparably for all learners. The type, design, assessment criteria and distribution of the examinations are geared towards the achievement of the intended learning outcomes. The relevant provisions for examinations are made in a regular procedure and include rules for make-up exams, non-attendance, cases of illness as well as compensation of disadvantages in the case of students with disabilities or special needs. The forms of examination and assessment standards are made known to the learners and documented at the beginning of the learning programme/unit. The examinations are organised in such manner that the learners have sufficient time to prepare. If examinations are carried out by external service providers, it is ensured that the aforementioned requirements are met.</p> <p><u>To be checked additionally, if necessary:</u> <i>Digital teaching</i> Forms of online examinations have been developed and established. They are suitable for determining whether and to what extent the intended learning outcomes have been achieved. The learners are informed about the technical and organisational requirements as well as the procedural rules for the online examinations.</p> <p><u>For learning programmes/composite learning units:</u> The number and distribution of examinations ensure a tolerable examination load.</p> <p><i>Quality assurance</i> It is regularly checked whether the forms of examination and the requirements demanded reflect the intended learning outcomes and the desired level of qualification, and to what extent they measure the achievement of the learning outcomes.</p>	<p>ESG 1.3</p> <p>ESG 1.9</p>
3	RESOURCES: STAFF AND INFRASTRUCTURE	

7.1.2 Procedural principles

7.1.2.1 Procedure steps

The accreditation procedure of a learning programme/unit is divided into three stages:

1. Preparation (application and offer)	Applying body	An application is sent to the accreditation agency (hereafter agency). A request form to apply for an accreditation can be sent via electronic mail. The applying body is asked to suggest areas of expertise for the experts.
	Agency	After receiving the request, the agency will determine the necessary number of experts. Based on this information, the agency will draw up a quote for the accreditation procedure (costs) which the applying body will have to confirm. At the same time, the applying body will receive a proposed schedule for the procedure, which can be adapted as required.
	Agency + Applying body	The accreditation procedure will be contracted once the applying body agrees in written form to the quote provided by the agency or, upon request, with the closing of a separate agreement signed by both parties.
2. Application for accreditation (self-evaluation including documentation) and examination of the documents	Applying body	Submission of the application for accreditation to the agency, i.e., the self-evaluation and documentation proving that the requirements have been met.
	Agency	Formal preliminary assessment by the agency whether the application is complete and sufficiently documented. Meeting at the agency offices, a conference call or online meeting to discuss the results of the preliminary assessment. Alternatively, the results can also be communicated in writing.
	Agency (experts)	The agency appoints the expert team .
	Agency + Applying body	On-site at the institution <i>or, where circumstances permit, remote audit</i> (length depending on number of learning programmes/units, usually 1 or 2 days. One member of the expert team acts as a chair.
	Agency	Delivery of the accreditation report (experts' draft version after the on-site audit) for the applying body to check for formal mistakes and voice their opinion.
	Applying body	Statement of opinion by the applying body, corrections and/or additions to the experts' draft version of the accreditation report (where required).
3. Decision	Agency	Final evaluation by the expert team , recommendations for a decision.
	Decision-making Authority	Decision on the accreditation by the decision-making authority. Delivery of the decision to the applying body.
	Agency	Submission of the accreditation report (final version) to the applying body. Award of the accreditation seal. Publication of the accreditation report as set forth by the ESG.

7.2 Annex 2: Subject-specific accreditation criteria

This annex presents an extract of the ESSA booklet “Subject-Specific Criteria for the Accreditation of Learning Programmes for Software Professionals” (2023). — [see the full booklet](#).

The focus of these subject-specific criteria (SSC) is clearly on the description of the core competences that are to be acquired in specified roles, in which software professionals with different qualification profiles are looked for. Within this framework, the SSC aim to exemplarily lay out the characteristic competence profile of some major types of software specialists, namely: Software developer, DevOps expert, Solution designer, Technical (software) specialist, and Test specialist.

7.2.1 PLOs for Software Developers (EQF levels 4/5–7)

7.2.1.1 Qualification Profile

The present profile description refers to the educational profiles as defined within the ESSA framework by the consortium partners.

