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D5.3 ARISA Quality Label Subject-Specific Criteria

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Project information

The Artificial Intelligence Skills Alliance (ARISA) fast-tracks the upskilling and reskilling of employees, job seekers, business leaders, and policymakers into AI-related professions to open Europe to new business opportunities. It is a four-year transnational project funded under the EU's Erasmus+ programme. For more information, contact info@aiskills.eu | aiskills.eu

Project Partners

List of Abbreviations

EQA	External Quality Assurance
EQF	European Qualifications Framework for Lifelong Learning
HEI	Higher Education Institution
PLO	Programme Learning Outcome
VET	Vocational Education & Training
SSC	Subject-Specific Criteria

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1. Executive Summary

1.1 Introduction

These Subject-Specific Criteria (SSC) are written to complement the General Criteria as part of the ARISA Quality Label Framework. They are based on the results of Work Package 4, which delivered the Learning Outcomes (programme and unit learning outcomes) and the Core Curriculum for 7 (seven) educational profiles in the field of AI. The partners in the ARISA project are piloting learning programmes that are developed for each of these educational profiles.

1.2 Objective

The objective of creating the SSC is to have an instrument – a set of validated, subject-specific standards – to be able to review AI learning programmes within the framework of the ARISA Quality Label, and to establish whether or not the learning programmes under review meet these quality criteria.

1.3 Methodological Approach

The ARISA SSC in this document have been created by executing the following steps:

1. Analysis of the deliverables 4.1 and 4.2 in work package 4, namely the programme and unit learning outcomes as well as the core curriculum document.

2. Re-developing this information into a clear set of subject-specific criteria organized by educational profile and EQF (European Qualifications Framework) level.

3. Validating the merit and applicability of these criteria by external, recognised organisations and experts in the field of informatics and artificial intelligence.

4. Adjusting and clarifying the SSC based on the feedback from the external validation process.

5. Internally validating the usability and applicability of these SSC to fulfil their function within the ARISA Quality Label Framework.

1.4 Results

The result is the SSC document as part of the ARISA Quality Label Framework.

1.5 Conclusions

The SSC, as they are defined and developed, have gone through a process of internal and external validation and will serve as a benchmark for reviewing the pilot learning programmes when they enter the ARISA Quality Label procedure.

1.6 Use of This Document

The SSC will be utilised as an instrument – a set of validated, subject-specific standards – to be able to review AI learning programmes within the framework of the ARISA Quality Label, and to establish whether or not the learning programmes under review meet these quality criteria.

2. Introduction

The Subject-Specific Criteria (SSC) in this document function as a benchmarking instrument in order to establish whether or not the learning programmes under review as part of the ARISA Quality Label procedure meet de criteria. These SSC are written to complement the General Criteria as part of the ARISA Quality Label Framework. They are based on the results of Work Package 4, which delivered the Learning Outcomes (programme and unit learning outcomes) and the Core Curriculum for 7 (seven) educational profiles in the field of AI. The partners in the ARISA project are piloting learning programmes that are developed for each of these educational profiles.

The SSC here are intended for experts to apply in the external quality assurance process in order to obtain the ARISA Quality Label for the piloting learning programmes. They have been validated by AI experts representing the ASIIN Technical Committee on Informatics and Computer Science, The European Quality Assurance Network for Informatics Education (EQANIE), and the pool of experts participating in ASIIN accreditation and certification procedures.

3. Subject-Specific Criteria (SSC) Related to ARISA Learning Programmes EQF Levels 5, 6, and 7

The following specifications complement the "ARISA Quality Label General Criteria" (D5.2).

3.1 Methodology

The ARISA SSC in this document have been created by executing the following steps:

1. Analysis of the deliverables 4.1 and 4.2 in work package 4, namely the programme and unit learning outcomes as well as the core curriculum document.
2. Re-developing this information into a clear set of subject-specific criteria organized by educational profile and EQF (European Qualification Framework) level.
3. Validating the merit and applicability of these criteria by external, recognised organisations and experts in the field of informatics and artificial intelligence
4. Adjusting and clarifying the SSC based on the feedback from the external validation process
5. Internally validating the usability and applicability of these SSC to fulfil their function within the ARISA Quality Label Framework.

3.2 Classification

3.2.1 Function and Context

The ARISA SSC serve as the central benchmark for evaluating the educational programmes submitted for the ARISA Quality Label. The SSC define the abilities, skills, and competencies considered to be "state of the art" in the subject area of AI, which can be exceeded or adapted according to the goals of a training provider.

The SSC represent best practices in higher and vocational education for specific learning programmes related to Artificial Intelligence (AI) within the professional community. The AI educational profiles in these documents have been developed by the ARISA partnership through collaboration between academia, vocational education professionals, and industry professionals, considering current labour market needs to ensure future-oriented training quality. The expectations set forth in the SSC for achieving learning outcomes and competency profiles are dynamic and

should undergo continuous review in close cooperation with organizations within the specialized community, including professional associations and industry federations.

In the Quality Label procedures (both the full and the shortened procedure as outlined in the ARISA Quality Label Framework (D5.1 and D5.2), the SSC provide a professionally developed foundation for discussions between experts and training providers. They play a crucial role in ensuring the comparability of educational programmes at EQF levels5, 6, and 7 and related external quality assurance (EQA) procedures.

