D4.1 Competence Matrix for Short-Term Trainings

June 2025

Co-funded by the European Union

Document Control Information

Project	SMARt COmmunities Skills Development in Europe
Project number	101186291
Document Title	Competence Matrix for Short-Term Trainings
Work Package Number	WP4
Deliverable Number	D4.1
Lead Beneficiary	CEFRIEL
Project Coordinator:	European DIGITAL SME Alliance
Dissemination Level	Public
Authors	Domenico Orlando (Cefriel), Francesca Carosio (Cefriel), Panos Fitsilis (UTH), Theodor Panagiotakopoulos (HOU), Praskevi Tsoutsa (UTH), Luis Bernardo Pulido Gaytan (NCI)
Reviewers	Yao Yao (NCI), Andrianna Georgia (EMPHASYS)
Description	Competence matrix, which includes competences, skills and knowledge (learning outcomes) to be achieved through the short-term trainings for both profiles, will be detailed in this deliverable. It will provide a basis for curriculum and content development within T4.2.
Status	Draft or Final for Submission
Delivery Date	30.06.2025 – indicate same as date of final deliverable ready for submission
Due date	30.06.2025 – indicated as per GA

EU Disclaimer

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

Co-funded by the European Union

Document history

Version	Date	Author	Description of the change
V0.1	21.05.2025	Domenico Orlando, Francesca Carosio (CEFRIEL)	First draft
V0.2	28.05.2025	Luis Bernardo Pulido Gaytan (NCI), Panos, Fitsilis (UTH), Theodor, Panagiotakopoulos (HOU);	Review by Contributors
V0.3	10.06.2025	Domenico Orlando, Francesca Carosio (CEFRIEL)	Second Draft
V0.4	18.06.2025	Andrianna Georgiou (Emphasys); Yao Yao (NCI)	Peer review
V0.5	20.06.2025	Konstantinos Kirytopoulos	External Quality Review
V1.0	25.06.2025	Domenico Orlando, Francesca Carosio (CEFRIEL)	Third draft after the Peer review and External Quality Review

Abbreviations

Acronym	Explanation
CA	Consortium Agreement
SCRE	Smart Community Resilience Engineer
SCRP	Smart Community Resilient-solutions Procurer/Planner
EQF	European Qualification Framework
ESCO	European Skills, Competences, Qualifications and Occupations

Co-funded by the European Union

Table of Contents

Co-funded by the European Union

List of Tables

Co-funded by the European Union

List of Figures

Co-funded by the European Union

Short Project Introduction

SMARCO project addresses two key issues identified in digital ecosystem under the Pact for Skills: 1) lack of focus on the development of resilient solutions for smart communities by ICT professionals (such as Smart Cities Engineers) and 2) on the other side of the scale, lack of green, digital, cybersecurity skills among public administrations' staff (smart city planners, procurers) working on smart communities. These two problems hinder the development of resilient smart communities, and hence decrease economic competitiveness, employability, potential to deliver on green targets, etc. Therefore, SMARCO project aims to address these issues serving as an all-encompassing umbrella for smart communities skills on both sides – industry and public administrations – offering evidence-based research, trends analysis, training programmes, certification, and other resources for its stakeholder community.

SMARCO community is evolving around its Smart Communities Skills Partnership which is about to be established under Digital Ecosystem Large-scale Partnership within the Pact for Skills. Throughout the project lifetime, it is aiming to become a unique one-stop-shop for smart community skills focusing on the three main aims: to ensure the development of resilient and sustainable smart communities by addressing the skills gaps of smart city engineers and planners/procurers through the development of urgent upskilling courses and forward-looking training programmes; to grant flexible and user-centric learning, trans-national dimension and learning mobility, as well as a wide recognition of trainings through the development of micro-credentials, training certificates and wider certification scheme; to create a sustainable community of stakeholders to discuss, share and scale training, upskilling and reskilling linked to smart communities' skills and relevant best practices via participation in the Pact for Skills (and its Digital Large-scale ecosystem).

Work Package 4

Work Package 4 of the SMARCO project aims to achieve several key objectives:

Co-funded by the European Union

- Development of a Competence Matrix: This matrix will outline the essential competences, skills, and knowledge required for two specific professional profiles through targeted short-term training programs.

- Definition of Training Methodology: The project will establish a clear methodology for delivering urgent short-term training sessions, ensuring effectiveness and relevance.

- Curriculum Preparation: Two comprehensive curricula will be designed for short-term training programs: one tailored for smart community engineers and another for public procurers of smart community solutions. Additionally, all necessary materials and resources will be compiled or produced to support the implementation of these curricula.

- Guidelines for Trainers: Concise guidelines will be developed for trainers, including both academic staff and business professionals, equipping them with the knowledge and resources needed to deliver effective training on the topics of resilient and sustainable smart communities.

- Pilot Training Programs: The project will conduct pilot sessions for the short-term training programs in an industrial setting, engaging public administrations in at least five countries. The goal is to train at least 150 professionals, gather feedback from both trainers and participants, and subsequently refine the training curricula, materials, and guidelines to better align with market needs.

This structured approach ensures that the training delivered is practical, relevant, and able to meet the demands of the evolving landscape of smart community development.

Scope of deliverable

The current deliverable is the Competence Matrix. This matrix outlines the essential competences, skills, and knowledge required for two specific professional profiles through targeted short-term training programs. It will detail the competences, skills, and knowledge (learning outcomes) to be achieved through these short-term trainings for both profiles. Additionally, this matrix will serve as a foundation for curriculum and content development within T4.2.

Co-funded by the European Union

1. Introduction

1.1 Purpose of Deliverable

In this deliverable, we will outline a Competence Matrix, which includes the competences, skills, and knowledge (learning outcomes) to be achieved through the short-term training programs for the profiles researched and trained in this project. The Competence Matrix will serve as a foundation for curriculum and content development within T4.2.

Task 4.1 involves the development of competence, skills and knowledge (learning outcomes) which shall be achieved upon completion of a short-term upskilling training – one focusing on public service procurers who work with smart communities procurement, and another focusing on upskilling of smart communities engineers with sustainability and resilience-related competences.

The task includes both: the design of relevant competences and the definition of clear and measurable learning outcomes that articulate the expected achievements of training participants for both profiles. It will include compulsory (core) competences and learning outcomes, as well as specialised and optional ones. It will also detail on the duties to be performed by each profile, and the hierarchy of the profile.

The outcomes of the task will guide the design of the educational program and serve as benchmarks for assessing the success of the learning experience ensuring that the identified learning outcomes align with the overarching objectives of the program, creating a cohesive framework for effective skill development and assessment.

1.2 Synergies and input from other deliverables

This deliverable employs information from Work Package 2, specifically focusing on the data and interim results derived from the identification of current occupational profiles (T2.2), analysis of demand (T2.3) and supply (T2.4) related to skill mismatches in smart communities, as well as insights from the future foresight report. The primary output of this deliverable is a

Co-funded by the European Union

competencematrix for two designated profiles, which will delineate and forecast the future competence requirements for smart communities.

Additionally, this deliverable will serve as a guide for the formulation of a comprehensive training methodology and the development of curricula for both short-term and long-term learning courses produced within the scope of the project.

