D2.1 Smart communities' skills mismatches and future foresight Report and Smart Communities Skills Demand Two-pages

January 2026

Document Control Information

Project	SMARt COmmunities Skills Development in Europe
Project number	101186291
Document Title	D2.1 Smart communities' skills mismatches and future foresight Report and Smart Communities Skills Demand Two-pages
Work Package Number	WP2
Deliverable Number	D2.1
Lead Beneficiary	NCSRD
Project Coordinator:	European DIGITAL SME Alliance
Dissemination Level	Public
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Description	The deliverable summarises all work carried out in WP2, including methodological approach and considerations to smart communities' skills supply and demand analysis, as well as gaps identification and development of future foresight scenarios. Further, it provides the findings on skills demand and supply and concludes with the identified gaps and mismatches between skills supply and demand. Following the activities in T2.6, this Report will be updated biannually and will be published together with a short version, the Smart Communities' Skills Demand Two-Pages.

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Status	Version 1.0
Delivery Date	12.12.2025
Due date	31.01.2025 – indicated as per GA

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Document history

Version	Date	Author	Description of the change
1	21.11.2025	All WP2 Task Leaders	First Draft
2	28.11.2025	All WP2 Task Leaders	Internal Review
3	28.11.2025	External Advisory Board	Expert Review
4	05.12.2025	All WP2 Task Leaders	Second Draft
5	12.12.2025	NCSR Demokritos	Third Draft
6	19.12.2025	Cefriel	Internal Review

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Abbreviations

Acronym	Explanation
AI	Artificial Intelligence
ARISA	Artificial Intelligence Skills Alliance
D2.1	Deliverable 2.1
D4S	Digital4Sustainability
DGH	Digital Growth Hub
DVI	Digital Visibility Index
e-CF	European e-Competence Framework
EAB	External Advisory Board
EQF	European Qualifications Framework
ESCO	European Skills, Competences, Qualifications, and Occupations
ESG	Environmental, Social, and Governance
ESSA	European Software Skills Alliance
EU	European Union
FPI	Fondazione Piemonte Innova
GDPR	General Data Protection Regulation
HEIs	Higher Education Institutions
HU	University of Applied Sciences Utrecht
VET	Vocational Education and Training
ICT	Information and Communications Technology
IoT	Internet of Things
KPIs	Key Performance Indicators
M1- M48	Month 1 through Month 48
NCSRD	National Center for Scientific Research Demokritos

NGO	Non-Governmental Organization
PCA	Principal Component Analysis
SCo	Smart Communities
SCRE	Smart Community Resilience Engineer
SCRSP	Smart Community Resilient Solutions Procurer/ Planner
SMACITE	SMACITE Boosting the technical and non-technical skills and competences of Smart Cities technicians and engineers
SMARCO	SMARt COmmunities Skills Development in Europe (Project Name)
Task 2.1–T2.6	Task 2.1 through Task 2.6
UAH	University of Alcalá
UTH	University of Thessaly
VET	Vocational Education and Training
WP	Work Package

Editorial note on AI usage

This deliverable was prepared using AI-supported tools as an auxiliary resource. All content was developed, supervised, reviewed and validated by human experts within the SMARCO consortium, who retain full responsibility for the accuracy, integrity and quality of the information presented.

Table of Contents

Table of Figures

About SMARCO

Smart Communities Skills Development in Europe (SMARCO) is an EU-funded Erasmus+ Blueprint project that aims to become a one-stop shop for skills development in smart communities. The project supports the creation of resilient and sustainable smart communities by addressing critical skills gaps among smart city engineers and planners/procurers through targeted upskilling courses and forward-looking training programmes. SMARCO promotes flexible, user-centred and transnational learning pathways, ensuring wide recognition of learning outcomes through micro-credentials, training certificates and a broader certification scheme. In parallel, the project fosters a sustainable European community of stakeholders to exchange, scale and institutionalise smart communities skills and best practices, notably through participation in the Pact for Skills and the organisation of policy roundtables with decision-makers.

Figure 1 About SMARCO

1. Introduction

1.1 Work Package 2

Work Package 2 (WP2) of the SMARCO project, Analysis of smart communities' skills supply and demand, will be led from M1 (February 2025) to M48 (January 2029) by HU University of Applied Sciences Utrecht (HU). The activities provisioned in this WP were carried out by all the consortium partners involved in specific tasks.

WP2 targets **six specific objectives**:

1. To propose and agree on methodology which would ensure a science-based approach to smart communities' skills supply and demand analysis, as well as foresight scenario development within WP2;

2. To analyze smart communities' skills needs among ICT professionals and public administrations, and project emerging future demand for such skills in Europe;

3. To map available trainings, upskilling and reskilling initiatives and resources which address smart communities' skills development, and make them public in an accessible and open online catalogue, as well as to analyse and summarise this existing offer;

4. To identify skills mismatches (gaps) between smart communities' skills supply and demand in Europe;

5. To produce future foresight scenarios for smart communities skills development;

6. To continuously upgrade the research in available supply and demand, and update the main findings.

The overarching logic of WP2 is structured sequentially, moving from methodological groundwork (1) to a comprehensive dual analysis of Demand (2) and Supply (3). The core deliverable involves fusing these findings to formally identify skill mismatches (4). These results then feed into the crucial, future-oriented tasks of developing foresight scenarios (5). The final objective ensures the entire analytical process is continuously monitored and updated (6) throughout the project lifecycle.
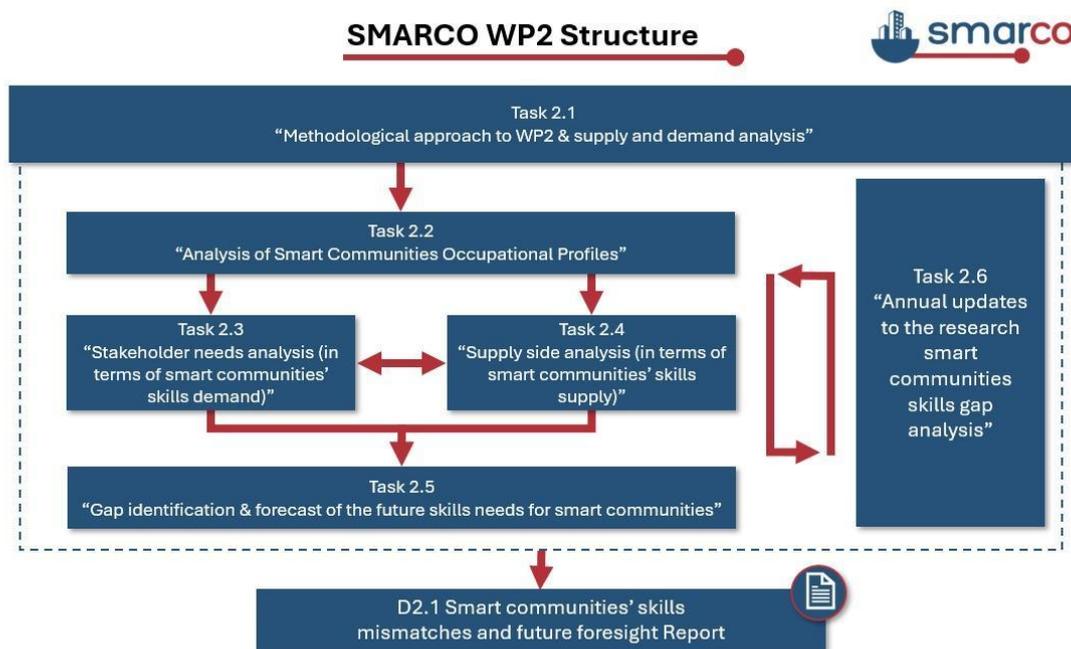
Figure 2 SMARCO WP2 Structure

1.2 Scope of D2.1

The present deliverable "Smart Communities' Skills Mismatches and Future Foresight Report and Smart Communities' Skills Demand" (D2.1) summarises the work carried out under WP2, which focuses on analysing the skills ecosystem for smart communities. The scope of this report is fourfold:

1. To establish a common methodological framework (developed under T2.1) for analysing skills supply and demand in the context of smart communities, ensuring consistency and comparability across partner contributions.

2. To analyse occupational profiles and skills demand and supply (T2.2, T2.3, T2.4), providing a comprehensive picture of current and emerging requirements, as well as the existing training offers and initiatives addressing these needs.

3. To identify skills mismatches and gaps, and to develop foresight scenarios (T2.5), highlighting short-, medium-, and long-term developments that may impact smart communities and their workforce.

4. To ensure continuous relevance and adaptability of findings through a systematic process of updates (T2.6), which will be integrated into subsequent versions of the deliverable and

complemented by the dissemination-friendly "Smart Communities' Skills Demand Two-Pages."

This deliverable therefore provides both a baseline analysis and a forward-looking perspective, supporting evidence-based decision making for education providers, policymakers, and smart community stakeholders. It also feed directly into the development and piloting of the Training Programme for HEIs and VET foreseen in WP5 and WP6, ensuring alignment between identified needs and project outputs.

This deliverable is structured to mirror the logic of WP2 and to present a clear flow from methodology to findings and foresight:

- **Section 1 (current section)** introduces **the description and objectives of WP2 as well as the scope of this deliverable**.

- **Section 2** outlines the **methodological framework** (T2.1), describing the approach, data collection tools, and update mechanism.

- **Sections 3 to 5** present the **core analyses**:

    o **Occupational profiles** (T2.2)

    o **Skills demand** (T2.3)

    o **Skills supply** (T2.4)

- **Section 6** consolidates findings into the **identification of skills gaps and mismatches**, and develops **future foresight scenarios** (T2.5).

- **Section 7** introduces the Smart Communities' Skills Resources Catalogue.

- **Section 8** provides conclusions.

- **Section 9** (Annex) includes a **short dissemination version ("Smart Communities' Skills Demand Two Pager")**, summarising the most relevant findings for external stakeholders.

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2. Methodological Framework

2.1 Development Process

As this project is an Erasmus+ initiative, its methodological framework is built upon and refined compared to previous approaches. Various Erasmus+ initiatives addressing skills gap assessment and competence development across Europe have employed diverse methodological approaches and analytical frameworks. Examining these projects provides a contextual basis for understanding existing practices in skills intelligence and for situating the SMARCO project within a broader European landscape. In particular, Partnerships for Innovation – Alliances' projects such as ESSA (European Software Skills Alliance, 2021), ARISA (Artificial Intelligence Skills Alliance, 2022), Digital4Sustainability (D4S) (Digital4Sustainability Project Consortium,2025), and SMACITE (SMACITE Consortium, n.d.) illustrate different yet complementary strategies for identifying skills demand and supply, developing occupational profiles, and aligning findings with European classification systems such as European Skills, Competences, Qualifications, and Occupations (ESCO) (ESCO Dataset, n.d.) and the European e-Competence Framework (e-CF).

The methodology for the skills gap analysis was developed through a structured, iterative, and participatory co-creation process involving the WP2 partners. An overview of the research methodology development approach is provided below in Figure 2. The process began with an initial draft prepared by the work package (WP) leader, HU University of Applied Sciences Utrecht (HU) and was jointly developed into a full research methodology. The outcome of this process is a coherent set of structured, task-specific methodological definitions that are systematically integrated into the research methodology. described in a jointly validated methodology document—SMARCO Research Methodology Report | Guidance for the analysis of smart communities' skills supply and demand (WP2).

Figure 3 SMARCO Task 2.1- Research Methodology Development Approach

2.2 Design of the common methodological approach and tools

The methodological framework has been designed to offer a multi-phase sequential mixed-methods design. Instead of collecting qualitative and quantitative data concurrently, the project structured data collection and analysis in consecutive phases. Given the dual needs of the urgent short-term upskilling and the forward-looking long-term training, it is most reasonable to combine the sequential—not concurrent—collection of qualitative and quantitative data sets over multiple phases of this project (Creswell & Plano Clark, 2011, p. 73). The clarity of the timing of the data gathering is important to distinguish between 'convergent' and 'multi-phase' designs.

By choosing multi-phase design, we fulfill the need to implement two phases (i.e., the development of urgent upskilling courses and the development of forward-looking training programmes) to address the overall objective. Multi-phase design also guarantees the interactions, not independency, among different work packages. Such interactions will be supported by the participatory process. It's critical that the mixed methods design be supportive of all phases of the data collection and analysis.

This approach allowed early findings—such as qualitative insights from stakeholders or preliminary occupational mappings—to directly inform subsequent quantitative instruments and the development of competence matrices, curricula, and training materials. The sequential design supports the project's dual objective: addressing immediate upskilling needs with short-term courses while also building long-term training pathways for emerging smart community skills.

To enhance methodological robustness and ensure European-level relevance, the framework was aligned with established EU standards and policy directions. ESCO was used as the core taxonomy for defining skills, competences, and occupations, enabling country-independent comparisons and consistent terminology across partners. The European Qualifications Framework (EQF) provided reference levels for assessing existing training programs and planning new learning pathways. In parallel, the methodology was informed by strategic guidance from the European Skills Agenda, the EU Digital Decade targets for 2030, and the Urban Agenda for the EU, ensuring alignment with priority areas such as digital competences, sustainability-related skills, and smart city governance. These European frameworks shaped the methodological choices from the proposal stage onward and remained integral throughout the approach.

