

Roveri, Camilla; Mortati, Marzia; Corcho, Oscar; Feijóo, Claudio

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Closing the AI Skills Gap in the Public Sector: A Review of Upskilling and Reskilling Programmes, Pedagogical Modalities, and Essential Requirements

Camilla Roveri¹, Marzia Mortati², Oscar Corcho¹, Claudio Feijóo¹

¹ Universidad Politécnica de Madrid (UPM), Spain

² Politecnico di Milano (PoliMi), Italy

Emails: camilla.roveri@upm.es, marzia.mortati@polimi.it, oscar.corcho@upm.es,
claudio.feijoo@upm.es

Abstract

As Artificial Intelligence (AI) becomes a structural driver of change in public administration, a critical gap persists between the rapid deployment of algorithmic systems and the institutional capacity to govern them responsibly. This paper addresses this tension through a comparative analysis of 70 continuing education programmes in Europe aimed at upskilling and reskilling public sector professionals in AI. It proposes a functional competency framework, grounded in regulatory, technical, and academic sources, which identifies five distinct public sector profiles and maps them across operational, governance, and meta levels. The study uses this framework to evaluate programme coverage, pedagogical modalities, and structural features supporting institutional transformation. Results reveal a widespread focus on digital transformation and regulatory compliance, while competencies in strategic foresight, ethical reasoning, and participatory design remain significantly underrepresented. Programmes combining modular design, blended learning, and competency-based certification show the highest transformative potential. The paper concludes by outlining the principles of a strategic and replicable model for public sector AI training, arguing that effective upskilling requires curricular innovation and sustained organisational infrastructures to translate individual learning into systemic democratic capacity.

Keywords:

Artificial Intelligence (AI), Public Sector, Upskilling and Reskilling, Competency Framework, Institutional Capacity

1. Introduction**1.1 Digital Transformation and the Rise of AI in Public Administration**

Artificial Intelligence (AI) is no longer optional in public administration; it is a structural driver of change. Over 900 AI projects are already in motion across European governments, from justice to healthcare. (Agustina Brizuela et al., 2024; Fuentes Nettel et al., 2024). Despite this abundance, many roadblocks persist, not necessarily from a technical point of view but an institutional one, including fragmented structures, outdated competence frameworks, and a shortage of qualified professionals (European Commission. Joint Research Centre., 2022). This mismatch between technological ambition and organisational capacity remains critical. Although AI is gaining traction in public administration, its implementation across public services and public administration workflows and structures remains limited. Manual processing still prevails in many cases, reflecting a gap between technological potential and actual institutional uptake (European Commission. Joint Research Centre., 2022; Wirtz et al., 2021). The risk of not acting upon this gap is inefficiency and legitimacy. If AI is not deployed critically, with public values, ethical safeguards, contextual awareness, and critical governance embedded at its core, there is the greater risk of undermining the capacity of the public sector to act transparently, equitably, and accountably. Without these foundational elements, AI may contribute to eroding democratic trust, entrench inequalities, and compromise the responsiveness and fairness that are essential to the public sector's social contract (Janssen et al., 2017).

To avoid these risks, public institutions need more than digital literacy. They require new institutional capacities grounded in anticipatory governance, participatory design, and continuous algorithmic oversight. Rather than merely “surviving digital transformation” through chasing the latest technological breakthroughs, the focus should be on enabling lasting organisational transformation through the development of new skill sets, the rethinking of administrative procedures, and the cultivation of more transparent dialogue with society to ensure that AI serves the public interest.

1.2 The Capacity Gap and the Strategic Value of Reskilling and Upskilling

While the need for new organisational capacities and stronger engagement with people and stakeholders is increasingly acknowledged (Mergel et al., 2019), the rapid deployment of AI is outpacing the ability of public administrations to adapt. In particular, a growing gap is emerging between the capabilities of public employees and the technical, ethical, and managerial demands of AI systems. This mismatch risks undermining both implementation efforts and the legitimacy of public innovation itself. However, addressing this gap is complex, as it requires both new institutional frameworks and strategic rethinking of how public employees are prepared to work alongside AI systems. At the same time, current training programs are not designed to address this ambitious goal. Predominantly, they focus on basic digital skills, neglecting crucial competencies such as AI explainability, algorithm oversight, and data ethics (Kenan Institute of Private Enterprise, 2024). This lack diminishes AI's potential impact on the public sector and jeopardises fundamental democratic principles like fairness, transparency, and accountability. Scholars are therefore calling for urgent action to bridge the growing divide between the accelerating deployment of AI technologies and the institutional, ethical, and human capacities required to govern them responsibly (Wirtz et al., 2021; Mikalef et al., 2022).

Against this backdrop, upskilling and reskilling should not be understood as just tools for catching up, but as strategic levers for creating and adapting knowledge and strengthening democracy. As the UNESCO Institute for Lifelong Learning (2020) warns, overly technical models risk erasing legal, civic, and organisational expertise under a veneer of neutrality. Hence, the strategic value of these initiatives is a crucial asset for maintaining a knowledgeable and responsible workforce in the face of AI's rapid advancement.

Despite relevance, building the required new workforce is complex, as it demands critical reflection on the topics and approach (process, tools, modalities) for learning. Meaningful learning in the public sector must be collaborative, contextual, and role-specific. Frameworks like the AI4Gov Canvas (Misuraca et al., 2025) offer structured proposals on how to build individual competencies covering three dimensions (technological, organisational, and ethical-political) and spanning operational, governance, and meta levels, while highlighting that no individual can master it all. Collective learning and institutional infrastructuring are also essential to reach organisational change and embed AI capabilities across teams while ensuring that knowledge is institutionalised, not just individualised. The creation of conducive organisational environments that value and support continuous development is one

of the most important gaps in current training offers (OECD, 2021). Even the most ambitious initiatives have failed without this internal infrastructuring, made of internal training units, mentoring programmes, and competency-based career paths. Yet building organisational capacity is not only about improving internal efficiency but also a prerequisite for enabling more ethical, participatory, and democratically grounded uses of AI. Ensuring access not only to technical skills but also to the knowledge and capabilities required for ethical reflection, democratic participation, and policy reasoning (deliberative knowledge, Fisher, 2009) is essential for creating fair and trustworthy AI in public services. Without such inclusive learning structures, the risk is that AI deployment reinforces technocratic decision-making, marginalising both public servants and people from meaningful participation in shaping digital governance.

1.3 Research Rationale and Aims

This paper addresses a growing tension: while the adoption of AI in public institutions is accelerating, many organisations still lack the internal capacity and conditions to govern these technologies responsibly and effectively. At the same time, efforts to address this gap through training and upskilling are gaining momentum, yet not only we are lacking a robust evaluation of the impact of existing programs, but we continue to witness three persistent challenges at the intersection of institutional readiness, learning infrastructures, and public sector legitimacy.