Software developers accordingly build and create computer programmes, including mobile applications, desktop applications, hybrid applications, or even sometimes operating systems. They may also be involved in other aspects of software development, including identifying user needs, software design, testing new software, software implementation, and making changes to the system. Software developers play a critical role in many different professional fields such as computer systems, manufacturing, finance, and software publishing. Referencing the competence profile to the different qualification levels, the following specifications are being made:

Junior developers (EQF 4/5) support all aspects of software development processes: development, testing, implementing, and maintaining of basic software solutions. They master the codebase, attend design meetings, write basic code, and fix bugs. They have an inquiring attitude, oversee the coherence, and work in a structured manner within clear boundaries.

Software developers at Bachelor level (EQF 6) develop, test, implement, and maintain basic software solutions in accordance with customer needs. They may be also involved in the design of these applications. They account for development activities of others.

Software developers at Master level (EQF 7) develop, test, implement, and maintain advanced/ innovative software solutions in accordance with customer needs. They may be also involved in the design of these applications. Developers at Master level have a deeper knowledge of one or more technologies, e.g., mobile computing, cloud technologies, Internet of Things, artificial intelligence,

and blockchain. They also oversee development and integration processes and projects and may initiate, plan, and coordinate these processes and projects.

7.2.1.2 PLOs for Software Developers

Competence [e-CF] ²	Programme Learning Outcomes (EQF / e-CF levels)		
	Junior Developer (EQF 4/5 / e-2)	Software Developer (EQF 6 / e-3)	Software Developer (EQF 7 / e-4)
1. Application Design [A.6.]	Learners are able → to interpret a design for a software application or component.	Learners are able → to specify a design for a software application or component that meets requirements; → to organise the planning of the design of an application or software component.	Learners are able → to specify a design for an advanced/ innovative solution, software application or component.
2. Application Development [B.1.]	Learners are able → to systematically develop a simple software application or component; → to propose modifications to an existing solution; → to document the development activities.	Learners are able → to creatively develop software applications and components, by interpreting the software design; → to optimise the application development.	Learners are able → to creatively develop and validate an advanced/ innovative solution, software application or component.
3. Component Integration [B.2.]	Learners are able → to systematically identify the compatibility of software specifications; → to integrate efficiently a software application or component into an existing system; → to document the installation activities.		Learners are able → to provide expert guidance or advice on integration of an advanced/ innovative solution, software application or component.
4. Testing [B.3.]	Learners are able → to test a software application or component through organizing test programmes and building scripts to identify potential vulnerabilities; → to document test outcomes.		Learners are able → to exploit wide ranging specialist knowledge to create a process for the entire testing activity, including the establishment of internal standard of practices; → to provide expert guidance or advice on testing an advanced/ innovative solution, software application or component.
5. Documentation Production [B.5.]	Learners are able → to draft technical documentation and ensure that it is complete, correct and provided in a suitable place and format.	Learners are able → to produce different technical documents, taking into account the needs of different populations and legal requirements.	

² The framework references 41 competences in altogether five competence areas as applied at the Information and Communication Technology (ICT) workplace: *Plan* (A.1.-A.10.), *Build* (B.1.—B.6.), *Run* (C.1.-C.5.), *Enable* (D.1.-D.11.) and *Manage* (E.1.-E.8.).