An overview of the research methodology for Year 1 of the project is provided in Figure 3.
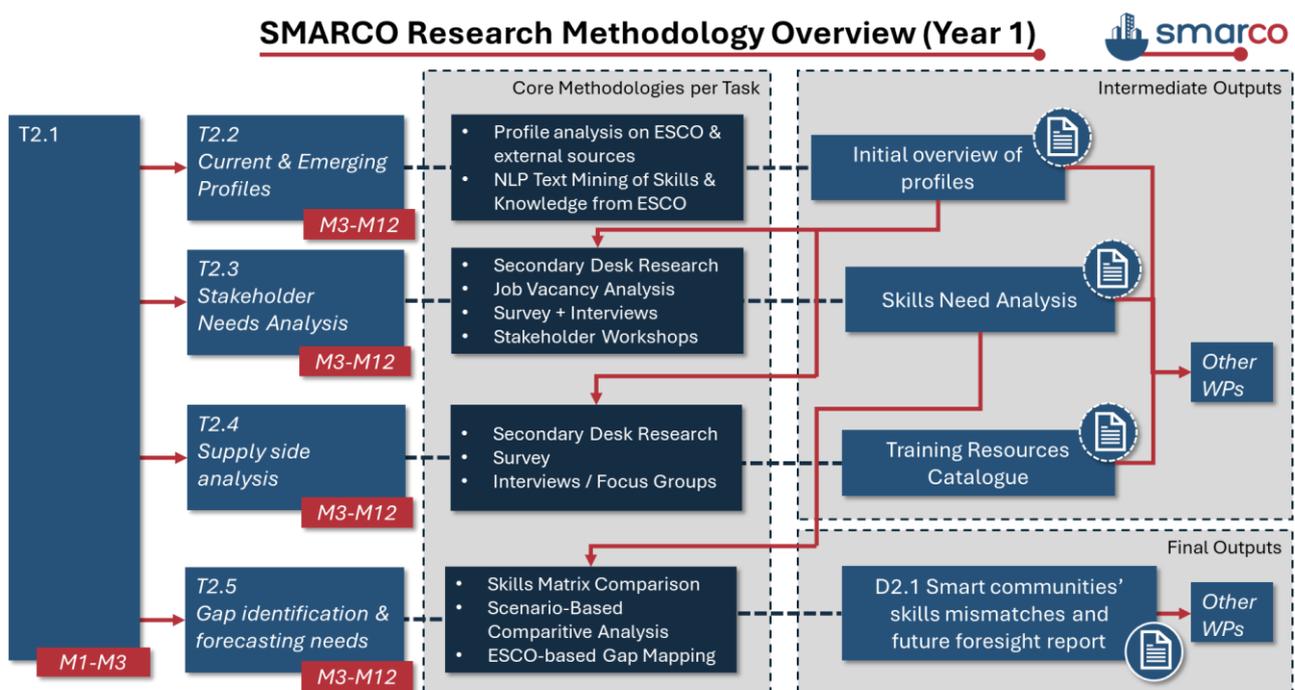

Figure 4 SMARCO Research Methodology Overview (Year 1)

2.3 Data collection and validation process

It's critical that the mixed methods design be supportive of all phases of the data collection and validation.

For T2.2, WP2 partners provided reference, summary and content of studies addressing occupations for smart cities/communities' projects or activities as well as local reports addressing talent needs. Then the task leader (i.e., UAH) applied Text Similarity (Jemal et al., 2025) to find relevant occupations in the ESCO framework (with word embedding and similarity functions) and selected occupations from the partners' inputs related to SMARCO profiles. The findings were updated with inputs from T2.3, T2.4, and T2.5 through coordinated stakeholder validation.

For T2.3, the triangulation of multiple data sources—including job vacancy analysis, literature reviews, stakeholder surveys, and expert validation—ensures a comprehensive and reliable insight into current and emerging workforce demands. Results are coded using standard occupational frameworks (ESCO primarily) for interoperability with WP2 tasks.

For T2.4, to enable cross-country comparisons, a standardized data collection framework was adopted, which aligns with methodologies used in global skills assessments, such as: the ESCO framework (ESCO Dataset, n.d.) and the World Economic Forum's Future of Jobs Report (World Economic Forum, 2023). The involvement of education providers, industry representatives, and policymakers is key to validating findings and ensuring practical relevance. Given the overarching/overlapping processes, T2.3 and T2.4 continued to align with each other on the definitions in each questionnaire/interview, the use of defined formats/tools and stakeholder engagement, for the convenience of T2.5 to proceed with gap assessment.

For T2.5, a skills inventory is formed by T2.2, T2.3 and T2.4 (with quantitative data and raw datasets) to be used as input for T2.5 to enable direct, data-driven comparisons between skills supply and demand across various analytical dimensions. Then the task leader (i.e., UTH) will conduct a workshop with stakeholders, aimed at validating T2.5's findings and foresight scenarios, ensuring consensus on findings and enhancing the credibility and acceptance of results.

For T2.6, a light-weight monitoring strategy during the second project year (M13-M24) will be applied to prepare for a concise repetition of the methodology of T2.3, T2.4 and T2.5 in the third project year (M25-M36). Data that will be monitored is from publications, stakeholders and/or

experts, job vacancies, and skill profiles. As the task leader, HU will provide indications in consultation with WP2 partners, that allows administration of the above information.

Specific quality and reporting standards operationalized for WP2 consider the following aspects

- **Tool usage**: the following tools have been agreed upon to be used in the context of WP2:
    - **EU Survey** (EUSurvey, 2025) will be used as tool to conduct surveys;
    - **NextCloud** for data sharing & storage, as also outlined in the project management handbook.
- **Referencing**: the use of references throughout (internal) project deliverables as part of WP2 and the methodological research approach shall be formatted in the APA 7th edition (APA Style, n.d.), unless specific reasons dictate another approach.
- **Data Harmonization**:
    - Ensure consistency in terminology and taxonomies across WP2 to facilitate cross-task data comparability through regular WP2 meetings to give insight into intermediate progress of deliverables and align accordingly;
    - Partner validation checkpoints during interim milestones (e.g., draft taxonomy review, preliminary findings) to ensure coherence within WP2.
- **Triangulation of data sources** as using multiple data collection methods (quantitative job market data, qualitative expert interviews, scenario planning) ensures balanced and comprehensive findings, minimizing bias and inaccuracies, and specifically:
    - For T2.2: Cross-referencing findings from ESCO, literature and expert consultations;
    - For T2.3: Combining literature, job vacancy data, and stakeholder input — to validate skill needs across different types of evidence and reduce bias.
- **Stakeholder engagement & validation**: engaging stakeholders to ensure that the analysis remains aligned with their needs and expectations and to review and confirm findings, and specifically:
    - For T2.3: Stakeholder validation through the workshop, offering a participatory feedback loop to confirm the prioritised skill areas and ensure they reflect real-professional world needs.
- **Internal peer review of methodologies and tools** (e.g., questionnaires, interview guides, trend analysis criteria), coordinated among WP2 partners. Task leaders will ensure visibility and the timely sharing of draft documents with task and WP members prior to finalisation

and sharing with other internal or external members, fostering collaborative input, while enhancing clarity, consistency, and alignment with the project's objectives.

- This is among others operationalized through documentation of methodological choices (e.g., tagging systems, classification logic, interview protocols) in an internal technical note, available on the shared project folders in SMARCO Cloud, to promote transparency and reproducibility.
- **Alignment with recognized EU frameworks,** e.g. ensuring compliance with ESCO classification standards and Erasmus+ project frameworks
- **Updates of the findings** (as part of T2.6) allow to periodically review and refine findings to maintain relevance amidst evolving market and technological trends.

2.4 Summary

The methodology, developed in a participatory manner in a short timeframe, allowed the partners to continue throughout the full duration of WP2 with a focused execution. The intensive alignment phase resulted in a relatively smooth process in its execution. The multi-phase approach resulted in a time-based and balanced distribution of activities, whereas a diverse dataset was allowed to be gathered by the WP2 partners through the mixed-method design. Subsequent chapters will provide insight in the results obtained during the execution of the methodology.

3. Occupational Profiles Analysis

According to the project proposal, Task T2.2 focuses on providing an initial overview and analysis of the two main target occupational profiles relevant to smart communities (SCo):

- Smart Community Resilience Engineer (SCRE)
- Smart Community Resilient Solutions Procurer/Planner (SCRSP)

University of Alcala (UAH) as the leader of task 2.2 is responsible for providing an initial overview and analysis of current and emerging occupational profiles for SCo.

3.1 Desk Research and Role Mapping

The desk research begins by defining the scope of Task T2.2, confirming its focus on two key occupational profiles (SCRE and SCRSP). Existing literature, policy reports, and international best practices were then reviewed to establish an informed baseline on current and emerging roles. In parallel, relevant ESCO profiles were identified and mapped to ensure consistent terminology and classification within the European skills context. Given the huge number of information items involved, natural language processing was used.

This was followed by an additional detailed analysis of tasks, responsibilities, and required competencies supported by multidisciplinary insights collected from partners and documented stakeholder sources. Results were benchmarked against similar initiatives worldwide. Finally, findings are synthesized into a structured output, highlighting responsibilities and tasks of the two target occupational roles, their ESCO alignment, and competencies for subsequent activities under WP2.

3.2 Validation

The preliminary results of the desk research were reviewed and refined through consultations with domain experts (local focus group) and project partners to validate the findings. Analysis of information collected by T2.3 of WP2 (survey, interview and workshop) ensured the accuracy, relevance, and completeness of the description of the two role profiles, their ESCO mapping, and skill groups composition. The inputs collected through expert discussions, partner workshops, and

iterative exchanges helped confirm all items, providing additional illustrative non-exhaustive examples for the skills groups.

3.3 Final Occupational Profiles

The final results for the two occupational profiles are fully presented in Report Version v1.3.1. For each profile, a detailed description was developed based on expert review and consultation with project partners. In addition, the extracted skills for each role were categorized, and these skill groups were introduced as the necessary competencies required for each profile. Seven skill groups were defined for the SCRE position, while eight skill groups were identified for the SCRSP role. These skill groups were further evaluated and validated as commented above.

Smart Community Resilience Engineer (SCRE)	Smart Community Resilient Solutions Procurer/Planner (SCRSP)
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 or 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.
Required Skill Groups	**Required Skill Groups**
Emergency & Disaster Management, Smart Infrastructure & Urban Resilience, Cybersecurity & ICT Resilience, Community Engagement & Social Resilience, Strategic & Project Management, Technology, Data & Digital Services, Situational Awareness & Environmental Adaptation	Sustainability Strategy & Policy Integration, Urban & Infrastructure Resilience Planning, Stakeholder Engagement & Governance, Sustainable Procurement & Resource Planning, Project & Change Management, Community Development & Social Innovation, Strategic Foresight & Systems Thinking, Research, Data & Intelligence

4. Skills Demand Analysis

According to the project proposal, Task 2.3 focuses on analysing the skills demand for smart communities' professionals through a multi-method approach that integrates desk research and expert validation. The task is designed to ensure a comprehensive and evidence-based understanding of skills needs, which will directly contribute to the project's broader goal of enhancing smart community skills development.

Fondazione Piemonte Innova (FPI), the task leader of T2.3, directed the research and analysis process, ensuring methodological rigor, transparency and coherence across the different research methods, and provided structured insights for understanding the skills needs of smart communities.

4.1 Research Findings and Stakeholder Insights

The integrated analysis of desk research, survey (159 responses), expert interviews (20), and an international workshop (42 participants) confirms convergence on key competences for Smart Communities:

Digital Transformation & AI Governance: Skills in data management, interoperability, cybersecurity, and responsible AI use are critical. The challenge is not only technical but also ethical and regulatory (GDPR, AI Act).

Resilience & Climate Adaptation: Predictive capabilities (digital twins, risk foresight) and adaptive design are needed to address environmental and social disruptions.

Inclusive Governance & Co-Creation: Stakeholder engagement, citizen-centric design, and innovative procurement are essential to ensure public value and trust.

Transversal Skills: Leadership, communication, systems thinking, and cross-sector collaboration are seen as crucial yet still undervalued.

Main Gaps: Cybersecurity, AI/data governance, digital literacy in public administrations, integration of green and digital transitions, and participatory competences. Public

administrations are the least prepared, while universities and VET providers must accelerate curriculum updates toward interdisciplinary and modular approaches.

Despite these divergences, a notable convergence was observed on three points:

1. **Hybrid competences are the future of work** in Smart Communities, merging digital, green, and social dimensions.
2. **Resilience is both technical and cultural,** requiring leadership, ethical responsibility, and trust across institutions.
3. **Collaboration is itself a skill,** essential for innovation ecosystems where data, infrastructure, and community goals intersect.

This last aspect also includes the ability to digitally project collaborative efforts, ensuring that local initiatives are visible and accessible online. Concepts such as the Digital Visibility Index (DVI) highlight that coordinated digital communication and joint promotion activities are increasingly necessary for communities to be effectively recognised in the digital sphere.

Overall, the interpretive synthesis reveals a strong alignment between quantitative and qualitative evidence, confirming that Europe's transition toward Smart and Resilient Communities hinges not only on advanced technologies but on the people and systems that enable them to work together effectively.