1.3 Methodology

The methodology for implementing the Competence matrix for two job profiles will be based on desk research literature review, and stakeholders consultation ensuring a scientifically sound and reliable approach. This deliverable will also incorporate the interim results from T2.2 regarding the delineation of the two profiles, along with findings from T2.3 on competence demand analysis and T2.4 on competence supply analysis.

The research conducted in WP2, combined with desk research, allows for the systematic collection and analysis of information from credible sources, including academic articles, industry reports, and organisational documents. This will provide a comprehensive overview of the competences required for each role.

The literature review will further support this process by critically evaluating and synthesising findings from previous studies. This will help identify core competences, proficiency levels, and best practices relevant to the job profiles being analysed.

This approach ensures that the Competence matrix is not only evidence-based but also in line with current European standards and public needs. By leveraging established frameworks and validated research, the resulting matrix will accurately reflect the knowledge, skills, and behaviours that are essential for effective job performance.

The draft matrix is reviewed and refined through consultation with project experts and stakeholders, including European universities and specialists in smart cities, educational technologies, and digital skills.

Additionally, the concept of Personas (one per each job profile) has been added to clearly and engagingly convey the main characteristics of the two job profiles. Personas are fictional, data-driven representations of typical role incumbents that synthesise key attributes, motivations, and challenges. This approach enhances communication and understanding among stakeholders,

Co-funded by the European Union

making the Competence matrix more actionable and relatable for both decision-makers and end-users.

1.4 Key Concepts

According to ESCO and EQF, "***competence*** *means the proven ability to use* ***knowledge***, ***skills*** *and personal/social and/or methodological* ***abilities***, *in work or study situations and in professional and personal development*". [1] In SMARCO, the sole focus will be on the professional field, therefore, in work situations.

While sometimes used as synonyms, the terms skill and competence can be distinguished according to their scope. The term skill refers typically to the use of methods or instruments in a particular setting and in relation to defined tasks. The term competence is broader and refers typically to the ability of a person, facing new situations and unforeseen challenges, to use and apply knowledge and skills in an independent and self-directed way.[2] Given the scope of the project, the term competence will be preferred over skills, but they could also be used interchangeably.

Running a Competence matrix means identifying the specific skills, knowledge, and abilities to operate effectively in an occupation or job position. One of the main goals is to gain awareness of the current competence inventory, as well as identify competence gaps.

The Competence matrix would result in the number of competences that jointly define a successful job performance. It sets out the specific skills, knowledge and abilities that enable an employee to perform their job successfully. It is very important that each competence is define

[1] https://esco.ec.europa.eu/en/about-esco/escopedia/escopedia.

[2] Ibid.

Co-funded by the European Union

properly with the use of competence definition that makes it very clear what these competences mean.

Instead of creating an exhaustive Competence matrix with hundreds of individual competences, we will structure it around broader, general competence categories. Each general category will encompass multiple related and aligned specific competences.

For each general competence category, we will select examples of specific competences that are particularly relevant to the two profiles being evaluated. This approach maintains comprehensive coverage while making the matrix more manageable within time constraints.

This streamlined framework allows for efficient assessment while still capturing the most significant competence distinctions between the profiles.

1.5 Overview of Target Profiles

As outlined in the SMARCO proposal, two key target profiles are central to advancing smart community development: the Smart Community Engineer with sustainability and resilience-related competences and public procurers who work with smart communities procurement.

Indeed, the SMARCO project tackles two significant challenges identified in the digital ecosystem under the Pact for Skills: the insufficient focus on developing resilient solutions for smart communities by ICT professionals (such as Smart Cities Engineers) and the lack of green, digital, and cybersecurity skills among public administration staff (including smart city planners and procurers) working on smart communities. These issues impede the growth of resilient smart communities, thereby reducing economic competitiveness, employability, and the ability to meet green targets. To address these challenges, the SMARCO project serves as a comprehensive umbrella for smart community skills across both industry and public administrations.

We welcome the reframing of the two profiles' names proposed by T2.2.: Smart Community Resilience Engineeer (hereinafter also 'SCRE' for the sake of brevity) and the Smart Community Resilient Solutions Procurer/Planner (hereinafter also 'SCRP'). See next section 10.2.1 *Components of the Matrix/profiles* for the detailed definition.

Co-funded by the European Union

2. Personas for Smart Community Roles

2.1 Personas concept

To effectively convey the characteristics of two job profiles, this project will utilise the concept of Personas—a design tool that represents user groups to enhance ideation and empathy in areas like software development and marketing (Sainz Salces FJ, 2025; Bradley C, 2021 ; Nielsen L, 2014; Pruitt J, 2003). Personas provide insights into user interests that can influence IT applications and products (Nielsen L, 2019) and are used early in the design process to represent future users and their needs (Bowen J, 2020). Roman Pichler's framework for persona creation emphasises including key details such as role definition, objectives, and first-person statements for actionable personas that align with project goals. He advocates for concise personas to foster shared understanding among stakeholders early in the design process.

In this project, we will adopt Pichler's standard approach to create static persona profiles[3], which will define learning objectives related to the necessary skills and competences for proposed courses (see Figure 1). Each persona will feature a visual representation, role definition, duties, summary of motivations, and details on education, work history, tools used, behavioural traits, and key challenges.

[3] https://www.romanpichler.com/blog/persona-template-for-agile-product-management/