First, there is a lack of comparative analysis of existing training initiatives to assess whether they comprehensively address the core competencies needed—technical, organisational, and ethical—for AI-ready public administration. Second, pedagogical approaches remain fragmented, with limited synthesis of the methods, formats, and delivery models best suited to different roles and institutional contexts. Third, there are no widely accepted criteria for evaluating whether and how the skills acquired translate into actual organisational change or improved AI governance capabilities.

To tackle these gaps, we analysed 70 continuing education programmes on AI for public employees in Europe. Based on this review, we propose a comparative framework based on functional profiles, which allows us to detect gaps, evaluate pedagogical fit, and design tailored learning pathways.

The study pursues three main objectives: (O1) to quantify gaps in critical competencies for the responsible adoption of AI in the public sector; (O2) to assess the suitability of the pedagogical modalities employed (in-person, online, blended) to the needs of public sector staff; and (O3) to identify the structural features shared by the most comprehensive and effective programmes. The analysis also builds on two hypotheses. Hypothesis 1 (H1) posits that most of the programmes under review provide only partial or unbalanced coverage of the key competencies required for the responsible adoption of AI in the public sector. In particular, while technical skills may be present, competencies related to organisational change, ethical reasoning, or citizen engagement are often underrepresented or treated superficially. This imbalance limits the effectiveness of training programmes in fostering holistic readiness across the multiple dimensions—technological, organisational, and political—necessary for trustworthy public sector AI. Hypothesis 2 (H2) suggests that training programmes delivered through blended modalities—combining online and in-person learning formats—offer greater institutional alignment and support more context-sensitive learning outcomes. The blended approach allows for stronger integration with organisational realities, enabling peer interaction, local relevance, and iterative feedback loops that are often missing from entirely online or decontextualised models. As such, blended learning may be better suited to build not only individual skills but also collective capacities that can be sustained within the public administration.

2. Methodology

This study examines 70 continuing education programmes in AI for the public sector across Europe through a descriptive-comparative lens. It aims to evaluate their coverage of essential competencies, the effectiveness of their pedagogical approaches, and the structural features that support their practical application within public institutions.

2.1 Scope and Selection Criteria

This study is grounded in the principle of lifelong learning, recognised both as a human right and as a foundational element of modern education systems. As emphasised by UNESCO (2020), lifelong learning extends beyond traditional schooling to include formal, non-formal, and informal settings, and is essential for both personal development and professional adaptability. Central to this approach is a commitment to equity, inclusion, and the common good, recognising learning as an inherently social and political process.

Within this broader vision, continuing education refers to structured programmes designed to support adult learners after their initial education. These programmes, ranging from modular courses and professional certificates to micro-credentials and on-the-job training, are increasingly vital in the context of digital transformation and AI adoption in the public sector. As digital and AI technologies reshape public service roles and workflows, continuing education enables public employees to remain responsive to evolving institutional and societal demands.

Two complementary strategies are particularly relevant: upskilling, which enhances existing competencies to meet emerging requirements, and reskilling, which equips individuals for entirely new functions. In the context of AI adoption, both strategies are necessary to prepare staff for responsibilities involving algorithmic systems, data-informed decision-making, and ethically complex service delivery. When embedded within a lifelong learning perspective, these efforts contribute not just to technical adaptation but to strengthening public institutions' democratic legitimacy and responsiveness.

Scholars have long emphasised that professional learning should not be reduced to a narrow tool for functional adaptation. Drawing on empirical evidence from workplace learning, Taylor and Evans (2009) show that structured training can catalyse informal, self-directed learning, enabling workers—particularly those with low formal education—to take greater ownership of their learning trajectories. Similarly, Freire (1970) advocates for an emancipatory vision of education grounded in dialogue, critical reflection, and collective transformation. For Freire, learning is not a passive process but a “practice of freedom,” allowing individuals to question and reshape the social realities they inhabit. Building on these scholarly perspectives, upskilling and reskilling should extend beyond technical adaptation to foster individual agency, ethical awareness, and institutional transformation, particularly in the context of the digitalisation of the state.

This study builds on these perspectives and focuses on continuing education as a key mechanism for preparing the public sector for the challenges posed by AI and digital transformation. Specifically, the analysis considers programmes launched since 2020 and that meet five specific criteria: (1) a focus on AI, data, or digital transformation; (2) relevance to public sector roles; (3) mainly delivered by European institutions; (4) a flexible or modular format; and (5) availability of public documentation.

Programmes framed as higher education, purely focusing on technical training without a public sector orientation, or delivered outside Europe, were excluded. The final sample was assembled through a structured, simulated search across more than 70 official sources. Each programme was systematically coded according to a set of attributes, and details of this analysis are provided in full in the annexe.

2.2 Analytical Framework

The assessment of training programmes was based on a competency-oriented analytical framework developed from three complementary sources: (i) the AI4Gov Canvas and relevant academic literature on AI governance and institutional capacity; (ii) key European regulatory and strategic documents (e.g., the AI Act – 2024, AI Skills Strategy – 2024); and (iii) the DigComp 2.2 framework (2022). The resulting model integrates technical, regulatory, organisational, and ethical dimensions, structured across three levels—operational, governance, and meta—and grouped into five functional profiles, each aligned with a specific role in the implementation of AI in the public sector: Technical; Legal, Regulatory, and Public Policy; Service Design and Participation; Programme Management and Digital Transformation; and Anticipatory Governance and Strategic Foresight. These profiles, outlined in Section 3, structure the analysis presented in Section 4.

Rather than relying on pre-defined categories, the profiles emerged inductively from the convergence of functional demands identified in policy, institutional practices, and curriculum content. This inductive approach ensured strong contextual relevance. However, it also presents a limitation: coding and categorisation were conducted by a single researcher without formal inter-coder validation. Although internal consistency was reviewed on a subsample, future iterations would benefit from collaborative coding or expert review to enhance reproducibility.

The framework was internally validated through an iterative calibration process: a subset of 15 programmes was independently analysed and compared to verify the categorisation's robustness and the coding scheme's replicability. This framework provided the basis for constructing the comparative matrix used to code programme content, described in the following section.

2.3 Comparative Matrix and Coding

The evaluation was based on a matrix structured around the five functional profiles previously described. The analysis relied on publicly available learning documentation drawn

from two primary sources: (i) official programme websites and (ii) centralised repositories such as the EU Academy, Digital Skills and Jobs Platform, and ITU Academy. These sources provided descriptive metadata—such as programme title, target audience, duration (and, in some cases, number of credits), delivery mode, and structural format—and qualitative information, when available, on learning objectives, content, and pedagogical approaches. Together, these sources supported the selection of a sample of 70 programmes, which was in line with the criteria established in this study.

Based on the qualitative analysis of available documentation, each programme was scored on a scale from 0 to 1 according to its level of alignment with each profile. The scoring criteria were as follows: 0 = no coverage, 0.5 = partial or general coverage, and 1 = substantial and specific coverage.