4.2 Prioritization of skills and emerging trends

Based on the full body of evidence collected from M1–M10 by T2.3 activity, five interrelated Priority Skills Areas have been validated:

a. **Digital Transformation & AI Governance** – This area remains the backbone of Smart Communities, encompassing data governance, cybersecurity, interoperability, and AI ethics. The challenge is not only to master digital tools but to deploy them responsibly, ensuring transparency, inclusivity, and trust. Public administrations, in particular, must strengthen their internal capacities for data management and AI literacy to reduce dependency on external providers.

b. **Resilience & Climate Adaptation** – Resilience emerged as both a technical and organisational competence. Beyond emergency management, it includes foresight, climate risk assessment, and adaptive design of infrastructures and services. Skills in predictive modelling, digital twins,

and risk analytics are essential to anticipate disruptions and sustain urban continuity under environmental and social stress.

c. **Sustainable Resource Management** – Stakeholders consistently stressed the need to link digitalisation with sustainability. This skill domain covers energy efficiency, circular economy principles, and low-carbon infrastructure management, as well as monitoring tools for water, waste, and mobility. The capacity to interpret and act on sustainability data is becoming a key differentiator for future professionals.

d. **Governance & Co-Creation Skills** – The governance dimension is central to ensuring that smart technologies deliver equitable public value. Skills in participatory planning, innovation procurement, and multi-level coordination are critical for aligning technological innovation with citizens' needs. This area also includes communication, facilitation, and mediation skills: often described as "soft" but in fact essential to operational success.

e. **Systemic Foresight & Innovation Readiness** – Finally, stakeholders emphasised the importance of foresight, adaptability, and systems thinking. Professionals must be able to connect technological innovation with long-term vision, anticipate shifts in policy or demography, and guide organisations through continuous transformation. Innovation readiness depends as much on mindset as on skillset: openness, curiosity, and reflective learning are increasingly strategic competences.

To support a clearer understanding of how these five Priority Skills Areas interact and contribute to Smart Community capacity-building, they have been organised into two categories, Foundational and Emerging (Table 1 and Figure 4).

This distinction reflects both their current level of maturity within organisations and their strategic role in enabling long-term transformation: foundational skills form the essential base for effective digital and green transitions, while emerging skills represent forward-looking capacities that will increasingly shape the resilience and innovation readiness of European communities.

Category	Skills Area	Rationale
Foundational	Digital Transformation & AI Governance	Core digital infrastructure, trust, interoperability, regulatory compliance
Foundational	Governance & Co-Creation	Ensures alignment of innovation with citizen needs and public value
Foundational	Sustainable Resource Management	Essential for green transition and everyday service management
Emerging	Resilience & Climate Adaptation	Growing need for predictive, adaptive urban systems; not yet embedded everywhere
Emerging	Systemic Foresight & Innovation Readiness	Enables long-term vision, anticipatory governance, and change management

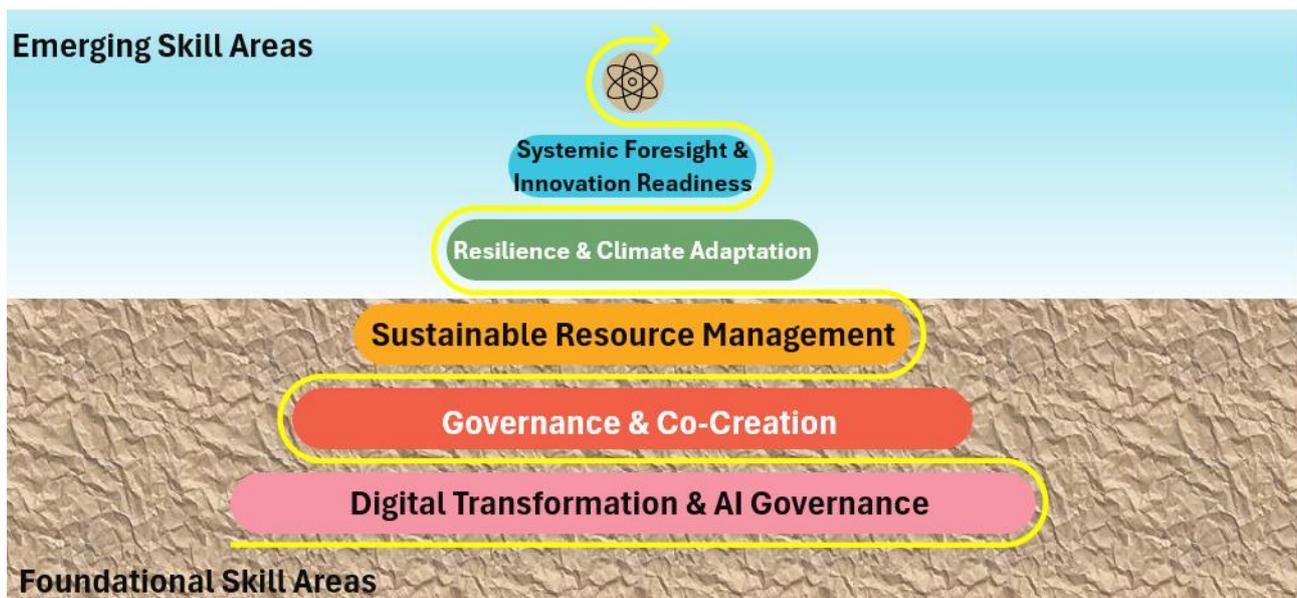**Figure 5 Foundational and Emerging Skill Areas**

Figure 6 Foundational and Emerging Skill Areas

In short, Smart Communities are not defined by technology alone: they thrive on trust, resilience, and co-creation. Building these ecosystems requires hybrid professional profiles capable of connecting digital transformation with green transition and participatory governance. This integrated skillset will enable Europe to shape communities that are not only technologically advanced, but also sustainable, inclusive, and future-ready.

4.3 Linking Priority Skills Areas to the SCRE and SCRSP Skill Groups (Section 3.3)

The five Priority Skills Areas validated by T2.3 through the research process map consistently onto the Skill Groups defined for the Smart Community Resilience Engineer (SCRE) and the Smart Community Resilient Solutions Procurer/Planner (SCRSP) by T2.2. While both roles benefit from all five areas, each area aligns more strongly with specific clusters of skills, reflecting the distinct but complementary nature of the two profiles.

1. Digital Transformation & AI Governance

Key Relevance for SCRE

This area directly reinforces technical, operational, and risk-prevention competencies central to the SCRE role:

- Cybersecurity & ICT Resilience - securing digital infrastructures, managing threats, ensuring operational continuity.
- Technology, Data & Digital Services - interoperable systems, data governance, IoT integration.
- Situational Awareness & Environmental Adaptation - leveraging data streams and analytics to monitor risks and anticipate disruptions.

Key Relevance for SCRSP

For the SCRSP, digital and AI governance is essential to ensure responsible adoption of emerging technologies:

- Research, Data & Intelligence - evidence-based planning, technology scanning, regulatory alignment.
- Sustainable Procurement & Resource Planning - integrating cybersecurity, data standards, and AI ethics in procurement requirements.
- Stakeholder Engagement & Governance - ensuring transparent, trusted use of digital tools.

2. Resilience & Climate Adaptation

Key Relevance for SCRE

This area lies at the core of the SCRE mission:

- Emergency & Disaster Management - preparedness, rapid response, recovery planning.
- Smart Infrastructure & Urban Resilience- designing adaptive systems, applying risk analytics, digital twins, predictive modelling.
- Community Engagement & Social Resilience - ensuring resilience approaches are socially meaningful.

Key Relevance for SCRSP

For the SCRSP, climate and resilience competences guide all planning and investment decisions:

- Urban & Infrastructure Resilience Planning - long-term risk assessment, scenario planning.
- Sustainability Strategy & Policy Integration - embedding resilience in policy frameworks.
- Strategic Foresight & Systems Thinking - anticipating environmental and societal disruptions.

3. Sustainable Resource Management

Key Relevance for SCRE

Resource efficiency is fundamental to resilient infrastructure and operations:

- Smart Infrastructure & Urban Resilience - energy systems, water networks, mobility flows.
- Situational Awareness & Environmental Adaptation - reading sustainability performance data.
- Strategic & Project Management - implementing low-carbon interventions.

Key Relevance for SCRSP

Resource management is even more central for the SCRSP:

- Sustainable Procurement & Resource Planning - selecting green technologies, integrating circular economy criteria.
- Sustainability Strategy & Policy Integration - linking digital systems with environmental goals.

- Community Development & Social Innovation - ensuring green solutions generate social benefits.

4. Governance & Co-Creation Skills

Key Relevance for SCRE

The SCRE increasingly operates at the boundary between technology and society:

- Community Engagement & Social Resilience - involving citizens in preparedness and adaptation.
- Strategic & Project Management - coordinating multi-stakeholder initiatives.
- Emergency & Disaster Management - communicating clearly in high-stake situations.

Key Relevance for SCRSP

Governance and co-creation are core pillars of the SCRSP function:

- Stakeholder Engagement & Governance - participatory planning, negotiation, multi-level coordination.
- Community Development & Social Innovation - ensuring inclusive decision-making.
- Project & Change Management - translating community needs into procurement and design requirements.

5. Systemic Foresight & Innovation Readiness

Key Relevance for SCRE

Foresight enables the SCRE to anticipate future risks and technological evolutions:

- Situational Awareness & Environmental Adaptation - interpreting long-term signals.
- Smart Infrastructure & Urban Resilience - planning adaptive system architectures.
- Strategic & Project Management - guiding organisations through transitions.

Key Relevance for SCRSP

This is the most strategic skill area for the SCRSP:

- Strategic Foresight & Systems Thinking - designing long-range investment strategies and resilient pathways.
- Research, Data & Intelligence - monitoring technological and policy trends.
- Project & Change Management - preparing organisations for innovation adoption.

Integrative view

Taken together, the Priority Skills Areas reveal a clear and complementary distinction between the two emerging professional profiles. The Smart Community Resilience Engineer (SCRE) embodies a more operational and technical orientation, grounded in risk prevention, digital infrastructure management, and the capacity to respond to disruptions. Yet, the growing emphasis on community engagement, communication, and cross-sector coordination shows that this role is becoming increasingly relational and collaborative.

By contrast, the Smart Community Resilient Solutions Procurer/Planner (SCRSP) operates primarily at the strategic and governance level, translating long-term resilience and sustainability objectives into actionable plans, procurement frameworks, and policy-aligned interventions. While more outward-facing and policy-driven, this profile also requires strong digital and analytical foundations to make informed decisions and guide innovation responsibly.

Across both roles, a common thread emerges: **the future of Smart Communities depends on hybrid, future-oriented competences that blend technology, governance, and human-centered practices**. Rather than traditional job profiles with siloed expertise, SCRE and SCRSP represent systemic professions, capable of navigating complexity, shaping resilient transitions, and fostering inclusive, digitally empowered urban ecosystems.

5. Skills Supply Analysis

As part of WP2 activities, an organized mapping of the existing training offers at the EU level was initiated, under the coordination of the National Center for Scientific Research Demokritos. The Skills Supply Analysis aimed to identify and analyse existing training programmes related to smart communities, including national and international offerings, to inform the project's objectives and support WP4 in the development and piloting of an urgent short-term training programme.

To map the current training landscape for smart community skills across Europe, a structured, collaborative assessment process was designed and implemented during the first year of the SMARCO project. Throughout the project a Structured Excel Tool for Data Collection was developed and updated during all phases of the data collection, analysis, and validation process. To identify existing national and international training programs that align with smart communities' skills needs and to gather insights from education providers, the mapping integrated desk research and stakeholder engagement, as described in detail in the following sections.

The volume and the content of the data reflects the systematic, phased expansion of the mapping scope, moving from national/partner-focused identification (Phases 1 and 2) to a targeted large-scale EU-wide scale-up (Phase 3), which resulted in significant growth of the dataset. Furthermore, the refinement of the SMARCO occupational profiles (M5-M11) allowed for more precise and successful identification of relevant training programmes in the later stages. This comprehensive approach ensures the final analysis is informed by a broad spectrum of educational provisions, including those from key international players.

5.1 Mapping of training offers

1st Phase of Data Collection [National Level]:

During this first phase, the mapping of existing training offers related to smart communities took place within the national landscape of all partners' countries. A first version of the Structured Excel Tool for Data Collection was developed, aligned with the initial identification of current and emerging occupational profiles provided in M5. This initial identification provided an initial skill set aligned with the two main target occupational profiles related to Smart Communities: the Smart

Community Resilience Engineer (SCRE) and the Smart Community Resilient Solutions Procurer/ Planner (SCRSP).

The 1st Phase of Data Collection yielded the following results:

- **31 training offers gathered** in the Structured Excel Tool for Data Collection
- **16 represented countries**, with the following distribution of offers: Netherlands (6), Spain (4), Greece (3), Bulgaria (2), USA (2), Belgium (2), Hungary (2), Norway (2), Switzerland (1), New Zealand (1), Ireland (1), Italy (1), Portugal (1), Germany (1), Austria (1).
- **15 skills covered** by the training offers, aligned with the initial target occupational profiles. These skills were categorized into the following groups:
    - Technical & Digital Skills
    - Sustainability & Environmental Skills
    - Community & Relationship Skills
    - Management Skills

2nd Phase of Data Collection [National Level]:

During this phase, the Structured Excel Tool for Data Collection was updated to align with the reviewed identification of current and emerging occupational profiles provided in M6.

The 2nd Phase of Data Collection yielded the following results:

- **33 training offers gathered** in the Structured Excel Tool for Data Collection.
- **14 represented countries** and 1 EU-wide category, with the following distribution of offers: Greece (5), Italy (3), UK (3), Bulgaria (3), Hungary (2), Switzerland (2), Netherlands (2), Denmark (1), Finland (1), Germany (1), Belgium (1), Austria (2), India (1) USA(1), EU-Wide (3)
- **30 skills covered** by the training offers, aligned with the second version of the target occupational profiles. These skills were categorized into the following groups:
    - Systems & Technologies
    - Strategy, Planning & Design
    - Cloud
    - Sustainability & Environment
    - General Safety and Cybersecurity
    - Project & Program Management
    - Business & Stakeholder Relations
    - Data Analysis & Research

○ ICT Project Management Methodologies

3rd Phase of Data Collection [EU Wide Scale-Up]:

During this phase, the Structured Excel Tool for Data Collection was finalized in alignment with the latest description and recommended skills for SMARCO profiles provided in M11. This Phase aimed to expand the data collection to an EU-wide scale.