Co-funded by the European Union

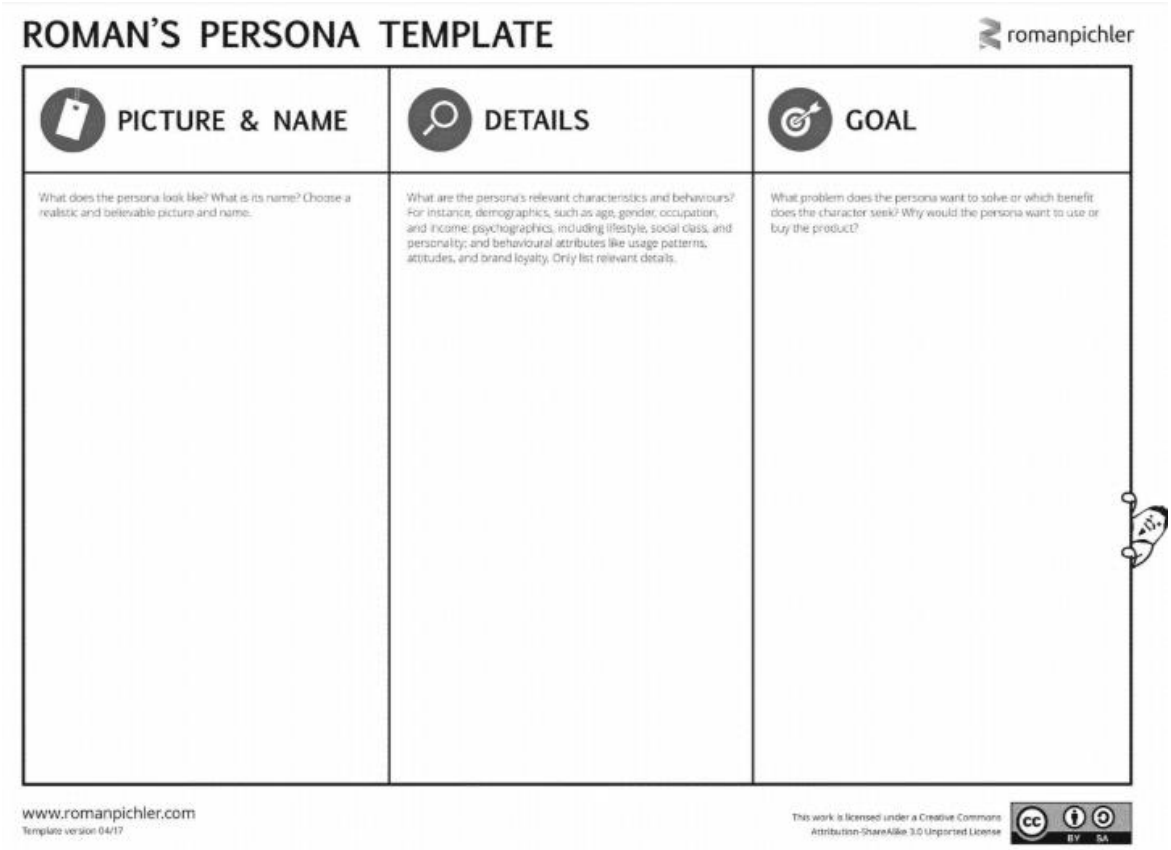

Figure 1 - Pilcher's Persona Template

Personas can be categorised into four perspectives: goal-directed, role-based, engaging, and fiction-based (Nielsen L., 2019), with design aligned to their purpose. We will focus on the following elements for each Persona profile:

1. Visual Representation: A relevant fictional photo.

2. Role Definition and Objectives.

3. Goal: Summary of motivations and key Challenges in Smart Community Contexts.

These persona outlines are based on the SMARCO proposal and will be further refined through ongoing research into the Competence matrix.

2.1.1 Persona 1: Smart Community Resilience Engineer

2.1.1.1 Visual Representation: A relevant fictional photo.

Figure 2 - Smart Community Resilience Engineer Persona

2.1.1.2 Role Definition, Duties and Objectives.

The Smart Community Resilience Engineer is a forward-thinking Information and Communication Technology (ICT) professional specialising in the design, implementation, and maintenance of innovative, cyber-secure, and sustainable solutions for smart communities.

The primary goal of this role is to integrate resilience and sustainability into digital infrastructure, thereby supporting the economic competitiveness, social well-being, and environmental sustainability of both urban and rural communities. Her duties include conducting risk assessments, developing and deploying secure digital infrastructure, collaborating with stakeholders to align solutions with community needs, and ensuring compliance with sustainability and cybersecurity standards throughout the lifecycle of smart community projects. This position is essential for addressing the skills gap in the engineering sector, ensuring that smart community solutions are resilient against emerging threats and aligned with the green and digital transitions outlined in the SMARCO proposal.

Co-funded by the European Union

2.1.1.3 Goal: Summary of motivations and key Challenges in Smart Community Contexts

Driven by the ambition to create safer, more efficient, and sustainable communities, the Smart Community Resilience Engineer leverages digital innovation to address pressing urban and rural development challenges. With the European Commission's *Digital Decade* targets aiming for 100% of key public services to be online and 80% of citizens to use digital IDs by 2030,[4] resilient ICT infrastructure is increasingly essential. Key challenges in this role include staying ahead of evolving cybersecurity threats—highlighted in ENISA's Threat Landscape reports[5]—and suggesting systems that are both technologically advanced and inclusive. The engineer must also ensure adaptability to diverse territorial contexts and bridge the gap between emerging digital tools (e.g., IoT, AI) and practical, community-oriented outcomes. This demands not only technical proficiency but also an understanding of socio-environmental goals set out in initiatives like the European Green Deal[6] and twin digital-green transitions.

[4] European Commission. *2030 Digital Compass: the European way for the Digital Decade*. COM(2021) 118 final, Brussels, 9 March 2021. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021DC0118 .

[5] European Union Agency for Cybersecurity (ENISA). *ENISA Threat Landscape 2024*. Luxembourg: Publications Office of the European Union, 2024. https://www.enisa.europa.eu/publications/enisa-threat-landscape-2024.

[6] European Commission. *The European Green Deal*. COM(2019) 640 final, Brussels, 11 December 2019. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52019DC0640

Co-funded by the European Union

2.1.2 Persona 2: Smart Community Resilient-solutions Procurer/Planner'

2.1.2.1 Visual Representation: A relevant fictional photo.

Figure 3 - Smart Community Resilient-solutions Procurer/Planner

2.1.2.2 Role Definition, Duties and Objectives.

The Smart Community Resilient-solutions Procurer/Planner is a professional who is responsible for strategically planning and acquiring smart community solutions. This role requires expertise in digital technologies, environmental sustainability, procurement, and urban or regional planning. The Procurer/Planner translates policy objectives into actionable projects and standards, ensuring that public or private investments promote the adoption of resilient, sustainable, and innovative technologies.

Additionally, they engage stakeholders and align their efforts with broader community goals. Their objectives include fostering effective procurement practices, facilitating collaboration across different sectors, and supporting the sustainable transformation.

2.1.2.3 Goal: Summary of motivations and key Challenges in Smart Community Contexts

Motivated by a commitment to sustainable development and public value creation, the Smart Community Resilient-solutions Procurer/Planner plays a pivotal role in operationalizing EU-wide digital and green transformation strategies. With the European Commission promoting 100

Co-funded by the European Union

Climate-Neutral and Smart Cities by 2030,[7] SCRP faces the challenge of translating high-level policy into actionable procurement frameworks. They must navigate complex EU procurement directives such as Directive 2014/24/EU on public procurement,[8] often hindered by fragmented local capacities and inconsistent digital readiness across municipalities. Further, they confront institutional inertia, limited data literacy among stakeholders, and the need to align procurement with circular economy and social equity goals.

[7] European Commission. *100 Climate-Neutral and Smart Cities by 2030 – by and for the citizens*. Brussels, 2022. Available at: https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/eu-missions-horizon-europe/climate-neutral-and-smart-cities_en.

[8] European Parliament and Council. *Directive 2014/24/EU on public procurement and repealing Directive 2004/18/EC*. OJ L 94, 28.3.2014, p. 65–242. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32014L0024

Co-funded by the European Union

3. Competence Matrix Structure

The Competence matrix that this deliverable develops links competences with specific job profiles, outlining the particular skills, knowledge, and attitudes required to excel in a given profession or job position[9].

3.1 Methodology for Building the Matrix

The construction of the Competence Matrix for the SMARCO project is grounded in established European methodologies for skills and competence frameworks, ensuring both academic rigour and practical relevance. The process is designed to systematically map the essential (core) and supplementary (optional) competences required for emerging professional profiles in smart communities, as outlined in the SMARCO proposal and in alignment with frameworks such as ESCO[10], the European e-Competence Framework (e-CF), GreenComp[11] and Smart Cities Body of Knowledge (hereinafter also SCBOK)[12]. The concept of competence used in this deliverable has already been explicated in the previous Section 8.4 "Key Concepts".