While the coding process was not formally validated through double coding, consistency was reviewed internally using a sample of 15 programmes. The matrix enabled the identification of coverage gaps, the evaluation of alignment with institutional roles, and the formulation of targeted training pathways. Despite verification, the analysis only offers an initial exploratory phase. Coding was manual and based on secondary sources, with no external triangulation or inter-coder validation. In the future, to further strengthen insights, other activities may cover expert consultations, cross-coding exercises, and longitudinal case study analysis to better assess programmes and their impact.

Table 1. Comparative matrix and coding

Functional Profile	Score		
	0	0,5	1
Technical	No mention of technical AI, algorithms, tools, or digital skills.	General references to technical concepts (e.g., AI, automation, data).	Includes specific technical content (e.g., ML, NLP, generative AI), practical tools, technical evaluation, or algorithmic solution design.
Legal, Regulatory, & Public Policy	No reference to regulations, ethics, or legal implications of AI.	General mention of legal aspects (e.g., AI Act, GDPR) or ethics.	Covers applied regulation, impact assessment, AI-compatible policy design, compliance, or applied ethics using

			specific methodologies.
Service Design & Citizen Participation	No mention of citizen experience, participatory design, or inclusive governance.	General references to UX, user-centred design, or digital inclusion.	Explicit focus on co-creation, citizen deliberation, participatory algorithmic assessment, public service design with AI, or algorithmic justice.
Programme Management & Digital Transformation	No discussion of institutional management, organisational change, or digital planning.	Mentions digital transformation or leadership without clear tools or frameworks.	Covers institutional strategies, digital leadership, change management, strategic planning, interoperability, or governance structures.
Anticipatory Governance & Strategic Foresight	No mention of the future, foresight, risk assessment, or adaptive analysis.	Vague references to emerging risks or adaptive frameworks.	Includes foresight methodologies, scenarios, anticipatory analysis, adaptive regulatory frameworks, or critical technology assessment.

3. Functional Competency Framework for AI in the Public Sector

3.1 Conceptual Foundations and Source Review

The AI4Gov Canvas (Misuraca et al., 2025) – the foundation of the framework presented in this paper – is an analytical tool designed to map and prioritise key competencies for AI adoption in the public sector. Developed through interviews, surveys, and a literature review, the Canvas identifies three thematic dimensions—Technology, Management and Design, Policy, Legal and Ethics and organises competencies across three levels of abstraction: operational, governance, and meta. This layered approach reflects a continuum from abstract to applied competences, ranging from high-level attributes such as attitudes (e.g., risk proclivity, user centricity) and general knowledge (e.g., foundational understanding of AI), to practical skills like data collection and budgeting. To systematically capture this diversity, competences are grouped into three categories: meta-competences (the most abstract), governance competences, and operational competences (the most practice-oriented).

Together, these levels form the foundation of a modular and progressive training model, adaptable to varying degrees of institutional maturity and professional responsibility. However, while the Canvas provides valuable diagnostic and analytical insights, its suitability for training design is limited by three main shortcomings: the lack of a structured progression through learning or mastery levels, the absence of distinctions between functional roles within public institutions (such as technical experts, managers, regulators, and policy designers); and the incomplete coverage of critical dimensions such as digital literacy, interoperability, citizen co-creation, and institutional innovation.

To address these gaps, the framework presented in this paper expands the Canvas architecture and incorporates insights from three complementary sources:

1. EU Regulatory and Strategic Frameworks: Instruments such as the Artificial Intelligence Act (AI Act), the AI Skills Strategy, the Ethical Guidelines for Trustworthy AI (AI HLEG), the Council of Europe's Convention on AI, and DigComp 2.2 establish the normative, legal, and operational foundations necessary for training design. These frameworks contribute to shaping a competency model by introducing differentiated training requirements (AI Act), emphasising both citizenship and specialisation (AI Convention), and establishing level-based responsibility structures (AI Skills Strategy; Council of Europe, 2024; European Commission, 2024; European Parliament and Council of the European Union, 2024). They also highlight essential competencies—such as explainability, auditing, impact assessment, and oversight—as shared reference points for shaping training that aligns with the fundamental responsibilities of public sector actors working with AI.

2. Technical and Institutional Frameworks: Sources such as the UNESCO/OECD Toolkit for AI in the public sector, AI Watch reports, and the European Framework for Interoperability Skills and Competences (EFISC) assist in operationalising competencies and designing differentiated learning pathways aligned with public sector functions. These references clarify the distinction between technical and strategic skills (UNESCO/OECD), introduce an interoperability-focused vision of institutional capacity (EFISC), and highlight the absence of national training strategies for public employees (AI Watch) while advocating for stronger links between training and career development (Agustina Brizuela et al., 2024; European Commission Joint Research Centre, 2024, 2022; OECD and United Nations Educational, Scientific and Cultural Organization, 2024; Tangi et al., 2023).

3. Academic Literature: Recent contributions, particularly from Straub et al. (2023) and Stix (2022, 2021), provide key conceptual insights on additional relevant topics for the framework, such as epistemic governance, normative alignment, and deliberative capacity, essential for managing AI systems within public institutions. Straub et al. (2023) propose a tripartite model of competencies: Operational Fitness (technical implementation), Epistemic Alignment (interpretation and contextualisation), and Normative Divergence (ethical decision-making under uncertainty). Stix (2022, 2021) adds a typology of institutional roles—coordinators, auditors, and policy designers—and emphasises the need to establish public infrastructures for AI learning, including academies and specialised agencies. These perspectives inform a framework that recognises explicit competencies codified in policies and curricula and implicit ones embedded in roles, institutions, and governance practices.

This triangulated approach enables the development of a framework that accounts for explicit competencies (established in regulations or curricula) and implicit ones (associated with institutional functions or ethical imperatives).

3.2 Framework Structure

Building on the foundations examined in the previous paragraph, our competency framework builds on the strengths of the AI4Gov Canvas and introduces two additional components that make it better suited for training design.

First, it introduces five functional profiles that reflect distinct roles within the public sector AI ecosystem, each addressing specific institutional functions and challenges:

- The Technical profile includes developers, data analysts, interoperability specialists, and technical officers responsible for designing, implementing, auditing, or maintaining AI systems.
- The Legal, Regulatory, and Public Policy profile comprises legal professionals, regulators, policy advisors, and public policy designers. It focuses on legal compliance and the development of adaptive regulatory frameworks.
- The Service Design and Citizen Participation profile brings together service designers, civic technologists, and participatory process facilitators working to ensure that algorithmic systems are inclusive, fair, and responsive to citizen needs.

- The Programme Management and Digital Transformation profile covers public managers, innovation leaders, and institutional decision-makers who are responsible for leading digital transformation processes.
- The Anticipatory Governance and Strategic Foresight profile includes actors involved in long-term impact evaluation, scenario analysis, adaptive regulation, and strategic planning under uncertainty.

Each profile is mapped across the three abstraction levels—operational, governance, and meta—to support targeted training strategies aligned with real-world responsibilities in AI implementation.

Second, the framework includes a transversal critical layer that cuts across all profiles and levels. This underscores the horizontal relevance of essential competencies like algorithmic explainability, institutional accountability, ethical impact assessment, and awareness of epistemic bias. Specifically, the layer helps ensure that AI systems are technically reliable, understandable, trustworthy, and aligned with democratic values.