The 3nrdPhase of Data Collection yielded the following results:

● **162 training offers gathered** in the Structured Excel Tool for Data Collection
● **15 represented countries**, with the following distribution of offers: France (23), Poland (15), Romania (15), Sweden (15), Slovakia (14), Lithuania (13), Estonia (13), Luxemburg (12), Slovenia (11), Czechia (10), Malta (7), Latvia (6), Croatia (6), Hungary (1), Serbia (1)
● **67 skills covered** by the training offers, aligned with the finalized version of the target occupational profiles. The skills were categorized and totaled (based on mentions across all training offers) under the following groups:

SCRE Profile:

○ Technology, Data & Digital Services (209)
○ Smart Infrastructure & Urban Resilience (165)
○ Strategic & Project Management & Implementation (114)
○ Community Engagement & Social Resilience (45)
○ Cybersecurity & ICT Resilience (43)
○ Situational Awareness & Environmental Adaptation (42)
○ Emergency & Disaster Management (29)

SCRSP Profile:

○ Research, Data & Intelligence (127)
○ Strategic Foresight & Systems Thinking (94)
○ Sustainability Strategy & Policy Integration (73)
○ Stakeholder Engagement & Governance (57)
○ Project & Change Management (32)
○ Sustainable Procurement & Resource Planning (26)
○ Community Development & Social Innovation (14)

5.2 Stakeholder insights: survey and focus group

Survey

A structured survey was developed and disseminated from 8 July 2025 to 10 October 2025, to complement the desk research and collect insights on existing training programs. This survey aimed to assess the availability and structure of smart community-related programs, targeting Higher Education Institutions (HEIs), Vocational Education and Training (VET) providers, private training organizations and the public sector. The survey was designed in alignment with the Structured Excel Tool for Data Collection to ensure consistency and comparability across inputs.

- The Survey contributed an additional **28 training offers**, which were added to the total entries and analyzed using the Structured Excel Tool for Data Collection.
- **15 represented countries,** with the following distribution of offers: Sweden (23), Romania (19), Estonia (18), France (16), Luxemburg (14), Slovenia (12), Slovakia (11), Poland (10), Lithuania (10), Malta (9), Croatia (9), Czechia (8), Latvia (8), Serbia (1), Hungary (1)
- **63 skills were covered** by these offers, aligned with the finalized version of the two main occupational profiles. The skills were categorized as follows:

  SCRE Profile:

  - Technology, Data & Digital Services (186 entries covering this skill group)
  - Smart Infrastructure & Urban Resilience (145)
  - Cybersecurity & ICT Resilience (43)
  - Situational Awareness & Environmental Adaptation (30)

  SCRSP Profile:

  - Manage Projects (108)
  - Research, Data & Intelligence (105)
  - Strategic Foresight & Systems Thinking (81)
  - Sustainability Strategy & Policy Integration (69)
  - Stakeholder Engagement & Governance (49)
  - Project & Change Management (24)
  - Sustainable Procurement & Resource Planning (26 skills covered)
  - Community Development & Social Innovation (9 skills covered)

Focus Groups

The focus groups were designed to complement the key activities of the desk research and survey, providing qualitative insights from key stakeholders in the Smart Communities field. Two parallel focus groups were conducted simultaneously on 7 November 2025. The focus groups consisted of 11 participants (six and five participants, respectively), representing a diverse mix of educational and training institutions active in the fields such as technology, social care, administration, and design. The participants were based in Austria, Brussels, Bulgaria, Greece, Italy, Netherlands, Norway, Romania, and Spain, ensuring a broad geographical and institutional perspective on Smart Community training needs and practices.

The activity was designed as an interactive session, combining open discussions with real-time polling using the Slido platform. Participants responded to a series of structured questions on the current provision of Smart Community-related training, target audiences, skills coverage, and perceived gaps.

The focus group findings revealed a comprehensive overview of the current training provision identified skill gaps in the field of Smart Communities. The results consistently show a heavy focus on foundational digital skills but significant deficiencies in advanced, planning oriented resilience, and sustainability competencies. AI and Sustainability Policy emerged as the two most significant perceived gaps. Critical resilience and planning skills appear largely absent from current training offers. Experts stated that Emergency & Disaster Management is not addressed in current offerings, and skills like Urban Resilience Planning and Sustainable Procurement show low coverage. Participants emphasised the future need for interdisciplinary competencies, integrating technical expertise, strategic and governance skills, and sustainability and resilience considerations.

5.3 Methodological Considerations and Limitations

While the Skills Supply Analysis employed a comprehensive, multi-phased methodology, it is important to acknowledge certain limitations for full transparency and accurate interpretation of the results:

- **Geographical Imbalance and Bias:** Despite the deliberate expansion to an EU-wide scale (Phase 3), the data collected retains a degree of geographical bias. The density and depth of training offers identified correlate strongly with the project partners' countries and those countries with more active public reporting on smart community initiatives. This means the dataset may underrepresented programs in regions with lower visibility or different institutional reporting practices

- **Uneven Availability of Sources:** The methodology relied on publicly accessible training sources (desk research) and the participation of volunteer stakeholders (survey and focus groups). This led to an uneven availability of sources, potentially resulting in a slight bias toward academic (HEI/VET) and large public sector offerings. Training offered by smaller, niche private entities or internal corporate programs may be systematically excluded from the overall sample.

These methodological limitations have been taken into account during the final analysis and should be considered when interpreting the overall findings on the current skills supply and training gaps.

6. Skills Gaps Analysis & Forecasting of Future Skill Needs

Task 2.5, coordinated by UTH, consolidates and synthesises the results of Tasks 2.2, 2.3, and 2.4 to identify key skills gaps and emerging trends relevant to smart community professionals. The applied methodology is detailed in the Technical Report: Gap Analysis and Future Skills Forecasting for Smart Communities (UTH, 2025a).This chapter presents the skills mismatches, shortages, and oversupply observed across the smart community workforce. It builds upon previous tasks (T2.2, T2.3, and T2.4), triangulating data from occupational profiles, stakeholder demand signals, and training program supply. The analysis applies a quantitative and qualitative comparison between the demand for competences (expressed through expert interviews, workshop prioritisation, and surveys) within the existing training provision. This comparison is structured around 15 consolidated skill clusters, as defined in Task 2.2. These clusters align with the ESCO framework and reflect the dual perspective of the two emerging roles (SCRE and SCRSP). By overlaying these datasets, the section reveals where clear mismatches exist, including skills that are highly demanded yet poorly addressed by current programmes.

UTH followed the multi-stage methodology illustrated in the following figure. First, Tasks 2.2–2.4 generated ESCO-based occupational profiles, quantified demand (demand and time-urgency indices), and mapped existing training supply. These outputs were then fed into Task 2.5, where they were triangulated, fuzzy-matched, normalised, and used to calculate skill gaps (shortage, balance, oversupply). Finally, the gap typology was combined with foresight and horizon scanning of 2,700+ signals to identify future competence domains and produce the strategic recommendations and curriculum design proposals.
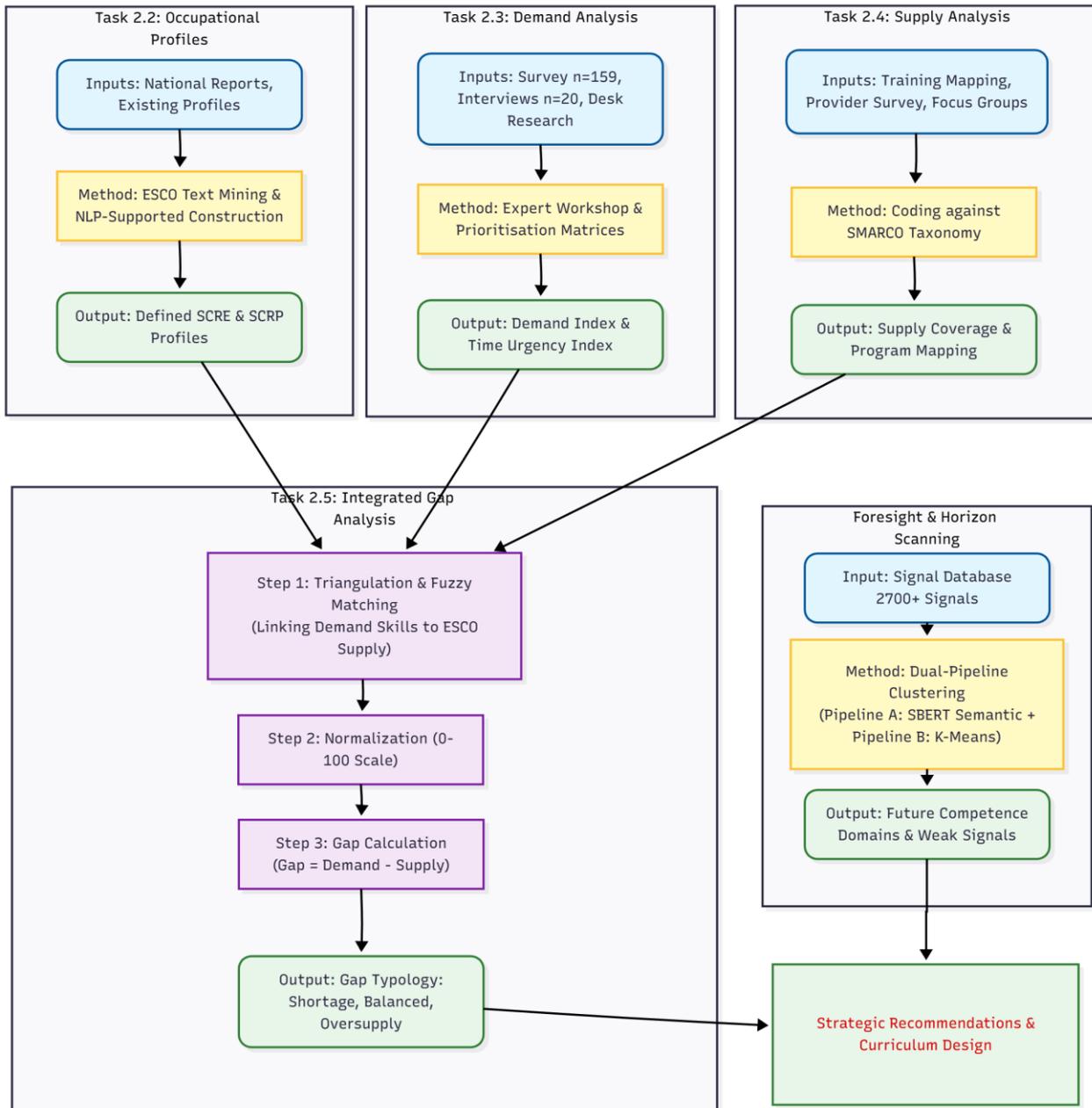
Figure 7 Skills Gap Anaysis & Forecasting Methodological Workflow

6.1 Results on Demand-Supply Gap Analysis

This section applies the fuzzy matching method comparing prioritised demand-side skills with ESCO-labelled training offers to identify areas of misalignment.

6.1.1 Smart Community Resilience Engineer (SCRE)

For SCRE, the Figure 6 presents the top 10 skills with the highest shortages by using the fuzzy matching approach. The radar diagram provides an at-a-glance view of the gap profiles across these skills.
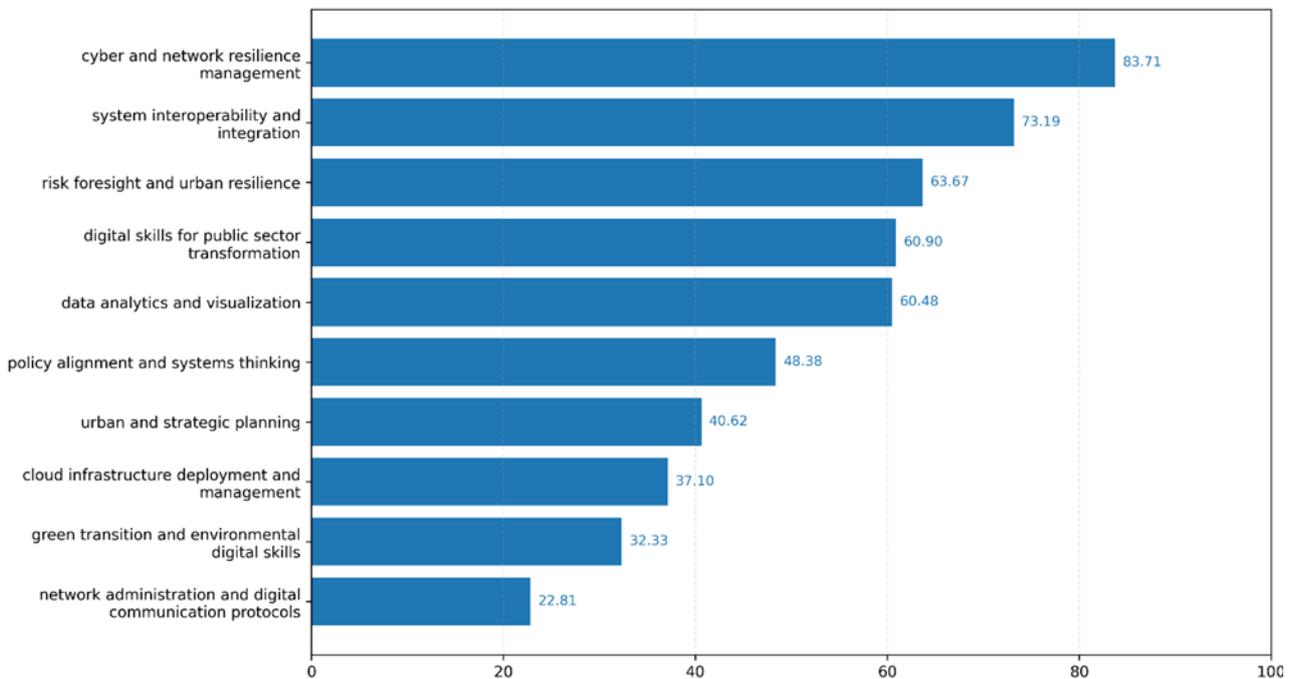

Figure 8 Top 10 skills with highest shortages for SCRE

The top 15 skills associated with the SCRE job profile, ranked in descending order based on their gap index, are presented below. Among these, the following skills have been identified as facing a high level of shortage:

1. cyber and network resilience management,

2. system interoperability and integration,

3. risk foresight and urban resilience,

4. digital skills for public sector transformation,

5. data analytics and visualization,

6. policy alignment and systems thinking,

7. urban and strategic planning,

8. cloud infrastructure deployment and management, and

9. green transition and environmental digital skills.