[9] https://esco.ec.europa.eu/en/about-esco/escopedia/escopedia/competence

[10] European Commission, ESCO Mapping Methodology: https://ec.europa.eu/esco/portal/escopedia/ESCO_Mapping_Methodology

[11] European Commission, Joint Research Centre. *GreenComp, the European sustainability competence framework*. Publications Office of the European Union, 2022. DOI: 10.2760/13286

[12] Fitsilis, P., & Kokkinaki, A. I. (2021). *Smart Cities Body of Knowledge*. In *25th Pan-Hellenic Conference on Informatics, PCI 2021*. https://doi.org/10.1145/3503823.3503853

Co-funded by the European Union

Step 1: Competence Identification and Benchmarking

The initial phase involves the identification and collection of relevant competences from authoritative sources, primarily the ESCO (European Skills, Competences, Qualifications and Occupations) database, previous EU project experiences such as SMACITE[13], GreenComp and SCBOK. This desk research ensures that the matrix is built on up-to-date, standardised, and sector-relevant skills, particularly in the digital, green, and resilience domains (European Commission, ESCO; CEDEFOP[14], 2022).

Step 2: Cross-Referencing with Labour Market and Training Data

The competences identified are cross-referenced with data collected in SMARCO Work Package 2 (WP2), which includes an analysis of the most sought-after job profiles and skills from recent training programs and labour market trends. This triangulation ensures that the selected competences are responsive to current and anticipated job market requirements, as recommended by CEDEFOP and the European Training Foundation (ETF).[15]

Step 3: Clustering and Structuring of Competences

[13] https://smacite.eu/en/

[14] CEDEFOP, Defining and Classifying Key Competences: https://www.cedefop.europa.eu/en/publications/5530

[15] European Training Foundation (ETF), Defining and Classifying Key Competences: https://www.etf.europa.eu/en/publications-and-resources/publications/defining-and-classifying-key-competences

Co-funded by the European Union

Competences are organized into meaningful clusters, representing key competence areas for each target profile. This clustering facilitates a structured overview and supports the differentiation of competences according to their relevance and importance for each professional role (ESCO Mapping Methodology). Based on the results of T2.3 on demand and T2.4 on the supply of competences, we will consider less granular competences ('clusters') instead of the very specific ones. T2.4 interim results reduced the 107 identified competences to a less granular group of 19 competences (see also section 10.3.1 "List of Competences" below for an example). To those we added 4 additional clusters derived from sources alternative to ESCO, for a total of 23 clusters. This approach will make the work more agile and suitable for the preparation of short-term courses.

Step 4: Defining Core and Optional Competences

The 23 competence clusters will be listed in an initial table. In the first phase, each family will be assigned a minimum desired European Qualification Framework (EQF) level for each profile, ranging from 4 to 6. Levels lower than 4 will be disregarded because they are deemed inapt for the purpose. EQF provides a standardized reference for expected complexity and autonomy.

Subsequently, in another table, the competences clusters will be listed, and for each profile, the mandatory and optional competences will be identified. This selection aligns with the previously assigned EQF value, demonstrating consistency through intentional assessment rather than automatic calculation. In line with best practices (ESCO, e-CF[16], EQF), competences are classified as either "core" or "optional" based primarily on their relevance to effective job performance.

Core Competences are those identified as essential for the effective and consistent performance of the role. This classification is informed by expert consultation, review of occupational standards,

[16] European e-Competence Framework (e-CF) https://www.ecompetences.eu/

Co-funded by the European Union

and stakeholder validation (ESCO, e-CF). Core competences are typically required by all professionals in the profile and are fundamental to the role's objectives.

Optional Competences are those that provide added value, specialization, or flexibility within the role, but are not strictly necessary for all jobholders. These competences may be relevant for specific contexts or advanced career pathways.

Finally, for each professional profile, a list of the most important competences will be produced. Top competences will have to be considered urgent for the setup of short-term courses.

However, the distinction between core and optional competences is based primarily on job relevance and stakeholder consensus, not solely on EQF level, in accordance with recommendations from CEDEFOP and the European e-Competence Framework.

Step 5: Iterative Review and Stakeholder Validation

The draft matrix is reviewed and refined through consultation with project experts and relevant stakeholders, as outlined in the SMARCO proposal. The stakeholders include higher education institutions, particularly European universities, as well as experts specializing in smart cities, educational technologies, digital skills, and employment. They have been involved in in-person meetings. This participatory approach ensures that the matrix is accurate, comprehensive, and adapted to the needs of both education providers and employers (CEDEFOP, 2022; ETF, 2023).

This methodology results in a clear and actionable Competence Matrix, structured by professional profile and by core/optional competences with corresponding EQF levels. The matrix serves as a foundation for future curriculum development and will be further detailed and validated in subsequent phases of the SMARCO project.

3.2 Components of the Matrix:

3.2.1 Profiles

The designated profiles are (i) the 'Smart Community Resilience Engineer' and (ii) the 'Smart Community Resilient Solutions Procurer/Planner'.

While keeping the suggestions from the sketches of the Personas, from a theoretical point of view we rely on the interim results from Task 2.2 that describe the two profiles as follows:

Co-funded by the European Union

*A **Smart Community Resilience Engineer** is responsible for designing, implementing, and maintaining systems and strategies that enhance the resilience of urban communities against physical, digital, and environmental threats. They work at the intersection of smart city infrastructure, cybersecurity, and emergency response planning, integrating IoT technologies, data analytics, and risk assessment models to develop proactive solutions for disaster prevention and recovery. By collaborating with local governments, utility providers, and technology partners, they ensure that urban systems are adaptive, secure, and capable of maintaining essential services during disruptions. Their role is crucial in building future-proof, connected communities that can withstand and rapidly recover from crises.*

*A **Smart Community Resilient Solutions Procurer/Planner** plays a key role in identifying, designing, and coordinating the implementation of innovative, technology-driven solutions that enhance the resilience of communities. This professional works closely with stakeholders—including municipal authorities, private sector partners, and citizens—to assess risks, define resilience goals, and procure smart technologies and infrastructure that address climate, social, and digital vulnerabilities. Their work involves strategic planning, needs assessment, market analysis, and aligning procurement processes with sustainability and resilience objectives. By integrating smart systems, green infrastructure, and inclusive governance models, they help shape urban environments that are adaptable, equitable, and prepared for future challenges.*

These descriptions will be used together with the Personas as the basis for populating the matrix.

3.2.2 Core/mandatory Competences

Core competences are primary skills that are essential for a specific occupation or role. These are the fundamental abilities that every individual in that role must possess. Core competences represent the bedrock of professional capability within any occupation, serving as the critical skills that separate qualified practitioners from those who lack essential preparation. These competences typically emerge through formal education, practical experience, and deliberate skill development over time. They not only enable baseline job performance but also provide the foundation upon which career advancement and specialisation become possible. Organisations frequently use core competence frameworks to establish hiring criteria, develop training programs, and create performance assessment standards that align with their operational needs.

Co-funded by the European Union

3.2.3 Optional Competences

Optional competences are supplementary skills that enhance performance in a specific occupation or role but are not essential for baseline functioning.

These competences provide several advantages in professional settings. They create competitive differentiation among practitioners, enable adaptation to niche or emerging areas within a field, support career pivoting and cross-functional collaboration, and address specific organisational needs or market demands. Organisations often view optional competences as valuable additions that complement core requirements. They may be highlighted in job descriptions using terms like "preferred qualifications," "desired skills," or "plus factors."