These three structural components—abstraction levels (coming from the AI4Gov Canvas), functional profiles, and critical layer—form an integrated framework that supports the evaluation and design of public sector training. This enables benchmarking, curriculum development, and long-term capacity building that are in line with the institutional challenges of AI adoption.

Finally, the framework is aligned with the DigComp 2.2 (2022) reference model, which provides a common foundation for digital literacy and progressive competence development. This alignment ensures coherence with broader European efforts to equip all people, including public employees, with the skills required to engage critically and effectively with digital technologies, including AI.

3.3 Institutional Enablers

Besides competencies and roles recognition, our framework is also built on the principle that no training initiative—regardless of quality—can lead to sustainable change without being embedded in an institutional ecosystem capable of enabling, valuing, and sustaining the competencies acquired. For this reason, it incorporates an institutional dimension focused on the enabling structures necessary to support long-term capacity building in the public sector.

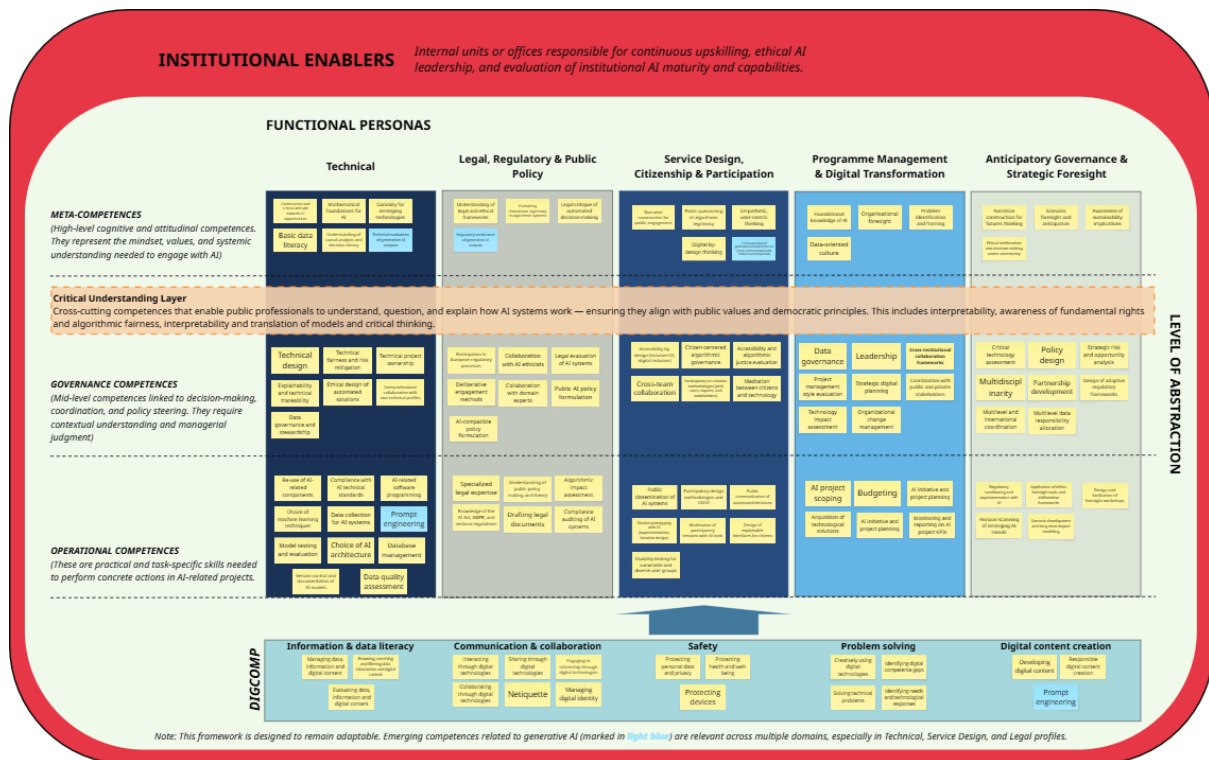
This dimension is articulated around four key elements:

- Internal training units are responsible for designing and coordinating upskilling and reskilling pathways aligned with functional roles and regulatory frameworks.
- AI maturity assessment systems are used to identify institutional gaps, guide strategic interventions, and link training to broader transformation processes.
- Ethical and cross-functional leadership is able to steer AI adoption through strategic vision, transversal coordination, and deliberative governance.
- Organisational learning spaces include public innovation labs, communities of practice, learning networks, and algorithmic governance hubs.

These enablers draw on proposals such as the UNESCO/OECD Toolkit (2024), which promotes system-level capacity development; the Joint Research Centre's call (2024) for coordination across fragmented training efforts; and Stix's (2022, 2021) advocacy for dedicated public AI knowledge infrastructures.

This institutional layer is conceived as a structural condition for success rather than a supplementary feature. Without these types of supportive mechanisms that integrate learning within institutions, training initiatives may remain disconnected, unable to lead to significant institutional change and continue to reinforce existing capacity gaps.

Figure 1. Framework Synthesis¹



4. Results

4.1 Institutional, Functional, and Pedagogical Diversity in an Expanding but Uneven Training Landscape

The analysis of 70 continuing education programmes in AI targeting public sector employees across Europe reveals an increasingly dense and heterogeneous training ecosystem. This growth reflects an institutional awakening to the demands of algorithmic governance, yet also exposes persistent structural tensions around coherence, targeting, and pedagogical depth.

4.1.1 Geographical and Institutional Distribution: Pluralism with Uneven Reach

The programmes analysed span 14 countries, with notable concentrations in Spain (12) and Italy (10) and a strong presence of pan-European initiatives led by the European Commission (14). This distribution illustrates a growing commitment to building AI capacities in the public sector but also reveals asymmetries in institutional investment and coordination across Member States.