<p>6. Problem management [C.4]</p>	<p>Learners are able →to act systematically in handling incidents and problems through identifying and classifying incident types and service interruptions; →to record incidents cataloguing them by symptom and resolution.</p>	<p>Learners are able [capability] →to systematically resolve incidents and problems; →to optimise system performance; →to appraise the impact of a failure on the business.</p>	<p>Learners are able →to provide leadership and take over accountability for the entire problem management process; →to schedule and ensure well trained human resources, tools, and diagnostic equipment are available to meet emergency incidents.</p>
<p>7. New Technology</p>	<p>Learners are able →to apply basic methods, techniques and tools related to a new technology.</p>	<p>Learners are able [capability] →to consider and apply methods, techniques and tools related to a new technology; →to consider possible societal, environmental, and ethical issues related to the application of a new technology.</p>	<p>Learners are able →to give advice on the application of a new technology; →to critically analyse a new technology.</p>
<p>8. Profession related competences</p>	<p>Learners are able →to work in project settings and apply project management methods and tools; →to apply and report on measures, methods, tools and techniques related to security; →to consider basic ethical issues.</p>	<p>Learners are able [capability] →to manage a project and select appropriate project management methods and tools; →to consider ethical issues and apply their considerations in professional contexts and activities; →to build and communicate an opinion based on considerations of relevant social, professional, scientific and ethical aspects.</p>	<p>Learners are able →to lead a project; →to continuously consider ethical issues and apply these considerations in professional contexts and activities; →to build and communicate an opinion based on incomplete and or limited information taking into account social, scientific and ethical responsibilities related to the application of own knowledge and opinions.</p>
<p>9. Interpersonal and personal soft competences</p>	<p>Learners are able →to work together with others in a team; →to communicate with peers, colleagues, supervisors and/or relevant others, appropriately to the context; →to master the English language at level B2; →to understand the main ideas of complex text on both concrete and abstract topics, including technical discussions in his/her field of specialisation; →to realise personal development on request, where necessary with support.</p>	<p>Learners are able →to manage teamwork processes and facilitate collaboration to reach common objectives; →to communicate with peers, colleagues, supervisors and/or relevant others, specialists and non-specialists, clients, as well as to the scientific and professional community; →to master the English language at level B2 and understand the main ideas of complex text on both concrete and abstract topics, including technical discussions in his/her field of specialisation; →to realise personal development on one's own initiative.</p>	<p>Learners are able →to critically apply / translate / interpret results of research (possibly executed by others) to the own context (the occupation and/or knowledge domain); →to execute detailed scientific research; →to realise personal development, mostly autonomous and based on intrinsic motivation.</p>
<p>10. Functioning in organisations</p>	<p>Learners are able →to work in an organisational context under specific direction with limited autonomy and responsibility.</p>	<p>Learners are able →to work in an organisational context under specific direction with limited autonomy and responsibility.</p>	<p>Learners are able →to work in an organisational context under broad direction, performing coordinating activities, with at least three years of working experience at an intermediate or senior level.</p>

7.2.2 PLOs for DevOps Experts (EQF levels 6–7)

7.2.2.1 Qualification Profile

The present profile description refers to the respective educational profiles as defined within the ESSA framework by the consortium partners.

DevOps experts create an efficient cooperation and workflow between software development and IT operations to accelerate delivery and enhance quality of solutions and services. In this way, time is reduced between committing a change to a system and the change being placed into the production environment. DevOps experts strive for a continuous deployment and apply specific methods, practices, and tools, such as agile ways of working, shared ownership, and workflow automation.

Referencing the competence profile to the different qualification levels, the following specifications are being made:

DevOps experts at Bachelor level (EQF 6) develop, test, and deploy solutions in close collaboration with the operations team and take into account the multi-disciplinarity of the context. They account for others' development activities.

DevOps experts at Master level (EQF 7) create and manage the integration and testing lifecycle of hardware, software, or sub-system components into an existing or a new system.

7.2.2.2 PLOs for DevOps Experts

Competence [e-CF]	Programme Learning Outcomes (EQF / e-CF levels)	
	Junior DevOps expert (EQF 6 / e-3)	DevOps Expert (EQF 7 / e-4)
1. Application Development [B.1]	<p>Learners are able</p> <ul style="list-style-type: none"> → to creatively develop software applications and components, by interpreting the software design; → to optimise the application development, maintenance and performance by employing design patterns and by reusing proved solutions. 	
2. Component Integration [B.2]	<p>Learners are able</p> <ul style="list-style-type: none"> → to integrate efficiently a software application or component into an existing system, compliant with standards and procedures; → to document the installation activities 	<p>Learners are able</p> <ul style="list-style-type: none"> → to provide expert guidance or advice on integration of an advanced / innovative solution, software application or component.
3. Testing [B.3]	<p>Learners are able</p> <ul style="list-style-type: none"> → to construct and execute tests for solutions, software applications or components; → to document test outcomes to provide input to subsequent process owners such as designers, users or maintainers. 	<p>Learners are able</p> <ul style="list-style-type: none"> → to exploit wide ranging specialist knowledge to create a process for the entire testing activity, including the establishment of internal standard of practices; → to provide expert guidance or advice on testing of an advanced / innovative solution, software application or component.