The following skills are classified as having a moderate shortage:

10. network administration and digital communication protocols,
11. cybersecurity and critical infrastructure protection,
12. IoT platforms and smart infrastructure,
13. smart resource management,
14. monitoring of smart services, and
15. stakeholder engagement and co-creation.

Figure 7 illustrates the skills with the largest gaps by comparing demand (blue line) and training supply (green line), while the red dashed line represents the **magnitude of the gap** (Gap_norm). The greater the distance between the blue and green lines, the larger the imbalance between demand and supply. Labels around the circle indicate the skills, with red text for High shortage and orange for Moderate shortage, making critical areas easy to identify. The numeric values next to each axis show the Gap_norm score, providing a quick view of how severe the shortage is for each skill.
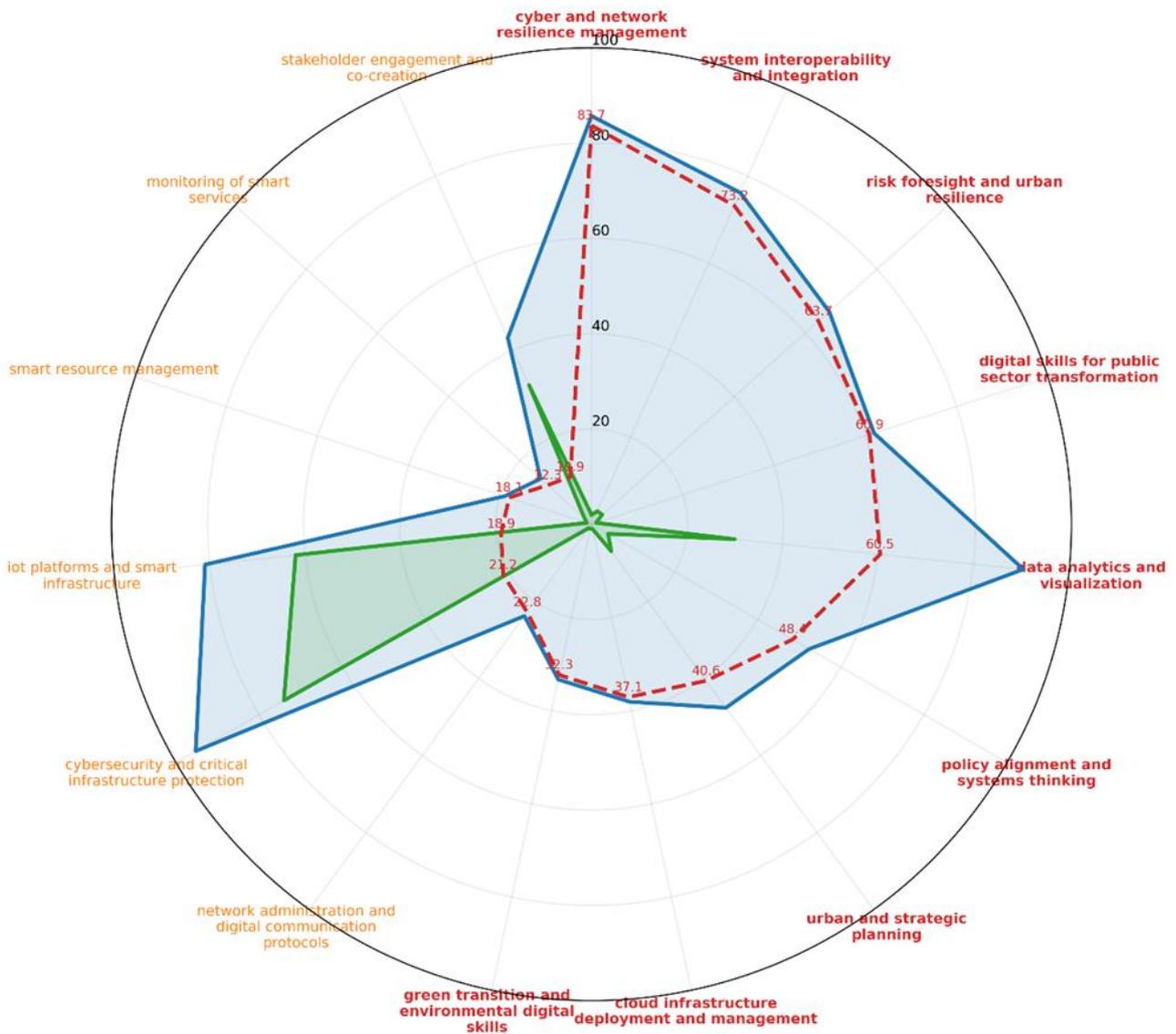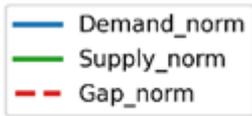
Figure 9 Radar diagram: Top 10 shortage skills for SCRE

6.1.2 Smart Community Resilient Solutions Procurer/ Planner

For SCRSP, the following figure presents the top 10 skills with the highest shortages. The Radar diagram provides an at-a-glance view of the gap profiles across these skills.
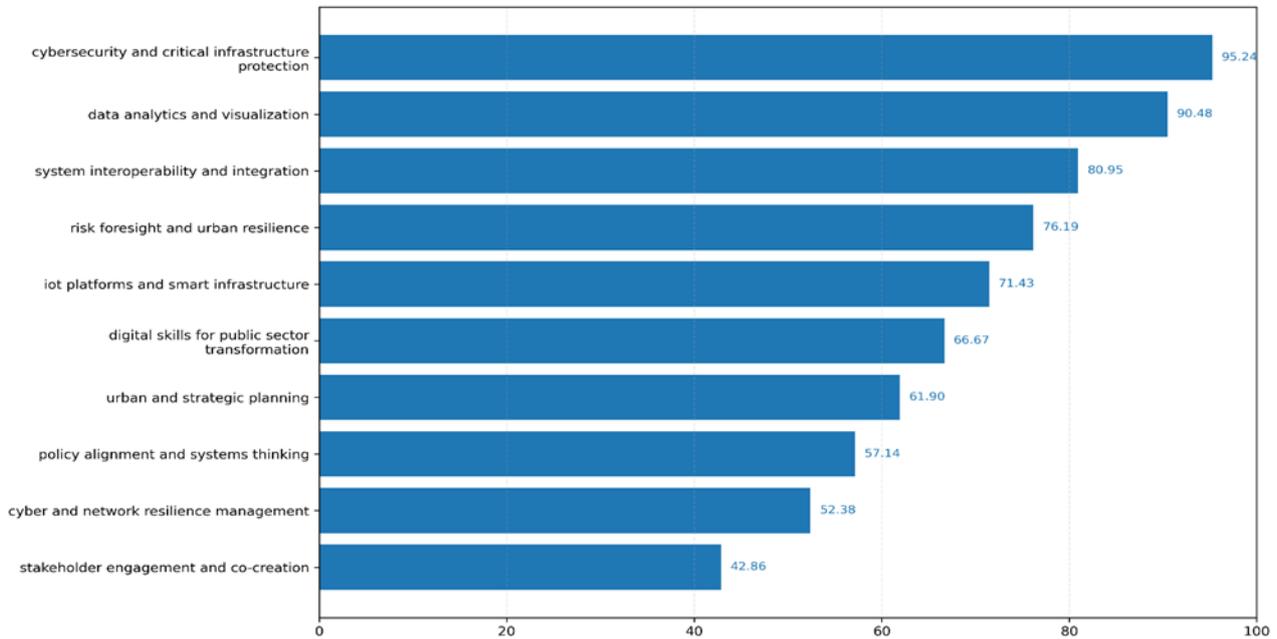
Figure 10 Top 10 skills with highest shortages for SCRSP.

The top 15 skills associated with the **SCRSP** job profile, ranked in descending order based on their gap index, are presented below. Among these, the following skills have been identified as facing a high level of shortage:

1. system interoperability and integration,
2. risk foresight and urban resilience,
3. digital skills for public sector transformation,
4. data analytics and visualization,
5. urban and strategic planning,
6. policy alignment and systems thinking,
7. cyber and network resilience management,
8. green transition and environmental digital skills, and
9. smart resource management.

Skills classified as experiencing a moderate shortage are:

10. cloud infrastructure deployment and management,
11. public procurement for innovation,
12. cybersecurity and critical infrastructure protection,

13. network administration and digital communication protocols

14. stakeholder engagement and co-creation , and
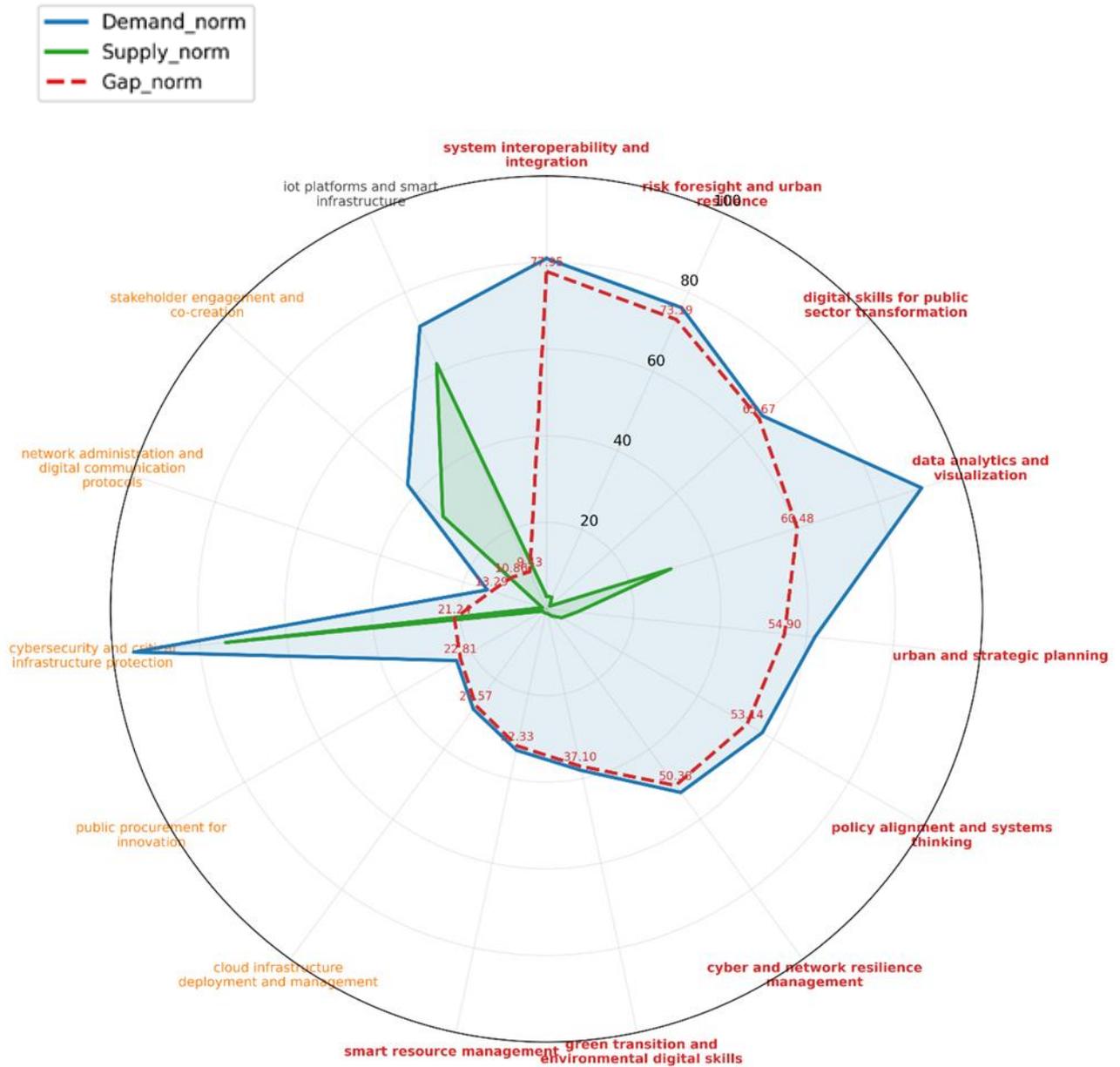
15. IoT platforms and smart infrastructure

Figure SEQ Figure * Arabic 10 **Radar diagram: Top 10 shortage skills for SCRSP.**

The radar chart provides a visual comparison of three key indicators for each skill: **Demand**, **Supply**, and **Gap**. Each axis represents a skill, and the values are normalized on a scale from 0 to 100 for consistency. The **blue polygon** shows the level of demand for each skill, the **green polygon** represents the current training supply, and the **red dashed line** indicates the gap between them. When the blue line is far outside the green line, it signals a significant shortage, meaning demand exceeds supply. Conversely, when the two lines are close, the skill is relatively balanced. The red dashed line highlights the magnitude of the gap, making it easy to identify priority areas for intervention. This visualization helps stakeholders quickly spot critical shortages, assess alignment between training provision and market needs, and plan targeted actions to close gaps.