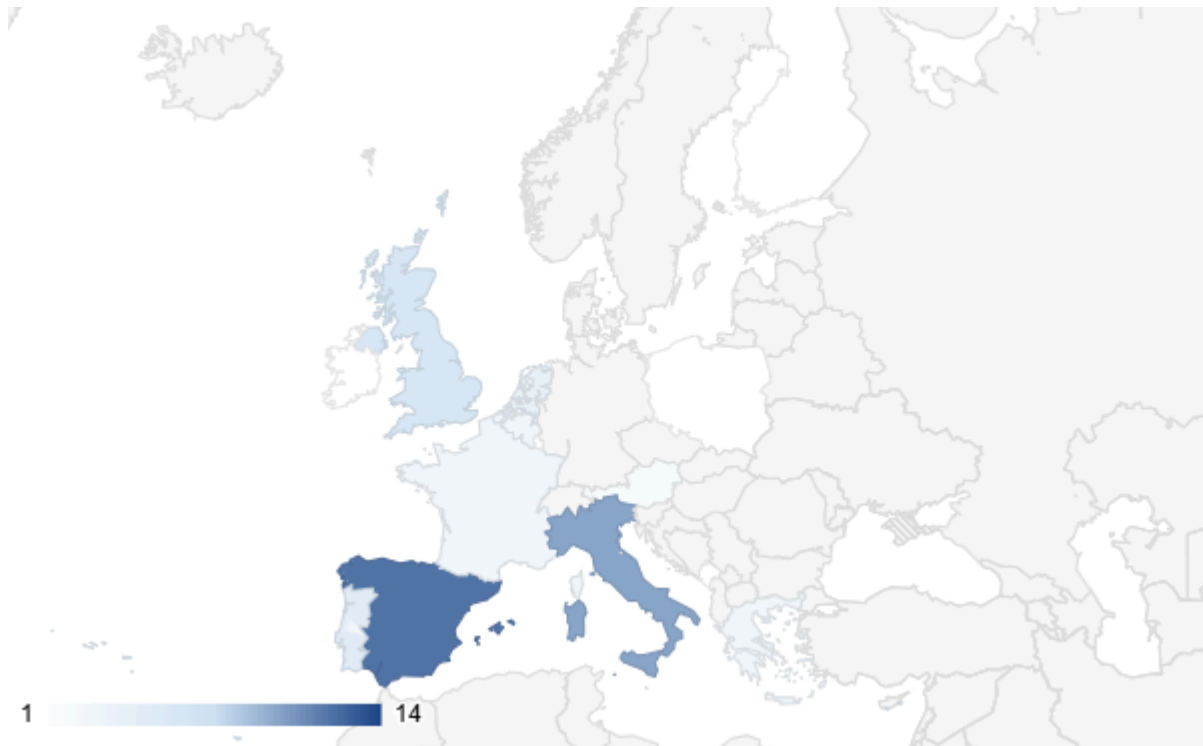
¹ While this framework presents institutional enablers as a supporting structure, future iterations could explore their representation as a transversal or higher-order dimension, possibly in a multi-layered or three-dimensional format to better reflect their enabling role across functional profiles.

Three primary types of institutions deliver the programmes:

- Academic institutions (over 40% of the sample), including KU Leuven, Politecnico di Milano, and TU Delft, tend to emphasise theoretical depth, research-based approaches, and analytical content.
- Government training centres, such as INAP (Spain), AEC (France), or the EIPA (EC), prioritise practice-oriented learning, organisational change, and service delivery.
- Public-private consortia and multistakeholder initiatives, such as Apolitical, GovStack, or FARI Academy, operate at the intersection of innovation and governance, offering hybrid capacity-building models.

This institutional diversity reflects a plurality of training governance models, from decentralised academic innovation to strategically coordinated public-sector professionalisation. However, it also results in inconsistent depth, duplication, and limited training interoperability across Europe.

Figure 2. European heat map



4.1.2 Target Audiences: Functional Segmentation Gaining Ground

One of the most notable shifts across the training landscape is the move from generic content to programmes tailored to specific institutional roles, in line with the five functional profiles outlined in Section 3. Rather than addressing public employees as a homogeneous group, many initiatives now target distinct categories: those in strategic positions responsible for leadership, policy development, and AI governance; technical professionals such as developers and system administrators involved in the deployment and maintenance of AI systems; legal and regulatory actors tasked with ensuring compliance, audit, and oversight; and professionals engaged in service design and participatory processes, focused on inclusion and user experience. Alongside these role-specific tracks, some programmes continue to offer generalist AI literacy for civil servants with limited prior exposure to digital technologies.

While around two-thirds of programmes exhibit some functional targeting, the remaining third retains a generic or undifferentiated focus, which limits their alignment with institutional needs and impedes tailored upskilling strategies.

4.1.3 Pedagogical Approaches and Durations: Flexibility as a Structural Feature

In terms of delivery format, the vast majority of programmes favour flexible approaches that accommodate the diverse schedules and contexts of public sector professionals. Entirely online courses are the most prevalent, with 39 programmes - primarily asynchronous - designed for accessibility and scalability across geographies. Blended learning formats appear in 16 programmes, combining self-paced digital content with interactive components to encourage applied learning. In-person training, present in 14 cases, is generally limited to national initiatives or intensive residential formats.

Programme duration varies significantly across the sample, reflecting differences in scope, intensity, and intended learning outcomes. A total of 15 programmes are classified as very short, lasting less than one day or up to six hours, typically designed for awareness-raising or basic orientation. Short courses, lasting from one day to less than a week, make up the largest category with 26 programmes, often focusing on core legal or technical topics. Only 4 programmes fall into the medium range, lasting from one week to under a month, while longer formats—from one month to under one year—are represented by 8 programmes, generally linked to modular professional certifications. In 11 cases, the duration was not specified, suggesting gaps in publicly available documentation or the presence of ongoing, self-paced learning formats.

The prevalence of flexible formats, especially online and blended options, aims to meet the needs of public sector professionals. However, the focus on short-duration programs emphasises accessibility over depth. The lack of longer, structured pathways and missing duration data highlight ongoing challenges in promoting sustainable and transparent learning.

4.1.4 Persistent Challenges: Lack of Progression, Modularity, and Integration

Three structural limitations hinder the coherence of the training landscape. First, there's limited progression across competence levels, with many programmes lacking connections between introductory and advanced content. Second, the absence of modular design restricts learners from building on prior knowledge or transitioning between specialisations. Lastly, most programmes narrowly focus on management or legal aspects, neglecting essential competencies like ethical reasoning and strategic foresight. Only a few successfully integrate technical, legal, and organisational perspectives, which is crucial for democratic AI

governance in public institutions. These limitations affect both the pedagogical quality and strategic relevance of offerings.

4.2 Competency Coverage by Functional Profile: Patterns, Gaps, and Maturity

Each programme was evaluated for coverage breadth and depth using the five functional profiles and a three-point ordinal scale (0 = none, 0.5 = partial, 1 = substantive). The results reveal clear patterns of institutional priority, thematic neglect, and asymmetries in programme maturity.

4.2.1 Most Frequently Covered Profiles: Digital Transformation and Regulation

The most represented profiles are:

- Programme Management and Digital Transformation (average score: 0.74) is addressed in 94% of the programmes, with 38 providing substantive coverage of this profile.
- The Legal, Regulatory and Public Policy profile follows closely, with an average score of 0.66 and satisfactory coverage achieved in 32 programmes (86% of the sample).

These figures reflect the current institutional emphasis on steering organisational change, integrating AI tools, and complying with emerging legal frameworks such as the AI Act. These profiles are often better articulated, benefiting from available normative guidance and apparent institutional demand.

4.2.2 Least Covered Profiles: Strategic Foresight and Technical Depth

By contrast, two profiles remain underdeveloped:

- Anticipatory Governance and Strategic Foresight (avg. 0.43) are the least addressed despite their importance for adaptive policymaking and managing uncertainty. Scenario planning, impact anticipation, and epistemic preparedness remain peripheral.
- Technical content (avg. 0.54) is unevenly represented. While present in many programmes, technical content is often generic and limitedly adapted to public sector contexts (e.g., interoperability, explainability, and responsible use of generative AI).