3.2.2 Scope and Application

The SSC are aligned with the European e-Competence Framework (e-CF) and the European Qualifications Framework for Lifelong Learning (EQF) in terms of competencies and proficiency levels. They are designed to assess training programmes in selected AI fields and professions. Together with the "ARISA Quality Label General Criteria" developed within the ARISA project, they form the basis for making informed decisions to award the ARISA Quality Label to the learning programmes under review.

The core of this document is the definition of the major subject-specific criteria for each of the professional AI roles. These learning outcomes must be achieved by learners in learning programmes at EQF levels 5, 6, and 7 in order for the programmes to be eligible for quality review by a competent body that validates their quality in teaching and learning. Consequently, the SSC utilise the educational profiles developed and recognized for selected AI roles by a broad alliance of academic, vocational, and professional organisations within the ARISA project alliance. Each profile's characteristic LOs are referenced and differentiated according to the relevant proficiency level.

Each training provider is responsible for specifying the learning outcomes at the unit level and the corresponding content deemed adequate for their achievement. This so-called "Specific Curriculum", including also the teaching and assessment methods, has been developed by the training providers as part of the ARISA project.

The SSC are based on the **principle of academic freedom,** which ensures that content, didactical methods, and assessment forms collectively contribute to achieving the defined PLOs. The list of unit learning outcomes and unit-related assessment forms (defined and listed in the accompanying educational profiles of the ARISA project) serve as reference points for programme coordinators and expert groups during the Quality Label procedure and as additional information sources during the auditing process.

3.2.3 Educational Profiles

Following an outcome-oriented approach, the next section outlines the requirements for AI practitioners and AI Managers from a professional perspective. The focus of these SSC is on detailing the core competencies that must be acquired for specific roles sought after by employers for AI professionals with various qualification profiles. Within this framework, the SSC aim to exemplify the characteristic competence profiles of several major types of AI specialists:

Educational Profile	EQF Levels		
	EQF 5	EQF 6	EQF 7
1. Data Analyst	✔	✔	
2. Data Scientist		✔	✔

3. Machine Learning Engineer		✔	✔
4. NLP Engineer		✔	✔
5. Policy Makers			✔
6. Decision Makers			✔
7. AI Advisor/Consultant			✔

4. Educational Objectives and Learning Outcomes

In this section, the requirements for the educational profiles as mentioned above will be outlined with a description of the qualification profile (sourced from the Core Curriculum document) and a table of the learning outcomes per competence and for each EQF level that is piloted.

4.1.1 Requirements for Data Analysts

4.1.1.1 Qualification Profile

"Data analysts import, inspect, clean, transform, validate, model, or interpret collections of data with regard to the business goals of the company. They ensure that the data sources and repositories provide consistent and reliable data. Data analysts use different algorithms and IT tools as demanded by the situation and the current data. They might prepare reports in the form of visualizations such as graphs, charts, and dashboards.

Data analysts at **EQF 5** apply specialized knowledge and practical skills in AI technologies and big data analytics to import, inspect, clean, and transform data aligning with business goals. They develop solutions to ensure data consistency and reliability, creating visual reports like graphs and dashboards. Responsible for managing data projects, they also focus on continuous personal and team development within dynamic environments. They should resolve, or signal to higher management, ethical issues arising from these data or their utilization(s).

Data analysts at **EQF 6** apply advanced skills in AI technologies, machine learning, and big data to manage and interpret complex data sets, ensuring alignment with business goals. They lead small projects, innovate data-driven solutions, and are responsible for data integrity and security, making key decisions in dynamic business environments and resolving, or signalling to higher management, ethical issues arising from these data or their utilization(s)" (D4.2 Core Curriculum p. 68, 77)

4.1.1.2 Learning Outcomes for Data Analysts

Competence	Programme Learning Outcomes (EQF Levels)	
	Data Analyst (EQF 5)	Data Analyst (EQF 6)
1. Deep Learning		The learner has demonstrated the ability to design and implement deep learning models and architectures, encompassing their development, implementation, and application across various domains,
2. AI technologies	The learner has demonstrated the ability to integrate and innovate using various AI technologies to address real-world challenges, while considering ethical implications and industry standards.	The learner has demonstrated the ability to know and effectively utilize AI frameworks and libraries for the development and deployment of AI models and technologies, applying these tools across different domains to solve complex problems while considering ethical implications and industry standards.
3. ML Ops		The learner has demonstrated the ability to proficiently implement AI and machine learning projects, utilizing ML Ops principles to streamline development, ensure high-quality outputs, and manage projects efficiently. This includes deploying scalable AI solutions, managing the lifecycle of machine learning models, and applying quality control and cybersecurity measures to maintain accuracy and reliability in AI applications.
4. Machine Learning	The learner has demonstrated the ability to design, implement, and evaluate machine learning models and algorithms to address (simple) problems across various domains.	The learner has demonstrated the ability to effectively design, implement, and refine machine learning algorithms, managing simple projects within interdisciplinary teams in dynamic and diverse settings
5. Explainable AI	The learner has demonstrated the ability to develop and implement AI systems that are not only effective but also transparent and understandable, ensuring that these systems are accessible and interpretable to diverse stakeholders in various sectors.	The learner has demonstrated the ability to design, implement and evaluate AI models that are both transparent and interpretable, ensuring that stakeholders can understand, trust, and effectively manage AI solutions. Also, the learner has demonstrated the ability to assess the explainability level of an AI system. This includes applying principles and techniques of explainable AI to enhance the accountability, fairness, and ethical use of AI technologies across various domains.
6. Big Data & Data Analytics	The learner has demonstrated the ability to masterfully manage, analyse, and interpret large datasets using advanced data analytics techniques, driving decision-	The learner has demonstrated the ability to effectively harness big data technologies and data analytics methodologies to extract insights and inform decision-making. This includes the application of