6.1.3 Recommendations

Based on the preceding analysis, the following recommendations aim to align curricula with observed mismatches and stakeholder priorities

1. Adopt the gap-analysis results as the primary reference point for curriculum planning, as they offer the most accurate representation of the current training provision and its alignment with market needs.
2. Prioritise skills with high or moderate shortages when developing new modules or enhancing existing ones, paying particular attention to skills that are shared across both job profiles to maximise curriculum efficiency.
3. Leverage oversupplied skills by embedding them within multidisciplinary modules or by using them as prerequisites, rather than expanding standalone learning pathways that may further widen the oversupply.
4. Repeat the gap-analysis process at regular intervals, especially as new programs emerge and ESCO mappings evolve, to ensure that curriculum planning remains dynamic, up-to-date, and evidence-driven

6.1.4 Limitations and Next Steps

The fuzzy matching rules are heuristic and based on token overlap and substring relations; they do not capture the full semantic richness of the skill taxonomy. In some cases, distinct skills may be grouped together, or relevant matches may still be missed. Future work could incorporate more advanced semantic similarity methods, expert validation, and outcome-based measures to further refine the gap analysis.

Moreover, while digital topics appear well-covered in quantitative training supply data, stakeholder feedback from Task 2.3 and T2.4 focus groups highlights a **critical misalignment in quality, specificity, and timeliness**. This suggests a need not for more digital training in general, but for **updating, adapting, and contextualising** existing digital programs to smart communities' evolving needs.

6.2 Forecasting and Future Skills Needs

The final stages of Task 2.5 go beyond the identification of current skill mismatches by introducing a foresight dimension that anticipates future demands in the smart communities skills landscape. While previous sections offered a solid foundation by mapping demand and supply imbalances for the SCRE and SCRSP profiles, this section extends the analytical lens to explore long-term signals, emerging competence domains, and systemic transformation pathways. The purpose is to inform the evolution of the SMARCO competence framework and support the design of learning pathways that remain relevant through 2030 and beyond.

To this end, Task 2.5 adopts a dual foresight approach, using advanced clustering and semantic analysis techniques to synthesise insights from hundreds of signals related to technologies, policies, education trends, and labour market shifts. The result is a multi-layered and cross-validated perspective on what competences will be essential—not only to bridge today's gaps, but also to empower smart community professionals to anticipate and lead complex urban transformations.

The following sections summarise these foresight outputs and translate them into actionable guidance for curriculum and micro-credential development.

6.2.1 Signal Database Construction and Sense Making

To extract meaningful patterns from thousands of heterogeneous signals, WP2 applies two complementary clustering pipelines that together offer a cross-validated view of the emerging competence landscape. The full foresight methodology, including clustering logic and signal validation, is described in the Technical Report: Horizon Scanning for Smart Cities Job Foresight (UTH, 2025b).

Semantic, density-based pipeline (SBERT[1] + UMAP[2] + HDBSCAN[3])

This pipeline aims to capture deep semantic relationships and to explicitly identify weak signals:

1. **Text consolidation and cleaning:** Titles, descriptions, objectives and tags are merged into a single text field, with removal of boilerplate and stopwords (e.g. "project", "EU", "opens in new window").
2. **Semantic embeddings:** Sentence-BERT (all-MiniLM-L6-v2) encodes each signal into a dense vector representing its meaning.
3. **Metadata integration:** One-hot encoding of PESTLE category, competence domain, time horizon, impact, likelihood and source type; these vectors are concatenated with the SBERT embeddings.
4. **Dimensionality reduction:** UMAP projects the high-dimensional concatenated features into a moderately lower-dimensional space while preserving local neighbourhoods.
5. **Density-based clustering:** HDBSCAN identifies clusters without pre-setting the number of groups and can label low-density points as **noise**, i.e. weak signals. An optimisation loop explores parameter combinations and selects those with favourable silhouette scores and cluster stability.

The pipeline yields **10 semantic clusters** and **344 weak signals**.

Vector-space pipeline (TF–IDF + metadata + K-Means)

The second pipeline focuses on **interpretability and stable, macro-level themes**:

1. Text is vectorised with **TF–IDF**, using an extended stopword list similar to the SBERT pipeline.
2. Categorical metadata (PESTLE, competence area, etc.) are again appended.
3. **K-Means clustering** is applied, with the number of clusters chosen based on silhouette scores and domain interpretability.
4. Truncated SVD and PCA are used to visualise the cluster structure.

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[1] Sentence-BERT (SBERT)

[2] Uniform Manifold Approximation and Projection

[3] Hierarchical Density-Based Spatial Clustering of Applications with Noise

This approach produces **9 high-level thematic clusters**, with clear separation in PCA space and meaningful topic labels (e.g. Smart / Energy / Cities, Ai / Governance / Procurement, Education / Smart / Skills).

Complementarity and triangulation

The two approaches are explicitly compared: SBERT provides semantic nuance, cross-domain hybrids and explicit weak-signal detection; TF–IDF/K-Means provides stable, non-overlapping groups that align well with policy language and are therefore suitable for curriculum design.

A comparative table summarises that:

- **BERT approach** adds: quantum/frontier tech cluster, climate-innovation hybrids, deeper IoT-security and environmental-intelligence themes, plus systematic weak signals.
- **K-Means approach** adds: clear boundaries and directly usable competence domains for training design.

Together, they provide a **multi-layered, cross-validated map** of trends and emerging competences, forming the backbone of the SMARCO job foresight.

6.2.2 Key Findings: Domains, Trends and Signals

Macro competence domains

Both pipelines converge on a stable set of **macro domains** that structure the future skills landscape for smart communities:

1. **Smart Energy & Infrastructure**: Smart grids, digital energy systems, district heating/cooling, micro-energy cells, retrofitting, energy efficiency, energy data and predictive maintenance.

2. **AI & Data Governance**: AI governance and compliance, algorithmic transparency, ethical and trustworthy AI, data stewardship and interoperability, privacy and trust, IoT and edge cybersecurity.

3. **Digital Skills & Education**: Digital literacy and advanced digital competences, smart city skills, competence frameworks, capacity building, lifelong learning and youth skills.

4. **Mobility & Transport**: Smart mobility, multimodal and connected transport systems, logistics, real-time analytics for transport and safety, emerging autonomous mobility.

5. **Climate Innovation**: Climate data, environmental intelligence, AI-assisted climate modelling, adaptation and resilience planning, environmental monitoring.

6. **Green & Community Participation**: Co-creation with residents, participatory governance, behavioural change for green transition, heritage and environmental public spaces.

These domains form a **multi-level competence architecture**: macro themes (K-Means) → meso competences (SBERT sub-clusters) → micro competences (weak signals) → future job profiles. Several of the subdomains identified, such as resilience governance and data ethics, were also highlighted in the CRISIS project (2022) and the Open Data City Officer project (2023), where early foresight efforts helped shape initial role-specific competence models for smart city governance.

The "Skills Wave"

A central insight is the **temporal shift** in focus:

- **Non-skills signals** (infrastructure, systems, technologies) are heavily concentrated in **near-term (H1)** horizons, reflecting current investment in technology deployment.
- **Skills and competences signals** are predominantly located in the **mid-term (H2)** horizon, across both SBERT and K-Means outputs.

This pattern suggests that **technology deployment is happening now**, while the **main burden of transformation will soon move to human capacities,** the workforce's ability to manage, govern and optimise these systems. Education and training must therefore anticipate a coming **"skills wave"** rather than reacting once skills shortages have fully materialised.

Future-demand and phasing-out skills

Detailed analysis of 505 competence-related signals leads to a distinction between **future-demand** and **phasing-out** skills.

High future-demand skills include:

- AI and data governance, AI ethics and algorithm auditing.
- Citizen participation and participatory governance.
- Sustainability and ESG competences, including green transition and circular economy.

- Entrepreneurship and social innovation.
- Energy systems, renewable energy and predictive energy analytics.
- Climate and urban resilience, urban planning and strategic planning.
- Robotics, autonomous systems and advanced automation.
- Inclusion, well-being and community-oriented skills.

Skills appearing to phase out, in this skills-focused context, are:

- Basic data analytics and generic ICT skills.
- Traditional ROI-centric finance metrics and standard process workflows.
- High-level or generic "digital literacy" labels.
- The umbrella term "Internet of Things (IoT)" as a skills descriptor, which is gradually replaced by more precise notions like autonomous systems, robotics or IoT-specific cybersecurity.

The shift is from **tool-specific, low-complexity skills** to **integrated, socio-technical competences** that combine technology, governance, sustainability and human factors.

Gap, weak and trend signals

A dedicated analysis identifies three types of signals: **gap**, **weak** and **trend**. **Gap signals** point to important domains that are underrepresented in current frameworks and projects. Notable gaps include:

- AI for climate action and environmental intelligence,
- AI governance and risk management (e.g. AI Act compliance),
- Data governance, interoperability and data stewardship at municipal level,
- Predictive energy analytics and digital twins,
- Quantum technologies and frontier systems,
- Behavioural green skills and engagement,
- Next-generation mobility governance.

Weak signals are early, low-density signals that have not yet formed stable clusters but show strategic importance. Themes include:

- AI x climate expertise,
- environmental intelligence,
- micro-energy systems,

- advanced 5G/6G wireless for energy and mobility,
- behavioural and social AI,
- quantum technologies and
- IoT edge security.

These are treated as **horizon-watch priorities** for 2030–2035.

- **Trend signals** describe how the competence landscape is evolving over time rather than what is merely missing or emerging. Key trends include:
- a **"two-wave" implementation pattern**, where technology and infrastructure are deployed in the near term (H1) while the main demand for new skills and competences peaks in the mid-term (H2),
- a **shift from narrow technical skills to systemic, socio-technical competences**, moving beyond basic ICT and analytics towards integrated digital–green–governance, participation, resilience and entrepreneurship competences,
- **convergence of thematic poles**, with smart energy and infrastructure increasingly intertwined with AI, data governance and climate innovation (e.g. AI for energy optimisation, AI for climate resilience, data governance for smart grids),
- **mainstreaming of sustainability, participation and entrepreneurship** across domains, with green transition, circular economy, citizen engagement and entrepreneurial mindsets becoming horizontal requirements rather than niche topics,
- a **terminology and framing shift**, away from generic labels such as "IoT", "AI" or "digital literacy" towards more specific, governance-oriented and risk-aware notions (e.g. AI governance, AI ethics, IoT/edge security, autonomous systems, robotics),
- a **temporal misalignment between frameworks and emerging needs**, where existing competence frameworks remain focused on short-term incremental digital skills (H1) while project and signal analysis indicates that the most critical future competences lie in the mid-term horizon (H2), requiring more anticipatory curriculum design.

6.2.3 Implications for SMARCO Competence Framework and Curriculum Design

The converging evidence from both pipelines feeds directly into SMARCO's competence framework and training strategy.

Empirically grounded competence domains

These macro-domains, previously detailed in the foresight section, provide the foundational structure for SMARCO's competence framework, aligning with EU policy priorities and curriculum design logic.

Multi-level competence architecture and job profiles

The integration of K-Means and SBERT supports a **four-level hierarchy**:

1. **Macro domains** (K-Means).
2. **Meso competences** (SBERT sub-clusters, e.g. climate data intelligence, behavioural green transition, AI governance, energy data analytics).
3. **Micro competences** (weak signals, e.g. AI-based energy forecasting, risk-based IoT authentication, AI auditing, quantum-awareness, behavioural AI for engagement).
4. **Job profiles**, derived from the above and mapped to labour-market needs.

Curriculum and micro-credential design

The study provides concrete directions for **training modules and micro-credentials**, for example:

- **AI Governance & Ethical AI:** AI Act compliance, algorithmic transparency, bias awareness, human-centred AI, public procurement for AI systems.
- **Smart Energy & Infrastructure:** smart grid literacy, energy digitalisation, energy-data analytics, digital twins and predictive maintenance.
- **Climate Resilience & Environmental Intelligence:** climate data interpretation, environmental monitoring with AI, resilience planning.
- **Digital & Data Skills:** data governance, interoperability, cybersecurity, data stewardship in public administrations.
- **Urban Governance & Participation:** co-creation, participatory digital platforms, behavioural insights for green transition.
- **Education & Lifelong Learning:** design of learning ecosystems, upskilling and reskilling strategies for city workers.