Table 2 summarises the average coverage scores across the five functional profiles, highlighting which roles receive the most pedagogical attention and where significant gaps persist.

Table 2. Functional coverage summary

Functional Profile	Average Score	% with Coverage ≥ 0.5
Technical	0,54	85,71%
Legal, Regulatory, & Public Policy	0,66	85,71%
Service Design & Citizen Participation	0,64	88,57%
Programme Management & Digital Transformation	0,74	94,29%
Anticipatory Governance & Strategic Foresight	0,43	74,29%

This imbalance reflects a lack of curricular integration and limited institutional frameworks for defining technical and foresight skills within public service roles.

4.2.3 Typologies of Coverage: Verticality without Integration

Only two programmes — Master in Artificial Intelligence for public services offered in conjunction by Politecnico di Milano and Universidad Politécnica de Madrid (UPM)- are managed by Poli.DESIGN — achieves full, balanced coverage across all five profiles. This program represents a best practice, demonstrating a model capable of training interdisciplinary digital transformation and AI professionals for the public sector.

At the other end of the spectrum, 19 programmes exhibit vertical specialisation, focusing on just one or two functional profiles. Some concentrate exclusively on technical competencies, such as the Máster Universitario en Inteligencia Artificial (UPM) or the AI Revolution Bootcamp. Others adopt a strictly legal-regulatory focus, including programmes like Curso de Formación Continua: Derecho Administrativo e Inteligencia Artificial, Derecho Público de la Inteligencia Artificial, and Especialista en el Reglamento Europeo de Inteligencia Artificial. Several initiatives target the Programme Management and Digital Transformation

profile, as seen in the Certificate Program: Digitale Transformation in Wirtschaft und Verwaltung. A smaller subset centres on service design, citizenship, and participation, such as the Ethics in AI Design MOOC. The AI & Public Administration Workshop developed by the JuLIA project appears to cover all five profiles, though only at a partial level (0.5 across each dimension).

These patterns highlight the absence of a shared reference framework that guides transversal integration, particularly in short, self-paced formats where profile differentiation is most fragile.

4.2.4 Competency Density and Balance as Quality Markers

Beyond total coverage, a key indicator of pedagogical maturity is competency density (number of profiles covered substantively) and balance across profiles. Programmes such as GovStack Essentials, AI Business School, and UOC AI in Public Administration score high in both dimensions, showing a symmetrical profile distribution and increased institutional relevance.

In contrast, low-scoring programs (<2.5 aggregate) tend to concentrate on a single domain, limiting inter-functional learning and reducing their transformative potential within complex governance systems.

4.3 Structural Drivers of Effective Training Architectures

A subset of high-density cases ($\geq 4/5$ in profile coverage) was analysed using qualitative criteria to identify what distinguishes the most effective programmes. These programmes demonstrate strong pedagogical coherence, functional alignment, and institutional applicability.

4.3.1 Common Design Principles in High-Performing Programmes

1. **Strategic Clarity in Learning Objectives:** Learning goals are explicitly tied to public sector functions—e.g., oversight of AI, service redesign, or decision-making under uncertainty. The Master in AI for Public Services (AI4Gov) exemplifies this alignment, combining technical, regulatory, and organisational tracks around use cases.
2. **Applied, Contextual, and Multidisciplinary Approach:** Content is not abstract or siloed. Instead, it combines ethical, legal, and institutional modules with

public-sector-specific labs, case studies, and participatory design exercises. Programmes like AI for the Common Good exemplify this integration.

3. **Transparent and Accessible Curricular Structures:** High-performing programmes publish syllabi, learning objectives, and modular sequences openly, enabling adaptation and replication. UOC's *Curso Online de Transformación Digital e IA en la Administración Pública* offers materials that are easily transferable across contexts.
4. **Competency-Based Assessment and Modular Certification:** Evaluation is built into the learning process through projects, rubrics, or formal credentials. Notably, *Zertifizierte_r KI-Manager_in* (Austria) meets ISO 17024 standards. Others use micro-credentials to recognise discrete functional competencies.

5. Discussion

5.1 Institutional Risks and Strategic Blind Spots in Competency Coverage

The comparative analysis reveals a persistent imbalance in how AI training programmes for the public sector address functional competency profiles. While institutional management and regulatory compliance domains are relatively well represented, strategic profiles such as Anticipatory Governance, Service Design, and Public Participation remain consistently underdeveloped.

This asymmetry clearly contrasts the emphasis placed on these elements by key European frameworks—including the AI Act, the AI Skills Strategy, and DigComp 2.2—all highlighting transversal competencies such as ethics, foresight, and civic participation in algorithmic systems development and deployment. The limited integration of these dimensions is not simply a curricular oversight; it represents a substantive institutional vulnerability. The provision of a concrete example can help explain this point. Suppose you do not train people to conduct fair AI impact assessment, inclusive design, or adaptive regulation. In that case, this can more easily lead to embedded algorithmic biases, exclusionary service models, and AI that rubs up against democratic norms. From this viewpoint, the less-represented profiles are not marginal; they are key to guaranteeing transparency, legitimacy, and institutional fairness in adopting AI technologies in the public sector. The Anticipatory Governance profile is especially crucial. As we argued in section 4.2, foresight and uncertainty-managing capabilities are necessary to develop AI-ready

institutions. Their current marginalisation, however, stems from a reactive model of training in which the emphasis is on short-term implementation rather than long-term institutional change. Building on this, training approaches must be reimagined to fill these gaps and mainstream underrepresented profiles, not treat them as optional extras. This demands enhanced inter-institutional collaboration, the development of reusable open learning resources, and the definition of a modular certification system to accredit key competencies. Partial or skewed training erodes the engineering effectiveness of AI deployment and its institutional legitimisation and democratic durability.

5.2 The Pedagogical Value of Blended Learning and Situated Approaches

In some programmes analysed, hybrid learning experiences (in-person + synchronous digital, in-person + asynchronous digital) were the focus. This format was found in our analysis to achieve an effective balance, meeting the flexibility needs of working professionals while maintaining the depth required to engage with diverse and complex competencies. Blended models enable integrated learning trajectories. Face-to-face components foster dialogue, leadership development, and collaborative problem-solving; digital components support self-paced learning, scalability, and adaptation to different institutional contexts.

Beyond format, the most promising programmes adopt innovative pedagogical strategies that situate learning in real public sector challenges. These include challenge-based learning, workplace-embedded training, and peer mentoring. Such approaches bridge the gap between abstract content and institutional practice, making learning relevant and immediately applicable. Further to this, participatory and situated learning experiences—such as regulatory simulations, public service co-design, or collaborative algorithm development—further reinforce this connection. These strategies anchor learning in concrete governance, legitimacy, and ethics dilemmas and align with recent recommendations by the OECD and national innovative education frameworks promoting adaptive, multimodal learning for public innovation.