For career advancement, developing strategic optional competences can significantly expand professional opportunities and versatility. While not fundamental to initial qualification, optional competences frequently become increasingly important as professionals advance in their careers, seeking to distinguish themselves in competitive environments. They represent the personalised dimension of professional development that allows individuals to craft unique career trajectories based on their interests and strengths.

Furthermore, in more structured organisations, some competences could be assigned to offices other than the one to which the profile belongs. It is fair to say that the larger and more articulated the organization is, the less the profile covering the job position will need to possess optional competences. Consider the example of a procurer relating to providers: in an SME, contract management and disputes will likely be their responsibility up until the phase of court disputes, whereas, in a more structured organization, the legal office would likely become involved in the process.

3.2.4 European Qualification Framework levels

We will assign EQF levels ranging from 4 to 6 to the competence families. The EQF values should be understood here as the target values to be pursued rather than the starting values. The levels below 4 have been deemed unsuitable for the two profiles and therefore will not be considered. EQF levels above 6 will not be considered, because, according to the proposal "*SMARCO will target EQF 4 learners with its VET curriculum and EQF 5 with HE curriculum.*". Therefore, considering an improving margin starting from EQF 4 or EQF 5 as result of the training, we considered levels up to EQF 6.

Co-funded by the European Union

EQF Level 4: This level corresponds to competences that involve factual and theoretical knowledge in broad contexts within a field of work or study. It includes a range of cognitive and practical skills required to generate solutions to specific problems in a field of work or study.[17]

EQF Level 5: At this level, competences involve comprehensive, specialized, factual, and theoretical knowledge within a field of work or study and an awareness of the boundaries of that knowledge. It includes a comprehensive range of cognitive and practical skills required to develop creative solutions to abstract problems.

EQF Level 6: This level corresponds to advanced knowledge of a field of work or study, involving a critical understanding of theories and principles. It includes advanced skills, demonstrating mastery and innovation, required to solve complex and unpredictable problems in a specialized field of work or study.

By assigning these EQF levels, we ensure that the competence families are appropriately categorized to reflect the complexity and depth of knowledge and skills required for each profile.

The chosen EQF level represents the minimum level that must be reached for each competence family to ensure the required proficiency for the professional profiles.

This categorization will guide the development of short-term courses tailored to the specific needs of each professional profile.

[17] "Description of the Eight EQF Levels," Europass, accessed May 13, 2025, https://europass.europa.eu/en/description-eight-eqf-levels.

Co-funded by the European Union

3.3 Competence Matrix for Target Profiles

3.3.1 List of competences

The competences have been derived from the interim results of T2.3 and T2.4. These tasks have associated their research findings with the competences identified by ESCO.

Instead of listing all the detailed competences, we have considered a higher and more general level of grouping ('clusters') according to ESCO classifications to streamline the analysis. For example, competences such as automate cloud tasks, cloud monitoring and reporting, cloud security and compliance, cloud technologies, deploy cloud resources, design cloud architecture, design cloud networks, design databases in the cloud, develop with cloud services, and manage cloud data and storage have all been grouped under the broader category of cloud technologies.

This approach allows us to present a more concise and manageable set of competences, making the analysis more efficient and focused.

Table 1 - Competence Matrix with EQF

Competence	Competence description	4 EQF	5 EQF	6 EQF
Liaise with property stakeholders	Liaising with property stakeholders involves effective communication and collaboration to understand their needs and convey important information.	SCRE	SCRP	
Work with communities	Engaging with diverse groups fosters collaboration, addresses shared concerns, and achieves common goals. It requires effective communication, trust-		SCRE	SCRPP

Co-funded by the European Union

	building, and creating inclusive environments.			
Build business relationships	Creating connections through strong communication, trust, and collaboration. Networking and offering valuable resources are key to maintaining these relationships.	SCREE	SCRPP	
Cloud technologies	Using and managing cloud computer services. This includes understanding cloud service models (like IaaS, PaaS, and SaaS), deploying and managing cloud infrastructure, ensuring security and compliance, and optimising cloud resources for cost and performance. Proficiency in popular and emerging cloud platforms, as well as skills in automation, DevOps, and cloud-native technologies, are also key components.		SCRP	SCRE
Manage data	Collecting, organising, storing, and maintaining data throughout the process. This includes		SCRPP	SCRE

Co-funded by the European Union

	ensuring data security and accessibility, as well as complying with ethical and legal standards. It also encompasses skills in data analysis, documentation, and sharing, facilitating collaboration and reproducibility.			
Cybersecurity	Protecting systems, networks, and data from digital attacks, ensuring confidentiality, integrity, and availability. Staying updated with the cybersecurity legislation to ensure compliance.		SCRP	SCRE
Manage budgets	Planning, allocating, and monitoring financial resources to meet organisational goals efficiently.	SCRE		SCRP
Perform project management	Planning, executing, and overseeing projects to achieve specific goals within constraints like time and budget. It ensures efficient resource use and timely completion.		SCRE	SCRP
Manage procurement planning	Strategising, organising, and overseeing the acquisition of goods and services to meet	SCRE		SCRP

Co-funded by the European Union

	project needs efficiently and cost-effectively. It ensures timely and quality resource availability.			
Design for organisational complexity	Creating structures and processes that effectively manage and navigate the intricate dynamics and interdependencies within an organisation. It aims to enhance adaptability, efficiency, and resilience.		SCRP	SCRE
Promote innovative infrastructure design	Advocating for and implementing cutting-edge, sustainable, and efficient solutions in the development and maintenance of physical and organisational structures. It aims to enhance functionality, resilience, and adaptability.			SCRE, SCRP
Advise on sustainable management policies	Providing expert guidance on developing and implementing policies that promote environmental, social, and economic sustainability. It aims to foster long-term resilience and responsibility in			SCRE, SCRP

Co-funded by the European Union

	organisational practices.			
Conduct environmental site assessment	Evaluating a location's environmental conditions to identify potential contamination, risks, and impacts. It aims to inform decision-making for sustainable and safe land use.	SCRP		SCRE
Apply knowledge of science, technology and engineering	Utilising interdisciplinary expertise to solve problems, innovate, and improve processes and systems. It aims to drive progress and efficiency in various fields.		SCRP	SCRE
ICT system programming	Developing and maintaining software that enables computer hardware to interface with other software and perform specific tasks. This includes writing code, debugging, and optimizing system-level programs.	SCRP	SCRE	
Internet of things	Designing and managing systems of interconnected devices to collect and analyse data for improved efficiency and		SCRP	SCRE

Co-funded by the European Union

	automation. This includes understanding IoT components, architectures, communication technologies, security measures, cloud platforms and data analytics, along with exemplifying how IoT systems impact smart city domains.			
Smart City features	Using technology and data to enhance urban living, improve infrastructure, and optimize city services for efficiency and sustainability.		SCRE	SCRP
Solve ICT systems problems	Diagnosing, troubleshooting, and resolving issues related to information and communication technology systems to ensure optimal performance and functionality.	SCRP		SCRE
Work with e-services available to citizens	Utilising and managing digital platforms and online services provided by governments or organizations to facilitate citizen access to information and public services.		SCRE	SCRP

