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Authors: R. Medaglia, P. Mikalef, L. Tangi

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Contents

Abstract

The diffusion of artificial intelligence (AI) in the public sector depends largely on ensuring the presence of appropriate competences and establishing appropriate governance practices to deploy solutions. This report builds on a synthesis of empirical research, grey and policy literature, on an expert workshop and on interviews from seven case studies of European public organisations to identify the competences and governance practices around AI required to enable value generation in the public sector. Based on the analysis, we present a comprehensive framework for relevant competences and a framework for the governance practices for AI in the public sector. The report also introduces six recommendations to be implemented through 18 actions to facilitate the development of the competences and governance practices needed for AI in the public sector in Europe.

Foreword

Francesca Campolongo

Director, Digital Transformation and Data Directorate,
European Commission Joint Research Centre (JRC)

In an era where Artificial Intelligence (AI) is becoming increasingly prevalent, its transformative potential within the public sector is undeniable. The integration of AI into public service management and delivery calls public administrations to rethink their relationships with citizens, firms, and civil society and step towards a new paradigm of efficiency and citizen engagement. The incorporation of AI into the public domain is not an automatic process. Rather, it is a journey requiring a shift toward innovative organisational structures, skill sets, and governance mechanisms. A sophisticated technological landscape does not inherently guarantee an improved public sector; it necessitates proactive management and oversight by public administrations to harness its benefits fully.

Considering the use of AI in the public sector, it is very important to understand that - despite its effects are expected to be predominantly beneficial - there might be adverse outcomes, such as erroneous or biased decisions that could potentially cause negative effects on both individual citizens and society at large.

To navigate the transformative journey of adapting AI in the public sector, the European Union has developed a robust framework of regulations and initiatives. Regulations such as the AI Act and the Interoperable Europe Act outline a clear trajectory for responsible AI adoption. In addition, the European Commission supports Member States with various funding mechanisms, including the Digital Europe Programme, the Recovery and Resilience Facility, and the Technical Support Instrument. This study is part of the Public Sector Tech Watch initiative, aiming to establish a central repository of knowledge and a collaborative platform for stakeholders across the public sector, civil society, GovTech entities, and academia.

Nevertheless, legislative measures and programmes alone are insufficient to fully address the complexities of AI deployment in the public sector. It is imperative for governments to cultivate the necessary competences, expertise, methodologies, and governance practices to ensure an ethical and effective use of Artificial Intelligence.

This imperative has fuelled the collaboration between the Joint Research Centre (JRC) and external experts, culminating in the insightful research presented in this report. The objective is to articulate the competences and governance practices essential for harnessing AI's potential to generate public value. This report represents a foundational step, offering to practitioners and policy-makers ready-to-use recommendations to enable the implementation and deployment of appropriate AI governance practices in public organisations.

I would like to express my gratitude to the authors for their valuable insights and recommendations. This report's findings will serve as a valuable guide for policymakers steering the AI transition. Let us collectively and ethically advance the adoption of AI solutions, establishing robust governance structures for AI in the public sector, with the ultimate goal of generating tangible public value across Europe.

Acknowledgements

The authors extend their gratitude to Carmen Capote de la Calle, Marco Combetto, Marina Manzoni, Jaume Martin Bosch, Eva Martínez Rodríguez and Sven Schade, along with the entire JRC.T1 Unit team, for their indispensable support, insightful reviews and valuable feedback. We also appreciate the contributions and revisions of Andrea Halmos and Stefanos Kotoglou from the Directorate-General for Digital Services. We are equally thankful to the various external contributors who provided guidance and reviewed our research. We are particularly grateful to several institutions and their representatives for their cooperation in our study, including:

- the Ministry of the Interior, Czechia;
- the municipality of Gladsaxe, Denmark;
- the district of Lüneburg, Germany;
- the Ministry of Digital Governance, Greece;
- the National Institute for Social Security, Italy;
- the municipality of Trondheim, Norway;
- the city of Amsterdam, the Netherlands.

Their willingness to participate in interviews, along with their openness in sharing materials and insights into their artificial intelligence-related initiatives, was essential for the study.

Finally, the authors wish to express their sincere thanks to all the focus group participants for their significant contributions and perspectives, which greatly enriched this study.

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Patrick Mikalef (Norwegian University of Science and Technology)

Luca Tangi (European Commission's Joint Research Centre)

Executive summary

This report presents a study on the **competences and governance practices needed for adopting and using artificial intelligence (AI) in the public sector** in Europe.

Policy context

The increased attention being paid to AI in the public sector by both researchers and policymakers, as a result, for instance, of the EU AI Act, calls for a deeper understanding of (1) what **individual competences** public managers must have and (2) what **governance practices** public organisations must adopt to effectively use AI. Addressing these two aspects can determine how quickly public organisations can adopt AI and how much value they are able to leverage from such emerging technologies.

Key conclusions

The report presents two comprehensive frameworks for AI in the public sector, one on relevant competences and one on governance practices. The **competence framework** consists of three dimensions, namely technical, managerial, and policy, legal and ethical competences, and three cross-cutting clusters, namely attitudinal, operational and literacy competences. The **governance practices framework** consists of three dimensions, namely procedural, structural and relational practices, and three cross-cutting levels, namely strategic, tactical and operational governance. In addition, the report provides **six recommendations** articulated in **18 actions** for the development of competences and governance practices for AI in the public sector in Europe.

Main findings

The study draws on **three empirical sources**: (1) a systematic review of academic **research literature** and **policy and grey literature** (48 documents); (2) feedback from an **online expert workshop** (40 participants); and (3) 19 interviews in **seven case studies** of public organisations in Europe adopting AI. Based on the analysis of the empirical sources, the study identifies and discusses **56 competences** and **34 governance practices** for AI in the public sector.

Competences are defined as comprising knowledge, skills and behaviours that are visible in an **individual**, and individual underlying attributes such as traits, motives, attitudes, values and self-image that tend to be deeper. The competences are classified as **technical** (25), **managerial** (16), and **policy, legal and ethical** (15), and as **attitudinal** (know-why) (16), **operational** (know-how) (28) and **literacy** (know-what) (12).

Governance practices are defined as the **organisational capacity** to control the formulation and implementation of the technology strategy and, in this way, ensure that there is fusion between organisational goals and the technology used to enable it. The governance practices are classified as **procedural** (14), **structural** (12) and **relational** (8), and are organized in three levels: **strategic** (11), **tactical** (13) and **operational** (10).

Related and future Joint Research Centre work

This study was developed, managed and overseen by the Innovation of Public Services and Digital Transformation of Governance (Innpulse) team of the Joint Research Centre (JRC), which focuses on the innovation of public services and the digital transformation of governance [(1)]. The findings of the research are incorporated within the scope of the Public Sector Tech Watch, a specialised observatory that tracks and shares information on the adoption of emerging technologies in the public sector across Europe [(2)]. This observatory is under the joint administration of the Directorate-General for Digital Services and JRC, the latter serving as the observatory's scientific partner. The JRC is deeply invested in aiding public authorities to embrace AI by providing scientific insights and policy guidance. This is likely to continue in the future with additional research that provides new insights and guidance.

Quick guide

Chapter 1 provides an overview of the status of knowledge about competences and governance practices related to AI in the public sector, highlighting the importance of understanding these concepts in more depth for practical and policymaking purposes. **Chapter 2** provides a policy context, with a discussion of relevant regulatory and policy initiatives in the EU. **Chapter 3** describes the methods used in this study, including the criteria used to conduct the literature review, the validation process used in the expert workshop and the methods used for data collection and analysis of the interviews from the seven case studies. **Chapters 4** and **5** present the findings of the study, respectively, on competences and on governance practices for AI in the public sector. Both chapters introduce a multidimensional framework, one for competences and one for governance practices, and then illustrate the detailed findings from the literature review, the expert workshop and the case study interviews, in the light of each framework. In **Chapter 6**, the frameworks developed are used as the basis for a set of six recommendations articulated in 18 actions for public organisations in relation to tackling competences and governance practices for AI use in the public sector.

(1) https://joint-research-centre.ec.europa.eu/scientific-activities-z/innovations-public-governance_en.

(2) https://joint-research-centre.ec.europa.eu/scientific-activities-z/innovations-public-governance_en.

1 Introduction

Globally, artificial intelligence (AI) adoption has been growing at a rapid pace, particularly during the last few years. The field of AI is no longer within the realm of science fiction but is now an integral component of many organisations and a key strategic asset for organisations in several sectors (Enholm et al., 2022; European Commission, 2024; Tangi et al., 2022). The domains of public administration and government are significantly impacted by the introduction of AI (Wirtz et al., 2019). As public agencies need to provide citizens, businesses and society with more efficient and effective services, the role of AI in enabling such a transition has been brought into the spotlight (Sun and Medaglia, 2019). The potential areas of application of AI technologies in the public sector have been highlighted in several recent reports and studies, ranging from automating manual office tasks to optimising resource use, improving the quality and variety of services provided, and reducing inequalities and other barriers for citizens (Tangi et al., 2022; Wirtz et al., 2019).

Despite the great promise of AI, recent studies report that the adoption and use of AI in the public sector are still at an early stage (Rjab et al., 2023). Studies have highlighted that some of the structural barriers to adoption concern the competences needed to realise AI implementation and the governance practices needed to manage and orchestrate the necessary resources to deliver AI solutions based on the relevant guidelines and regulations (Schaefer et al., 2021). These two main barriers are highly interdependent, as the right competences are needed to develop effective AI governance practices, and a comprehensive set of AI governance practices are necessary to continuously update and enhance the competences that public organisations should foster (Janssen et al., 2020; Mikalef et al., 2022; van Noordt and Tangi, 2023).

Competences concern important skills, know-how and knowledge that are relevant for different aspects of developing and leveraging AI in the public sector. For the purpose of this report, we use the European Centre for the Development of Vocational Training's definition of competences as 'The ability to apply learning outcomes adequately in a defined context (education, work, personal or professional development)' (European Centre for the Development of Vocational Training, 2008, p. 47). This definition also specifies that 'Competence is not limited to cognitive elements (involving the use of theory, concepts or tacit knowledge); it also encompasses functional aspects (involving technical skills) as well as interpersonal attributes (e.g. social or organisational skills) and ethical values' (European Centre for the Development of Vocational Training, 2008, p. 47).

While the skill gap for AI experts has been a topic of considerable debate in general, the issue is particularly pronounced in the public sector, which often faces challenges in attracting employees with advanced technical knowledge (Wirtz et al., 2019). This issue has been noted as one of the

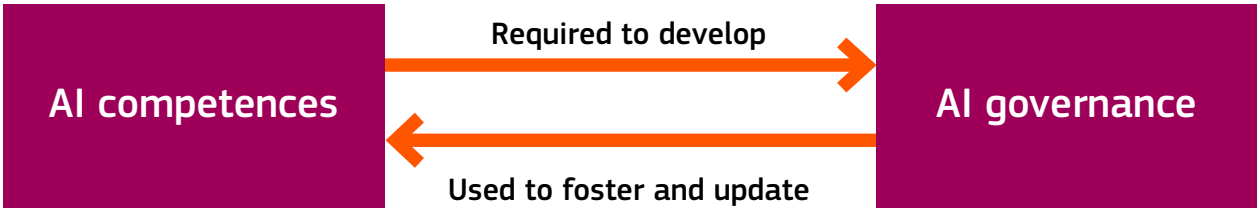
leading reasons for the public sector often lagging behind private organisations when it comes to novel technology diffusion (Mergel et al., 2019).

At the same time, rigid organisational structures, the inability to experiment and implement new digital solutions in an agile way, and unclear processes and rules around AI diffusion hinder efforts to utilise AI technologies in public administration (Maragno et al., 2023; Mikalef et al., 2022; Tangi et al., 2023). Such barriers, which are a result of ineffective governance practices, concern the organisational level.

While AI competences and governance practices may seem disconnected and to be independent elements of AI diffusion, there are in fact important interdependencies between them. The conceptualisation we use for AI competences goes beyond technical skills, to encompass management practices as well as knowledge of policy, legal and ethical matters. In fact, the principles of the AI Act and the general trend in discussions on AI skills emphasise a holistic approach to AI skills development that consider ethics as an integral part (Knoth et al., 2024). These competences at an individual level are important, since they diffuse in the organisational context through the establishment of governance practices. The effective orchestration of individuals with the relevant knowledge and skill sets allows organisations to develop appropriate governance practices that permeate the organisation and enable the deployment of AI solutions. Similarly, establishing robust AI governance practices enables the continuous updating of skills, and fosters knowledge creation and development throughout public organisations. Thus, there is a virtuous circle between the individual and organisational levels, where competences and governance practices can positively reinforce each other (Figure 1).

Figure 1.

Interdependencies of AI competences and AI governance.



Source: *JRC own elaboration.*

The objective of this report is to advance the understanding of relevant competences and appropriate governance practices for AI in the public sector, and identify key priority areas for practitioners and policymakers, drawing on a synthesis of existing research and on primary empirical data.

The report thus presents the results of a comprehensive review of the literature, the analysis of input from an expert workshop and the results of seven case studies focusing on the competences and governance practices needed to manage AI in the public sector.

The report is structured as follows. After this introduction, **Chapter 2** provides a policy context, with a discussion of relevant regulatory and policy initiatives in the European Union.

Chapter 3 describes the methods used in the study, including the criteria used to conduct the literature review, the validation process used in the expert workshop and the methods used for data collection and analysis of the interviews from the seven case studies.

Chapters 4 and **5** present the findings of the study, respectively, on competences and on governance practices for AI in the public sector. Each chapter introduces a multidimensional framework and then illustrates the detailed findings from the literature review, the expert workshop and the case study interviews, in the light of the two frameworks.

In **Chapter 6**, the frameworks developed are used as the basis for a set of six recommendations articulated in 18 actions for public organisations in relation to tackling competences and governance practices for AI use in the public sector.

2 Policy context

The active engagement of the EU in AI policy began with the 2018 Declaration of Cooperation on AI [3], which saw Member States commit to jointly fostering AI advancements while addressing its broad implications. The 2021 revision of the coordinated plan on AI [4] marked a significant advancement, pinpointing the role of AI in the public sector as a vital area for EU strategic leadership.

At present, numerous initiatives and legislative measures are under way to facilitate AI integration into public administration. This chapter encapsulates the legislative landscape and principal initiatives associated with this report's objectives. For an exhaustive examination, readers can refer to a recent study, published in 2024 (European Commission, 2024).

2.1 Legislative framework

In recent years, the European Commission has established a comprehensive legislative package aimed at regulating the use of new technologies, including AI. Although these regulations are not tailored specifically for the public sector, they have substantial implications for it. The most critical pieces of legislation in this context include the AI Act and the Interoperable Europe Act.

The **AI Act**, proposed in 2021 and adopted in May 2024, establishes a risk-based approach for regulating AI application. It bans systems posing unacceptable risks and delineates high-risk applications that will be subjected to stringent controls. Furthermore, the AI Act encourages innovation through regulatory experimentation areas and led to the formation of both the European Artificial Intelligence Board and an EU database for high-risk AI systems.

The **Interoperable Europe Act**, proposed in November 2022 and adopted in April 2024, aims to enhance the cross-border interoperability of IT systems employed in public services. It introduces the Interoperable European Board, responsible for curating a shared strategic agenda for cross-border interoperability, and mandates interoperability assessments for IT systems that operate across borders. In addition, it announced the launch of the Interoperable Europe Portal, a collaborative platform for sharing and reusing IT solutions. The Interoperable Europe Act also endorses innovation by way of regulatory experimentation areas and GovTech partnerships.

(3) https://digital-strategy.ec.europa.eu/en/news/eu-member-states-sign-cooperate-artificial-intelligence.

(4) https://digital-strategy.ec.europa.eu/en/library/coordinated-plan-artificial-intelligence-2021-review.

Relevant EU laws include:

- the **Digital Services Act** [5] (19 October 2022), purposed to set definitive regulations for digital service providers, thereby ensuring user safety online and enhancing transparency and accountability;
- the **Digital Markets Act** [6] (14 September 2022), designed to establish equitable conditions within the digital marketplace by overseeing large online platforms and fostering competition, innovation and consumer choice;
- the **Data Governance Act** [7] (30 May 2022), which seeks to increase trust in data sharing, strengthen mechanisms to increase data availability and overcome technical obstacles to the reuse of data;
- the **Data Act** [8] (23 February 2022), which prescribes unified guidelines on data accessibility for business-to-consumer, business-to-business and public–private exchanges;
- the **Cybersecurity Act** [9] (17 April 2019), dedicated to augmenting the EU's cybersecurity capabilities, encouraging Member State collaboration and guaranteeing a high level of cybersecurity throughout the EU.