However, a structural tension remains: the need to create training interventions that are flexible and portable, effectively allowing the knowledge to come to the learner within the time constraints of a public professional, and the need for intensity to ensure that the learning is sufficiently genuine and rigorous to transform the institutional capacity that it is designed to strengthen. A promising path forward involves designing modular and scalable training

architectures—combining micro-credentials, clearly sequenced learning routes, and delivery formats adapted to different levels of organisational maturity and functional roles.

Within this framework, blended learning's added value is an educational experience that can be flexible yet integrate the technical, legal, and institutional aspects with a coherent educational approach. If used strategically, it can help support individual skill development and shift organisational practices more broadly, encouraging efforts to move AI toward being ethical, inclusive, and effective across the public sector.

5.3 Toward a Strategic and Replicable Model for Public Sector AI Training

Programmes demonstrating high competency density and balance share a set of structural characteristics that go beyond thematic content. They are built on robust pedagogical architectures designed to connect individual upskilling/reskilling and organisational transformation. These features offer the foundation for a replicable model of strategic training in AI across European public administrations.

5.3.1 Strategic Alignment with Institutional Priorities

Effective programmes clearly articulate learning objectives that reflect concrete public challenges, such as digital service reform, algorithmic governance, or compliance with AI regulation. Their alignment with broader policy agendas (e.g. the AI Act, GDPR, national digital strategies) enhances curricular relevance and positions training as a legitimate public policy tool. Examples include the Master on AI for Public Services (AI4Gov) and the Micromaster AI for Leaders, which structure learning around functions like leadership, risk management, and strategic planning.

5.3.2 Applied, Situated, and Interdisciplinary Pedagogy

Top-performing programmes use active and context-driven methods—including real case analysis, institutional labs, co-design processes, and regulatory simulations. These approaches enable the acquisition of complex skills and ensure their transfer into practice. Crucially, they also integrate technical, legal, organisational, and participatory perspectives—reflecting the interdisciplinary nature of ethical public sector AI.

5.3.3 Modular, Transparent, and Scalable Curriculum Design

High-impact programmes provide clear documentation, including learning objectives, modular content, downloadable resources, and flexible learning pathways. This enhances transparency, replicability, and scalability—organisationally tailored to specific roles, levels of seniority, or institutional contexts. Programmes like UOC’s Online Course on AI and Digital Transformation and the EIF Online Training illustrate this approach effectively.

5.3.4 Competency-Based Evaluation and Formal Certification

Strong programmes incorporate structured assessment mechanisms—rubrics, applied projects, and real-world simulations—alongside certification systems aligned with recognised standards. Some, like *Zertifizierte_r KI-Manager_in* (Austria), meet ISO certification requirements. Micro-credentials are increasingly used to certify role-specific skills, allowing for flexible, modular Recognition of learning.

Together, these components form the pillars of a strategic training model that aligns individual capabilities, organisational structures, and principles of cognitive justice.

To operationalise this model, the following five principles are proposed:

- Co-creation: Actively involve public employees in shaping learning pathways.
- Inclusive traceability: Monitor and address gaps by role, geography, and seniority.
- Epistemic plurality: Recognise and integrate technical, legal, and civic knowledge systems.
- Rights of the public learner, including certification, protected learning time, and professional progression;
- Cognitive redistribution: Break down hierarchical silos and foster distributed institutional intelligence.

Such an approach positions AI training as a lever for institutional transformation. Its recognition depends on curricular design and sustained organisational infrastructure—training units, innovation labs, distributed leadership, and competence-based career frameworks. Replicability lies in the model’s strategic, ethical, and adaptive coherence across different levels of government.

5.4 Limitations and Future Directions

This study offers an initial comparative framework for analysing training programmes on AI for the public sector, targeting Europe as the main geographical area of interest. However, it presents limitations typical of its exploratory nature. First, the analysis relies on publicly available documentation, which is often incomplete or inconsistent. Second, the assessment is based on indirect quality indicators—such as structure, format, or profile coverage—without longitudinal data on real-world learning outcomes or institutional impact.

Moreover, while the proposed framework of functional profiles is grounded in robust sources, it requires further validation by practitioners. A participatory phase involving public servants and training coordinators is essential to refine the framework based on diverse institutional experiences.

In response to these limitations, three priority areas for future research and development are proposed:

1. Longitudinal studies to track participant learning and institutional uptake over time;
2. Organisational impact evaluations to measure how training affects governance, transparency, and service design;
3. Participatory validation workshops to refine functional profiles and learning levels in authentic contexts.

Finally, the study reinforces that AI upskilling and reskilling strategies will only be effective if embedded in permanent organisational structures. These include organisational-dedicated training units, innovation hubs, distributed leadership models, and competency-based HR frameworks. Only under these conditions can individual learning translate into systemic, lasting transformation in the public sector.

6. Conclusions

This study has begun by identifying a structural gap between the rapid deployment of algorithmic systems in the European public sector and the limited institutional capacity to govern them ethically, strategically, and effectively. Through the comparative analysis of 70 continuing education programmes in AI, the study revealed a marked imbalance in training coverage: while competencies related to digital transformation and regulatory compliance are

widely addressed, other critical areas—such as anticipatory governance, participatory and service design, and organisational innovation—remain significantly underrepresented.

This disparity cannot be corrected by simply expanding technical or legal content. What distinguishes high-quality programmes is their thematic scope and ability to link individual learning with institutional transformation. The organisational dimension—embodied distributed leadership, situated evaluation, and internal training structures—emerges as the bridge between upskilling and systemic capacity-building.

The proposed framework, grounded in functional profiles and levels of competency abstraction, offers more than a comparative tool: it provides a foundation for identifying key features of the most effective public sector AI training. The most robust programmes share four key features:

1. Strategic alignment with real institutional challenges and policy frameworks;
2. Applied and multidisciplinary pedagogy, connecting technical, legal, and participatory perspectives;
3. Modular and accessible design, allowing adaptation across roles and contexts;
4. Competency-based certification, reinforcing learning legitimacy and institutional value.

These elements are essential for transforming AI training from a reactive adaptation tool into a public strategy for organisational transformation. Empowering public employees to engage critically and constructively in digital transformation requires inclusive, adaptable, and public-interest-driven learning systems. In this sense, the framework developed here is analytical and generative. It lays the groundwork for the design of sustainable, modular, and transferable training strategies capable of strengthening the state's capacity to govern AI in democratic, anticipatory, and socially legitimate ways.