Co-funded by the European Union

Green topics and sustainability awareness	Assessing impact on nature and consider the protection of nature an essential task for every individual. Identifying processes or action that avoid or reduce the use of natural resources.	SCRE, SCRP		
Familiarity with EU procurement directives and sustainability goals	Understanding the European Union's public procurement regulations (such as the Public Procurement Directives 2014/23/EU, 2014/24/EU, and 2014/25/EU) and how they integrate with the EU's environmental and social sustainability objectives, including requirements for green public procurement, circular economy principles, and sustainable development targets.	SCRE		SCRP
Urban data analytics	The ability to comprehend the key aspects of urban data analytics and apply techniques and tools to solve real-world problems. It includes being able to (i) explain the main sources and types of urban data (ii) discuss the different stages within the data		SCRP	SCRE

Co-funded by the European Union

	lifecycle, (iii) describe big data characteristics, sources and types; (iv) present the big data analytics categories, (v) provide use cases for each category in the context of smart cities; (vi) use tools to perform big data analysis, (vii) demonstrate in detail how data analytics can enhance decision making through comprehensive real-world case studies.			
Artificial Intelligence	The ability to identify, select and apply AI solutions in a smart city context. It includes being able to (i) understand fundamental concepts, practical applications, and ethical considerations of AI in smart cities, (ii) distinguish different types of Machine Learning (ML), (iii) describe basic ML approaches, techniques and algorithms, (iv) provide real-world examples of the use of AI in smart cities			SCRE, SCRP

Co-funded by the European Union

Table 2 - Competence Matrix Core/Optional

List of Competences	Smarr Community Resilience Engineer		Smart Community resilient SolutionsProcurer/ Planner	
/	Core	Optional	Core	Optional
Liaise with property owners		X (4)	X (5)	
Work with communities	X (5)		X (6)	
Build business relationships		X (4)		X (5)
Cloud technologies	X (6)			X (5)
Manage data	X (6)		X (5)	
Cybersecurity	X (6)		X (5)	
Manage budgets		X (4)	X (6)	
Perform project management		X (5)	X (6)	
Manage procurement planning		X (4)	X (6)	
Design for organisational complexity	X (6)		X (5)	
Promote innovative infrastructure design	X (6)		X (6)	
Advise on sustainable management policies	X (6)		X (6)	
Conduct environmental site assessment	X (6)			X (4)
Apply knowledge of science, technology and engineering	X (6)			X (5)
ICT system programming		X (5)		X (4)

Co-funded by the European Union

Internet of Things	X (6)			X (5)
Smart city features	X (5)		X (6)	
Solve ICT systems problems	X (6)			X (4)
Work with e-services available to citizens	X (5)		X (6)	
Green topics and sustainability awareness		X (4)		X (4)
Familiarity with EU Procurement Directives and sustainability goals		X(4)	X(6)	
Urban data analytics	X(5)		X(6)	
Artificial Intelligence	X(6)		X(6)	

*Between brackets, the EQF assigned in the previous table to show consistency between the level of competence and the core/optional choice.

3.3.2 List of competences with high priority

Based on the results of the Competence matrix, the following are the competences that should be given priority for each profile to perform its role effectively. They have a value of EQF equal or greater than 6 and, additionally, have the features of a core competence according to the given definition. We identified 12 for the Smart Community Resilience Engineer and 9 for the Smart Community Resilient Solutions Procurer/Planner.

Smart Community Resilience Engineer: cloud technologies, manage data, cybersecurity, design for organisational complexity, promote innovative infrastructure design, advise on sustainable management policies, conduct environmental site assessment, apply knowledge of science, technology and engineering, IoT, solve ICT problems, understanding of ICT data and urban analytics, understanding of AI.

Smart Community Resilient Solutions Procurer/Planner: manage procurement planning, work with communities, manage budgets, perform project management, promote innovative infrastructure design, advise on sustainable management policies, smart city features, work with

Co-funded by the European Union

e-services available to citizens, familiarity with EU procurement Directives and sustainability goals.

The competences outlined in this section are classified as high-priority learning objectives. However, pending the outcomes of Task 2.5 regarding the gap analysis, we reserve the right to revise this section to accurately reflect the competences that are most critical at this time. This approach ensures that our priorities are informed by empirical data and ongoing assessment.

3.3.3 Learning Outcomes

Table 3 - Learning outcomes SCRE

Competence	Learning Outcomes
cloud technologies	1. Select appropriate cloud service and deployment models for business requirements. 2. Deploy and manage cloud infrastructure using major platforms and automation tools. 3. Implement cloud security measures and ensure regulatory compliance. 4. Develop cloud-native applications using containers and serverless technologies. 5. Optimize cloud resources for cost and performance efficiency.
manage data	1. Design secure data management systems ensuring legal and ethical compliance. 2. Implement effective data storage and organization methodologies. 3. Perform data analysis with proper documentation standards.

Co-funded by the European Union

	4. Develop collaborative data sharing protocols for reproducible research. 5. Evaluate and improve organizational data governance practices.
Cybersecurity	1. Implement security frameworks to protect systems and networks. 2. Apply cryptographic solutions to ensure data confidentiality and integrity. 3. Assess cybersecurity risks and develop mitigation strategies. 4. Deploy security monitoring and incident response systems. 5. Pursue compliance with cybersecurity legislation and regulations.
design for organisational complexity	1. Analyze organizational interdependences and their impact on operational effectiveness. 2. Design adaptive management processes that respond to changing organizational dynamics. 3. Evaluate structural frameworks for optimizing efficiency across organizational units. 4. Develop strategies to build organizational resilience in complex environments. 5. Implement integrated systems that balance stakeholder needs and organizational goals.

Co-funded by the European Union

promote innovative infrastructure design	1. Evaluate and select sustainable technologies and materials for infrastructure development projects. 2. Consider adaptive organizational frameworks that enhance operational resilience and efficiency. 3. Analyse the lifecycle performance of physical structures to optimize maintenance strategies. 4. Integrate cutting-edge digital solutions to improve infrastructure functionality and monitoring.
advise on sustainable management policies	1. Analyze sustainability challenges across environmental, social, and economic dimensions. 2. Design evidence-based sustainability policies for organizational implementation. 3. Evaluate policy effectiveness using appropriate measurement frameworks. 4. Synthesize multi-disciplinary approaches to create integrated sustainability solutions. 5. Assess organizational sustainability performance through monitoring and reporting systems.
conduct environmental site assessment	1. Evaluate site-specific environmental conditions using appropriate assessment methodologies and regulatory frameworks.