2.2 Public Sector Tech Watch: a European platform for artificial intelligence and advanced technologies

The **Public Sector Tech Watch (PSTW)** observatory is a key initiative informing this study. Established in September 2023 and managed by the European Commission's Directorate-General for Digital Services and Joint Research Centre (JRC), the PSTW observatory operates on the EU Joinup platform. It provides a comprehensive resource for public sector employees, policy strategists, private enterprises, and academic and research bodies.

As a knowledge centre, the PSTW observatory facilitates the sharing of insights, experiences and educational resources among its members. It bolsters the European Commission's endeavours to promote digital transformation and system compatibility within the European public sectors. The establishment of the PSTW observatory seeks to bridge the knowledge gap regarding the advantages of novel technologies in public administration, and aid in devising effective strategies through collective expertise and experiences.

It contains a range of resources, including a database of more than **1,000 cases** of AI and other emerging technologies in the public sector. It also aims to foster a collaborative environment where public administrations can share their practices and experiences. For example, it has launched a best case award competition, where public administrations can submit their use case to foster an automatic learning process among Member States.

(5) https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32022R2065.

(6) https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32022R1925.

(7) https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32022R0868.

(8) https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2022%3A68%3AFIN.

(9) https://eur-lex.europa.eu/eli/reg/2019/881/oj.

Furthermore, the mission of the PSTW observatory includes generating knowledge to aid public administrations in their pursuit of innovation. The scope, the data and information available and the mission of PSTW has been extensively explained in a dedicated report (European Commission, 2024). This report is a component of the extensive research conducted on public sector AI adoption.

2.3 Additional EU initiatives on artificial intelligence in public administration

Other significant EU initiatives related to AI in the public sector are worth mentioning, such as the **Technical Support Instrument (TSI)** projects, particularly the flagship 'AI-ready public administration' project [10]. This initiative is part of the TSI programme, offering custom technical expertise to Member States, assisting in AI adoption preparedness. It encompasses enhancing computing and data infrastructure, interoperability, IT and data governance, digital skill development and regulatory mapping in light of impending EU digital legislation, including the AI Act.

The **Procurement of AI Community** [11] supports the public procurement of AI solutions that are trustworthy, fair and secure. A key endeavour of this community is to create EU model AI contractual clauses for pilot usage in AI system procurements.

GovTech Connect and GovTech4all [12] aim to nurture the European GovTech ecosystem. **GovTech Connect** includes various initiatives that bring together the GovTech Innovation Community, while **GovTech4all** focuses on initial implementation through three pilot projects.

(10) https://reform-support.ec.europa.eu/tsi-2024-flagship-ai-ready-public-administration_en.

(11) https://public-buyers-community.ec.europa.eu/communities/procurement-ai.

(12) https://joinup.ec.europa.eu/collection/govtechconnect.

3 Methodology

To develop a comprehensive and current perspective on the competences and governance practices that are necessary in relation to AI use in public organisations, we have followed a **multimethod approach** that builds on three main phases.

The first phase aimed to provide an overview of existing knowledge based on academic and policy/grey literature. The second phase focused on validating and enriching the findings of phase 1 through an online expert workshop. The third phase consisted of conducting interviews in seven case studies of European public organisations using AI, to further validate and expand on the findings.

3.1 Phase 1: literature review

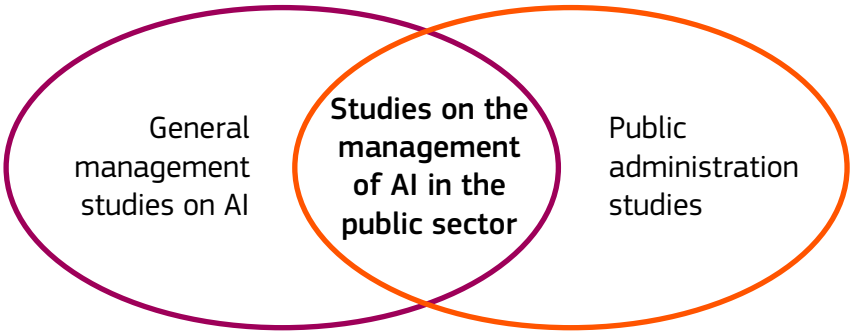
To identify current research on competences required for the design, use, implementation and management of AI in the public sector and research on AI governance practices in public organisations, we conducted **a review of relevant published academic literature and of relevant policy and grey literature**. The policy and grey literature includes white papers, project reports, annual reports, position papers and policy documents that concern competences for public servants dealing with AI competences and AI governance practices in public organisations. This literature is published by both governmental entities and private entities, such as consultancy companies.

The combination of literature searches of academic literature and of policy and grey literature represents a methodology that has been fruitfully adopted by previous studies on digital competences in the public sector, which have not focused specifically on AI-related competences. These include the European Commission's study on the development of a European framework for interoperability skills and competences in the public sector (European Commission, 2021), the digital competence framework (Vuorikari et al., 2022) for European citizens and the entrepreneurship competence framework (Bacigalupo et al., 2016) for enterprises.

Regarding the academic literature, we conducted two parallel searches: one scanning research literature on general management studies on AI and one scanning public administration studies. The focus of the literature review, at the intersection of the two disciplinary areas of general management studies on AI and public administration studies, is depicted in Figure 2.

Figure 2.

Focus area of the literature review.



Source: *JRC own elaboration.*

To cover research in general management that focuses on AI in the public sector, we carried out a keyword search in the EBSCOhost [13] database of academic literature, using the phrase 'artificial intelligence public sector' and then analysing each of the resulting articles, looking for research foci on competences and governance practices related to AI in the public sector.

To cover research in public administration studies that has a focus on AI, we carried out a search focusing on key academic journals within the public administration discipline that had published more than two articles on AI in the public sector as of June 2023, following the approach suggested by Wirtz et al. (2021). The journals were as follows:

- *Government Information Quarterly*
- *Telecommunications Policy*
- *Public Administration Review*
- *Digital Policy, Regulation and Governance*
- *Computer*
- *International Journal of Information Management*
- *Technology in Society*
- *Public Management Review.*

All resulting publications were scanned, searching for articles focusing explicitly on AI, using the keywords 'artificial intelligence'. Based on the analysis of the resulting articles, further cited papers were similarly identified and analysed.

In addition, the following literature review articles on AI in the public sector were analysed: de Sousa et al. (2019), Kankanhalli et al. (2019), Mutawa and Rashid (2020), Reis et al. (2019), Sharma et al. (2020), Wirtz et al. (2021, 2022) and Zuiderwijk et al. (2021).

As a second step, we incorporated policy and grey literature. To explore the policy and grey literature, we adopted a snowball approach, whereby we first started by looking into the policy and

(13) This is the cross-database search function hosted by EBSCO. The search includes the following databases: Academic Search Elite, Communication & Mass Media Complete, eBook Collection (EBSCOhost), EconLit, Education Resources Information Center, American Psychological Association (APA) PsycArticles, APA PsycInfo, Regional Business News and SocINDEX.

grey literature sources cited the most in the pool of academic articles identified in the academic research search; subsequently, we reviewed the most cited documents within these policy and grey literature items to identify further sources. The search was completed when no new relevant source was identified.

The combined search resulted in a total of **48 unique relevant sources** (i.e. academic articles and policy and grey literature documents) that covered the topic areas of competences and governance practices for AI in the public sector. It is to be noted that some items covered both competences and governance practices for AI in the public sector.

Table 1 illustrates the distribution of sources, distinguishing between academic sources and policy and grey literature sources.

Table 1.

Literature review: distribution of foci and sources.

	Competences	Governance practices	Unique sources
Academic literature	18	15	30
Policy and grey literature	14	5	18
Total	**32**	**20**	**48**

Source: *JRC own elaboration.*

3.2 Phase 2: expert workshop

The second phase consisted of an **expert workshop**, to consolidate and further explore the findings on competences and governance practices related to AI adoption in the public sector that emerged from the literature review. The workshop took place online on 25 October 2023 and was attended by **40 experts** in domains that represented different public organisations. The workshop began with a plenary session where the participants were briefly presented with the findings of phase 1. All participants had received the details of results from phase 1 two weeks before the workshop and were asked to read them before the online workshop. After going through the key findings, the participants were informed about the purpose of the workshop, and they were further split up into **four breakout sessions**.

Two of the breakout sessions focused on discussing the findings on competences and the other two focused on governance practices. Each session had an assigned coordinator, selected from the workshop organisers, as well as a presenter, who was selected from the participants. The breakout sessions used an online collaborative file that all participants could edit. In total, the breakout sessions lasted approximately 60 minutes, after which all participants reconvened in the plenary session. During the final plenary session, there was a short presentation by each group of the key points they discussed, as well as any important aspects that they felt had not been identified during the literature review phase. The deliverables of the session were slides that included competences and governance practices identified as particularly important, as well as additional

competences and governance practices per category. The transcripts and notes from the expert workshop were also used to further verify findings, and a report was drafted on the workshop content.

3.3 Phase 3: case studies

In the third and final phase, **semi-structured interviews** were conducted with managers in public organisations involved in AI projects in Europe. Seven public organisations in **Czechia**, **Denmark**, **Germany**, **Greece**, **Italy**, **the Netherlands** and **Norway** were selected, with the aim of having a diversity of geographical coverage and governance levels (central and local). The majority of the managers interviewed had participated in the previous expert workshop.

For each organisation, between one and three interviews were conducted, amounting to a total of **19 interviews**. The interviews were conducted between May and November 2023 by three researchers. The average length of the interviews was 37 minutes. Table 2 provides an overview of the interviews.

Table 2.

Overview of the interview data sources.

Country	Entity	Number of interviews	Interviewees' positions	Code	Duration
Czechia	Ministry of the Interior	3	Data Analyst	C1INT1	53 minutes
			IT Project Leader	C1INT2	53 minutes
			Head of IT division	C1INT3	53 minutes
Denmark	Municipality of Gladsaxe	4	Data Analyst	C2INT1	40 minutes
			Head of Educational Knowledge Centre	C2INT2	25 minutes
			Head of Digitalisation Department	C2INT3	27 minutes
			IT Project Leader, Digitalisation Department	C2INT4	25 minutes
Germany	District of Lüneburg	1	Chief Digital Officer	C3INT1	25 minutes
Greece	Ministry of Digital Governance	2	Project Manager	C4INT1	38 minutes
			External consultant	C4INT2	30 minutes
Italy	National Institute for Social Security	2	Head of Technological Innovation and Digital Transformation	C5INT1	37 minutes
			Project Manager	C5INT2	48 minutes
	National Institute for Social Security / consultancy company	2	Project Manager	C5INT3	31 minutes
			Data Science and Artificial Intelligence Associate Manager	C5INT4	35 minutes

Country	Entity	Number of interviews	Interviewees' positions	Code	Duration
Netherlands	City of Amsterdam	2	Public Tech Project Manager	C6INT1	28 minutes
			Computer Vision Lead	C6INT2	26 minutes
Norway	Municipality of Trondheim	3	Chief Technology Officer	C7INT1	26 minutes
			AI Project Manager	C7INT2	48 minutes
			Data Scientist	C7INT3	48 minutes
Total		19			11 hours 36 minutes

Source: *JRC own elaboration.*

The interviews focused on individuals' experience with AI, the perception of the relevance of AI in the specific workplace and perceived difficulties in obtaining competences related to AI in the public sector. The protocol used for the semi-structured interviews, including all question items, is presented in the Appendix.

The interviews were transcribed with the support of the software Konch [(14)], and then manually edited for accuracy. Some interviews were conducted in Italian, and then translated into English. Once transcribed, the interview text was coded with the support of NVivo [(15)]. Each interview was coded independently by one of the researchers and then validated through a cross-check.

Table 3 provides an overview of the features of the case studies.

Table 3.

Features of the case studies.

Country	Administrative level	Institution	Policy area(s) (*)
Czechia	National	Ministry of the Interior	Transport
Denmark	Local	Municipality of Gladsaxe	General public services
Germany	Regional	District of Lüneburg	General public services
Greece	National	Ministry of Digital Governance	General public services
Italy	National	National Institute for Social Security	Social protection

(14) https://www.konch.ai/.

(15) https://lumivero.com/products/nvivo/.

Country	Administrative level	Institution	Policy area(s) (*)
Netherlands	Local	City of Amsterdam	Police services; housing and community amenities; waste management
Norway	Local	Municipality of Trondheim	Housing and community amenities; human resources

Source: *JRC own elaboration.*

(*) Using the classification of the functions of government by Eurostat.

The following subsections provide background information on each of the seven case studies.

3.3.1 Case study 1: Ministry of the Interior, Czechia

The Ministry of the Interior of Czechia is the supreme office for the areas of public administration, internal security, border protection and e-government in Czechia. The ministry deals with a range of activities, including ensuring public order and dealing with matters relating to internal order and security, fire protection activities, maintaining archives, arranging territorial structure and surveying the national border, as well as being responsible for matters pertaining to nationality, identity documents, reporting residence, the register of inhabitants and birth (personal) identification numbers.

Due to the large number of activities it undertakes, particularly tasks that are data-centric, **the Ministry of the Interior has been piloting a number of projects** to enable it to analyse datasets effectively and make informed decisions. Several of the projects that have been launched relate to the commuting patterns of citizens, understanding how mobility affects economic activity and understanding the way in which the regions of the country are connected, to develop better services for citizens. To this end, there is a dedicated group that combines expertise from different disciplines in testing out and launching activities around data analysis. The group has also begun the process of exploring how AI applications can be developed and utilised. Nevertheless, attempts are still at the piloting phase, where the goal is to learn about the technology rather than deploy projects in the short term.

The Ministry of the Interior is further organised into different sections, including those of the civil service, legislation and archiving, public administration, financial affairs, strategies and EU funds, social and health security, security research and programme management, and information and communication technologies. The section of information and communication technologies is responsible for **co-developing digital services and projects utilising AI** to address the requirements of the different sections.

3.3.2 Case study 2: municipality of Gladsaxe, Denmark

Gladsaxe is a municipality in Denmark of around 70 000 inhabitants, in the north-western outskirts of Copenhagen. The municipality of Gladsaxe hosted one of the first applications of AI in public services in Denmark. As early as 2017, the municipality experimented with **an algorithmic system to identify children at risk of abuse** – based on health records, employment information, etc. – to allow authorities to flag families for early intervention by social workers, which could ultimately result in forced removals. The project, however, encountered strong criticisms related to data privacy, lack of transparency and bias, and was discontinued in 2019.

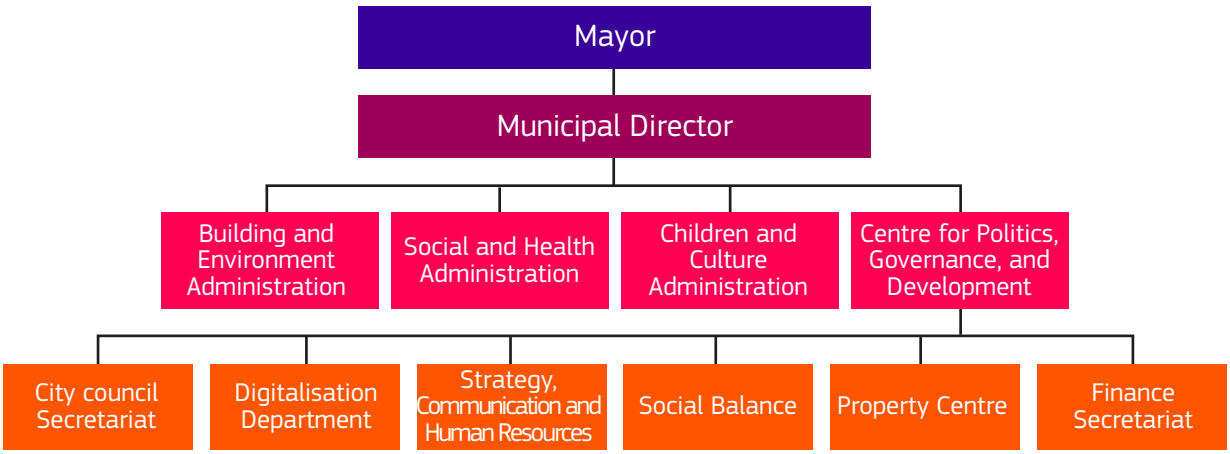
Nevertheless, the municipality continues to focus on the potential of AI. For example, in December 2023, it launched **'GladGPT', an internal chatbot based on the technology of OpenAI ChatGPT 4**, operated in a closed environment. The chatbot is trained on all content of Gladsaxe's intranet and selected parts of the municipality's website to help employees with a wide range of tasks, from finding information to generating text drafts.

The municipality is organised into three macro administrations, each dedicated to a service area, plus the Centre for Politics, Governance and Development, which includes a number of subdepartments. Figure 3 provides an overview of the organisational structure of the municipality.