	making processes and strategic initiatives in various industries.	data science principles to analyse datasets that express large velocity, volume, value, variety, and veracity. Also, the learner has shown the ability to implement data visualization techniques to communicate findings clearly.
7. Human-centred AI		The learner has demonstrated the ability to integrate human-centred design principles in AI development, ensuring sustainable, ethical, and effective AI solutions. This includes formulating and implementing AI governance policies, managing AI-related risks, devising strategic AI plans, and enhancing human-computer interaction to create AI systems that are aligned with human values and societal goals.
8. AI Ethics	The learner has demonstrated the ability to critically assess, develop, and implement AI technologies in accordance with ethical principles, ensuring that AI systems are developed and used responsibly across various sectors.	The learner has demonstrated the ability to critically assess the ethical implications of AI technologies, develop and implement strategies to address ethical challenges, and effectively advocate for responsible AI practices, ensuring AI innovations align with societal values and human rights across various contexts.
9. AI Futures & Innovation		The learner has demonstrated the ability to critically analyse future AI developments, leveraging research skills to innovate and contribute to the advancement of AI technologies. This encompasses a deep understanding of current trends, the capability to forecast technological evolutions, and the application of this knowledge to drive forward-thinking AI solutions that address emerging challenges and opportunities for companies.
10. Business Intelligence	The learner has demonstrated the ability to effectively harness business intelligence tools and techniques to analyse data, inform strategic decision-making, and improve organizational performance across various business contexts.	The learner has demonstrated the ability to effectively utilize business intelligence tools and methodologies to analyse data, extract actionable insights, and support strategic business decisions.
11. AI Awareness	The learner has demonstrated the ability to understand and articulate the fundamental concepts of artificial intelligence, its potential impacts, and the challenges it presents in various societal and business contexts.	The learner has demonstrated the ability to understand and articulate the fundamental concepts of artificial intelligence, its potential impacts, and the challenges it presents in various societal and business contexts. This includes a fundamental awareness of AI technologies and their capabilities, alongside an introduction to their limitations and the potential for unintended consequences.
12. Cyber & Data Security		The learner has demonstrated the ability to identify cybersecurity threats and vulnerabilities, implement and manage robust security

		measures, and develop comprehensive strategies to protect digital assets and ensure data privacy across various operational environments, while understanding the ethical, legal, and societal implications.
13. Generative AI		The learner has demonstrated the ability to design, implement, and evaluate routing generative AI systems, utilizing appropriate techniques including prompt engineering for Large Language Models. This includes the capacity to identify AI-generated content.
14. Soft Skills	The learner has demonstrated the ability to master a suite of essential soft skills, including communication, teamwork, problem-solving, presentation, innovation, critical thinking, conflict management, and change management, effectively applying these skills to enhance personal effectiveness and support organizational performance in simple professional settings.	The learner has demonstrated the ability to master a suite of essential soft skills, including communication, teamwork, problem-solving, and presentation, applying these skills to enhance personal effectiveness and organizational performance in simple professional settings.

4.1.2 Requirements for Data Scientists

4.1.2.1 Qualification Profile

"Data scientists find and interpret rich data sources, manage large amounts of data, merge data sources, ensure consistency of data-sets, and create visualizations to aid in understanding data. They build mathematical models using data, present and communicate data insights and findings to specialists and scientists in their team and if required, to a non-expert audience, and recommend ways to apply the data.

Data scientists at **EQF 6** apply AI machine learning and big data analytics to manage and interpret large datasets, building data-driven models and creating visualizations for insightful communication. They lead projects to ensure data consistency and security while integrating ethical AI practices. Their role involves adapting to evolving business needs and managing change effectively.

The Data Scientist curriculum at **EQF 7** is designed to enhance participants' expertise in advanced data analysis, machine learning, and AI technologies. It focuses on the development of robust big data infrastructures, sophisticated data analytics, and generative AI models. Participants will gain the ability to manage ML Ops, integrate explainable AI techniques, and apply human-centred design principles to AI solutions. The program also emphasizes ethical data handling, cybersecurity, and effective communication of complex data insights to drive data-driven decision-making and innovation across diverse business contexts." (D4.2 Core Curriculum p.93, 109)

4.1.2.2 Learning Outcomes for Data Scientists

Competence	Programme Learning Outcomes (EQF Levels)	
	Data Scientist (EQF 6)	Data Scientist (EQF 7)
1. Deep Learning	The learner has demonstrated the ability to design and implement deep learning models and architectures, encompassing their development, implementation, and application across different domains,	The learner has demonstrated the ability to critically analyse and design deep learning architectures and methodologies, as well as to develop and implement advanced deep learning models in complex, interdisciplinary contexts. This includes taking responsibility for managing the development process of these models and designing hardware and software architecture.
2. AI technologies	The learner has demonstrated the ability to know and effectively utilize AI frameworks and libraries for the development and deployment of AI models and technologies, applying these tools across different domains to solve complex problems while considering ethical implications and industry standards.	The learner has demonstrated the ability to critically evaluate and apply various AI technologies across different domains, managing complex projects that innovate and integrate AI solutions, thereby enhancing professional practice and contributing to the field.
3. ML Ops		The learner has demonstrated the ability to design, implement, and manage ML Ops frameworks that efficiently operationalize machine learning models within production environments, ensuring scalable, reproducible, and AI solutions.
4. Machine Learning	The learner has demonstrated the ability to effectively design, implement, and refine machine learning algorithms, managing simple projects within interdisciplinary teams in dynamic and diverse settings	The learner has demonstrated the ability to effectively design, implement, and refine machine learning algorithms, managing complex projects within interdisciplinary teams in dynamic and diverse settings
5. Explainable AI	The learner has demonstrated the ability to design, implement and evaluate fundamental AI models that are both transparent and interpretable, ensuring that stakeholders can understand, trust, and effectively manage AI solutions. Also, the learner has demonstrated the ability to assess the explainability level of an AI system. This includes applying principles and techniques of explainable AI to enhance the accountability, fairness, and ethical use of AI technologies across various domains.	The learner has demonstrated a deep understanding to design, implement, and evaluate artificial intelligence (AI) systems that are not only effective but also transparent and understandable by humans, ensuring these systems can be audited and trusted by users and stakeholders. This capability includes leading the integration of explainable AI components into broader AI projects to enhance accountability and foster trust in AI applications.