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8. Annexes

Annex 1. Coding Matrix by Functional Profile

Programme Name	1. Technical	2. Legal, Regulatory & Public Policy	3. Service Design, Citizenship & Participation	4. Programme Management & Digital Transformation	5. Anticipatory Governance & Strategic Foresight
<i>Advanced International Training (CIP)</i>	0,5	1	1	1	0,5
<i>Advancements in AI in Public Administration</i>	0,5	1	0,5	1	0,5
<i>AI & EU Law primer</i>	0,5	1	0,5	0,5	0,5
<i>AI & Public Administration Workshop</i>	0,5	0,5	0,5	0,5	0,5
<i>AI and Governance: Embracing and Harnessing AI for the Public Good</i>	0,5	1	0,5	1	1
<i>AI Business School AP (en colaboración con INA)</i>	0,5	1	1	1	0,5
<i>AI Fundamentals for Public Servants: Opportunities, Risks and Strategies</i>	1	1	0,5	1	0,5
<i>AI governance in practice: developing secure and innovative frameworks</i>	0,5	1	0,5	1	0,5
<i>AI in Practice – Professional Certificate (edX)</i>	0,5	0,5	0,5	0,5	0
<i>AI in Public Service: Risks and Opportunities</i>	0,5	1	0,5	0,5	0,5
<i>AI Regulatory Landscape for Boards: Masterclass</i>	0	1	0	0,5	1
<i>AI Revolution Bootcamp</i>	1	0	0,5	1	0

<i>Artificial Intelligence & Leadership: Impact on Strategy and Innovation</i>	0,5	0,5	0,5	1	0,5
<i>Artificial Intelligence for Business</i>	0,5	0,5	0,5	1	0
<i>Artificial Intelligence for Innovation</i>	0,5	0	0,5	1	0
<i>Artificial Intelligence for Public Sector Leaders</i>	0,5	1	0,5	1	1
<i>Artificial Intelligence for the Public Sector</i>	1	1	1	0,5	0,5
<i>Artificial Intelligence Masterclass for Senior Public Service Leaders</i>	0,5	1	0,5	1	1
<i>Artificial Intelligence Summer School</i>	0,5	0	0,5	0,5	0
<i>Building AI Confidence in Government</i>	0,5	0,5	1	1	0,5
<i>Certificate Program: Digitale Transformation in Wirtschaft und Verwaltung</i>	0	0	0	1	0,5
<i>Certified AI Ethics & Governance Officer (CAEGO)</i>	0,5	1	0,5	0,5	1
<i>Co-creating AI-enabled Public Services (AICOSERV workshop + MOOC GenAI)</i>	0,5	0,5	1	0,5	0,5
<i>Corso biennale di Specializzazione in Studi sull'Amministrazione Pubblica</i>	0	1	1	1	0,5
<i>Corso di Alta Formazione in Digitalizzazione della Pubblica Amministrazione</i>	0,5	0,5	1	1	0,5
<i>Curso de Formación Continua: Derecho Administrativo e Inteligencia Artificial</i>	0	1	0,5	0	0,5
<i>Curso de IA para Administraciones Públicas</i>	1	0,5	1	1	0,5
<i>Curso Online de Transformación Digital e IA en la Administración Pública</i>	1	0,5	1	1	0,5
<i>Curso sobre Implantación de la IA en las AAPP</i>	1	0,5	1	1	0,5
<i>Derecho público de la inteligencia artificial</i>	0	1	0,5	0	0,5
<i>Design Thinking Methodology for</i>	0	0,5	1	1	0

<i>Stakeholder Engagement in GovTech</i>					
<i>Digital Transformation in the Public Sector</i>	0,5	0,5	1	1	0,5
<i>Digital-ready Policymaking</i>	0,5	0,5	1	1	0,5
<i>EIRA© & eGovERA© in support to a Digital Public Service analysis</i>	0,5	1	1	1	0,5
<i>EIRA© & eGovERA© in support to a Digital Public Service Design</i>	0,5	0	1	1	0
<i>Especialista en el Reglamento Europeo de Inteligencia Artificial</i>	0	1	0	0,5	0,5
<i>Ethics in AI Design (MOOC)</i>	0	0,5	1	0	0,5
<i>European Interoperability Framework (EIF) Online Training</i>	0,5	1	0,5	1	0
<i>Excellence in digital government</i>	0,5	0,5	1	1	0,5
<i>Executive Certificate in Law, Policy & Technology</i>	0	1	0	0,5	0,5
<i>Fundamentos para una Inteligencia Artificial responsable</i>	0,5	1	0,5	0,5	0,5
<i>GovStack essentials: transforming public services with modern digital infrastructure</i>	1	0,5	1	1	0,5
<i>Inovação de Produtos Digitais com IA</i>	0,5	0	0,5	1	0
<i>Inteligência Artificial Generativa</i>	0,5	0	0,5	0,5	0
<i>Intelligenza Artificiale in ambito pubblico</i>	1	0,5	1	0,5	0,5
<i>Intelligenza Artificiale nella Pubblica Amministrazione: opportunità, applicazioni e disciplina</i>	0,5	1	0,5	0,5	0
<i>Intelligenza Artificiale, Mente e Impresa (Master II livello)</i>	1	1	0,5	0,5	0,5
<i>Introduction to Artificial Intelligence for Public Service Interoperability</i>	0,5	0,5	0,5	0,5	0
<i>Introduction to Artificial Intelligence for Public Service Interoperability</i>	0,5	0,5	0,5	0,5	0
<i>Introduction to eGovERA©</i>	0,5	1	0	0,5	0,5

<i>Introduction to GovTech and the GovTech Connect Community</i>	0,5	0,5	0,5	0,5	0
<i>La collaborazione umano-AI nelle imprese e nelle organizzazioni</i>	1	0,5	0,5	1	0,5
<i>La transizione digitale della Pubblica Amministrazione</i>	0,5	0,5	1	1	0,5
<i>Master In Intelligenza Artificiale Per La Pubblica Amministrazione</i>	1	1	1	1	1
<i>Master on AI for Public Services (AI4Gov)</i>	1	1	1	1	1
<i>Máster Universitario en Inteligencia Artificial</i>	1	0	0	0	0
<i>Micromaster A.I for Leaders</i>	0,5	0,5	0,5	1	0,5
<i>Navigating the EU AI Act</i>	0,5	1	0,5	0,5	0,5
<i>Online AI for Government and Public Sector Training</i>	1	0,5	1	1	0,5
<i>OpenGov Summer School</i>	0,5	0,5	1	0,5	0
<i>Postgraduate Certificate “AI for the Common Good”</i>	0,5	0,5	1	1	0,5
<i>Public Sector Organisational Transformation in AI</i>	0,5	1	0,5	1	0,5
<i>Spanish INAP IA curso</i>	0,5	0,5	0,5	0,5	0
<i>Summer School on the Law, Ethics and Policy of AI</i>	0,5	1	1	0,5	0,5
<i>The Future-Proof Public Sector: Organisational Transformation in Times of AI</i>	0,5	1	0,5	1	0,5
<i>The Interoperable Europe Act: Introduction</i>	0,5	1	0,5	0,5	0,5
<i>Understand How AI Impacts You and Your Government</i>	0	0	1	0,5	1
<i>Understanding Law as Code</i>	0,5	1	0,5	0,5	0,5

<i>University of Helsinki: Elements of AI</i>	1	0	0	0,5	0,5
<i>Zertifizierte_r KI-Manager in</i>	0,5	0,5	0	1	0
Average Score	0,54	0,66	0,64	0,74	0,43