In general, IT projects are under the responsibility of the Digitalisation Department under the Centre for Politics, Governance and Development. However, AI-related projects are often led by a team in the Finance Secretariat, which is a central unit that works on projects that are ordered from all over the municipality, as they rely on the large amounts of data that the Finance Secretariat deals with.

Figure 3.

Organisational structure of the municipality of Gladsaxe.



Source: *JRC own elaboration.*

3.3.3 Case study 3: district of Lüneburg, Germany

The district of Lüneburg is in Lower Saxony, Germany, with a population of a little over 180 000 inhabitants. Lüneburg is the capital of the district, which is further divided into seven administrative divisions. As the overarching administrative body of the region, the district of Lüneburg is

responsible for the **provision of IT services to its citizens and the planning of the digital technologies** that are implemented at the regional level. Tasks that are assigned to the district include the organisation and maintenance of mobility and transport, health services, building and construction permits, and culture and leisure.

During the past years, the district of Lüneburg has been experimenting with some **applications of AI**, primarily AI solutions from market vendors. These solutions have proven to be quite problematic in their implementation and difficult to adapt to the local needs of the citizens. In addition, most efforts have been placed on implementing chatbots to reduce the need for direct communication between citizens and agents of the district. Moreover, the effectiveness of the solutions deployed has been varied, and so the district is now in the process of developing an action plan for the coming years with the aim of customising such solutions to local needs.

The process of developing an AI capability in-house is dependent on several factors, including state-level financing, the availability of talent with the right skills to drive applications and the ability to allocate other complementary resources. In addition, since AI solutions depend heavily on data, there is a need to ensure that any deployed application conforms with national and EU directives and regulations. Considering this current situation, the district of Lüneburg is exploring the AI landscape and trying to identify the optimal strategy for making use of these emerging technologies.

3.3.4 Case study 4: Ministry of Digital Governance, Greece

The Ministry of Digital Governance is a government department of Greece that was established in 2011 and has been consolidated in its final form since the last reform in 2019. The ministry is responsible for all the digital transformation projects and e-government initiatives in Greece. The responsibilities of the ministry extend to all matters concerning public administration and the simplification of administrative procedures. Thus, the goal of the ministry was, on the one hand, to digitalise existing activities that are central to the government and, on the other hand, to simplify these procedures by means of different digital technologies. The ministry is also responsible for underlying electronic governance and the development of IT and new digital tools in public administration, meaning that it provides a service to the other government ministries.

A key goal of the Ministry of Digital Governance over the past 5 years, in its new form, has been to create a series of digital services for citizens and businesses. In this way, it aims to centralise all the infrastructure and data that relate to the provision of digital services for citizens and the broader digital transformation of the country. The goal of the ministry is to create a modern, effective and inclusive government using digital tools that can improve the lives of citizens, promote transparency and contribute to economic growth. Working in this direction, the ministry has built on several emerging technologies over the past years.

Over the past 2 years, discussion has been growing about **the role that AI can play in transforming such operations**. Currently, several early prototypes are used internally for different purposes. However, the ministry is developing its capabilities in this domain and ensuring that any tools developed conform with EU regulations and data protection directives. As such, the early

phases of working with such tools and understanding their affordances have been coupled with exploring their responsible deployment and use.

3.3.5 Case study 5: National Institute for Social Security, Italy

The National Institute for Social Security (Istituto Nazionale di Previdenza Sociale (INPS)) manages almost all social security in Italy, insuring the majority of self-employed workers and public and private sector employees. Originally established in 1898, over time, the INPS has taken on a role of growing importance to the point of becoming the pillar of the national welfare system.

INPS manages the settlement and payment of pensions and social security and welfare benefits. Pensions are social security benefits determined on the basis of insurance relationships and financed by contributions from workers and public and private companies. Welfare or 'income support' benefits, however, protect workers who find themselves in particularly difficult moments in their working life, and provide for the payment of sums intended for those with modest incomes and large families. For some of these services, INPS is involved in the provision phase only; however, for others, it carries out the entire assignment procedure.

Digitalisation initiatives within INPS, including AI initiatives, lie under the competence area of the 'technological innovation and digital transformation' (Struttura Innovazione tecnologica e trasformazione digitale) branch of INPS. The main initiative using AI within INPS focuses on the **classification and sorting of certified electronic mail** (Posta Elettronica Certificata) [(16)]. The certified electronic mail initiative is intended to provide a legal equivalent of the traditional registered mail, where users can legally prove that a given email has been sent and received.

The AI-based system of classification and sorting of certified electronic mail automatically classifies the thousands of certified electronic mails sent to the institute every day, allowing for immediate forwarding to the most suitable office for processing the requests contained therein. This allows the institute to respond more quickly and accurately to citizens. The project is implemented by INPS in collaboration with a consultancy company, and was included in the ten "outstanding solutions" among the world's top 100 AI solutions [(17)], as ranked by the International Research Centre on Artificial Intelligence, the agency of the United Nations Educational, Scientific and Cultural Organization (UNESCO) that deals with technological innovation at an international level.

3.3.6 Case study 6: municipality of Trondheim, Norway

Trondheim municipality is the third most populous municipality in Norway, with a population of a little over 210 000 inhabitants. The municipality of Trondheim is the administrative body responsible for the services concerning urban development, health and welfare, culture and sports, industry, transformation, climate and the environment, and primary and pre-school education. In line with Norway's national structure of public administration, the municipality of Trondheim corresponds to the third level of management, which is at the local/municipal level.

(16) https://www.inps.it/content/inps-site/it/it/inps-comunica/inps--inclusione-e-innovazione/i-progetti-per-i-cittadini/classificazione-e-smistamento-pec.html.

(17) https://ircai.org/wp-content/uploads/2022/03/IRCAI-2021-Annual-Artificial_Intelligence-SDGs-TOP-100-Report.pdf

In terms of developing digital services, the municipality of Trondheim has a dedicated department with over 30 employees that works on different projects related to the development and use of digital tools. As the municipality needs to provide services for different activities and tasks, it operates through interdisciplinary teams that bring together different functional units from the municipality and other public bodies. In terms of implementing novel digital solutions, Trondheim municipality is one of the forerunners nationally and at the European level for the early adoption and use of emerging technologies. This is partially because it has managed to attract employees with high levels of technical skills and has a management culture that supports digital transformation projects.

Over the past 5 years, the IT group in Trondheim municipality has been working on AI-related projects that have been utilised for different key functions. Among these, two projects are at a mature stage of implementation, one on AI services for the **automatic evaluation of property prices** for yearly valuations and the other on **predictive tools for staffing**. These AI applications have over time been refined and have now been deployed in production. Through these, the municipality has learned lessons and is using this experience for future AI deployments. In fact, a roadmap has been developed for the further use of different AI tools over the next few years to fulfil several of the key tasks that the municipality is responsible for.

3.3.7 Case study 7: city of Amsterdam, the Netherlands

The city of Amsterdam has a well-established focus on the **use of AI for public services**. Amsterdam was among the first cities to establish an **AI registry**, which provides a standardised, searchable and archivable method for recording the decisions and underlying assumptions made throughout the life cycle of algorithms used by the city of Amsterdam, from development and implementation to management and eventual decommissioning [(18)].

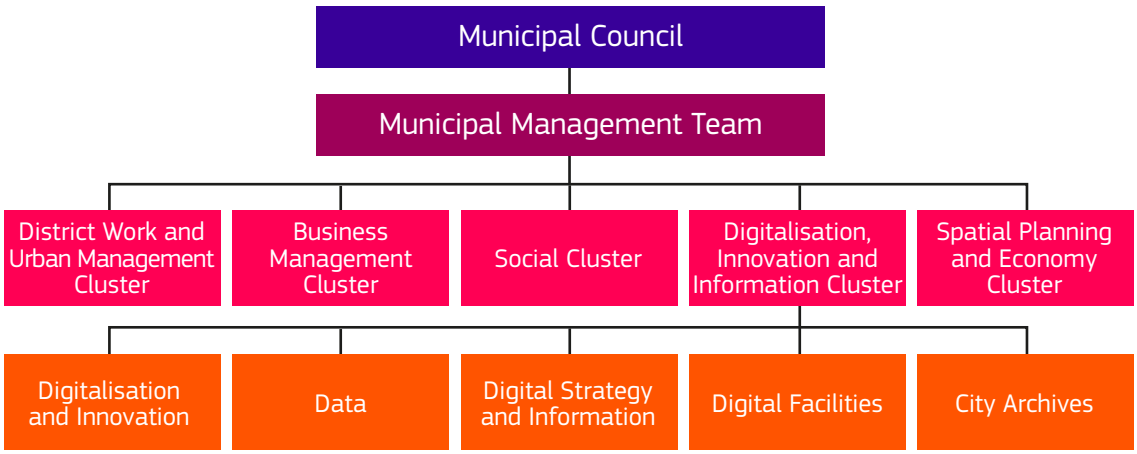
Notable pilot initiatives that have focused on the use of AI in the city of Amsterdam span different policy areas. In the policing area, a **crime anticipation system** drew on data about neighbourhoods and residents, supplemented by the police's own knowledge about crimes and local situations and information from Statistics Netherlands, to search for crimes that show a pattern, such as bicycle thefts. In the hospitality area, algorithms were employed to **combat holiday rental home fraud**, drawing on data from previous housing fraud cases, information from the city's population registries and building data from the city's registry of addresses and buildings. In the **waste management** area, an object detection kit was established as an open-source platform, to automatically scan and detect rubbish in public spaces and generate an alert when rubbish needed to be removed.

Digital initiatives, including AI-based ones, come under one of the five clusters that are under the control of Amsterdam Municipal Council and the Municipal Management Team. Clusters develop policy into city-wide frameworks, within which the city districts can carry out the executive work. Figure 4 provides an illustration of the organisational structure of the city of Amsterdam.

(18) https://algoritmeregister.amsterdam.nl/en/ai-register/.

Figure 4.

Organisational structure of the city of Amsterdam.



Source: *JRC own elaboration.*

The Digitalisation, Innovation and Information Cluster consists of five directorates. The Digitalisation and Innovation Directorate is the point of contact for all digitalisation initiatives of the city, and includes an innovation team that focuses on the influence of technology on the city and translates this into new guidelines and investments. The Data Directorate leads all data-related activities within the municipality, drawing on a team of researchers, statisticians, data engineers and information analysts. The Digital Strategy and Information Directorate is responsible for the frameworks and policy of the digital services and digital facilities of the city. The Digital Facilities Directorate supplies all digital products and infrastructure services within the municipality, in collaboration with outside suppliers. Finally, the City Archives Directorate has competences in acquiring, preserving and making available archives and collections from the city government, and from Amsterdam private institutions.

4 Competences for artificial intelligence in the public sector

4.1 Defining competences

For the purposes of this analysis, competences are considered attributes of an individual, not of an organisation (Salman et al., 2020). In this sense, the construct of competence differs from the construct of **capability**, which is usually conceptualised as an attribute of organisations (Chowdhury et al., 2023) and is akin to the concept of **organisational resources**.

We refer to competences as 'the ability to apply learning outcomes adequately in a defined context (education, work, personal or professional development)' (European Centre for the Development of Vocational Training, 2008, p. 47). In this sense, 'competence is not limited to cognitive elements (involving the use of theory, concepts or tacit knowledge); it also encompasses functional aspects (involving technical skills) as well as interpersonal attributes (e.g. social or organisational skills) and ethical values' (European Centre for the Development of Vocational Training, 2008, p. 47).

The notion of competence is also akin to, but different from, the one of **skills**. Digital skills, in fact, 'generally refer to people having and applying skills, abilities, competences, knowledge, and attitudes to learn, earn and thrive in digital societies' (Andrews et al., 2022, p. 46). Digital competences, however, are 'generally used to refer to a range of different abilities, many of which are not only skills per se, but a combination of behaviours, expertise, knowhow, work habits, character traits, dispositions, and critical understandings' (Andrews et al., 2022, p. 46).

4.2 A framework for competences

Our findings point to the presence of three groups of competences needed or used by individuals engaging with AI in the public sector: **technology, managerial, and policy, legal and ethical** competences. These groupings emerged from the analysis of the reviewed literature, and from the input received in the workshops and during the case study interviews. These groupings are also in line with similar groupings of issues related to AI adoption in the public sector present in the research literature (Sun and Medaglia, 2019).

In addition, our study has identified another dimension of competences for AI in the public sector that cuts across the three groups, that is, the level of abstraction that each competence features. Given the wide encompassing nature of the definition of competences adopted in this study, which includes both operational aspects, such as functional skills, and more abstract attributes, such as value and attitudes, we also grouped the competences into three cross-cutting clusters: **attitudinal competences**, **operational competences** and **literacy competences**. The clusters draw on the distinction between know-why, know-how and know-what types of knowledge (Garud, 1997).

Attitudinal competences refer to mindsets or dispositions that contribute to a public manager's ability to effectively use AI. This type of competence is related to a know-why type of knowledge, which involves drawing on principles, theories or underlying strategic rationales behind the adoption of AI in the public sector that are more abstract in nature. Attitudinal competences found in our analysis include technology inquisitiveness, that is, being able and willing to keep learning about new developments in AI; a positive attitude towards AI; technical design thinking, that is, being able to approach innovation of AI technology in an iterative and user-centred way; and a data-oriented culture.

Operational competences refer to practical applications of the knowledge required to work with AI in the public sector. Operational competences are related to a know-how type of knowledge, that is, procedural knowledge developed through practice that combines understanding with the ability to apply. Examples of operational competences in the technology domain include database management, data quality assessment and algorithm training. In the managerial domain, they include competences such as knowledge brokering, project ownership and the choice to delegate to AI. In the policy, legal and ethical domain, operational competences include auditing, dissemination and collaboration with domain experts.

Literacy competences include all fact-based knowledge required to use and work with AI and are related to a know-what type of knowledge, that is, proficiency in facts, data or information related to AI use in a public sector context. Examples of literacy competences in the technology domain include basic data literacy, understanding the fundamentals of machine learning, and understanding computer vision and natural language processing. In the policy, legal and ethical domain, literacy competences include AI procurement literacy and specialised legal expertise.

Based on the analysis of all the competences, we propose a comprehensive framework that captures both the distinction of the three dimensions of technology, managerial, and policy, legal and ethical competences, and the three cluster types of attitudinal, literacy and operational competences. Figure 5 provides a graphical representation of the framework.

Figure 5.

Competences for AI in the public sector: a comprehensive framework.

Source: *JRC own elaboration.*

The framework shows how each group of competences can be positioned within one of the three dimensions of technology, managerial, and policy, legal and ethical competences, and, at the same time, belongs to a cluster of attitudinal competences (linked to 'know-why' knowledge), operational competences (linked to 'know-how' knowledge) and literacy competences (linked to 'know-what' knowledge).

In addition, the framework highlights, through the side arrows, how each cluster of competences is related to the others. Specifically, it is operational competences that are informed by both literacy and attitudinal competences. As described above, operational competences refer to practical applications of knowledge required to work with AI in the public sector and are thus related to a know-how type of knowledge, that is, procedural knowledge developed through practice that combines understanding with the ability to apply. Therefore, operational competences imply the presence of competences related to facts and information about AI use in the public sector (i.e. literacy competences), and of competences related to mindsets and dispositions (i.e. attitudinal competences).

For example, in the technology dimension, the operational competence of 'database management' refers to the ability to manage data and databases effectively. This ability logically implies a literacy competence of 'basic data literacy', that is, a specific know-what type of knowledge, and an attitudinal competence such as 'data-oriented culture', which is the ability to think of data as central to the activities of a public manager and is linked to a more abstract, know-why type of knowledge.

In the managerial dimension, the operational competence of 'cross-team collaboration' refers to the ability to collaborate with different teams and organisations to pursue AI projects. This ability logically implies an attitudinal competence such as 'leadership', which is the ability to lead AI initiatives, and is linked to a more abstract know-why type of knowledge.

In the policy, legal and ethical dimension, the competence of 'AI-compatible policy formulation' refers to the ability to formulate policy questions as questions that can be answered by AI techniques, and as such it is part of the operational competence cluster. This ability logically implies a literacy competence of 'understanding of public policymaking and theory', that is, a specific know-what type of knowledge, and an attitudinal competence such as 'policy design thinking', which is the ability to approach AI policymaking in an iterative and user-centred way and is linked to a more abstract know-why type of knowledge.

This framework, being developed through a triangulation between research findings and practitioner experiences, can provide a number of practical uses. As competence frameworks are non-binding, however, users are not required to adhere strictly to them but are encouraged to apply them flexibly, allowing for customisation and adaptation to meet their specific objectives (Bacigalupo, 2022). As such, this comprehensive framework aims to fulfil three objectives.