6. Big Data & Data Analytics	The learner has demonstrated the ability to effectively harness big data technologies and data analytics methodologies to extract insights and inform decision-making. This includes the application of data science principles to analyse datasets that express large velocity, volume, value, variety, and veracity. Also, the learner has shown the ability to implement data visualization techniques to communicate findings clearly.	The learner has demonstrated the ability to effectively design, implement, and lead advanced data analytics projects that leverage big data technologies to extract meaningful insights from large, diverse datasets. This includes managing projects that integrate big data solutions into business or research environments, enhancing decision-making processes and strategic development.
7. Human-centred AI	The learner has demonstrated the ability to integrate human-centred design principles in AI development, ensuring sustainable, ethical, and effective AI solutions. This includes formulating and implementing AI governance policies, managing AI-related risks, devising strategic AI plans, and enhancing human-computer interaction to create AI systems that are aligned with human values and societal goals.	The learner has demonstrated the ability to design and lead the development of AI systems that are user-friendly, ethical, and transparent, integrating human-centred design principles into AI development to enhance user trust and engagement.
8. AI Ethics	The learner has demonstrated an understanding of basic ethical principles and the ability to critically assess the ethical implications of AI technologies, develop and implement strategies to address ethical challenges, and effectively advocate for responsible AI practices, ensuring AI innovations align with societal values and human rights across various contexts.	The learner has demonstrated deep understanding of advanced ethical concepts and the ability to critically analyse and navigate the ethical challenges associated with AI technologies, developing, and implementing strategies to ensure AI systems are designed and used in a responsible and ethical manner. The learner has demonstrated the ability to implement and manage AI governance systems.
9. AI Futures & Innovation	The learner has demonstrated the ability to critically analyse future AI developments, leveraging research skills to innovate and contribute to the advancement of AI technologies. This encompasses a deep understanding of current trends, the capability to forecast technological evolutions, and the application of this knowledge to drive forward-thinking AI solutions that address emerging challenges and opportunities for companies.	The learner has demonstrated the ability to critically assess and creatively engage with emerging AI technologies, predicting future trends and spearheading innovative projects that explore new possibilities and applications of AI in various fields.
10. Business Intelligence	The learner has demonstrated the ability to effectively utilize business intelligence tools and methodologies to analyse data, extract actionable insights, and support strategic business decisions.	The learner has demonstrated the ability to effectively and critically analyse large datasets, develop and implement strategic business intelligence (BI) systems, and lead projects that

		transform data into actionable insights, thereby driving business optimization and innovation.
11. AI Awareness	The learner has demonstrated the ability to understand and articulate the fundamental concepts of artificial intelligence, its potential impacts, and the challenges it presents in various societal and business contexts. This includes a fundamental awareness of AI technologies and their capabilities, alongside an introduction to their limitations and the potential for unintended consequences.	The learner has demonstrated the ability to comprehensively understand and communicate the foundational principles of AI, its current and potential applications, and the ethical, legal, and societal challenges associated with its deployment and deploy AI strategies in business operations
12. Cyber & Data Security	The learner has demonstrated a foundational understanding of cybersecurity threats and vulnerabilities, and the ability to implement and manage robust security measures, develop comprehensive strategies to protect digital assets and ensure data privacy across various operational environments, while understanding the ethical, legal, and societal implications.	The learner has demonstrated an advanced understanding to design, implement, and lead comprehensive cybersecurity strategies that protect information assets against emerging threats and vulnerabilities, while ensuring compliance with international data protection regulations, data governance and lifecycle policies
13. Generative AI	The learner has demonstrated the ability to design, implement, and evaluate routing generative AI systems, utilizing appropriate techniques including prompt engineering for Large Language Models. This includes the capacity to identify AI-generated content.	The learner has demonstrated the ability to design, implement, and evaluate novel generative AI models applying best practices in prompt engineering to leverage their capabilities to innovate and drive forward creative solutions in various sectors such as media, healthcare, and technology.
14. Change Management	The learner has demonstrated the ability to participate in and support change processes within organizations. This includes understanding the basic principles of change management, assisting in the implementation of change initiatives, and contributing to efforts that address resistance and foster stakeholder buy-in. The learner can communicate the importance of change to team members, align their efforts with organizational objectives, and apply basic change management techniques to help ensure successful transitions	The learner has demonstrated the ability to effectively lead and manage change processes within organizations, employing strategies to facilitate smooth transitions, overcome resistance, and ensure stakeholder engagement. This includes understanding the dynamics of organizational change, communicating effectively to align team and organizational goals, and applying change management models to support and sustain organizational transformation.