These insights can be directly used to prioritise **micro-credentials** corresponding to high future-demand skills and to design learning pathways that support emerging job profiles.

6.2.4 Limitations and Future Work

While the study provides a robust, data-driven basis for competence design, several limitations are acknowledged:

- **Temporal and data coverage:** International frameworks tend to emphasise short-term readiness (H1), leaving long-horizon competences under-specified.
- **Methodological tensions:** The dominance of energy and smart-city projects in the dataset required careful qualitative differentiation in K-Means clustering to avoid overlap, and some important concepts (AI, open data, data analytics) remain only partially specified in existing frameworks.
- **Weak signal interpretation:** Although 344 weak signals are systematically identified, their meaning and importance rely on manual grouping and expert judgement.
- **Legal/regulatory competences:** Legal aspects appear relatively underrepresented in analysed frameworks, risking an underestimation of skills related to AI regulation, data protection and cybersecurity compliance.

Building on these findings, the report outlines three main directions for future SMARCO work:

1. **Stakeholder validation workshops** to confront the quantitative patterns with practitioners' experiences and refine priorities.
2. **Continuous horizon scanning** to turn the signal database into a living resource, expanding sources (e.g. patents, job ads, new policy documents) and improving metadata taxonomies.
3. **Deep integration with other work packages**, especially WP3 on curriculum and job profiles, ensuring that the foresight outcomes directly shape training design and governance innovation.

Overall, WP2 delivers a **comprehensive, cross-validated foresight map** of the skills, competences and job profiles that will underpin smart and resilient cities up to 2035. It provides SMARCO and its stakeholders with a strategic, evidence-based foundation for developing the educational responses needed to navigate Europe's intertwined digital and green transitions

6.3 Actionable Recommendations

This section translates the evidence from Tasks 2.2–2.5 and the foresight analysis into concrete, prioritised actions for curriculum design, training provision and policy support in the smart

communities domain. Recommendations are organised around: (i) closing priority skills gaps for the SCRE and SCRSP profiles, (ii) rebalancing the training ecosystem, and (iii) supporting the long-term relevance of SMARCO outputs using foresight insights.

6.3.1 Focus training on high-shortage competence domains

Building on the prioritised skills and supply-demand mismatches identified earlier, the following actions outline targeted learning and curriculum design responses.

Recommendations

1. **Make "cyber & resilience" a design priority in curricula.**
- Develop dedicated modules and micro-credentials on cyber and network resilience management, cybersecurity for critical infrastructures, and AI/data governance, using the prioritised skill lists as direct input.
- Ensure that these modules are explicitly tailored for city administrations and utilities, where capacity gaps are most evident.
2. **Establish a coherent "urban resilience" learning track.**
- Bundle competences such as urban resilience planning, risk foresight, hazard mapping, climate risk assessment and infrastructure stress testing into a clearly identifiable learning pathway for SCRE, with an adapted, governance-oriented variant for SCRSP.
- Integrate applied casework on floods, heatwaves, energy disruptions and other climate-related risks.
3. **Strengthen emergency and disaster management skills.**
- Introduce practice-oriented modules covering emergency response coordination, crisis communication, situational awareness and multi-stakeholder coordination during shocks and slow-burn crises.
- Connect these learning outcomes to existing national or EU civil-protection frameworks, to facilitate recognition and uptake.

6.3.2 Consolidate a shared core curriculum and profile-specific specialisations

Six core skills emerged as priorities shared across both job profiles, alongside distinct specialisation areas aligned with either the technical–operational (SCRE) or strategic–governance (SCRSP) orientation.

Recommendations

4. **Design a common backbone of "core" modules for all smart community professionals.**

- Build a mandatory core around: 1) AI and data governance, 2) cybersecurity and critical infrastructure protection, 3) data analytics and visualisation, 4) cloud infrastructure management, 5) digital twins and simulation, and 6) cyber/network resilience.

- Use this backbone as the entry point to both SCRE and SCRSP learning paths, ensuring a shared language and minimum digital-resilience baseline across roles.

5. **Create clearly separated SCRE and SCRSP specialisation paths.**

- For **SCRE**, emphasise smart infrastructure, system interoperability, risk foresight and urban resilience, environmental monitoring, and advanced technical implementation competences.

- For **SCRSP**, emphasise urban and strategic planning, smart resource management, public procurement for innovation, policy alignment, stakeholder co-creation and citizen-centric governance. The SCRSP specialisation path should be enriched with additional training modules related to spatial planning, green infrastructure design, citizen engagement, and public-private partnership facilitation.

- In addition, the training could incorporate competencies for implementing and managing Digital Growth Hubs (DGHs). These hubs serve as operational structures that empower local communities through citizen-centric governance, local business support, and digital upskilling.

6. **Use the integrated priority indices as the main curriculum "decision lens".**

- When sequencing modules, draw directly on the prioritizing skills list that are simultaneously high-demand, time-critical and high-consensus.

6.3.3 Address structural gaps in governance, procurement and citizen-centric competences

Qualitative evidence indicates that **governance-related competences**, including innovation-oriented procurement, sustainability strategy, policy alignment and community co-creation, are systematically underrepresented in current training offers, particularly for the SCRSP role.

Recommendations

7. **Develop a governance & procurement group of modules for SCRSP (with SCRE interfaces).**

- Introduce dedicated modules on sustainable and innovation-oriented public procurement, lifecycle costing, risk-informed investment and regulatory compliance (including AI, data protection and cybersecurity obligations).
- Include "joint sessions" where SCRE and SCRSP participants work together on procurement and design briefs, strengthening mutual understanding.
- In addition, SCRSPs could be trained to design structural support mechanisms for AI adoption in micro-enterprises, including collaborative funding schemes, digital clusters, and public-private innovation agreements. These approaches go beyond individual grants and enable systemic support for local digitalisation.

8. **Systematically embed citizen-centric governance and participation.**

- Ensure that at least one module in each pathway covers stakeholder engagement, participatory planning, co-creation methods, and digital participation platforms as core learning outcomes.
- Use real projects (e.g. mobility transitions, energy communities, public space redesign) as practical exercises connecting technical solutions to social legitimacy.

9. **Integrate sustainability governance rather than expanding generic sustainability content.**

- Given the oversupply in broad "sustainability strategy" courses, the emphasis should shift from generic sustainability messaging to concrete governance tools: measurable KPIs, monitoring frameworks, and integration of sustainability criteria in procurement and financing decisions.

6.3.4 Re-balance oversupplied areas and embed transversal competences

The quantitative gap analysis reveals **high oversupply** in categories such as Strategic & Project Management, Smart Infrastructure & Urban Resilience and Sustainability Strategy & Policy Integration, while transversal competences (systems thinking, collaboration, adaptive leadership) are essential but often treated implicitly.

Recommendations

10. **Avoid creating new stand-alone modules in oversupplied domains.**

- Instead of developing additional courses in project management or generic "smart city" topics, integrate these elements as cross-cutting competences within technical and governance modules.

- Encourage partners to streamline or phase out overlapping offers and reposition existing content as prerequisites or refresher units.

11. **Make transversal competences explicit learning outcomes.**

- Embed systems thinking, foresight literacy, collaboration, communication and adaptive leadership into assessment rubrics and module descriptors, rather than treating them as "soft" side effects.

- Use problem-based learning, group projects and simulations to train these skills in realistic smart-community scenarios.

- In addition, transversal skills could be embedded through the design and execution of real-world digital coordination efforts, such as collaborative outreach campaigns. Mechanisms like the Digital Visibility Index (DVI) can be introduced in the training to assess and strengthen the online presence and recognition of local smart communities. This digital projection capability is key to increasing participation, legitimacy, and access to funding.

12. **Use oversupplied skills as enablers for deeper, specialised learning.**

- Leverage existing project-management and strategic-planning competences to support more complex tasks (e.g. orchestrating multi-partner resilience projects, managing data-intensive infrastructure upgrades), rather than teaching them in isolation.

6.3.5 Translate foresight insights into future-oriented curricula

Drawing on the macro-domains presented earlier in the foresight analysis, the following actions highlight future-oriented skill areas that are essential for building resilient, digitally capable communities.

Recommendations

13. **Create "next-generation" elective modules aligned with foresight domains.**
- Use the priority skill areas identified in the foresight section (e.g., AI governance, predictive energy analytics, environmental intelligence) as a basis for advanced or elective micro-credentials.
- Position these as optional specialisations that can be added on top of the core curriculum for learners needing a future-oriented profile.

14. **Introduce an explicit "skills for 2030" component in each pathway.**
- Dedicate at least one session or module in each track to horizon scanning, megatrends and weak signals, helping learners build foresight literacy and preparedness for evolving job profiles.
- Use the signal clusters and weak-signal list as teaching material and as a basis for student projects on emerging roles (e.g. Climate AI Analyst, Environmental Intelligence Officer).

15. **Ensure strong alignment between WP2 foresight and WP3–WP4 design.**
- Introduce a formal check that new or revised modules explicitly map to at least one foresight competence domain, reducing the risk that curricula lag behind emerging technologies and governance challenges.

6.3.6 Tailor delivery formats and access for key target groups

The mapping of existing training shows a heterogeneous but uneven landscape: digital and ICT skills are widely available, but integrated smart-community resilience, innovation procurement and citizen-centred governance remain niche; public-sector-oriented offers and flexible upskilling pathways are limited.

Recommendations

16. **Prioritise modular, stackable micro-credentials.**

- Structure SMARCO content as short, recognisable units that can be combined into larger certificates, enabling working professionals in cities and utilities to upskill without long study interruptions.

17. **Differentiate learning journeys for public-sector and private-sector learners.**

- Offer variants of key modules that address the specific regulatory, organisational and political constraints of municipal administrations (e.g. public procurement rules, accountability, multi-level governance), alongside industry-oriented versions.

18. **Promote blended and online formats to reach smaller or less-resourced cities.**

- Use blended and online delivery to make high-priority modules accessible beyond major metropolitan areas, where in-person provision is likely to be concentrated.

6.3.7 Establish governance, validation and continuous improvement mechanisms

Finally, the report underlines the need for **ongoing validation and refinement** of the gap analysis and foresight outcomes, including stakeholder review and periodic methodological updates.

Recommendations

19. **Set up a recurring validation loop with stakeholders.**

- Organise regular (e.g. bi-annual) workshops with city representatives, industry partners, training providers and learners to review skills gaps, test the relevance of modules and adjust priorities.

20. **Institutionalise the gap-analysis tools as monitoring instruments.**

- Use the demand–supply indices as a recurring monitoring tool, updating the analysis as new programmes and ESCO mappings appear and feeding results into curriculum adjustments.

21. **Link SMARCO outputs to European and national frameworks.**

- Align micro-credentials and competence descriptions with ESCO and other EU frameworks, facilitating recognition and portability and increasing the likelihood of long-term adoption by universities, VET providers and city academies.

Taken together, these recommendations provide a roadmap for transforming the analytical results of WP2 into concrete educational and policy interventions. They support the design of **evidence-based, future-ready curricula** that directly address current shortages, make smarter

use of existing training provision and anticipate the next wave of skills needs for smart and resilient communities.

6.4 Next Steps

To ensure that the gap analysis, foresight insights and competence framework remain relevant beyond the initial project phase, SMARCO should treat them as **living instruments** that are periodically revisited and refined. The next steps therefore focus on establishing a light but robust mechanism for **bi-annual updates**, aligned with project progress and new evidence.

1. **Introduce a bi-annual review and update cycle linked to project milestones.**

- Organise a structured review of the gap analysis, priority skills and curriculum mapping, using inputs from all work packages (pilot feedback, evaluation results, new policy or technological developments).
- Document each cycle in a short "Skills & Curriculum Update" note, summarising key changes and decisions.

2. **Update the demand–supply analysis and foresight signals on an annual or bi-annual basis.**

- Update the demand–supply matching and priority indices , incorporating new programmes, ESCO updates and additional training offers identified by partners.
- Refresh the set of signals and weak signals with new projects, frameworks and policy documents, and highlight any newly emerging competence domains that may require curricular adjustment.

3. **Refine module content and pathways based on annual findings.**

- Use the results of the yearly review to adjust module descriptions, learning outcomes and recommended pathways for SCRE and SCRSP, ensuring that oversupplied areas are contained and high-demand skills are adequately covered.

4. **Progressively align updates with European and national frameworks.**

- With each yearly cycle, check that SMARCO competences and modules remain aligned with ESCO and relevant national frameworks, incorporating new classifications or descriptors as they appear.
- This progressive alignment will support long-term recognition and integration of SMARCO outputs in formal education and professional development systems.

Taken together, these recommendations provide a roadmap for transforming the analytical results of WP2 into concrete educational and policy interventions. They support the design of evidence-based, future-ready curricula that directly address current shortages, make more systematic use of existing training provision and anticipate future skills needs for smart and resilient communities.

7. Smart Communities' Skills Resources Catalogue

7.1 Scope and methodology

The Smart Communities' Skills Resources Catalogue was developed on the basis of the Structured Excel Tool for Data Collection, under Task 2.4 by Task Leader NCSR Demokritos. This tool served as the primary collection instrument, consolidating detailed information on training programmes, providers, skills areas and associated descriptions. The methodological steps involved the transformation of this dataset into a functional electronic catalogue were as follows:

1. **Data consolidation and review:** All entries in the dataset were systematically reviewed to ensure completeness, coherence, and consistency. Duplicate items were removed, terminology was harmonised, and ambiguous entries were clarified.