Co-funded by the European Union

	2. Develop evidence-based recommendations for sustainable land use practices and risk mitigation strategies. 3. Apply environmental regulations and standards to ensure compliance in site assessment and remediation planning.
apply knowledge of science, technology and engineering	1. Integrate knowledge from multiple disciplines to develop comprehensive solutions for technical and organizational challenges. 2. Analyze system inefficiencies using interdisciplinary approaches to identify opportunities for process improvement and innovation. 3. Learn how to facilitate knowledge transfer across disciplinary boundaries and implement sustainable improvements in various professional contexts.
Internet of Things	1. Describe the main concepts and characteristics of IoT. 2. Present the basic components and system architectures of IoT systems. 3. Compare the most important communication technologies for IoT deployments. 4. Summarize the major cloud IoT platforms. 5. Describe meaningful IoT applications for smart cities

Co-funded by the European Union

solve ICT problems	1. Evaluate the root causes of technology performance issues through system analysis and evidence-based investigation. 2. Implement effective resolution strategies for ICT problems while considering system interdependencies. 3. Assess and optimise ICT system performance through proactive monitoring, preventive maintenance. 4. Synthesise technical solutions with business requirements to ensure ICT systems deliver optimal functionality and user experience.
Urban Data Analytics	1. Describe basic data analytics techniques. 2. Present big data analytics applications to smart cities. 3. Explain data analytics tools. 4. Describe visualization techniques. 5. Demonstrate an outlier detection algorithm. 6. Apply PySpark and Collab to perform basic data processing techniques.
Artificial Intelligence	1. Describe the basic artificial intelligence and machine learning concepts and categories. 2. Discuss the basic supervised learning techniques. 3. Present the basic unsupervised learning techniques.

Co-funded by the European Union

	4. Demonstrate a learning algorithm in a smart city related classification problem. 5. Demonstrate a learning algorithm in a smart city related regression problem. 6. Demonstrate a forecasting algorithm in a time-series smart city related problem. 7. Demonstrate a clustering algorithm in a smart city related problem.

Table 4 - Learning outcomes SCRP

Competence	Learning Outcomes
manage procurement planning	1. Develop strategic procurement plans aligned with project requirements. 2. Evaluate suppliers and negotiate cost-effective contracts. 3. Design compliant procurement processes and procedures. 4. Assess procurement risks and implement mitigation strategies. 5. Monitor procurement performance and drive continuous improvement.
work with communities	1. Analyse cultural differences to develop effective cross-group communication strategies. 2. Evaluate and apply trust-building techniques across diverse stakeholder groups.

Co-funded by the European Union

	3. Design inclusive processes ensuring equitable participation in collaborative initiatives. 4. Assess group dynamics to identify and address engagement barriers. 5. Synthesise multiple perspectives to develop solutions for shared concerns.
Manage budgets	1. Analyse financial data to develop strategic resource allocation plans and track financial deviations. 2. Evaluate financial planning methodologies to optimize resource utilization. 3. Assess financial risks and implement appropriate mitigation strategies.
Perform project management	1. Develop comprehensive project plans aligned with strategic objectives. 2. Apply project management methodologies to control scope, schedule, and budget. 3. Evaluate risks and implement mitigation strategies for project success. 4. Lead cross-functional teams and manage stakeholder relationships effectively. 5. Assess project performance and recommend process improvements.
Promote innovative infrastructure design	1. Evaluate and select sustainable technologies and materials for infrastructure development projects.

Co-funded by the European Union

	2. Consider adaptive organizational frameworks that enhance operational resilience and efficiency. 3. Analyse the lifecycle performance of physical structures to optimize maintenance strategies. 4. Integrate cutting-edge digital solutions to improve infrastructure functionality and monitoring.
Advice on sustainable management policies	1. Analyze sustainability challenges across environmental, social, and economic dimensions. 2. Design evidence-based sustainability policies for organizational implementation. 3. Evaluate policy effectiveness using appropriate measurement frameworks. 4. Synthesize multi-disciplinary approaches to create integrated sustainability solutions. 5. Assess organizational sustainability performance through monitoring and reporting systems.
Smart city features	1. Analyse urban data systems to optimize city infrastructure performance. 2. Evaluate sustainability metrics and design data-driven municipal solutions. 3. Assess environmental impact of urban technologies for sustainable development. 4. Synthesize stakeholder needs to develop strategic smart city implementation plans.

Co-funded by the European Union

Work with e-services available to citizens	1. Evaluate government digital platform effectiveness and citizen accessibility. 2. Conceive integration strategies for multiple digital public services. 3. Analyse user barriers and recommend service improvements. 4. Develop frameworks for equitable digital service access. 5. Assess interoperability requirements for government platforms.
Familiarity with EU procurement Directives and sustainability goals	1. Comprehend the legal framework of EU Public Procurement Directives 2014/23/EU, 2014/24/EU, and 2014/25/EU. 2. Evaluate green public procurement integration into tender specifications and award criteria. 3. Assess circular economy principles application in public procurement processes. 4. Conceive procurement strategies aligned with EU sustainable development targets. 5. Examine the balance between economic efficiency and social sustainability in procurement decisions.

Co-funded by the European Union

4. Conclusions

In this deliverable, we have outlined the Competence Matrix for Short-Term Trainings, which includes the essential competences, skills, and knowledge required for the two specific professional profiles: the Smart Community Resilience Engineer and the Smart Community Resilient Solutions Procurer/Planner. This matrix serves as a foundation for curriculum and content development within T4.2, ensuring that the training delivered is practical, relevant, and able to meet the demands of the evolving landscape of smart community development 1.

The next steps will involve setting up the short-term courses based on the results of this deliverable. These courses will be designed to address the identified competence gaps and provide targeted training to enhance the skills and knowledge of professionals in the field. The ultimate aim is to support the development of resilient and sustainable smart communities, contributing to the economic competitiveness, social well-being, and environmental sustainability of both urban and rural areas.

Co-funded by the European Union

EU Disclaimer

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

Project Number: 101186291 — SMARCO — ERASMUS-EDU-2024-PI-ALL-INNO-BLUEPRINT

Website: ***www.smarco.eu***
Email: ***info@smarco.eu***
LinkedIn: ***@smarcoproject***
Instagram: ***@smarcoproject***
YouTube: ***@smarcoproject***

Co-funded by the European Union

Appendix of D4.1 - Updated Competence Matrix for Short-Term Trainings

September 2025

Co-funded by the European Union

Document Control Information

Project	SMARt COmmunities Skills Development in Europe
Project number	101186291
Document Title	Update Appendix of D4.1 Competence Matrix for Short-Term Trainings
Work Package Number	WP4
Deliverable Number	D4.1
Lead Beneficiary	CEFRIEL
Project Coordinator:	European DIGITAL SME Alliance
Dissemination Level	Public
Authors	Domenico Orlando (Cefriel)
Reviewers	Andrianna Georgiou, Luis Bernardo Pulido Gaytan, Konstantinos Kirytopoulos
Status	Final for Submission
Delivery Date	07.10.2025
Due date	09.2025

Table of Contents

List of Tables

Co-funded by the European Union

Key Updates to the Competence Matrix: Simplification and Alignment with Interim Results

This document is intended as an appendix to D.4.1 Competence Matrix for Short-Term Trainings (hereinafter "D4.1"). The purpose of this appendix is to update the results presented in June 2025, with respect to the interim results collected by Task T2.3 (Stakeholder needs analysis) and Task T2.5 (Gap identification & forecast of the future skills needed). The interim results were shared by Fondazione Piemonte Innova (FPI) for demand analysis and by University of Thessaly (UTH) for gap analysis.

The tables of this appendix should be considered the updated versions of Tables 3 and 4 from Deliverable D4.1.