15. Soft Skills	The learner has demonstrated the ability to master a suite of essential soft skills, including communication, teamwork, problem-solving, and presentation, applying these skills to enhance personal effectiveness and organizational performance in simple professional settings.	The learner has demonstrated and advanced ability to integrate and apply a broad range of advanced soft skills to lead teams, manage change, solve complex problems, and communicate effectively, enhancing organizational performance and driving innovation.

4.1.3 Requirements for Machine Learning Engineer

4.1.3.1 Qualification Profile

Machine learning engineers apply methods of artificial intelligence in engineering, robotics and computer science to design programs which simulate intelligence including thinking models, cognitive and knowledge-based systems, problem solving, and decision making. They also integrate structured knowledge into computer systems (ontologies, knowledge bases) in order to solve complex problems normally requiring a high level of human expertise or artificial intelligence methods.

Machine learning engineers at **EQF 6** design and develop AI-driven solutions in fields like engineering, incorporating advanced techniques in deep learning while considering AI ethics. They create and integrate complex knowledge systems to tackle problems requiring high-level expertise, ensuring secure and effective AI implementations and managing change.

Machine learning engineers at **EQF 7** wield highly specialized knowledge to pioneer AI applications in fields like engineering and robotics. They innovate by developing advanced methods in deep learning and machine learning, integrating these solutions across disciplines. They lead strategic, complex projects, setting new industry standards and driving technological advancements. (Source: D4.2. Core Curriculum p. 125, 138)

4.1.3.2 Learning Outcomes for Machine Learning Engineers

Competence	Programme Learning Outcomes (EQF Levels)	
	Machine Learning Engineer (EQF 6)	Machine Learning Engineer (EQF 7)
1. Deep Learning	The learner has demonstrated the ability to design and implement deep learning models and architectures, encompassing their development, implementation, and application across various domains,	The learner has demonstrated the ability to critically analyse and create deep learning concepts and methodologies, as well as to develop and implement advanced deep learning models in complex, interdisciplinary contexts. This includes taking responsibility for managing the development process of these models, designing hardware and software architecture and contributing to the advancement of knowledge and practice within the field of deep learning, while considering ethical implications and industry standards.
2. AI technologies	The learner has demonstrated the ability to know and effectively utilize AI frameworks and libraries for the development and deployment of AI models and technologies, applying these tools across different domains to solve complex problems while considering ethical implications and industry standards.	The learner has demonstrated the ability to critically evaluate and apply various AI technologies across different domains, managing complex projects that innovate and integrate AI solutions, thereby enhancing professional practice and contributing to the field.
3. ML Ops	The learner has demonstrated the ability to proficiently implement AI and machine learning projects, utilizing ML Ops principles to streamline development, ensure high-quality outputs.	The learner has demonstrated the ability to design, implement, and manage ML Ops frameworks that efficiently operationalize machine learning models within production environments, ensuring scalable, reproducible, and AI solutions.
4. HPC Cloud Services		The learner has demonstrated the ability to architect, deploy, and manage high-performance computing and cloud services solutions that meet advanced computing needs across various industries, ensuring scalability, reliability, and security.
5. Machine Learning	The learner has demonstrated the ability to effectively design, implement, and refine machine learning algorithms, managing simple projects within interdisciplinary teams in dynamic and diverse settings	The learner has demonstrated the ability to effectively design, implement, and refine machine learning algorithms, managing complex projects within interdisciplinary teams in dynamic and diverse settings
6. Explainable AI	The learner has demonstrated the ability to design, implement and evaluate AI models that are both transparent and	The learner has demonstrated the ability to design, implement, and evaluate artificial intelligence (AI) systems that are not only

	interpretable, ensuring that stakeholders can understand, trust, and effectively manage AI solutions. Also, the learner has demonstrated the ability to assess the explainability level of an AI system. This includes applying principles and techniques of explainable AI to enhance the accountability, fairness, and ethical use of AI technologies across various domains.	effective but also transparent and understandable by humans, ensuring these systems can be audited and trusted by users and stakeholders. This capability includes leading the integration of explainable AI components into broader AI projects to enhance accountability and foster trust in AI applications.
7. Big Data & Data Analytics		The learner has demonstrated the ability to effectively design, implement, and lead advanced data analytics projects that leverage big data technologies to extract meaningful insights from large, diverse datasets. This includes managing projects that integrate big data solutions into business or research environments, enhancing decision-making processes and strategic development.
8. Human-centred AI		The learner has demonstrated the ability to design and lead the development of AI systems that are user-friendly, ethical, and transparent, integrating human-centred design principles into AI development to enhance user trust and engagement.
9. AI Ethics	(EQF 6) The learner has demonstrated the ability to recognise the ethical implications of AI technologies, participate in the development and implementation of strategies to address ethical challenges, and effectively advocate for responsible AI practices, ensuring AI innovations align with societal values and human rights across various contexts.	
10. AI Futures & Innovation		
11. Business Intelligence		
12. AI Awareness	(EQF 6) The learner has demonstrated the ability to understand and articulate the fundamental concepts of artificial intelligence, its potential impacts, and the challenges it presents in various societal and business contexts. This includes a fundamental awareness of AI technologies and their capabilities, alongside an introduction to their limitations and the potential for unintended consequences.	
13. Cyber & Data Security	(EQF 6) The learner has demonstrated a foundational understanding of cybersecurity threats and vulnerabilities, and the ability to implement and manage robust security measures, develop comprehensive strategies to protect digital assets and ensure data privacy across various operational environments, while understanding the ethical, legal, and societal implications.and confidentiality data	