<p>4. Solution Deployment [B.4.]</p>	<p>Learners are able → to implement solutions and services on the basis of comprehensive communication with stakeholders; → to complete release documentation.</p>	
<p>5. ICT Systems Engineering [B.6.]</p>	<p>Learners are able → to create a system infrastructure that meets requirements; → to ensure interoperability of system components.</p>	<p>Learners are able → to propose and design a cohesive and efficient system infrastructure.</p>
<p>6. Change Support [C.2.]</p>	<p>Learners are able → to oversee and control system changes (e.g., functional updates, software or hardware additions and maintenance activities) in order to ensure the integrity of the system; → to take into account procedures, requirements and restrictions.</p>	
<p>7. New Technology</p>	<p>Learners are able → to apply methods, techniques and tools related to a new technology.</p>	<p>Learners are able → to give advice on the application of a new technology; → to critically analyse a new technology.</p>
<p>8. Profession related competences</p>	<p>Learners are able → to manage a project and select appropriate project management methods and tools; → to consider ethical issues and apply their considerations in professional contexts and activities; → to build and communicate an opinion based on considerations of relevant social, professional, scientific and ethical aspects.</p>	<p>Learners are able → to lead a project; → to continuously consider ethical issues and apply these considerations in professional contexts and activities; → to build and communicate an opinion based on incomplete and or limited information taking into account social, scientific and ethical responsibilities related to the application of own knowledge and opinions.</p>
<p>9. Interpersonal and personal soft competences</p>	<p>Learners are able → to manage teamwork processes and facilitate collaboration to reach common objectives; → to communicate with peers, colleagues, supervisors and/or relevant others, specialists and non-specialists, clients, as well as to the scientific and professional community; → to master the English language at level B2 and understand the main ideas of complex text on both concrete and abstract topics, including technical discussions in his/her field of specialisation; → to realise personal development on one's own initiative.</p>	<p>Learners are able → to critically apply / translate / interpret results of research (possibly executed by others) to the own context (the occupation and/or knowledge domain); → to execute detailed scientific research; → to realise personal development, mostly autonomous and based on intrinsic motivation.</p>
<p>10. Functioning in organisations</p>	<p>Learners are able → to work in an organisational context under specific direction with limited autonomy and responsibility.</p>	<p>Learners are able → to work in an organisational context under broad direction, performing coordinating activities, with at adequate working experience at an intermediate or senior level (three years at a minimum).</p>

7.2.3 PLOs for Solution Designers (EQF levels 6–7)

7.2.3.1 Qualification Profile

The following profile description refers to the respective educational profiles as defined within the ESSA framework by the consortium partners.

Solution designers specify appropriate IT solutions for a specific business or organisation context, based on a thorough understanding of the business, processes, technology, and needs and requirements of the customer, thus providing the translation of business requirements into IT solutions. Solution designers do this in such a way that these solutions fit well in the landscape of the business (in line with e.g., strategy, mission, organisation, needs, requirements) as well as ICT. Solution designers are well-informed about the latest developments and trends in the IT field, as well as the services the market offers. They operate in between business and IT. Referencing the competence profile to the different qualification levels, the following specifications are being made:

Solution designers at Bachelor level (EQF 6) are aware of the interests and needs of different stakeholders and carefully balance these in the proposal for an IT solution. They communicate and cooperate with customers, users, and specialists, supporting them and guarding the IT solution in the different stages of development and implementation.

Solution designers at Master level (EQF 7) oversee the bigger picture of business, market and technology. They creatively develop innovative solutions, incorporating latest trends and technologies if necessary and applicable. They combine a strategic vision with optimisation of resources. They have an overview of different processes and projects and may initiate, plan and coordinate these processes and projects.

7.2.3.2 PLOs for Solution Designers

Competence [e-CF]	Programme Learning Outcomes (EQF / e-CF levels)	
	<i>Junior Solution Designer (EQF 6 / e-3)</i>	<i>Solution Designer (EQF 7 / e-4)</i>
1. Needs identification [D.11.]	Learners are able → to translate customer needs into requirements; → to propose different ICT solutions.	Learners are able → to exploit a wide-ranging specialist knowledge of the customers' business; → to propose different creative solutions for complex problems and → to advise the customer.
2. Architecture Design [A.5.]	Learners are able → to identify and align relevant ICT technology and specifications.	Learners are able → to propose a coherent architecture design; → to specify a structured approach to implement an ICT solution.