First, it can be used as a mapping tool to assess the position of each competence in a **multidimensional view** that includes the type of competence (technology, management or policy/legal/ethical) and its clustering in terms of literacy, operational and attitudinal competences. This **descriptive** use of the framework can provide a heuristic for tackling practical challenges in the management of AI in the public sector. For instance, the framework can enable the evaluation of a public manager's abilities, pinpointing their strengths and areas for improvement across various criteria. This analysis can serve as a basis for comparative evaluations at the individual and organisational levels, and in reward systems within the public sector, pinpointing educational needs.

Second, the framework can serve to support the process of **personnel recruitment** in public organisations, by enabling a systematic analysis of potential public managers' capabilities in the context of AI-related projects.

Third, the framework lends itself to a **prescriptive** use. This goes beyond the descriptive approach that underpins the use of the framework for mapping competences to include the use of the framework as a starting point to **formulate recommendations** for the development of competences of AI use in the public sector. A number of recommendations are detailed in Chapter 6.

Based on this framework, in the following sections we provide a list of the grouped competences found in this study, with a discussion of some examples of empirical evidence from all three sources of empirical data: the literature reviews, the expert workshop and the case study interviews.

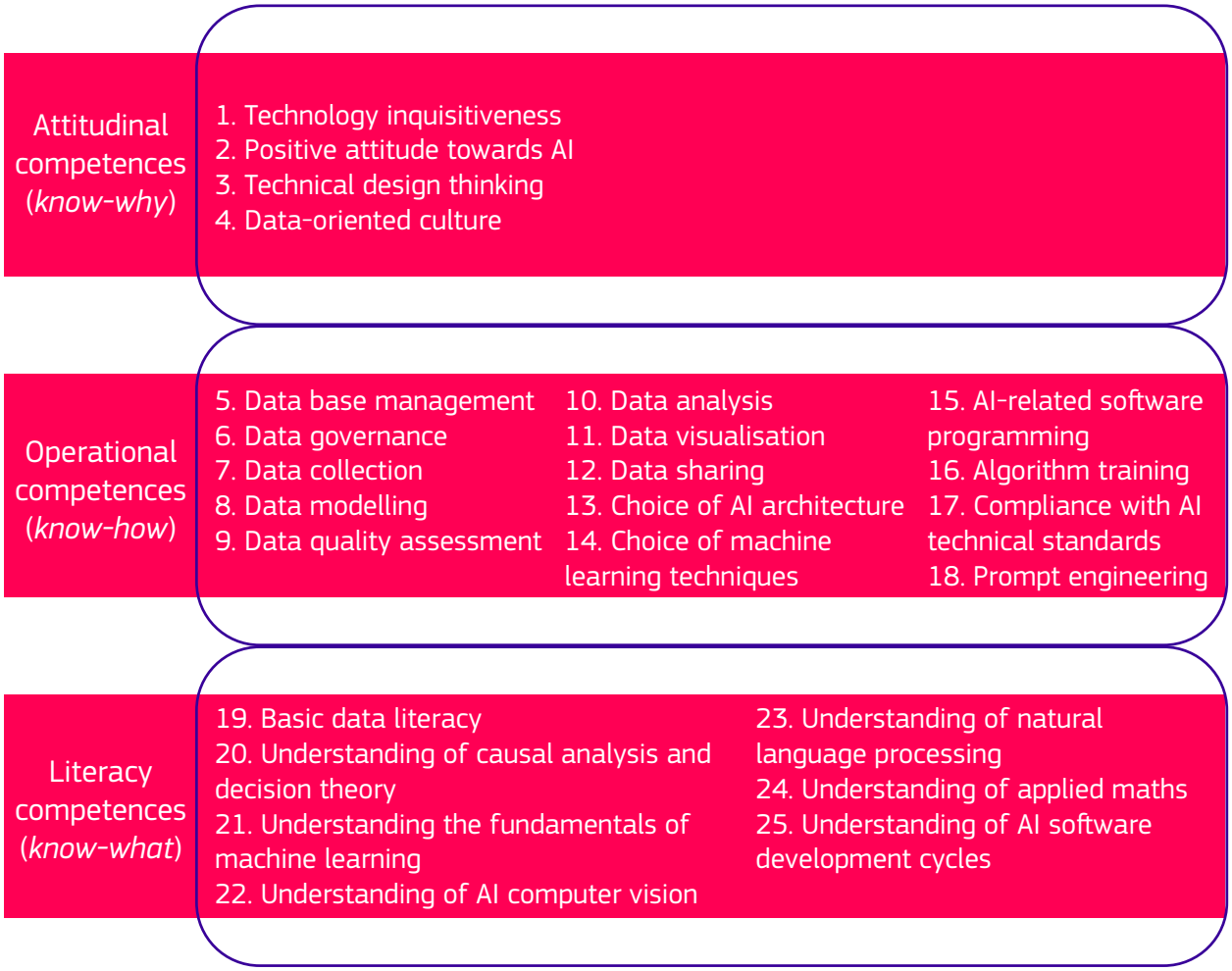
4.3 Technology competences

The first dimension is that of technology-related competences. Increasing numbers of empirical studies in the academic research literature and of documents from policy and grey literature provide details on the nature of these general technology competences. Such competences were also highlighted by participants of the expert workshop and in interviews in the case studies.

Figure 6 provides a graphical overview of all 25 **technology competences** identified in the study, divided by the clusters of attitudinal, operational and literacy competences.

Figure 6.

Technology dimension: attitudinal, operational and literacy competences.



Source: *JRC own elaboration.*

Table 4 provides an overview of the technology-related competences identified in the study, specifying the empirical source for each competence. The description of each competence is the result of the combined analysis of the corresponding sources indicated in the table together with (when available) the analysis of the transcripts of the case study interviews.

Table 4.

Technology dimension: attitudinal, operational and literacy competences.

Competence	Description	Source			Exemplary quotes from the interviews
		Academic literature	Policy/grey literature	Expert workshop	
Attitudinal competences (know-why)					
Technology inquisitiveness	Being able and willing to keep learning on new developments in AI		Broadband Commission (2022)		N/A
Positive attitude towards AI	Being able to have a positive attitude towards AI technologies	Ojo et al. (2019)			N/A
Technical design thinking	Being able to approach innovation of AI technology in an iterative and user-centred way		Broadband Commission (2022); Central Digital and Data Office (2024); Kupi et al. (2022)	✓	'We need an empathetic approach to the activities that need to be carried out: having a perception of what users do, being able to truly understand the meaning of what is possible, understanding what users do' (C5INT2)
Data-oriented culture	Being able to think of data as central in the activity of a public manager	Janssen et al. (2020); Pencheva et al. (2020)	Broadband Commission (2022)	✓	N/A
Operational competences (know-how)					
Database management	Being able to conduct data and database management effectively		Central Digital and Data Office (2024)		N/A
Data governance	Being able to apply data governance practices		Broadband Commission (2022); Central Digital and Data Office (2024); Dowdalls (2021)		N/A
Data collection	Being able to collect data in AI contexts	Maragno et al. (2022)			'Everybody I have worked with in the data science domain knows that it's 80 % about preparing data, making them become more or less structured so that it can actually be used as input to the intelligent algorithms. But even before that, it's an issue of getting the data out from wherever they are in' (C7INT1)

Competence	Description	Source			Exemplary quotes from the interviews
		Academic literature	Policy/grey literature	Expert workshop	
Data modelling	Being able to produce data models		Central Digital and Data Office (2024); US General Services Administration (2023)		'When you're designing technical setups, if you don't have a really good understanding of how the data works and flows within the organisation, within the infrastructure, you will get burned quickly … an AI project in the municipality will run into a data clog somewhere. You need to be able to understand the flows to actually unclog it. And you also need to be able to understand where the data originates' (C2INT4)
Data quality assessment	Being able to assess the quality of data in AI contexts	Wanckel (2022)			'You need to know your data and how clean it is and which data point you actually have access to' (C2INT4)
Data analysis	Being able to analyse data in AI contexts	Kuziemski and Misuraca (2020); Maragno et al. (2022)			N/A
Data visualisation	Being able to interpret requirements and present data using graphical representations		Central Digital and Data Office (2024)	✓	N/A
Data sharing	Being able to share data in AI contexts	Campion et al. (2022); Mikhaylov et al. (2018)			N/A
Choice of AI architecture	Being able to know when and how to use which AI architecture and why		US General Services Administration (2023)		N/A
Choice of machine learning techniques	Being able to know when to use a certain algorithm, tool and library in specific situation		Blok et al. (2021)		N/A
AI-related software programming	Being able to use relevant programming languages for the development of AI, such as Python and R		Broadband Commission (2022); Central Digital and Data Office (2024)		N/A

Competence	Description	Source			Exemplary quotes from the interviews
		Academic literature	Policy/grey literature	Expert workshop	
Algorithm training	Being able to train algorithms	Maragno et al. (2022)			N/A
Compliance with AI technical standards	Being able to adhere to and develop AI based on ethical and legal technical standards		Kupi et al. (2022)		N/A
Prompt engineering	Being able to prompt generative AI applications to obtain relevant and accurate outputs				'If we refer to the generative field, training courses also focus on prompt engineering skills … which seems like a big word, but in fact it is precisely knowing how to interact with this type of system and actually knowing what to take in output' (C5INT4)
Literacy competences (know-what)					
Basic data literacy	Being able to understand the basics of data		Dowdalls (2021); Kupi et al. (2022); US General Services Administration (2023)	✓	N/A
Understanding of causal analysis and decision theory	Being able to understand cause and effect relationships and being aware of decision theory related to data science practice		Kupi et al. (2022)		'[People working with AI in the public sector] need to be able to "look into the motor of the car" and understand what's going on in there. Because if you talk about these biases that can happen, we need to really understand what's going on inside these models: I think that's really important if you want to make responsible AI … we need to be able to understand what these models can do and where it can go wrong and how we can resolve that' (C6INT2)
Understanding the fundamentals of machine learning	Being able to understand key objectives and applications of machine learning	Ojo et al. (2019)	Blok et al. (2021); Dowdalls (2021)	✓	'You need to understand the technology … when these language-based models came out, I did some study. I took 2 days, 3 days at home and then set and did some studies on YouTube and asked ChatGPT itself about a lot of things: "What is a neural network? What's deep learning? What's a lot of these things?" And I think that's knowledge that I now stand on and actually use to work with this. And it didn't take that long actually' (C2INT3)

Competence	Description	Source			Exemplary quotes from the interviews
		Academic literature	Policy/grey literature	Expert workshop	
Understanding of AI computer vision	Being able to understand AI computer vision		Kupi et al. (2022); Samek et al. (2021)		N/A
Understanding of natural language processing	Being able to understand natural language processing		Kupi et al. (2022); Samek et al. (2021)		'You need to understand how and why it [a large language model] is answering wrong and what to use it for … Otherwise, you would be afraid of it and say it has its own mind and it can take over the world: no, it's just machine learning. It's just the predicting of the next word. It hasn't got a mind. If you don't understand that, you can get confused or you can get afraid for no reason' (C2INT3)
Understanding of applied mathematics	Being able to understand and use applied mathematics		Central Digital and Data Office (2024); Dowdalls (2021)		N/A
Understanding of AI software development cycles	Being able to understand the cycles of AI software development (e.g. development, testing, monitoring)				'Systems that have AI as their engine drastically change the way we approach the software development cycle … Once you've created a reliable model, once you've released it, you can't just leave it there and say: "My work is done, I'm leaving". You must always continuously monitor that the results are correct and consistent … The person who deals with AI projects must understand that it is a constantly evolving job' (C5INT1)

NB: N/A, not applicable.

Source: *JRC own elaboration.*

The first cluster of **attitudinal competences** in the technology dimension includes attitudes and mindsets considered necessary in relation to technical aspects of AI in the public sector.

Technology inquisitiveness – that is, being able and willing to keep learning new developments in AI (Broadband Commission, 2022) – and the role of a **positive attitude towards AI** as a technology has been a focus of research (Ojo et al., 2019). In addition, several grey literature and policy document sources highlight the relevance of **technical design thinking** – that is, being able to approach AI technology innovation in an iterative and

user-centred way – as AI requires an iterative development process with continuous integration of user feedback (Broadband Commission, 2022; Central Digital and Data Office, 2024; Kupi et al., 2022). The relevance of design thinking was also highlighted by some of the interviewees when referring to the need for 'an empathetic approach to the activities that need to be carried out: having a perception of what users do, being able to truly understand the meaning of what is possible, understanding what users do' (C5INT2).

A separate consideration has to be made in reference to the role of data. From an attitudinal perspective, both academic empirical studies (Janssen et al., 2020; Pencheva et al., 2020) and policy documents (Broadband Commission, 2022) highlight the relevance of understanding the importance of individual managers in embracing a culture that is **'data-oriented'**. Thinking of data as central in the activity of a public manager is an ability that brings about all the classic data-related competences, which occupy a central role when dealing with AI adoption in the public sector.

In the **operational competences** cluster, referring to 'know-how' knowledge, data-related competences are identified as being of core relevance.

Curricula aimed at training the public workforce, strongly focus on technical competences related to **database management** (Central Digital and Data Office, 2024) and **data governance** (Broadband Commission, 2022; Central Digital and Data Office, 2024; Dowdalls, 2021). Data-related competences in reference to AI adoption in the public sector include virtually all stages of data treatment. First, **data collection** competences are highlighted as key to laying the ground for successful public service AI applications (Maragno et al., 2022), especially considering that AI projects require large amounts of high-quality data (Campion et al., 2022): 'Everybody I have worked with in the data science domain knows that it's 80 % about preparing data, making them become more or less structured so that it can actually be used as input to the intelligent algorithms. But even before that, it's an issue of getting the data out from wherever they are in' (C7INT1).

The availability of collected data, however, does not suffice when considering applications of AI in the public sector. This is why **data modelling** is highlighted as a necessary competence in policy and grey literature (Central Digital and Data Office, 2024; US General Services Administration, 2023), and it was also focused on by interviewees in the case studies as a key requirement for the success of AI projects: 'When you're designing technical setups, if you don't have a really good understanding of how the data works and flows within the organisation, within the infrastructure, you will get burned quickly … an AI project in the municipality will run into a data clog somewhere. You need to be able to understand the flows to actually unclog it. And you also need to be able to understand where the data originates' (C2INT4).

The quality of data also affects considerations of necessary competences, as highlighted by one interviewee: 'you need to know your data and how clean it is, and which data point you actually have access to' (C2INT4). **Data quality assessment**, considered the ability to assess the quality of data in AI contexts, thus assumes great relevance, in line with findings form academic empirical research (Wanckel, 2022), together with **data analysis** (Kuziemski and Misuraca, 2020; Maragno

et al., 2022) and **data visualisation** (Central Digital and Data Office, 2024) to support decision outputs, and with **data sharing** (Campion et al., 2022; Mikhaylov et al., 2018), which is necessary for ensuring the scalability of the projects.

The competence of **choosing the appropriate AI architecture** is crucial for public servants involved in AI adoption. They need to possess the knowledge and skills needed to evaluate different AI architectures and make informed decisions on when and how to utilise them effectively. For example, understanding the benefits of cloud infrastructure and knowing when it is suitable for scalability, cost-effectiveness and data accessibility can greatly impact on the performance and efficiency of AI systems in the public sector (US General Services Administration, 2023).

Similarly, being able to make a **choice of machine learning techniques**, depending on each specific situation, is a key asset. This entails a deep understanding of the strengths, weaknesses and applicability of various machine learning algorithms, tools and libraries. By being proficient in choosing the most appropriate machine learning techniques, public servants can improve prediction accuracy, optimise resource allocation and enhance decision-making processes within the public sector (Blok et al., 2021).

Hands-on operational competences also include **AI-related software programming**, for example with languages such as R and Python (Broadband Commission, 2022; Central Digital and Data Office, 2024). Throughout implementation, AI systems have to be trained with appropriate data. **Algorithm training** is thus perceived as an emerging necessary competence that individuals working in public organisations have to master. For example, in a case of implementation of AI-powered chatbots, teams in public organisations are found to identify 'AI trainers' who need to be carefully selected on the basis of specific competences (Maragno et al., 2022).

Moreover, public servants must possess the competence of **compliance with AI technical standards**, which involves adhering to established ethical and legal guidelines and contributing to the development of such standards. This ensures that AI systems in the public sector are designed and implemented in a manner that upholds privacy, fairness and other ethical considerations. By demonstrating compliance with these technical standards, public servants can build trust among citizens and other stakeholders (Kupi et al., 2022).

Last, a technical competence specifically linked to the latest developments in AI technology is **prompt engineering**, that is, the ability to effectively communicate with generative AI to achieve desired outcomes. An interviewee emphasised the need for specialised training in prompt engineering, explaining that 'If we refer to the generative field, training courses also focus on prompt engineering skills … which seems like a big word, but in fact it is precisely knowing how to interact with this type of system and actually knowing what to take in output' (C5INT4). This indicates that the skill lies not only in the technical interaction but also in understanding how to guide the AI technology to produce useful results.