	integrity and confidentiality across various digital platforms and systems, and assist in risk management in diverse and unpredictable cybersecurity environments.	
14. Generative AI	The learner has demonstrated the ability to design, implement, and evaluate routing generative AI systems, utilizing appropriate techniques including prompt engineering for Large Language Models. This includes the capacity to identify AI-generated content.	The learner has demonstrated the ability to design, implement, and evaluate novel generative AI models applying best practices in prompt engineering to leverage their capabilities to innovate and drive forward creative solutions in various sectors such as media, healthcare, and technology.
15. Change Management	The learner has demonstrated the ability to participate in and support change processes within organizations. This includes understanding the basic principles of change management, assisting in the implementation of change initiatives, and contributing to efforts that address resistance and foster stakeholder buy-in. The learner can communicate the importance of change to team members, align their efforts with organizational objectives, and apply basic change management techniques to help ensure successful transitions	The learner has demonstrated the ability to effectively lead and manage change processes within organizations, employing strategies to facilitate smooth transitions, overcome resistance, and ensure stakeholder engagement. This includes understanding the dynamics of organizational change, communicating effectively to align team and organizational goals, and applying change management models to support and sustain organizational transformation.
16. Soft Skills	(EQF 6) The learner has demonstrated the ability to master a suite of essential soft skills, including communication, teamwork, problem-solving, and presentation, applying these skills to enhance personal effectiveness and organizational performance in simple professional settings.	

4.1.4 Requirements for NLP Engineers

4.1.4.1 Qualification Profile

"NLP Engineers specialize in developing and optimizing natural language processing (NLP) models and systems. They apply advanced AI technologies, deep learning, machine learning, and explainable AI techniques to interpret, analyse, and generate human language data. They also have skills in ML Ops, HPC and cloud services, ensuring graduates can deploy scalable and efficient NLP solutions. Finally, skills on human-centred AI, AI ethics, AI awareness, cyber and data security and Soft skills and change management are integrated to navigate the evolving landscape of AI futures and innovation, making NLP Engineers versatile and ethically aware leaders in the field.

NLP Engineers at **EQF 6** leverage advanced AI and machine learning to optimize natural language processing systems, using deep learning and explainable AI for data analysis and generation. They are able to ensure scalable deployments with ML Ops and cloud technologies. Skilled in AI ethics and security, they lead with a focus on innovation and ethical practices in the evolving AI field.

The NLP Engineer curriculum at **EQF 7** equips participants with advanced expertise in Natural Language Processing and Artificial Intelligence. It emphasizes the mastery of cutting-edge machine learning techniques, deep neural networks, and generative AI models, integrating these with cloud services and ML Ops for scalable AI solutions. The program fosters the ability to manage complex projects, design explainable AI systems, apply human-centred AI principles, and address complex ethical, legal, and societal challenges." (Source: D4.2. Core Curriculum p. 154, 173)

4.1.4.2 Learning Outcomes for NLP Engineers

Competence	Programme Learning Outcomes (EQF Levels)	
	NLP Engineer (EQF 6)	NLP Engineer (EQF 7)
1. Deep Learning	The learner has demonstrated the ability to design and implement deep learning models and architectures, encompassing their development, implementation, and application across various domains,	The learner has demonstrated the ability to critically analyse and create deep learning concepts and methodologies, as well as to develop and implement advanced deep learning models in complex, interdisciplinary contexts. This includes taking responsibility for managing the development process of these models, designing hardware and software architecture and contributing to the advancement of knowledge and practice within the field of deep learning.
2. AI technologies	The learner has demonstrated the ability to know and effectively utilize AI frameworks and libraries for the development and deployment of AI models and technologies, applying these tools across different domains to solve complex problems while considering ethical implications and industry standards.	The learner has demonstrated the ability to critically evaluate and apply various AI technologies across different domains, managing complex projects that innovate and integrate AI solutions, thereby enhancing professional practice and contributing to the field.
3. ML Ops		The learner has demonstrated the ability to design, implement, and manage ML Ops frameworks that efficiently operationalize machine learning models within production environments, ensuring scalable, reproducible, and AI solutions.
4. HPC Cloud Services		The learner has demonstrated the ability to architect, deploy, and manage high-performance computing and cloud services solutions that meet advanced computing needs across various industries, ensuring scalability, reliability, and security.
5. Machine Learning	The learner has demonstrated the ability to effectively design, implement, and refine machine learning algorithms, managing simple projects within interdisciplinary teams in dynamic and diverse settings	The learner has demonstrated the ability to effectively design, implement, and refine machine learning algorithms, managing complex projects within interdisciplinary teams in dynamic and diverse settings
6. Explainable AI		The learner has demonstrated the ability to design, implement, and evaluate artificial intelligence (AI) systems that are not only effective but also transparent and understandable by humans, ensuring these systems can be audited and trusted by users