3. Application Design [A.6.]	<p>Learners are able → to specify a design for a software application or component that meets requirements (customer needs); → to organize the planning of the design of an application or software component; → to ensure the application is correctly integrated within a complex environment.</p>	
4. Innovating [A.9.]	<p>Learners are able → to propose ideas on the application of novel technologies in a practical context; → to document the idea generation process.</p>	<p>Learners are able → to propose and evaluate creative ideas on the application of novel technologies; → to develop a product innovation plan; → to design a Proof of Concept.</p>
5. Risk management [E.3.]	<p>Learners are able → to apply risk management principles; → to perform common risk analysis of ICT solutions and services; → to propose actions to handle risks.</p>	
6. Sustainability management [A.8.]	<p>Learners are able → to analyse different IT solutions in terms of sustainability; → to recommend sustainable options.</p>	
7. Information and knowledge management [D.10.]	<p>Learners are able → to identify and analyse relevant business processes and collect related information and knowledge; → to propose practices and means for an effective use of this information and knowledge.</p>	
8. New Technology	<p>Learners are able → to apply methods, techniques and tools related to a new technology.</p>	<p>Learners are able → to give advice on the application of a new technology; → to critically analyse a new technology.</p>
9. Profession related competences	<p>Learners are able → to manage a project and select appropriate project management methods and tools; → to consider ethical issues and apply their considerations in professional contexts and activities; → to build and communicate an opinion based on considerations of relevant social, professional, scientific and ethical aspects.</p>	<p>Learners are able → to lead a project; → to continuously consider ethical issues and apply these considerations in professional contexts and activities; → to build and communicate an opinion based on incomplete and or limited information taking into account social, scientific and ethical responsibilities related to the application of own knowledge and opinions.</p>
10. Interpersonal and personal soft competences	<p>Learners are able → to manage teamwork processes and facilitate collaboration to reach common objectives; → to communicate with peers, colleagues, supervisors and/or relevant others, specialists and non-specialists, clients, as well as to the scientific and professional community; → to master the English language at level B2 and understand the main ideas of complex text on both concrete and abstract topics, including technical discussions in his/her field of specialisation; → to realise personal development on one's own initiative.</p>	<p>Learners are able → to critically apply / translate / interpret results of research (possibly executed by others) to the own context (the occupation and/or knowledge domain); → to execute detailed scientific research; → to realise personal development, mostly autonomous and based on intrinsic motivation.</p>
11. Functioning in organisations	<p>Learners are able → to work in an organisational context under specific direction with limited autonomy and responsibility.</p>	<p>Learners are able → to work in an organisational context under broad direction, performing coordinating activities, with at least three years of working experience at an intermediate or senior level.</p>

7.2.4 PLOs for Technical (Software) Specialists (EQF level 4/5)

7.2.4.1 Qualification Profile

The following profile description refers to the respective educational profiles as defined within the ESSA framework by the consortium partners.

Technical specialists deploy, support, maintain and repair software (mobile, desktop or hybrid applications) and corresponding infrastructure in a timely and effective way to ensure optimal system performance and superior customer satisfaction. They are an important link between end users, software developers and infrastructure admins in systems deployment, incident, and problem management.

Technical (software) specialists at entry-level (EQF 4/5) assist software systems users and software and hardware deployers with all aspects of software application implementation, support, and maintenance. Primarily, they provide user support and incident management for the software system and corresponding technology environment. They have an inquiring attitude, oversee the coherence, and work in a structured manner within clear boundaries.