Technology **literacy competences** (related to a know-what type of knowledge) include proficiency in using AI applications, which are mentioned as either missing or investigated for their

specific characteristics in an AI context (Mikalef et al., 2022, 2023; Montoya and Rivas, 2019; Sharma et al., 2022; Sun and Medaglia, 2019).

For example, the US General Services Administration, through its IT Modernization Centers of Excellence, has issued the *AI Guide for Government*, where different technical profiles are outlined, all sharing a **basic level of data literacy** (US General Services Administration, 2023). These profiles include a data analyst, focusing on answering routine operational questions using well-established data analysis techniques, including AI tools; a data engineer, building and engineering data science and AI tools for reliability, accuracy and scale; and a data scientist, designing data science / AI models, tools and techniques. Such profiles are echoed in other guideline documents (Dowdalls, 2021; Kupi et al., 2022). Similarly, the government of the United Kingdom has outlined a series of competences related to data roles in government, clustering them in competence profiles that have relevance for AI applications. These profiles include a data analyst, a data architect, a data engineer, a data ethicist, a data governance manager, a data scientist and a performance analyst (Central Digital and Data Office, 2024). The profiles combine to different extents a wide array of hands-on competences, which are often mentioned in both governmental and consultancy analyses.

An **understanding of causal analysis and decision theory** is another critical competence for public servants involved in AI implementation. This technical competence enables public servants to 'make useful and valid (causal or attributional) claims based on data' and to 'make the right assumptions that typically are not directly testable and thus require domain expertise' (Kupi et al., 2022, p. 4). The relevance of this competence is also highlighted in our case study: '[People working with AI in the public sector] need to be able to "look into the motor of the car" and understand what's going on in there. Because if you talk about these biases that can happen, we need to really understand what's going on inside these models: I think that's really important if you want to make responsible AI … we need to be able to understand what these models can do and where it can go wrong and how we can resolve that' (C6INT2).

A specific focus is devoted to competences related to machine learning, computer vision and natural language processing. As a minimum, both academic research and policy studies highlight the importance for public servants of **understanding the fundamentals of machine learning** (Blok et al., 2021; Dowdalls, 2021; Ojo et al., 2019).

Similarly, an **understanding of computer vision and natural language processing** is deemed relevant for public managers (Kupi et al., 2022; Samek et al., 2021), together with an **understanding of applied mathematics**, such as regression, time series forecasting, cluster analysis, anomaly detection and association discovery (Dowdalls, 2021). These competences become increasingly urgent with the diffusion of generative AI and large language models, as testified by our case studies: 'You need to understand how and why it [a large language model] is answering wrong and what to use it for … Otherwise, you would be afraid of it and say it has its own mind and it can take over the world: no, it's just machine learning. It's just the predicting of the next word. It hasn't got a mind. If you don't understand that, you can get confused or you can get afraid for no reason' (C2INT3).

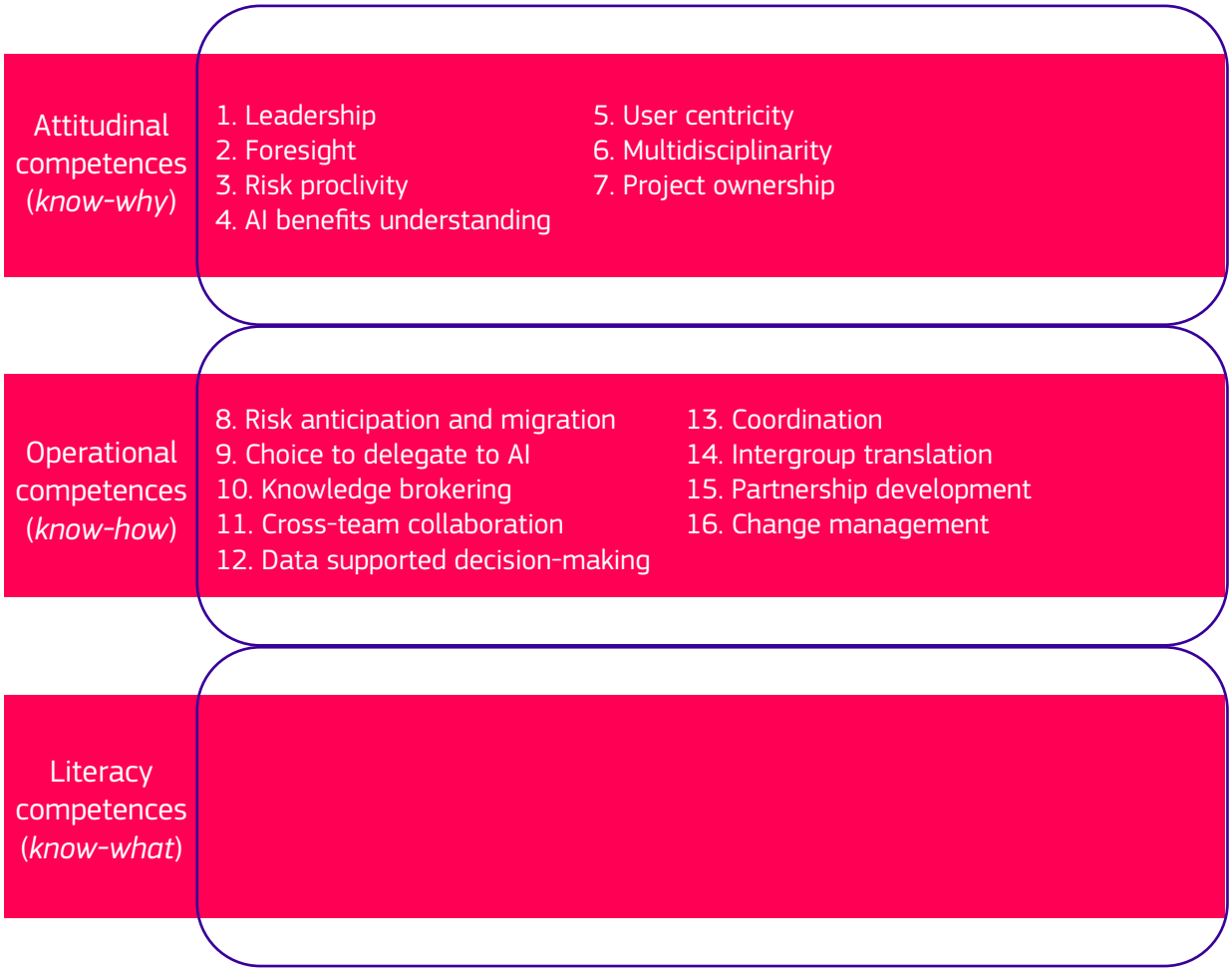
4.4 Managerial competences

The second dimension is that of managerial competences. As with technology-related competences, large numbers of empirical studies in the academic research literature and documents from policy and grey literature provide details on the nature of these managerial competences. Such competences were also highlighted by participants of the expert workshop and in interviews in the case studies.

Figure 7 provides a graphical overview of all the managerial competences identified in the study, divided into the clusters of attitudinal, operational and literacy competences.

Figure 7.

Managerial dimension: attitudinal, operational and literacy competences.



Source: *JRC own elaboration.*

Table 5 provides an overview of the **managerial competences** identified in the study, specifying the empirical source for each competence. Interestingly, neither the review of the literature nor the primary data collection (expert workshop and case studies) revealed any managerial competences in the literacy (know-what) cluster.

Table 5.

Managerial dimension: attitudinal, operational and literacy competences.

Competence	Description	Source			Exemplary quotes from the interviews
		Academic literature	Policy/grey literature	Expert workshop	
Attitudinal competences (know-why)					
Leadership	Being able to lead AI initiatives	Mikalef et al. (2022, 2023)	Andrews et al. (2022); Broadband Commission (2022)	✓	N/A
Foresight	Being able to anticipate future needs of functional managers, suppliers and customers, and proactively design AI solutions to support these needs	Mikalef et al. (2022, 2023)	Broadband Commission (2022)	✓	N/A
Risk proclivity	Being able to take risks in pursuing AI projects	Mikalef et al. (2022); Pencheva et al. (2020)			'You have to have a willingness to take risks. Especially if you're a leader, you have to be able to say: "Okay, we'll try this without thinking of everything that you should think of as well, in the first step". And also the ability to foresee that this has an impact without knowing what the impact might be. So a sort of playfulness, I would call it' (C2INT2)
AI benefits understanding	Being able to understand the benefits of AI	Alshahrani et al. (2022)			'From a management perspective, it's more about realising or acknowledging the potential so that you kind of support and facilitate that … you recognise that it should be a potential and you allow for people to investigate it, creating a necessary space in people's everyday life' (C7INT1)
User centricity	Being able and willing to collaborate with users of AI digital services and valuing their feedback		Broadband Commission (2022)	✓	N/A

Competence	Description	Source			Exemplary quotes from the interviews
		Academic literature	Policy/grey literature	Expert workshop	
Multidisciplinarity	Being able to blend traditional public service skills with modern digital skills		Central Digital and Data Office (2024); Farooq and Sołowiej (2020)	✓	'The core concept of being multidisciplinary is the respect for other people's competences. If you manage to let other people's point of view coexist without trampling anybody within these processes, you will have a more successful process in home … So: curiosity and respect' (C2INT4)
Project ownership	Being able to demonstrate ownership of AI projects	Mikalef et al. (2022, 2023)			N/A
Operational competences (know-how)					
Risk anticipation and mitigation	Being able to anticipate and mitigate risks of AI (e.g. privacy, security and ethical)		Blok et al. (2021); Broadband Commission (2022)	✓	'Even though the organisation as a whole experiences a productivity boost, some pockets in the organisation might actually experience that this technology is making their daily life more difficult. This ability to foresee these implications [is important]: to see how well received technology will be and what kind of aspects affect the reception of a technology' (C2INT1)
					'[The person dealing with AI projects] must also understand the impact that these AI projects have on the organisation in terms of impact on people's work and also understand where you can try to compensate a little. For example, for the efficiency gain in work that AI gives you, from another point of view that person is lost, or perhaps he works a little less. Then figure out how to reposition that person' (C5INT1)
Choice to delegate to AI	Being able to consider relevant factors in deciding whether or not to delegate a public service or a process to AI	Dickinson and Yates (2023)		✓	N/A

Competence	Description	Source			Exemplary quotes from the interviews
		Academic literature	Policy/grey literature	Expert workshop	
Knowledge brokering	Being able to access or exchange AI knowledge between different groups	Wilson and Broomfield (2022)	Andrews et al. (2022)		'There has to be people that take over roles which are not related to the AI itself, but are related to contacting, communicating, chasing the stakeholders that are involved to tick the box and get what they need from them' (C4INT2)
Cross-team collaboration	Being able to collaborate with different teams and organisations to pursue AI projects	Campion et al. (2022); Mikalef et al. (2022, 2023); Mikhaylov et al. (2018)		✓	'We also need some people that can understand the organisation's problems and wants. The technicians are not very good at that. So, they need to understand what it can do, what limitations there are to AI and to these language-based models. But also what the possibilities are, and go into a dialogue with the departments and say: "Okay, what are your problems? What can we solve?" So that's another kind of competences: they need to understand a department's issue' (C2INT3)
Coordination	Being able to coordinate AI-related activities	Mikalef et al. (2022, 2023)			N/A
Data-supported decision-making	Being able to make decisions based on data	Maragno et al. (2022)	Broadband Commission (2022)	✓	N/A
Intergroup translation	Being able to translate concepts from a bureaucratic language to a language that is understandable by users of AI public services	Maragno et al. (2022)	Central Digital and Data Office (2024)	✓	'It's a multidisciplinary focus of being able to understand the technical disciplines, and translate to the organisation, to the multidisciplinary fields and services that we service as a digitalisation department' (C2INT4)
Partnership development	Being able to develop partnerships, define opportunities for AI projects and define collaboration systems for new AI projects		Van Buren et al. (2021)	✓	N/A

Competence	Description	Source			Exemplary quotes from the interviews
		Academic literature	Policy/grey literature	Expert workshop	
Change management	Being able to manage changes in organisational processes introduced by AI				'Change management is the basis of everything. The introduction of any AI will lead to the change of an existing process or to the inclusion of a new step, or a new process … The inability to manage or think strategically about where this inclusion leads can create a critical issue. The basic competence is not so much knowing how to develop a model but knowing strategically where to include this model' (C5INT4)

NB: N/A, not applicable.

Source: *JRC own elaboration.*

Attitudinal competences needed by managers engaging with AI are highlighted in both academic research literature and policy and grey literature. These competences include **leadership**, that is, being able to lead AI initiatives, guiding and inspiring teams towards the successful implementation of AI projects (Andrews et al., 2022; Mikalef et al., 2022, 2023), for example managing GovTech projects and employees (Andrews et al., 2022). A joint report by UNESCO, the International Telecommunication Union and the Broadband Commission also highlights leadership as 'empowering teams in the government by creating enough room for members to take initiative, test and experiment with a common vision' (Broadband Commission, 2022, p. 43) and places strategic **foresight** as a central competence within the domain of digital planning and design for the public sector (Broadband Commission, 2022). The foresight competence entails the ability to anticipate and predict the future needs of functional managers, suppliers and customers. It involves proactively designing AI solutions that align with these anticipated needs, ensuring that the technology remains relevant and valuable (Mikalef et al., 2022, 2023).

Attitude-wise, the way managers involved in public AI projects approach risk (**risk proclivity**) is an important factor, whereby more risk-averse individuals might be less likely to effectively adopt and utilise AI (Mikalef et al., 2022; Pencheva et al., 2020). One interviewee explained: 'You have to have a willingness to take risks. Especially if you're a leader, you have to be able to say: "Okay, we'll try this without thinking of everything that you should think of as well, in the first step". And also the ability to foresee that this has an impact without knowing what the impact might be. So a sort of playfulness, I would call it' (C2INT2). For example, in the face of the risk of a short-term job loss or job replacement, public managers who **understand AI benefits** are found to have a positive impact on the success of AI projects (Alshahrani et al., 2022): 'From a management perspective, it's more about realising or acknowledging the potential so that you kind of support and facilitate that … you recognise that it should be a potential and you allow for people to investigate it, creating a a necessary space in people's everyday life' (C7INT1).

These benefits depend on which stakeholder's perspective is taken into account. The competence of **user centricity** encompasses the ability to collaborate with users of AI digital services and valuing their feedback. Civil servants are in fact expected to represent and advocate for user-centric tools and techniques when dealing with AI projects (Broadband Commission, 2022).

Multidisciplinarity is seen as the ability to blend traditional public service skills with modern digital skills; but it is also seen as a trait of public servants who can combine knowledge from different domains (e.g. anthropology, economics, sociology and philosophy) and use this knowledge to inform data projects, products and policies, and evaluate and challenge assumptions made in data science projects (Central Digital and Data Office, 2024). Multidisciplinarity is considered a competence required for working with a diverse team engaged in AI projects (Farooq and Sołowiej, 2020). In a similar fashion, the presence of managers who demonstrate **project ownership** and commitment to AI projects is correlated with increased organisational performance (Mikalef et al., 2022, 2023).

Within the cluster of **operational competences**, related to the know-how of managing AI projects, contributions from policy and grey literature highlight the need for proactive measures and strategies to address and mitigate potential risks, enabling the sustainable and ethical integration of AI technologies into the public sector. **Risk anticipation and mitigation** include the privacy, security and ethical dimensions (Blok et al., 2021; Broadband Commission, 2022). This was also remarked on in one of our case study interviews: 'some pockets in the organisation might actually experience that this technology is making their daily life more difficult. This ability to foresee these implications [is important]: to see how well received technology will be and what kind of aspects affect the reception of a technology' (C2INT1).

A unique characteristic of AI projects in the public sector is the necessity it brings to making decisions about which tasks and processes to **delegate to AI**. These decisions are complex, since they require the consideration of how easy it is to specify the processes to be automated, how much citizens value human interaction, what displaced costs might be involved in automation and how much human discretion is required for a process (Dickinson and Yates, 2023). A key competence thus becomes being able to consider relevant factors when deciding whether or not to delegate a public service or a process to AI.

Managers have to be able to **broker knowledge**, that is, accessing and exchanging AI-related knowledge between different groups, and facilitating the sharing of expertise, information and best practices to foster collaboration and innovation in public AI projects (Waardenburg et al., 2022). Unstructured learning forums, for example, are found to facilitate the transfer of important tacit procedural knowledge about AI (Wilson and Broomfield, 2022). Andrews et al. (2022) highlight the significance of knowledge brokering in fostering collaboration and driving innovation. By acting as intermediaries, knowledge brokers facilitate the flow of information and insights, bridging the gap between different stakeholders in the AI field. This enables the sharing of expertise, best practices and lessons learned. In the words of one interviewee, 'There has to be people that take over roles which are not related to the AI itself, but are related to contacting, communicating, chasing the stakeholders that are involved to tick the box and get what they need from them' (C4INT2).