		and stakeholders. This capability includes leading the integration of explainable AI components into broader AI projects to enhance accountability and foster trust in AI applications.
7. Big Data & Data Analytics		
8. Human-centred AI	The learner has demonstrated the ability to create AI systems that are user-friendly, ethical, and transparent, integrating human-centred design principles into AI development to enhance user trust and engagement.	The learner has demonstrated both the leadership and the ability to integrate human-centred design principles in AI development, ensuring sustainable, ethical, and effective AI solutions. This includes formulating and implementing AI governance policies, managing AI-related risks, devising strategic AI plans, and enhancing human-computer interaction to design AI systems that are aligned with human values and societal goals.
9. AI Ethics	The learner has demonstrated the ability to critically assess the ethical implications of AI technologies, develop and implement strategies to address ethical challenges, and effectively advocate for responsible AI practices, ensuring AI innovations align with societal values and human rights across various contexts.	The learner has demonstrated the ability to critically analyse and navigate the ethical challenges associated with AI technologies, developing, and implementing strategies to ensure AI systems are designed and used in a responsible and ethical manner.
10. AI Futures & Innovation	The learner has demonstrated the ability to critically analyse future AI developments, leveraging research skills to innovate and contribute to the advancement of AI technologies. This encompasses a deep understanding of current trends, the capability to forecast technological evolutions, and the application of this knowledge to drive forward-thinking AI solutions that address emerging challenges and opportunities for companies.	The learner has demonstrated the ability to critically assess and creatively engage with emerging AI technologies, predicting future trends and spearheading innovative projects that explore new possibilities and applications of AI in various fields.
11. Business Intelligence		
12. AI Awareness	(EQF 6) The learner has demonstrated the ability to understand and articulate the fundamental concepts of artificial intelligence, its potential impacts, and the challenges it presents in various societal and business contexts. This includes a fundamental awareness of AI technologies and their capabilities, alongside an introduction to their limitations and the potential for unintended consequences.	

13. Cyber & Data Security	The learner has demonstrated the ability to identify cybersecurity threats and vulnerabilities, implement and manage robust security measures, and develop comprehensive strategies to protect digital assets and ensure data privacy across various operational environments, while understanding the ethical, legal, and societal implications.	The learner has demonstrated the ability to design, implement, and lead comprehensive cybersecurity strategies that protect information assets against emerging threats and vulnerabilities, while ensuring compliance with international data protection regulations.
14. NLP	The learner has demonstrated the ability to apply natural language processing techniques to analyse, understand, and generate human language, leveraging computational methods to solve complex problems in linguistics and communication. This includes proficiency in utilizing NLP tools and algorithms to extract insights from text data, enhance human-computer interaction, and create applications that can process and produce language effectively.	The learner has demonstrated the ability to critically design, develop, and optimize NLP systems, using advanced algorithms and machine learning techniques to efficiently process and analyse large volumes of natural language data, leading projects that innovate and enhance communication technologies.
15. Generative AI	The learner has demonstrated the ability to design, implement, and evaluate generative AI systems, utilizing advanced techniques including prompt engineering for Large Language Models. This includes the capacity to identify AI-generated content, create innovative applications using generative AI models, and apply best practices in prompt engineering to achieve desired outcomes in various industrial domains.	The learner has demonstrated the ability to design, implement, and evaluate generative AI models, leveraging their capabilities to innovate and drive forward creative solutions in various sectors such as media, healthcare, and technology.
16. Change Management	(EQF 5)The learner has demonstrated the ability to participate in organizational change projects, executing systematic approaches to plan, implement, and sustain changes that align with stated strategic objectives and enhance organizational performance.	
17. Soft Skills	The learner has demonstrated the ability to master a suite of essential soft skills, including communication, teamwork, problem-solving, and presentation, applying these skills to enhance personal effectiveness and organizational performance in simple professional settings.	The learner has demonstrated the ability to integrate and apply a broad range of advanced soft skills to lead teams, manage change, solve complex problems, and communicate effectively, enhancing organizational performance and driving innovation.

4.1.5 Requirements for AI Decision Makers

4.1.5.1 Qualification Profile

(EQF 7) Goal:

Equip organizational decision-makers with necessary knowledge of key AI concepts, including machine learning, generative models, and various AI applications such as predictive analytics, computer vision, and natural language processing. This foundational understanding will enable participants to grasp the potential and limitations of AI technologies.

Develop participants' skills in evaluating the performance and impact of AI models using appropriate metrics and techniques. The course will also guide participants through the lifecycle of AI projects, from data collection and model training to deployment and maintenance, emphasizing the importance of data quality, governance, and collaboration between technical and nontechnical teams to ensure successful AI implementation.

Ensure that participants can critically assess and address the ethical implications of AI, including fairness, bias, transparency, and accountability.

Additionally, the programme aims to provide frameworks and best practices for integrating AI into organizational strategies, aligning AI initiatives with corporate objectives, and leveraging AI for competitive advantage while maintaining ethical standards.

1. Comprehend AI Fundamentals: Equip learners with a solid understanding of common AI technical terms and concepts, including key machine learning methodologies and the differences between narrow and broad AI.

2. Evaluate AI Applications and Performance: Enable learners to identify and assess the impact and effectiveness of AI applications across various fields, including data analysis, predictive analytics, and decision support.

3. Understand AI Explainability, Interpretability, and Ethics: Foster a solid understanding of the principles of AI explainability, ethical considerations, and the regulatory landscape governing AI and data privacy.

4. Analyse Economic and Social Impacts of AI: Develop the ability to critically evaluate the economic and social implications of AI technologies, recognizing potential risks and the importance of robust data governance.

5. Integrate AI Strategically and Lead Ethically: Provide learners with the skills to integrate AI into organizational strategies effectively, promote collaboration between technical and non-technical teams, and lead AI initiatives with a strong ethical foundation.