7.2.4.2 PLOs for Technical (Software) Specialists

Competence [e-CF]	Programme Learning Outcomes (EQF / e-CF level)
	<i>Technical Software Specialists (EQF 5 / e-2)</i>
1. Problem Management [C.4.]	Learners are able → to act systematically in handling incidents and problems through identifying and classifying incident types and service interruptions; → to record incidents cataloguing them by symptom and resolution.
2. Systems Management [C.5.]	Learners are able → to fulfil the organisation's operational needs related to the IT system and services; → to ensure a proper and secure operation.
3. Service Delivery [C.3.]	Learners are able → to monitor and analyse service delivery; → to notify potential service level failures and security risks; → to recommend actions to improve the service reliability.
4. Solution Deployment [B.4.]	Learners are able → to implement (parts of) a solution or software application or component; → to provide (part of) release documentation.
5. User Support [C.1.]	Learners are able → to address user problems.
6. Change Support [C.2.]	Learners are able

	→ to act systematically to minimise the impact of changes to a service or software application or component.
7. Risk Management [E.3.]	Learners are able → to apply risk management principles; → to perform a common risk analysis of ICT solutions and services; → to propose actions to handle risks.
8. ICT Quality Management [E.6.]	Learners are able → to monitor compliance with quality measures (the organizations quality policy).
9. New Technology	Learners are able → to apply basic methods, techniques and tools related to a new technology.
10. Profession related competences	Learners are able → to work in project settings and apply project management methods and tools; → to apply and report on measures, methods, tools and techniques related to security; → to consider basic ethical issues.
11. Interpersonal and personal soft competences	Learners are able → to work together with others in a team; → to communicate with peers, colleagues, supervisors and/or relevant others, appropriately to the context; → to master the English language at level B2 and understand the main ideas of complex text on both concrete and abstract topics, including technical discussions in his/her field of specialisation; → to realise personal development on request, where necessary with support.
12. Functioning in organisations	Learners are able → to work in an organisational context under specific direction with limited autonomy and responsibility.

7.2.5 PLOs for Test Specialists (EQF level 4/5)

7.2.5.1 Qualification Profile

The following profile description refers to the respective educational profiles as defined within the ESSA framework by the consortium partners.

Test specialists ensure that software applications and solutions comply with technical, and user needs and specifications. They design, execute, and record tests for software applications or services and report the results in a well-structured manner. They also interact with different stakeholders (e.g., developers, and users) and knows how to communicate their findings effectively.

Test specialists at entry-level (EQF 4/5) make test scenarios for testing the software. They choose an appropriate test form, such as a unit test, integration test, acceptance test, as well as an appropriate test methodology. They determine what is needed for testing, such as the test environment, resources, and test data. They also perform the test(s), interpret the findings, and draw conclusions. During the process, they proactively communicate with the parties involved. They have an inquiring attitude, oversee the coherence, and work in a structured manner within clear boundaries.

7.2.5.2 PLOs for Test Specialists

Competence [e-CF]	Programme Learning Outcomes (EQF / e-CF levels)
	<i>Test Specialists (EQF 5 / e-2)</i>
1. Component Integration [B.2.]	Learners are able → to systematically identify the compatibility of software specifications; → to integrate efficiently a software application or component into an existing system; → to document the installation activities.
2. Testing [B.3.]	Learners are able → to test a software application or component through organizing test programmes and building scripts to identify potential vulnerabilities; → to document test outcomes.
3. Solution Deployment [B.4.]	Learners are able → to identify failing components and carry out a failure analysis; → to implement (parts of) a solution or software application or component; → to provide (part of) release documentation.
4. Documentation Production [B.5.]	Learners are able → to draft technical documentation and ensure that it is complete, correct and provided in a suitable place and format.
5. Risk Management [E.3.]	Learners are able → to apply risk management principles to perform common risk analysis of ICT solutions and services; → to propose actions to handle risks.
6. New Technology	Learners are able → to apply basic methods, techniques and tools related to a new technology.
7. Profession related competences	Learners are able → to work in project settings and apply project management methods and tools; → to apply and report on measures, methods, tools and techniques related to security; → to consider basic ethical issues.
8. Interpersonal and personal soft competences	Learners are able → to work together with others in a team; → to communicate with peers, colleagues, supervisors and/or relevant others, appropriately to the context; → to master the English language at level B2 and understand the main ideas of complex text on both concrete and abstract topics, including technical discussions in his/her field of specialisation; → to realise personal development on request, where necessary with support.
9. Functioning in organisations	Learners are able → to work in an organisational context under specific direction with limited autonomy and responsibility.

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