2. **Classification and harmonised framework**: To ensure compatibility across entries, several controlled vocabularies were applied, including:

    - Provider types
    - Delivery mode
    - Skill categories
    - Education levels and certification types

    This harmonisation enables meaningful filtering and analysis within the catalogue.

3. **Digital transformation and interface design**: The refined data model guided the design of the electronic catalogue. The interface was developed to present the information in a structured, searchable, and user-oriented manner.

4. **Testing**: Sample entries were tested within the prototype environment to ensure accurate rendering, functional filtering and logical flow. Adjustments were made to labels, grouping, and display formats to improve clarity and user experience.

7.2 Structure of the Smart Communities' Skills Resources Catalogue

The electronic catalogue is organised according to the thematic sections that were originally defined in the initial dataset. These sections ensure that each training resource is presented in a consistent, comprehensive and comparable manner. The main components of the catalogue are the following:

Basic information: This section provides the foundational descriptors of each training programme. It includes:

- Training Programme Title
- Country of Origin (Indicates the country where the training is primarily offered or recognized)
- Language(s) of delivery
- Provider Name and Provider Type (e.g. university, VET provider, private company, NGO, online platform)
- Delivery Mode (online, in-person, hybrid)
- Duration
- Cost (free/paid)
- Website or Access Link
- Target groups (students, professionals, jobseekers, public sector, etc.)

Content and skills focus: This part of the catalogue addresses the depth, level, and formal recognition of the training resources:

- Educational level (minimum level required for the training)
- Certification (indicates whether the training provides a formal certificate)
- Occupational profile matched (indicates the alignment with the two target occupational profiles) as identified in T2.2

Skills developed: This section documents the skills dimension of each training resource, aligned with the validated Skill Groups of the SCRE and SCRSP profiles (as detailed in Section 3). It includes:

- Skills Developed
- Skill Category

This structure connects training programmes to the skills required in smart community professions, supporting competency-based exploration.

7.3 Functionalities of the Catalogue

The electronic catalogue provides several functionalities that significantly enhance the usefulness and usability of the collected training resources.

Searching and filtering: Users can search across all training entries and filter them based on:

- Provider type
- Delivery mode
- Country
- Target group
- Skills and skill categories
- Education level
- Occupational profile

Structured and comparable presentation: Each entry is displayed in a consistent format, allowing users to compare multiple programmes, assess their suitability for specific roles or skills needs and understand the skill content at a glance.

Scalability and update potential: The catalogue is designed to be expandable with new entries, easily updated when information changes, and suitable for integration with future project outputs or external systems. This ensures long-term relevance and adaptability.

7.4 Presentation of catalogue

The Catalogue is hosted on the official website of SMARCO project. Below, we provide several screenshots that visually demonstrate the layout and key features of the Smart Communities' Skills Resources Catalogue.

Figure 11Smart Communities' Skills Resources Catalogue: List of Trainings

Figure 12 Smart Communities' Skills Resources Catalogue: Training Details

8. Conclusions and update mechanisms

8.1 Key conclusions

The first year of WP2 provides a comprehensive and evidence-based understanding of the skills landscape required to develop Smart and Resilient Communities. The sequential mixed-methods framework, deveolped in T2.1, and applied across Tasks 2.2-2.5 enabled a coherent integration of occupational profiles, skills demand, skills supply, and future foresight analysis. Several key conclusions emerge from this consolidated body of work.

First, the analysis confirms that hybrid competences, combining digital, green, and governance dimensions, form the backbone of Smart Community professions. Across surveys, interviews, desk research and workshops, stakeholders consistently emphasised several interrelated priority domains: digital transformation and AI governance, resilience and climate adaptation, sustainable resource management, governance and co-creation, and systemic foresight and innovation readiness. These domains collectively define the evolving competence base required for both technical and strategic roles in smart communities.

Second, the occupational profiles developed for the Smart Community Resilience Engineer (SCRE) and the Smart Community Resilient Solutions Procurer/Planner (SCRSP) demonstrate clear complementarities as well as distinct specialisations. SCRE roles centre on the technical implementation of resilient digital-physical infrastructures. SCRSP roles emphasize planning, procurement, policy alignment and stakeholder governance. Despite their differences, both profiles rely on a shared core of digital, data, and resilience-oriented competences.

Third, the demand-supply analysis reveals significant skills mismatches across Europe. High-shortage areas include cybersecurity and network resilience, system interoperability, AI and data governance, climate and resilience planning and advanced data analytics. Training provision is comparatively stronger in generic digital skills, project management, and sustainability strategy. This imbalance highlights the need for more specialized, context-specific programmes tailored to the realities of smart community development.

Fourth, the supply mapping shows that current training offers, while abundant in some areas, remain fragmented, unevenly distributed across countries, and often misaligned with emerging needs. Public administrations in particular lack access to targeted, flexible upkilling opportunities that address the complexity of smart governance, innovative procurement, and integrated digital-green transitions.

Fifth, the foresight exercise confirms a clear temporal shift: technologies are being deployed today, but the most critical skills needed will intensify in the mid-term horizon. Future-demand competences include AI governance, environmental intelligence, predictive energy analytics, resilience modelling, citizen participation, and advanced cybersecurity. Weak signals indicate the emergence of frontier domains such as quantum-aware competences, autonomous mobility governance, and behavioural AI for engagement. Taken together, these findings underline that Europe's ability to develop resilient, inclusive, and technologically advanced communities depends not only on technological investment but on building a skilled workforce capable of governing, integrating, and adapting these systems. The conclusions of WP2 therefore provide a solid evidence base for WP3 and WP4, guiding the design of competence frameworks, curricula, and micro-credentials that respond directly to the identified gaps and future needs.

8.2 Biannual update process

To maintain the relevance and accuracy of the findings presented in this deliverable, SMARCO implements a structured biannual update mechanism, as defined under Task 2.6. Given the rapid evolution of technologies, policies, and labour-market demands shaping smart communities, periodic revisions are essential to ensure that skills intelligence, occupational profiles, and training recommendations remain current and actionable.

First, each update cycle will revisit the core analytical components—skills demand, skills supply, and gaps—using the established mixed-methods framework. This includes refreshed desk research, updated job market observations, stakeholder consultations, and the incorporation of new training offers identified by partners. New data will be integrated into the structured tools developed during WP2, including the Skills Resources Catalogue and the skills inventory used for gap analysis.

Second, partners will monitor emerging trends, policy developments, and technological advancements across Europe that may influence smart communities' skill needs. Sources include new EU legislation (e.g., AI Act updates, data governance frameworks), strategic initiatives (Digital Decade, Green Deal), and sector-specific innovations in energy, mobility, governance, and resilience. These insights will inform adjustments to occupational profiles and priority skills.

Third, the Skills Resources Catalogue will be reviewed and expanded during each update cycle. New training programmes, micro-credentials, and upskilling opportunities will be added, while outdated entries will be revised or removed. The catalogue's structure allows for progressive integration with other project components, ensuring it remains a living, user-centred tool.

Finally, each biannual update will culminate in the publication of a revised version of this deliverable, accompanied by an updated "Smart Communities' Skills Demand Two-Pages" summary. These outputs will transparently document methodological adjustments, key changes in skills priorities, new gaps identified, and recommendations for future curricula development.

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Annex 1

Smart Communities' Skills Demand Two-pager

1. Methodology Overview

SMARCO Task 2.3 focuses on analysing the skills demand for smart communities' professionals through a **mixed-method approach** that integrates desk research and expert validation. The task is designed to ensure a **comprehensive and evidence-based understanding of skills needs**, which will directly contribute to the project's broader goal of enhancing smart community skills development.

Task 2.3 applied a mixed-method approach combining both quantitative and qualitative approaches to achieve a comprehensive understanding of the skills demand for smart communities. To better frame the emerging skills needs, quantitative labour market intelligence techniques have been integrated with qualitative stakeholder validation. This approach aligns with best practices in skills forecasting, workforce analysis, and competency modelling as established in academic and institutional literature.

A labour market intelligence approach is necessary because the development of smart communities requires an understanding of dynamic and evolving skill needs, which cannot be captured through a single data source alone. The triangulation of multiple data sources - including job vacancy analysis, literature reviews, stakeholder surveys, and expert validation - ensures that the final prioritisation of skill needs is not only evidence-based but also practice-informed and future-oriented. The outcome is a harmonised framework that bridges academic foresight and operational realities enabling SMARCO to deliver a validated, policy-relevant, and transferable model for identifying and addressing Smart Community skills gaps.

2. Essential Outputs & Prioritised Skills

The integration of findings confirms both the robustness and coherence of the analytical framework developed in Task 2.3. Validation followed a sequential process: first through triangulation of quantitative data (survey results), then through qualitative refinement (interviews), and finally through collective confirmation (workshop discussions).

Research confirms convergence on hybrid competences integrating five interrelated Priority Skills Areas:

1. Digital Transformation and AI Governance: This area remains the backbone of Smart Communities, encompassing data governance, cybersecurity, interoperability, and AI ethics. The challenge is not only to master digital tools but to deploy them responsibly, ensuring transparency, inclusivity, and trust. Public administrations, in particular, must strengthen their internal capacities for data management and AI literacy to reduce dependency on external providers.

2. Resilience and Climate Adaptation: Resilience emerged as both a technical and organisational competence. Beyond emergency management, it includes foresight, climate risk assessment, and adaptive design of infrastructures and services. Skills in predictive modelling, digital twins, and risk analytics are essential to anticipate disruptions and sustain urban continuity under environmental and social stress.

3. Sustainable Resource Management: Stakeholders consistently stressed the need to link digitalisation with sustainability. This skill domain covers energy efficiency, circular economy principles, and low-carbon infrastructure management, as well as monitoring tools for water, waste, and mobility. The capacity to interpret and act on sustainability data is becoming a key differentiator for future professionals.

4. Governance and Co-Creation Skills: The governance dimension is central to ensuring that smart technologies deliver equitable public value. Skills in participatory planning, innovation procurement, and multi-level coordination are critical for aligning technological innovation with citizens' needs. This area also includes communication, facilitation, and mediation skills: often described as "soft" but in fact essential to operational success.

5. Systemic Foresight and Innovation Readiness: Finally, stakeholders emphasised the importance of foresight, adaptability, and systems thinking. Professionals must be able to connect technological innovation with long-term vision, anticipate shifts in policy or demography, and guide organisations through continuous transformation. Innovation readiness depends as much on mindset as on skillset: openness, curiosity, and reflective learning are increasingly strategic competences.

To support a clearer understanding of how these five Priority Skills Areas interact and contribute to Smart Community capacity-building, they have been organised into two categories, Foundational and Emerging (Figure 12).

This distinction reflects both their current level of maturity within organisations and their strategic role in enabling long-term transformation: foundational skills form the essential base for effective digital and green transitions, while emerging skills represent forward-looking capacities that will increasingly shape the resilience and innovation readiness of European communities.
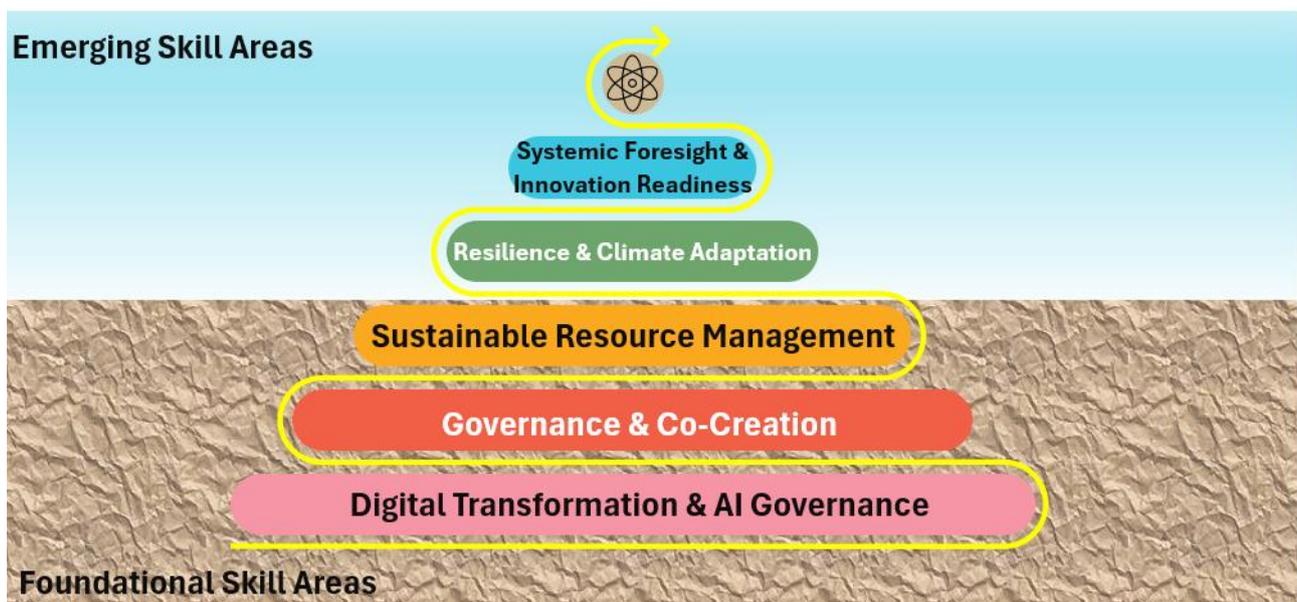

Figure 13Emerging Skill Areas

These findings show that technical innovation alone does not make a community "smart." What defines its intelligence and resilience is the human capacity to connect systems, anticipate change, and act collaboratively.

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Co-funded by
the European Union