(Source: D4.2. Core Curriculum p. 319, 337)

4.1.5.2 Learning Outcomes for AI Decision Makers

Competence	Programme Learning Outcomes	
	AI Decision Makers (EQF 7)	
1. AI Fundamentals	(EQF 6) The learner has demonstrated capability to explain the concept of AI, as well as related methods, tools and techniques and its potential risks and impact to generate information using a common AI tool.	
2. Organisational Decision-making on AI		(EQF 7) The learner has demonstrated capability to understand the impact and consequences of AI on organisational decision-making.

4.1.6 Requirements for AI Policy Makers

4.1.6.1 Qualification Profile

(EQF 6)

1. Comprehend AI Fundamentals: Equip learners with a solid understanding of common AI technical terms and concepts, including key machine learning methodologies and the differences between narrow and broad AI.

2. Evaluate AI Applications and Performance: Enable learners to identify and assess the impact and effectiveness of AI applications across various fields, including data analysis, predictive analytics, and decision support.

3. Understand AI Explainability, Interpretability, and Ethics: Foster a solid understanding of the principles of AI explainability, ethical considerations, and the regulatory landscape governing AI and data privacy.

4. Analyse Economic and Social Impacts of AI: Develop the ability to critically evaluate the economic and social implications of AI technologies, recognizing potential risks and the importance of robust data governance.

(EQF 7) AI and Policy: Recognising and understanding the impact and consequences of AI on policy and public affairs.

4.1.6.2 Learning Outcomes for AI Policy Makers

Competence	Programme Learning Outcomes	
	AI policy makers EQF 7	
1. AI Fundamentals	(EQF 6) The learner has demonstrated capability to explain the concept of AI, as well as related methods, tools and techniques and its potential risks and impact to generate information using a common AI tool.	
2. AI and Policy		(EQF 7) The learner has demonstrated capability to understand the impact and consequences of AI on policy and public affairs.

4.1.7 Requirements for AI Advisors/Consultants

4.1.7.1 Qualification Profile

(EQF 7) The programme aims to provide learners with a deeper understanding of what is involved in developing and implementing an AI strategy in an organisation. The participant will get tools to be able to advise organisations on this.
It is intended for professionals already working in or are very familiar with the ICT field, who want to gain insight about what the development and implementation of an AI strategy in organisations entails, so that they can advise on this within their own organisation or advise others. These professionals have an undergraduate (Bachelors) degree and/or at least five years of working experience as a business or IT consultant.

Goals:
- Basic technical knowledge on the functioning of AI systems
- Insight into the broader context in which AI systems will be embedded in the public domain
- Gain the ability to have a critical conversation about the design and development of AI systems in the public domain
- The student investigates, analyses, evaluates and/or identifies the challenges and opportunities of public values, (privacy) legislation, ethical dilemmas that play a role in digital transformation within government services
- Student investigates and/or analyses the possibility of using AI models and algorithms (hereinafter referred to as algorithms) with government data.
- Student is able to develop new implementations of algorithms for government services, using reliable and transparent methodologies with an emphasis on improving processes, working methods, culture, and citizen experience.

(Source: D4.2. Core Curriculum p. 327, 350, 372)

4.1.7.2 Learning Outcomes of AI Advisors/Consultants

Competence	Programme Learning Outcomes (EQF Levels)	
	AI Advisor/Consultant (EQF 7)	
1. AI Fundamentals	(EQF 6) The learner has demonstrated capability to explain the concept of AI, as well as related methods, tools and techniques and its potential risks and impact to generate information using a common AI tool.	

2. AI Strategy		(EQF 7) The learner has demonstrated a strong capability to advise on and formulate an AI strategy, aligned with the organisation strategy, compliant with relevant laws and regulations and considering opportunities, risks (including cybersecurity risks), and ethical considerations.
3. AI Implementation		(EQF 7) The learner has demonstrated capability to advise on the implementation of an AI solution considering risks, benefits, costs, and enabling factors.
4. AI Ethics Advanced		(EQF 7) The learner has demonstrated ability to realise and critically evaluate ethical ways of working with AI and develop an ethical AI policy, considering prevailing laws and relevant frameworks and criteria.
5. Impact of AI		(EQF 7) The learner has demonstrated ability to explain the abilities of AI-based technology and its implications in different areas and perform an AI impact assessment of an AI-based technology in a specific context.

5. Conclusions and Future Steps

The Subject-Specific Criteria outlined in this document are based on the Learning Outcomes and the Core Curriculum as developed in work package 4 of the ARISA project. As explained earlier, they are intended to serve as a benchmarking and quality assurance instrument to assess the pilot learning programmes. It is foreseen that these SSC, as well as the Programme Learning outcomes will need to be, and should be refined based on insights obtained during the development and delivery phase of the pilot learning programmes. Therefore, and to enhance the quality of the educational profiles, the learning outcomes, and the pilot learning programmes, there will be refinements and adjustments to these deliverables during the course of the project.

At the time of writing, negotiations about the project's grant agreement are yet to be finalized, however a proposal to add a task in work package 8 could benefit from the continuous re-alignment between the SSC and the programme learning outcomes. Given that the e-CF and ESCO frameworks do not fully address AI-related roles, this proposed task aims to build on ARISA results to develop a standardised scheme for AI roles and educational profiles. This will be done through the CEN-CENELEC standardisation framework, particularly the CEN Workshop Agreement (a pre-standardisation agreement) and with the support of HSBooster, a European Commission initiative that provide the European Standardisation Booster.

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