Main changes introduced in this appendix:

- For the Smart Community Resilience Engineer ('SCRE') profile, the competence "cloud technologies" has been updated to "digital transformation," and the related learning outcomes have also been revised. The change is justified by the fact that the latter is a highly sought-after skill that is currently lacking in the market. While the competence name has changed, cloud-related references remain included among the learning outcomes.
- For the SCRE, the competences "design for organisational complexity" and "apply knowledge of science, technology and engineering" have been merged into "Systems thinking and Cross-sectorial integration." This latter competence emerged from analysing the demand, and at the same time, it had enough similarities with the previous ones to justify merging them for the sake of simplification. The merge is reflected in the learning outcomes too.
- For both the SCRE and the Smart Community Resilient Solutions Procurer/Planner ('SCRP'), the competence "advise on sustainable management policies" has been renamed to "green transition and sustainability." This stems from the similarity of the competences and the intent to further emphasise the focus on green and environmental topics (both of which are present and relevant in the demand analysis and the gap analysis).
- For the SCRE, the competences "conduct environment site assessment" and "solve ICT problems" have been removed. The two were removed because they were not supported

Co-funded by the European Union

by the demand analysis or the gap analysis, and some of their aspects were already covered by other existing competences or by newly introduced ones.

- For the SCRP, the competences "manage procurement planning" and "EU procurement directives and sustainability goals" have been removed, as there was insufficient evidence to support their inclusion among the interim results of WP2.

In general, there has been a simplification, resulting in a reduction of competences to focus on real needs and at the same time a general alignment and harmonisation of the matrix and its learning outcomes. The competences passed from 12 to 9 for the SCRE and from 9 to 7 for the SCRP.

All modifications are based on the analysis and recommendations from the relevant project tasks and partners, ensuring the deliverable remains aligned with current needs and priorities.

Co-funded by the European Union

Table 3a Competences and learning outcomes SCRE updated

Competence	Learning Outcomes
digital transformation	1. Operate legacy system integration 2. Select appropriate cloud service and deployment models for business requirements. 3. Deploy and manage cloud infrastructure using major platforms and automation tools. 4. Understand cloud architectures 5. Understand microservices and API
manage data	1. Design secure data management systems ensuring legal and ethical compliance. 2. Implement effective data storage and organization methodologies. 3. Perform data analysis with proper documentation standards. 4. Develop collaborative data sharing protocols for reproducible research. 5. Evaluate and improve urban analytics for governance
cybersecurity	1. Implement security frameworks to protect systems and networks. 2. Apply cryptographic solutions to ensure data confidentiality and integrity. 3. Assess cybersecurity risks and develop mitigation strategies. 4. Deploy security monitoring and incident response systems.

Co-funded by the European Union

	5. Pursue compliance with cybersecurity legislation and regulations.
systems thinking and cross-sectorial integration	1. Integrate knowledge from multiple disciplines to develop comprehensive solutions for technical and organizational challenges. 2. Analyze system inefficiencies using interdisciplinary approaches to identify opportunities for process improvement and innovation. 3. Analyze organizational interdependences and their impact on operational effectiveness. 4. Plan for heterogeneous scenarios with limited interoperability.
promote innovative infrastructure design	1. Evaluate and select sustainable technologies and materials for infrastructure development projects. 2. Consider adaptive organizational frameworks that enhance operational resilience and efficiency. 3. Analyse the lifecycle performance of physical structures to optimize maintenance strategies. 4. Integrate cutting-edge digital solutions to improve infrastructure functionality and monitoring.
green transition and sustainability	1. Manage smart energy sources. 2. Plan circular economy strategies 3. Have a literacy on carbon emissions and carbon footprint

Co-funded by the European Union

	4. Analyze sustainability challenges across environmental, social, and economic dimensions. 5. Design evidence-based sustainability policies for organizational implementation. 6. Assess organizational sustainability performance through monitoring and reporting systems.
internet of things	1. Describe the main concepts and characteristics of IoT. 2. Present the basic components and system architectures of IoT systems. 3. Compare the most important communication technologies for IoT deployments. 4. Summarize the major cloud IoT platforms. 5. Describe meaningful IoT applications for smart cities
urban data analytics	1. Describe basic data analytics techniques. 2. Present big data analytics applications to smart cities. 3. Explain data analytics tools. 4. Describe visualization techniques. 5. Demonstrate an outlier detection algorithm. 6. Apply algorithmic accountability.
artificial intelligence	1. Describe the basic artificial intelligence and machine learning concepts and categories.

Co-funded by the European Union

	2. Discuss and present basic supervised and unsupervised learning techniques. 3. Demonstrate a learning algorithm in a smart city related classification problem. 4. Demonstrate a learning algorithm in a smart city related regression problem. 5. Demonstrate a forecasting algorithm in a time-series smart city related problem. 6. Demonstrate a clustering algorithm in a smart city related problem.

Table 4a Competences and learning outcomes SCRP updated

Competence	Learning Outcomes
work with communities	1. Analyse cultural differences to develop effective cross-group communication strategies. 2. Evaluate and apply trust-building techniques across diverse stakeholder groups. 3. Design inclusive processes ensuring equitable participation in collaborative initiatives. 4. Assess group dynamics to identify and address engagement barriers. 5. Synthesise multiple perspectives to develop solutions for shared concerns. 6. Communicate properly with stakeholders.
manage budgets	1. Analyse financial data to develop strategic resource allocation plans and track financial deviations. 2. Evaluate financial planning methodologies to optimize resource utilization. 3. Assess financial risks and implement appropriate mitigation strategies. 4. Apply budget management specifically to IT.

Co-funded by the European Union

perform project management	1. Develop comprehensive project plans aligned with strategic objectives. 2. Apply project management methodologies to control scope, schedule, and budget. 3. Evaluate risks and implement mitigation strategies for project success. 4. Lead cross-functional teams and manage stakeholder relationships effectively. 5. Apply agile/scrum and Scaled Agile Framework (SAFe) methodologies
promote innovative infrastructure design	1. Evaluate and select sustainable technologies and materials for infrastructure development projects. 2. Consider adaptive organizational frameworks that enhance operational resilience and efficiency. 3. Analyse the lifecycle performance of physical structures to optimize maintenance strategies. 4. Integrate cutting-edge digital solutions to improve infrastructure functionality and monitoring. 5. Demonstrate familiarity with digital information and service platforms
green transition and sustainability	1. Manage smart energy sources. 2. Plan circular economy strategies 3. Have a literacy on carbon emissions and carbon footprint 4. Analyze sustainability challenges across environmental, social, and economic dimensions. 5. Design evidence-based sustainability policies for organizational implementation. 6. Assess organizational sustainability performance through monitoring and reporting systems.

Co-funded by the European Union

smart city features	1. Analyse urban data systems to optimize city infrastructure performance. 2. Evaluate sustainability metrics and design data-driven municipal solutions. 3. Assess environmental impact of urban technologies for sustainable development. 4. Synthesize stakeholder needs to develop strategic smart city implementation plans.
work with e-services available to citizens	1. Evaluate government digital platform effectiveness and citizen accessibility. 2. Conceive integration strategies for multiple digital public services. 3. Analyse user barriers and recommend service improvements. 4. Develop frameworks for equitable digital service access. 5. Assess interoperability requirements for government platforms. 6. Integrate with legacy systems.

Co-funded by the European Union