Similarly, the ability to collaborate with different teams and organisations to pursue AI projects involves working across functional boundaries, fostering cooperation and leveraging diverse perspec-

tives to drive AI implementation. The absence of **cross-team collaboration** competences was found to be a predictor of the presence of problems in AI-related projects (Campion et al., 2022; Mikalef et al., 2022, 2023; Mikhaylov et al., 2018). This was also very apparent from the interviewees' personal experiences: 'We also need some people that can understand the organisation's problems and wants. The technicians are not very good at that. So, they need to understand what it can do ... and go into a dialogue with the departments' (C2INT3). In turn, this competence is complementary to **coordinating** diverse AI-related activities within the organisation (Mikalef et al., 2022, 2023).

Teams that engage in AI initiatives also need to include individuals who can make decisions based on data. This **data-supported decision-making** competence is found to be crucial when, for example, an AI system assumes the role of an organisational agent, with its own tasks (Maragno et al., 2022). Being able to communicate with different teams and organisations about AI's uses and related challenges involves being able to translate unwritten rules and norms about AI as a technology to groups that have different backgrounds and values (**intergroup translation**) (Maragno et al., 2022). Similarly, public servants should be able to translate concepts from bureaucratic language to a language that can be understood by users of AI public services (Central Digital and Data Office, 2024). One case study interviewee explained that 'it's a multidisciplinary focus of being able to understand the technical disciplines, and translate to the organisation, to the multidisciplinary fields and services that we service as a digitalisation department' (C2INT4).

When resources have to be found in the ecosystem, **partnership development** emerges as a crucial competence. Resources needed by public organisations engaging with AI include funding (Mikalef et al., 2023), technical expertise (Busuioc, 2021) and personnel (Wirtz et al., 2022). Public servants tasked with developing partnerships have to be able to define opportunities for AI projects and define collaboration systems. Partners can in fact be other public or private organisations, or even valuable individuals. For example, the city of Los Angeles brought volunteer data scientists from the private sector into government on a part-time basis to help with a variety of tasks, bringing some of the top data talent into public service with little cost to the government (Van Buren et al., 2021). Public agencies partnering with organizations in diverse ecosystems are more likely to have what they need to achieve their goals for AI (Van Buren et al., 2021).

The competence of **change management**, that is, the ability to manage changes in organisational processes introduced by AI, is one that emerged in only the case studies. According to one respondent, 'Change management is the basis of everything ... The inability to manage or think strategically about where this inclusion leads can create a critical issue. The basic competence is not so much knowing how to develop a model but knowing strategically where to include this model' (C5INT4). Here, the focus is on the strategic implementation of AI, rather than just the development of AI models, which suggests a broader view of how AI affects workflows and organisational structures.

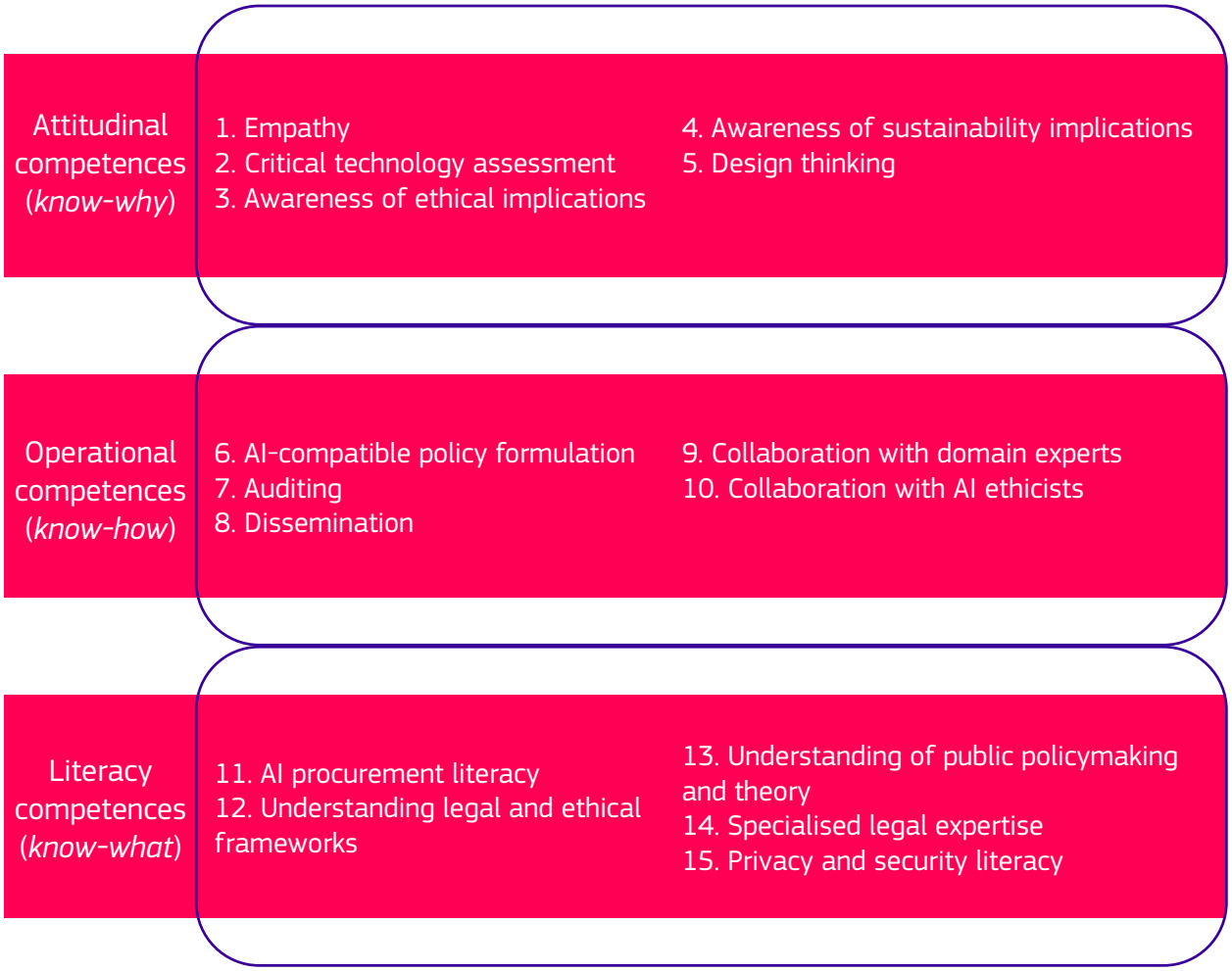
4.5 Policy, legal and ethical competences

The third dimension is the one of policy, legal and ethical competences.

Figure 8 provides a graphical overview of all the **policy, legal and ethical competences** identified in the study, divided by the clusters of attitudinal, operational and literacy competences.

Figure 8.

Policy, legal and ethical dimension: attitudinal, operational and literacy competences.



Source: *JRC own elaboration.*

Table 6 provides an overview of the policy, legal and ethical competences identified in our study, specifying the empirical source for each competence.

Table 6.

Policy, legal and ethical dimension: attitudinal, operational and literacy competences.

Competence	Description	Source			Exemplary quotes from the interviews
		Academic literature	Policy/grey literature	Expert workshop	
Attitudinal competences (know-why)					
Awareness of ethical implications	Being able to be aware of implications of AI on ethical and moral issues				'Anybody working in this field in a municipality context should have a very strong moral compass … being able to make an independent moral decision of the right and fullness of their conduct' (C6INT1)
Empathy	Being able to have an empathetic approach in implementing AI, identifying the needs, wants and objectives of end users and other stakeholders		Blok et al. (2021); Central Digital and Data Office (2024)	✓	N/A
Critical technology assessment	Being able to understand the limitations of data-driven technologies and choose whether to focus on augmenting experts' knowledge and skills or replacing them		Central Digital and Data Office (2024)	✓	'Humans are fundamentally moral beings. It's also one of the pure assets that sets us apart from computers … this is a realisation that I think is sometimes under-appreciated with people working in technology … also a result of decades of belief, specifically taught by big technology companies, that technology is neutral' (C6INT1)
					'It's rare to find the necessary critical thinking in engineers … most of the times they're so overconfident or over optimistic that they focus on the tree, and they miss the forest … I would like people that are active in asking questions' (C4INT1)
Awareness of sustainability implications	Being able to be aware of implications of AI on environmental sustainability		Manzoni et al. (2022)		N/A
Policy design thinking	Being able to approach AI policymaking in an iterative and user-centred way		Broadband Commission (2022)		N/A

Competence	Description	Source			Exemplary quotes from the interviews
		Academic literature	Policy/grey literature	Expert workshop	
Operational competences (know-how)					
AI-compatible policy formulation	Being able to formulate policy questions as questions that can be answered by AI techniques	Campion et al. (2022)			N/A
Auditing	Being able to apply auditing techniques to ensure compliance with design, performance and liability standards	Wirtz et al. (2022)	Eggers et al. (2019)		N/A
Dissemination	Being able to communicate AI initiatives		Central Digital and Data Office (2024)		N/A
Collaboration with domain experts	Being able to work together with domain experts from varying professional backgrounds		Kupi et al. (2022)	✓	'I'm just the data scientist. I know how to crack numbers and make predictions, but I don't necessarily know what a prediction means in that context … So the collaboration between domain experts and well AI experts is crucial' (C7INT2)
Consulting with experts on AI ethics	Being able to judge when experts on AI ethics should be consulted		Central Digital and Data Office (2024)		N/A
Literacy competences (know-what)					
AI procurement literacy	Being able to manage the procurement of AI in a way that is compatible with public interest values	Fountain (2022); Hickok (2022); Yeung et al. (2021)	Farooq and Sołowiej (2020); Kupi et al. (2022); US Government Accountability Office (2023); Tangi et al. (2022)	✓	'The competence that is important is being able to be critical towards these companies, understanding what their interests are, being able to actually technically compare what they're offering to someone else and being able to know what kind of contracts and needs we need to set up and work with these companies' (C2INT1)

Competence	Description	Source			Exemplary quotes from the interviews
		Academic literature	Policy/grey literature	Expert workshop	
Understanding of legal and ethical frameworks	Being able to understand and be aware of relevant legal and ethical frameworks for AI		Broadband Commission (2022); Central Digital and Data Office (2024); Kupi et al. (2022)		'One skill that I feel is very important is being able to understand how policies – the in-house policies and the European and national laws – are interpreted when it comes to using certain solutions' (C2INT1)
Understanding of public policymaking and theory	Being able to understand policymaking processes, governance and public management theory and practices		Kupi et al. (2022)		N/A
Specialised legal expertise	Being able to utilise specialised legal expertise on, for example, data rights, intellectual property, licensing, and relevant and domain-specific legislation		Blok et al. (2021); Broadband Commission (2022)		'I think it is the challenge [the AI Act] that everybody has to deal with around Europe, regardless of if it's a national level or local or regional level. It's interesting to see how this will be also informed from the AI Act … there is some information there, but it's still pretty high level' (C1INT3)
Privacy and security literacy	Being able to understand and act on the issues, concerns and threats around privacy and security raised by AI		Broadband Commission (2022)		N/A

NB: N/A, not applicable.

Source: *JRC own elaboration.*

The first key **attitudinal competence** emerging from the case studies is the **awareness of ethical implications** of AI in the public sector. The ability to make moral judgements when dealing with AI is seen as a requirement for a public manager: 'anybody working in this field … should have a very strong moral compass … being able to make an independent moral decision of the right and fullness of their conduct' (C6INT1).

Within the cluster of attitudinal competences, the literature highlights the importance of **empathy**, that is, the ability to adopt an empathetic approach in implementing AI, identifying the needs, wants and objectives of end users and other stakeholders (Central Digital and Data Office, 2024). Empathy is also associated with applying a flexible mindset by setting aside one's own assumptions (Blok et al., 2021).

Being able to undertake a **critical technology assessment** is another attitudinal competence and refers to the ability to understand the disadvantages of AI technologies, together with their benefits. Public servants are expected to steer away from a 'techno-solutionist' approach and consider the relevance and appropriateness of AI initiatives for context-based problems. For instance, public managers should be able to carefully choose whether to focus on augmenting experts or replacing them, on a case-by-case basis (Central Digital and Data Office, 2024). As interviewees note, techno-solutionism tends to be prevalent: 'Humans are fundamentally moral beings … this is a realisation that I think is sometimes under-appreciated with people working in technology' (C6INT1). As a result, critical competences are required: 'It's rare to find the necessary critical thinking in engineers … most of the times they're so overconfident or over optimistic that they focus on the tree, and they miss the forest … I would like people that are active in asking questions' (C4INT1).

A competence that is often overlooked, but that is starting to emerge as crucial, is the **awareness of the sustainability implications** of AI initiatives. The degradation of the natural environment is potentially exacerbated by AI technologies such as deep learning. These technologies are highly computationally demanding, relying on extensive training datasets and numerous hyper-parameter experiments to achieve the desired models. Consequently, AI consumes substantial amounts of energy, resulting in significant carbon emissions. For example, training a single large language model alone has been found to produce approximately 300 000 kg of carbon dioxide emissions, roughly equivalent to taking 125 round-trip flights between New York and Beijing (Dhar, 2020). Regrettably, current AI development practices tend to prioritise algorithm accuracy at the expense of energy efficiency. As the establishment of precise metrics for assessing the environmental impact of AI technologies is still in its nascent stage, public servants need to be aware of the implications of AI projects for the environment, and be able to plan, monitor and mitigate accordingly (Manzoni et al., 2022).

Finally, from an attitudinal point of view, relevance is attributed to adopting **policy design thinking**, that is, the ability to approach AI policymaking in an iterative and user-centric way, for example by involving citizens as end users in co-creating AI policies (Broadband Commission, 2022).

The cluster of **operational competences** includes a wide range of competences related to the know-how needed in the policy, legal and ethical domain of AI. Public managers need to be able

to translate policy challenges into questions that can be asked of AI systems (**AI-compatible policy formulation**). Decision-makers need to 'have a basic understanding of what a data-oriented question is' and be able to 'pose analytical questions which could be answered by AI techniques, even if they wouldn't know how to do it themselves' (Campion et al., 2020, pp. 31–32) to move away from thinking in terms of only policy documents.

Another key competence is related to the **auditing** of AI. Public servants need to be able to apply auditing techniques to ensure compliance with design, performance and liability standards. As AI systems are increasingly integrated into various aspects of government operations, auditing serves as a mechanism to assess and evaluate the performance, decision-making processes and outcomes of AI systems within public sector organisations. For example, the consultancy company Deloitte proposes the use of an 'algorithm auditor' who would be in charge of executing periodic reviews to determine fairness of a model after deployment (Eggers et al., 2019). Algorithm audits encompass the examination of black-box concerns, algorithmic prejudice, safeguarding privacy and unlawful bias. Alongside problem identification, algorithm auditors provide suggestions to enhance the model's ethicality and comprehensibility. The competences required for such a profile include machine learning literacy, programming and data analytics (Eggers et al., 2019). Auditing as a competence helps safeguard against potential risks, ultimately fostering public confidence in AI-driven government services (Wirtz et al., 2022).

The remaining operational competences in the policy, legal and ethical dimension are concerned with outward-facing activities. These include **dissemination**, that is, the ability to communicate AI initiatives to relevant stakeholders and to the general public (Central Digital and Data Office, 2024), and **collaboration with domain experts** from varying professional backgrounds (Kupi et al., 2022). Effectively communicating insights based on data to decision-makers requires an in-depth understanding of political and organisational contexts (Kupi et al., 2022), as highlighted by one interviewee in the case studies: 'I'm just the data scientist. I know how to crack numbers and make predictions, but I don't necessarily know what a prediction prediction means in that context … So the collaboration between domain experts and well AI experts is crucial' (C7INT2).

Moreover, public servants need to be able to team up with experts, since AI projects require a wide array of skills from different knowledge domains. In particular, **collaboration with AI ethicists** [19] is mentioned in policy recommendations. For example, the UK government, in detailing the public servant profile of the 'data ethicist', includes the competence of being able to work with specialised ethicists who provide legal and ethical assessments on AI (Central Digital and Data Office, 2024).

Finally, the policy, legal and ethical dimension also includes **literacy competences**. First and foremost, competences related to the **procurement of AI** have a central role. Policymakers are expected to navigate 'make-or-buy' decisions to gain access to external talent and expertise, while simultaneously maintaining control and monitoring quality (Kupi et al., 2022). It is considered important that the procurement of AI is aligned with relevant existing governmental strategies (Farooq and Sołowiej, 2020). For example, the US Government Accountability Office has recently

19) 'An ethicist is an individual with a robust knowledge of ethics who possesses the capacity to apply such abstract concepts to concrete situations … an AI ethicist is someone who does this in the context of artificial intelligence' (Gambelin, 2021, p. 89).

issued a report to the US senate providing guidelines for the procurement of an AI system in the US Department of Defense (US Government Accountability Office, 2023). Research shows that most adopters of AI-powered tools in a public sector context are bound to purchase technology from vendors instead of building them in-house, given the expertise required and upfront costs associated with developing them (Desouza et al., 2020). As a result, competences related to the procurement of AI are highlighted as very relevant at all stages of technology acquisition (Tangi et al., 2022). For instance, public managers need to be able to leverage purchasing power and identify contracting requirements to demand that technology vendors produce AI models that attend to racial bias (Fountain, 2022). However, requirement specification is only one part of the acquisition process; this process also includes acquisition planning, solicitation and selection, development, delivery, deployment, maintenance and sustainment (Hickok, 2022; Yeung et al., 2021), where public managers are required to have key competences, to mitigate the risks of AI applications (Fountain, 2022). In general, according to our case studies, AI procurement literacy does not only involve setting up contracts in alignment with public interests, but also requires 'being able to be critical towards these companies, understanding what their interests are, being able to actually technically compare what they're offering to someone else' (C2INT1).

As far as legal expertise is concerned, it is approached in multiple ways in the policy and grey literature. On the one hand, various reports and guideline documents highlight that public servants engaged in AI projects must possess an **understanding of legal and ethical frameworks**. Creating specific data science-based solutions in government requires familiarity with legal and ethical frameworks (Central Digital and Data Office, 2024; Kupi et al., 2022). To prevent systems from being dissolved through court decisions at a later stage, it is crucial to have a comprehensive understanding of the legal context in which the system is implemented and the constraints of the legal framework (Broadband Commission, 2022). Similarly, the policy literature highlights that an **understanding of public policymaking and theory** is a required competence, needed to anchor all other technical and managerial competences in the government context (Kupi et al., 2022).

Another reference to the relevance of the legal context is present in the call for **specialised legal expertise** for public servants involved in AI projects (Broadband Commission, 2022). Legal expertise here refers, for example, to issues on data rights, intellectual property and licensing that arise in relation to the implementation and management of AI systems (Blok et al., 2021). The enforcement of the AI Act, in particular, is seen as requiring legal expertise among public organisations at all levels in the EU: 'I think it is the challenge [the AI Act] that everybody has to deal with around Europe, regardless of if it's a national level or local or regional level. It's interesting to see how this will be also informed from the AI Act … there is some information there, but it's still pretty high level' (C1INT3).

In addition, the inclusion of individuals' personal information, such as tax returns, welfare benefits, law enforcement records and driving licence information, gives rise to numerous concerns related to **privacy and security**, in an attempt to strike the delicate balance between protecting individual rights and promoting the greater good (Broadband Commission, 2022). Public servants involved in AI projects have to be able to ensure that data used to train AI systems are secure and protected from tampering, and apply principles of data minimisation.

4.6 Discussion

4.6.1 General considerations

The analysis of the data from the literature review, the expert workshop and the case studies highlights a number of general key points about the role of competences in an organisation, and the related challenges.

The first key point refers to the need for **competence variety**. Multiple interviewees in the case studies remarked that different competences from different individuals need to be combined for the successful use of AI in a public organisation: 'Any team kind of needs a wide variety of competences' (C6INT1). Such variety is sought after by some public organisations in the hiring process. This might require looking beyond the traditional hiring criteria: 'I hire people not on their educational backgrounds, but what they have of different competences that I can see match into how they can work on developing things' (C2INT2).

The second consideration refers to the **difficulty in attracting technical talent** in the market. As noted by interviewee C6INT2, public organisations struggle to attract the most technically competent talent, that is, they might be able to attract individuals who have strong social motivation to work in the public sector, but who are not necessarily technically excellent: 'If I'm very honest, we don't get the best people. Or we get quite good people, but then they come because of the societal goals, most often, not because people think this is the coolest place to do AI' (C6INT2).

Among the key reasons for this difficulty is the disparity in salaries between public organisations and private companies: 'For the technical roles in the organisation, the salary stops at some point. In the government there are these days so much data and so many applications … but if we want to take care of all the difficult questions we have, then we also need to have skilled people, and pay for them' (C6INT2).

Another reason is the slowness of the hiring process in public organisations, which often have to fulfil heavy bureaucratic requirements to hire AI talent in a market where individuals with such talent are much more swiftly captured by private enterprises:

> For example, if a person is the best AI expert in the world and I want to hire him, and he also wants to work with the public administration, I can't hire him! Because there is the requirement to publish a tender, which takes time. Then, there has to be a series of interviews. In the end, if we're lucky, maybe in a year's time, I'll be able to hire this person. But in the meantime this person, after a year, has probably found another job and is no longer interested in coming to work in the public administration. So one of the problems is precisely the slowness in hiring (C5INT1).

However, as mentioned above, the public sector has other features that can be attractive for prospective AI talent, such as its societal mission:

> What [the public sector] can do is try to compensate for the lack of salary and the slow hiring with a mission by saying: 'Maybe you will be a little hungry compared to what you can obtain elsewhere. But you have an important impact in the society'. This resonates with many people, so it is the only lever that the public sector can draw on, because the work that you do in the public sector, when it works, has a positive impact on tens of millions of your fellow countrymen (C5INT1).

A third consideration relates to the **need to adopt a sociotechnical view** on AI solutions. On the one hand, in public organisations providing services to citizens, individuals who have technical competences often fail to understand what the practical problems are that need a solution. On the other hand, the average public employee who does not possess technical competences often fails to understand how AI could support the solution for existing problems.

This is well exemplified in the words of interviewee C2INT4:

> [An AI initiative] originates in the digitalisation department and then it runs the course and hits the service or the people who are supposed to use it too late … that's usually actually also in digitalisation projects where it fails, where either somebody gets served a new digital solution and thinks: 'What am I going to do with that?' Or the other way around, where somebody demands something of the digitalisation part and we look at them and say: 'How are we supposed to solve this for you?' (C2INT4).

4.6.2 Competences that are difficult to obtain

Based on these findings, it is worth discussing aspects related not only to how relevant different competences are considered, but also how some competences are seen as particularly difficult to obtain. Such insights into competences that are difficult to obtain are crucial in devising competence profiles that are not just comprehensive and multidisciplinary, but also realistic, given the constraints of the talent market.

Artificial intelligence procurement literacy

AI procurement literacy, that is, the task of negotiating with technology vendors, can be daunting, given that there is often information asymmetry between public servants and counterparts in vendor companies that try to sell complex AI products:

> Very often, people in the municipality approaching external companies end up in a very unbalanced situation, where **the company they're talking to has much more knowledge about the technology** and the ability to agree on a contract that is to their benefit, compared to the buyer in the municipality (C6INT1).

This results in a power imbalance that is unfavourable for the public organisation and requires specific competences on the side of the public managers engaged in the procurement process:

> Once you're buying a cloud solution that is going to have some semi-automatic machine learning employed into it, and you're actually even outsourcing the development and the training of the model to the consultancy, **most people in municipalities** that are doing that kind of market analysis, and trying to understand what kind of product they need to buy, what kind of deal that they have to make with this company, **are not in a great position in terms of negotiating the best agreement with that company** (C6INT1).

The challenges in relation to competences related to the procurement of AI do not disappear once an AI application has been purchased and implemented, but continue through the lifetime of the application, during its use by the public organisation. One such challenge is related to data access:

> That's a very broad issue with having an external company deliver certain services and wanting later on to play with the data yourself or innovate or develop itself: you will typically experience that **the data is difficult to access** because that was not a need that was expressed early on. You might have to pay extra, put a lot of resources into making that available (C6INT1).

Another challenge is related to the lock-in mechanism, whereby a public organisation heavily invested as a client of both AI system services and AI-related know-how becomes increasingly dependent on the vendor over time:

> Since the public sector lacks AI talent, it must rely on external companies. By relying on external companies, the problem is this: you risk having a colossal lock-in. Because if they have the know-how of this technology that is becoming more and more central to your services, a complex technology, and you rely on a supplier, that supplier then begins to become your supplier almost for life (C5INT1).

Such challenges resulting from the procurement process link to the wider issue of the **'buy or make' dilemma** that public organisations face when dealing with AI, given that 'if you're doing things in-house, there's a completely different skill set. You are in full control of what you're building' (C6INT1).

The next chapter reports on findings on the governance practices needed for AI in the public sector.

5 Governance practices for artificial intelligence in the public sector

5.1 Defining governance practices

To organise findings based on prior studies of governance, the first step was to build on a definition of governance that aligns with the goal of this report. Thus, the identification of key pillars of governance was based on the work of Van Grembergen et al. (2004), Tallon et al. (2013) and Mikalef et al. (2020), who stated that governance is the organisational capacity to control the formulation and implementation of the technology strategy and in this way to ensure that there is fusion between organisational goals and the technology used to enable it. From this perspective, AI governance is suggested to comprise procedural, structural and relational practices. These dimensions are also used to categorise the different forms of practices that have been described in relation to AI deployment. **Procedural practices** in relation to AI governance concern the ways in which organisations execute the different functions that are pertinent to effectively managing AI (Schiff et al., 2022). **Structural practices** have been defined as those that concern the identification of key decision-makers and their corresponding roles and responsibilities (Tallon et al., 2013). Finally, **relational practices** have typically included complementary, but equally important, aspects of governing technology that are concerned with the types of links between and within important stakeholder groups (Tallon et al., 2013).

5.2 A framework for governance practices

The identification of organisational governance practices around AI in the public sector indicates that there is a broad range of aspects that span multiple levels within organisations. Our initial analysis of the findings from the literature review, focus groups during the online workshop and case studies differentiated between three different facets that AI governance includes, as described above. Yet, the analysis also indicates that the practices that fall in these three categories also concern different levels within public organisations. Therefore, it is important to identify the relevant organisational level to which such practices are applicable to facilitate

planning and deployment in public organisations that intend to deploy AI. Specifically, the levels that are identified are categorised as strategic, tactical and operational.

Strategic-level AI governance practices are those that concern long-term focused decisions and actions, where the executive management division focuses on the vision and mission of an organisation. Decisions made at the strategic level relate to the direction that the organisation is heading, and how AI can support that path. In addition, the strategic level defines the network of collaborations that are required to achieve the long-term target and provides the environment in which tactical- and operational-level practices must be performed. Typically, strategic-level decisions are made by the higher levels of management within the organisation.

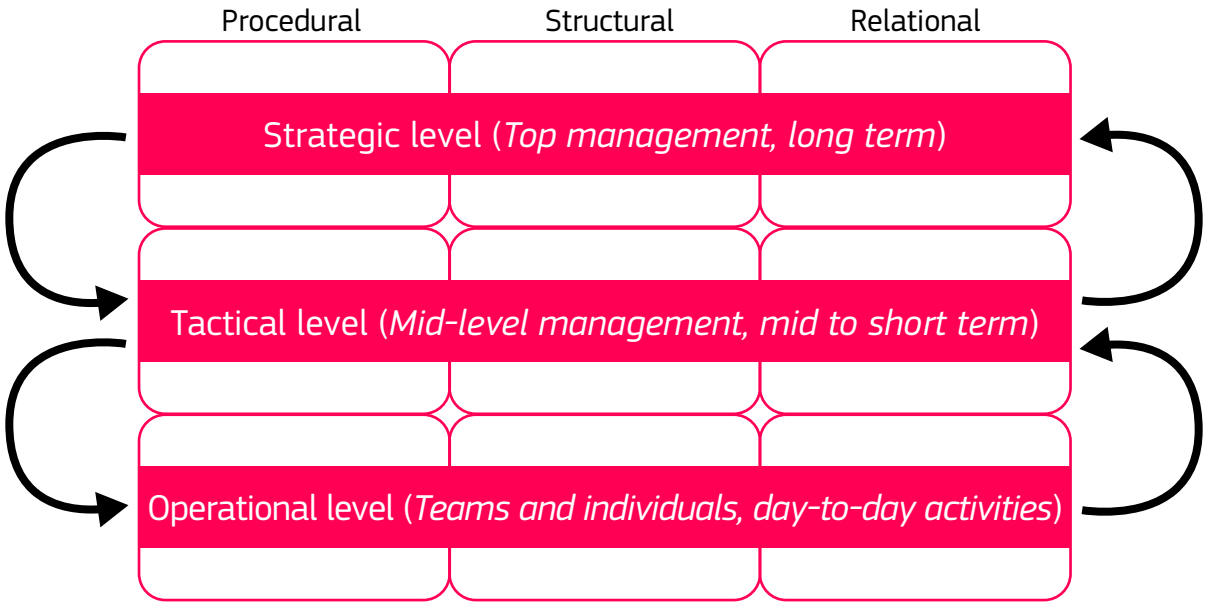
Tactical-level AI governance practices concern decisions and practices that are focused on the mid term. Typically, AI governance practices that are taken at the tactical level are focused on specific organisational departments, unlike strategic-level decisions, which concern the entire organisation. Thus, tactical-level AI governance practices are more focused on the individual departments but should also be aligned with the decisions made at the strategic level. The overall goal of tactical-level AI governance practices is that they should be able to explain how work should be carried out.

Operational-level AI governance practices are those that revolve around the short-term actions. They are mostly focused on day-to-day operations and are detail specific for concrete outcomes. AI governance practices at the operational level are those that have an immediate effect on the planning and execution of AI and typically have a lifespan of 3–6 months. The main responsibility for AI governance practices at this level lies with line managers, and they focus on how and when a specific activity needs to be carried out. Effectively, operational-level practices enable an organisation to achieve its outcomes and must be aligned with tactical-level practices.

By plotting the three different aspects of AI governance (i.e. procedural, structural and relational) and the three organisational levels at which they are enacted, a matrix emerges that clearly defines the activities and responsibilities of AI governance in public administration per level (Figure 9). Through this approach, it is possible to assign specific actions to different levels of public organisations concerning their responsibilities of AI governance. In addition, utilising the matrix of AI governance practices per level can expose areas that have not been appropriately addressed yet, or highlight practices that are misaligned among different levels.

Figure 9.

Governance practices for AI in the public sector: a comprehensive framework.



Source: *own elaboration.*

By plotting the governance practices identified onto the framework shown in Figure 9, it can be seen that there is a distinction between the levels at which AI practices need to be implemented. While the AI governance practices of each level have implications for the levels below and above, they are placed in the matrix based on the level that has the main responsibility for making the key decisions that shape them. In addition, in the framework presented in Figure 9, the arrows represent the interdependencies among the different levels, meaning that, for example, a decision made at the strategic level needs to be implemented and followed at the levels below. Similarly, AI governance practices that are made at the operational or tactical levels need to be aligned and coordinated with those that are made at the levels above.

The framework can thus be seen as a way of determining the key area of responsibility for specific decisions and actions related to AI governance in public organisations. In Figure 10, the identified practices of AI governance are mapped onto the three different levels at which the main responsibility and decision-making lie. In effect, the mapping of AI governance practices onto the three levels of decision-making can be used by practitioners to identify what tasks and responsibilities need to be considered at each level when implementing AI projects.

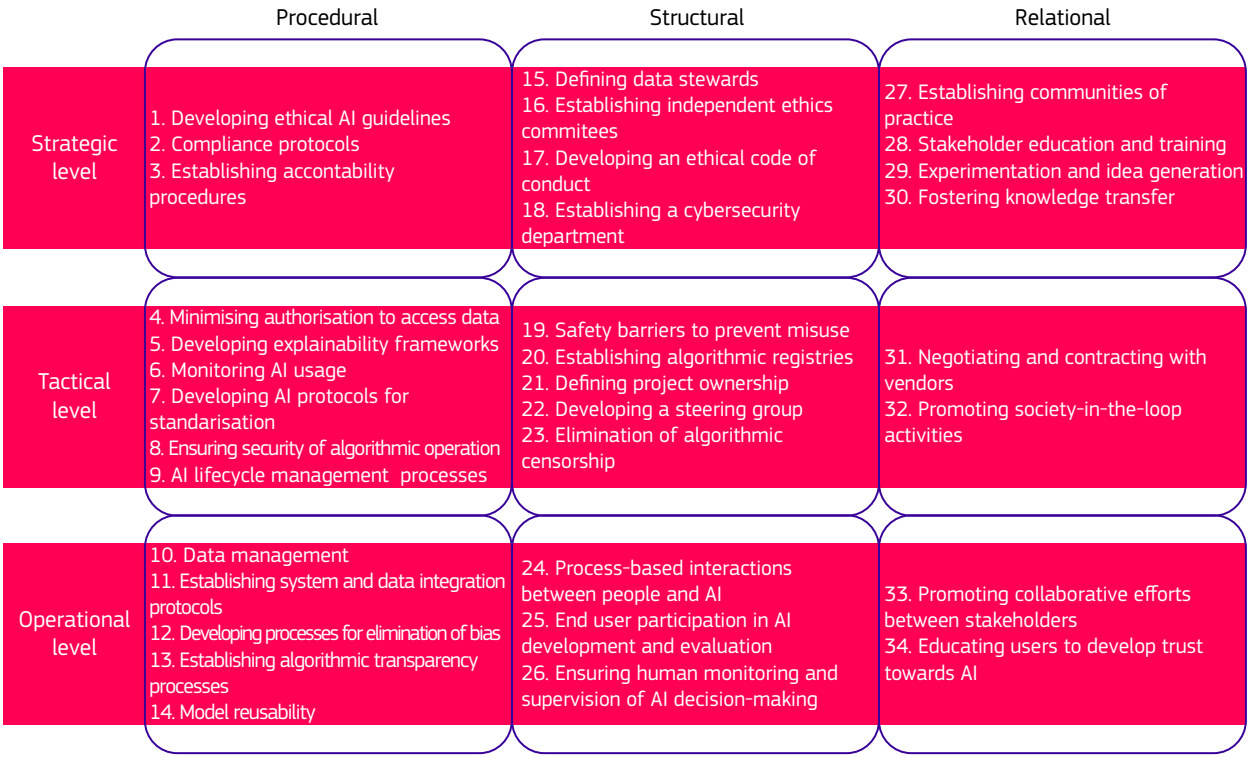
In addition, the framework can serve as a starting point for developing specific procedures, structures and relational mechanisms that are context dependent. While it is highly probable that all public organisations that are deploying AI will need to consider the AI governance practices that have been outlined below, it is unlikely that they will all implement such practices in the same way. Thus, the mapping can be seen as a guiding framework rather than a readily implementable toolbox of tasks to support AI development and implementation.

Finally, the framework can be utilised as a means of defining policymaking recommendations based on areas that prove to be challenging for many public organisations. Through the analysis of prior studies and the collection of primary data, several barriers facing public organisations' adoption and implementation of AI have been identified. The framework presented in Figure 10

can therefore also be seen as a means to propose actionable recommendations, which follow in Chapter 6.

Figure 10.

Governance practices for AI in the public sector, organised by level of responsibility.



Source: *own elaboration.*

From the interviews conducted with respondents in government agencies, there were several common patterns that emerged when compared with published research. The empirical research studies identified a broad range of practices for AI governance in the public sector, while the interviews identified a more limited number of practices, but did include those that are central to initiating AI projects. Following the similar categorisation of competences, these practices are presented under the categories of procedural, structural and relational AI governance practices. An overview of the practices that were identified through the literature review, the expert workshop and the interviews is presented in Tables 7–9, along with short descriptions and corresponding quotes from the interview transcripts. The tables also include the source(s) in which the specific governance practices were identified.

5.3 Procedural practices

The procedural practices that were identified concern broad aspects of AI development and use, and span different stakeholders involved in the process. The type of activities that procedural practices are related to are also quite diverse in nature, which can be explained by the fact that AI applications in the public sector are inherently interdisciplinary and span different facets.

Specifically, **minimising authorisation to access data** was consistently noted as an important practice that public organisations need to formulate, by establishing appropriate access rights and

developing processes for the authorisation of user groups to handle them (Desouza et al., 2020; Janssen et al., 2020). Similarly, **data management** represented a complementary aspect that defined what procedures should be carried out for data used in AI project life cycles to validate data in relation to their quality (Council of Europe, 2021; Evans, 2023; Fountain, 2022; Janssen et al., 2020). In addition, procedures need to be formulated for **establishing system and data integration protocols** to effectively transfer and merge datasets from different sources (IBM Center for the Business of Government, 2021; Wirtz et al., 2019). One interviewee highlighted that: 'If there are any data issues connecting to data in the different IT systems, we are helping them to get these connections, the data out of the system and stuff like that' (C2INT3).

The findings also indicate that there is a need to **develop ethical AI guidelines**. These processes are needed to ensure that AI applications are developed in accordance with societal norms and values (Wirtz et al., 2022; Zuiderwijk et al., 2021). Adding to the need for ethical guidelines, the need for **developing processes for elimination of bias** is recurringly found as an important part of AI governance. As bias may reside in the data or the training of algorithms, it is important to have formalised processes that check for its occurrence (IBM Center for the Business of Government, 2021; Janssen et al., 2020). Equally as important, however, is the need for **establishing algorithmic opacity / transparency processes** that can explain why algorithms produce certain results and what is the underlying logic for their outcomes (Sun and Medaglia, 2019). While such processes produce insight into the inner workings of AI algorithms, it is also critical to **develop explainability frameworks** that include formalised processes of explaining outcomes to different stakeholders, with the necessary level of information (Rjab et al., 2023). To ensure that there are no deviations from the expected use of AI systems, public organisations also need to develop procedural practices for **monitoring AI usage**.

As there is considerable variation in terms of outcomes of AI systems, it is important that public organisations **develop AI protocols for the standardisation of utilised systems**, which can align the way AI development and testing are conducted (Wirtz et al., 2022). Similarly, there is a need to clearly define **compliance protocols** to align what is carried out internally with the relevant regulatory and legal frameworks that are applicable (Accenture, 2023; Guenduez and Mettler, 2023; Wirtz et al., 2022). Another complementary aspect noted by interviewees concerns the need to **ensure security of algorithmic operations**, meaning that there are procedures that avert algorithm manipulation or misuse.

In planning for contingency events, **establishing accountability procedures in cases of AI failure or unintended consequences** are important, as they provide a well-dined protocol for identifying responsibility and can help improve AI use (Wirtz et al., 2022). Likewise, to guarantee that AI systems operate as intended, organisations should develop **AI life-cycle management processes** that update the system when needed. Finally, to be able to scale up the use of AI in public organisations, it is important to define processes for model reusability, which define under what contexts an AI model can be reused.

Finally, to be able to scale up the use of AI in public organisations, it is important to define processes for **model reusability**, which define under what contexts an AI model can be reused.

Table 7.

Procedural governance practices.

Governance practice	Description	Source			Exemplary quotes from the interviews
		Academic literature	Policy/grey literature	Expert workshop	
Strategic level					
Developing ethical AI guidelines	Establishing processes to ensure that AI applications are developed in accordance with ethics and norms	Wirtz et al. (2022); Zuiderwijk et al. (2021)			'There is also societal risks and harms that you should take under consideration. So that's why we introduced this idea of an impact assessment' (C2INT1)
Compliance protocols	Establishing processes that define how the design, development and testing of AI should be carried out so that it is in accordance with regulatory and legal AI frameworks	Guenduez and Mettler (2023); Wirtz et al. (2022)	Accenture (2023)		'.... a framework that is made by, like an independent party. And they tell you what you have to do to be compliant. This is the. This is our standard within the municipality. Yeah. This is like the minimum. This is what you have to do. And then there's a few extra documents that you have to have in place to organise the governance of your algorithm' (C6INT2)
Establishing accountability procedures	Formulating processes that define who is responsible for different aspects in the case of failure, and scenarios for dealing with such occurrences	Wirtz et al. (2022)		✓	N/A
Tactical level					
Minimising authorisation to access data	Establishing access rights to datasets so that only authorised individuals can handle them	Desouza et al. (2020); Janssen et al. (2020)		✓	'So with this in mind, we are looking in the health department, that has really sensitive patient data. So we are talking about really sensitive citizen and patient data we have to work with using AI' (C1INT1)
Developing explainability frameworks	Formalised processes of explaining outcomes of algorithms to different stakeholders, with relevant information	Rjab et al. (2023)		✓	'... therefore the moment in which important external services towards the citizen on the provision of a service are based on being able to explain the reason for a refusal and understand why he responded that way' (C1INT1)
Monitoring AI usage	Processes that examine how AI systems are utilised by end users and if there are any deviations from expected use	Wirtz et al. (2022)			'So in the start I was looking for the chatbot and it was gone, because it actually was not used enough, not by our colleagues, employees and also not by the citizens. So we think that we actually were missing implementation of the tool. Nobody actually knew about it, understood it, or was able to work with it' (C1INT1)

Governance practice	Description	Source			Exemplary quotes from the interviews
		Academic literature	Policy/grey literature	Expert workshop	
Developing AI protocols for standardisation	Establishing processes that ensure that AI development and testing are conducted in a uniform way	Wirtz et al. (2022)			N/A
Ensuring security of algorithmic operation	Developing and implementing security procedures so that AI algorithms are not manipulated or misused				'But apart from that, I think that the algorithmic uses is subjected to the same security and privacy checks that any kind of digital technology that we use in the city is' (C6INT1)
AI life-cycle management processes	Developing life-cycle management processes that ensure performance management and update the system when needed			✓	N/A
Operational level					
Data management	Establishing procedures that explain how data should be handled during AI project life cycles and how to ensure data quality	Fountain (2022); Janssen et al. (2020); Wirtz et al. (2019)	Council of Europe (2021); Evans (2023)	✓	'And in the [AI] strategy we will have a huge capital, a chapter saying how we are going to work with data and how are we going to work with AI and how do we want to use AI in the future' (C1INT1)
Establishing system and data integration protocols	Processes to effectively transfer or merge datasets from different sources to effectively develop AI applications	Wirtz et al. (2019)			'The problem is that the data is stored in many different silos around and the users are more updated on the user interface than the data in the system … and that's a main problem in in the municipality and the public sector' (C2INT2)
Developing processes for elimination of bias	Establishing processes to ensure that there is no unwanted bias in the data that are used for training AI algorithms	Janssen et al. (2020)		✓	'So which data we would touch, which data would not touch and why comes at the early stages of the project. As a manifesto, it is not discussed at low level. It is discussed at the very beginning at very high level. And I would say that the legal department had the first say in that' (C2INT2)
Establishing algorithmic transparency processes	Being able to explain why algorithms produce certain results and tracing the causality of outcomes	Sun and Medaglia (2019)		✓	'One of the main points in that policy is transparency: building models that any data-driven solution in production that uses public sector data, data of our citizens, needs to be transparent' (C2INT1)
Model reusability	Formalised procedures defining when and under what contexts an AI model can be reused			✓	N/A

NB: N/A, not applicable.

Source: *JRC own elaboration.*

5.4 Structural practices

Structural practices in the context of AI governance in public organisations concern the definition of key decision-makers and the allocation of their corresponding roles and responsibilities. The findings indicate that **defining data stewards** is critical to ensuring that there is appropriate oversight of data and how data are governed within the organisation (Accenture, 2023; Janssen et al., 2020). In addition, it is important that public organisations **establish independent ethics committees** to deal with difficult issues that may be related to the conflicting interests of different groups (Accenture, 2023; Janssen et al., 2020). To ensure the minimisation of unintended outcomes, it is also important that AI governance practices incorporate **safety barriers to prevent misuse** (Saura et al., 2022; Wirtz et al., 2022). As one respondent noted: 'We're going to look at the risks that are part of this project where the fundamental values of the city might be harmed. And we're going to look together different mitigation strategies, how the harm can be reduced as much as' (C6INT1).

The findings of the case studies also indicate that **establishing algorithmic registries** that list all algorithms used by public bodies is necessary, to increase transparency and enhance trust. Complementary to such practices is **defining project ownership rights**, which can then be referred to establish responsibility and accountability. In the case studies, respondents also highlighted the need to **develop an ethical code of conduct**. Specifically, one respondent highlighted 'That [ethical code of conduct] is something that guides how you work, that informs which decisions you make when you develop a new technology and that you bring into the world. So this is a realisation that I think is sometimes underappreciated with people working in technology, and that's both because people don't see themselves all the time as moral beings, but it's also a result of decades of belief, specifically taught by big technology companies that technology is neutral' (C6INT1).

In addition to the above, structural practices should include **process-based interactions between people and AI**, meaning that there should be structures that define what is permissible for AI agents when they interact with human agents (Rjab et al., 2023; Valle-Cruz et al., 2020). A central element in the above is **developing a steering group** that is responsible for making key decisions that concern AI projects and their entire life cycles. Nevertheless, there should also be appropriate structures that ensure **end user participation in AI development and evaluation** (Janssen et al., 2020; Zuiderwijk et al., 2021).

The introduction of AI in public organisations also necessitates developing appropriate structures that limit the potential risk of, security breaches of and attacks against AI applications. Thus, organisations that utilise AI widely will need to **establish cybersecurity departments** with specific mandates around AI. Similarly, and due to the inherent risks, it is important that organisations **employ human monitoring and supervision of AI decision-making** by defining appropriate structures that can mitigate or prevent unwanted actions (Wirtz et al., 2022). A complementary aspect is defining structures for the **elimination of algorithmic censoring** in applications (Wirtz et al., 2022).

Table 8.

Structural governance practices.

Governance practice	Description	Source			Exemplary quotes from the interviews
		Academic literature	Policy/grey literature	Expert workshop	
Strategic level					
Defining data stewards	Establishing structures that account for the oversight of data and of how it is governed within the organisation	Janssen et al. (2020)	Accenture (2023)		'We also say that before doing that you have to go on with an impact assessment regardless of the data protection regime, right. I'm sure they would do that anyway' (C2INT1)
Establishing independent ethics committees	Developing representative and qualified groups of stakeholders who can ensure that AI conforms with ethical standards and norms	Janssen et al. (2020)	Accenture (2023)	✓	'When such a project pops up that includes the ethics, I would say that all these ethical aspects and are being included under the legislate, the legislation umbrella. So it's entity in the public administration, in the governance, in all the other entities is being represented legally or has a legal department which is being run by any public body which actually consults on what is being allowed, what is not being allowed' (C2INT2)
Developing an ethical code of conduct	Formulating and adopting ethical and moral guidelines when developing AI systems				'And the first line of that oath is I will serve justice. Um, in the last line of the oath is I will always form myself an independent opinion about the rightfulness of my conduct. So from this follows that anybody working in this field for in in a municipality context should have like a very strong moral compass, you know, and it's able to make a moral and independent moral decision of the right and fullness of their conduct' (C6INT1)
Establishing a cybersecurity department	Developing a dedicated department that ensures that there is no risk of security breaches or attacks against AI applications				'Actually we have a special cybersecurity department [in] the ministry that's releasing regular updates on the cybersecurity and stuff and they will probably in the future they will be transferred to the office of the government with these guidelines as well' (C3INT3)
Tactical level					
Safety barriers to prevent misuse	Establish structures that allow organisations to have fail-safe mechanisms for intended or unintended outcomes	Saura et al. (2022); Wirtz et al. (2022)		✓	'But for example the [anonymised] said nobody can use it for internal data for example. And the same goes for using AI for translation of internal secret documents, it's prohibited very strictly for using it because nobody knows where this information will finally be' (C3INT3)
Establishing algorithmic registries	Develop registries to list all algorithms used by public bodies to increase transparency				'For example, um, all algorithms need to be listed in our algorithmic and register, which is public, so that citizens can have a fair understanding of what kind of algorithms the city is using and in what field, for example' (C6INT2)

Governance practice	Description	Source			Exemplary quotes from the interviews
		Academic literature	Policy/grey literature	Expert workshop	
Defining project ownership	Establishing discreet roles in terms of ownership and responsibilities, and accountability of AI projects				'We did one pilot where we would detect construction containers in the city. But then there was not really someone responsible for these construction containers. So there was multiple departments involved. But who was then the owner? Uh, that was quite hard, for example. So it's. Yes, it's sometimes quite hard to find the owners and to organise the governance' (C6INT2)
Developing a steering group	Defining key roles and responsibilities for decision-making around AI projects				'And my role is as well to be in the steering group head of the project, where we're sitting and deciding which projects are going to the next phase. So I have a decision-making role as well. So I'm a part of the strategic decisions of data work in the municipality as well' (C2INT3)
Elimination of algorithmic censorship	Establishing structures that promote the elimination of algorithmic censorship and minimisation of suppression of free and equitable reach	Wirtz et al. (2022)			N/A
Operational level					
Process-based interactions between people and AI	Establishing mechanisms that define what interactions are permissible for AI agents in relation to human agents	Rjab et al. (2023); Valle-Cruz et al. (2020)		✓	'In my opinion this is often not understood that artificial intelligence now does not replace man but goes along with him and supports him. So this too is not a, let's say, a somewhat blurred boundary' (C6INT2)
End user participation in AI development and evaluation	Establishing structures that involve end users in the design and testing of AI algorithms	Janssen et al. (2020); Zuiderwijk et al. (2021)		✓	
Ensuring human monitoring and supervision of AI decision-making	Establishing structures that enable control over decision-making of AI to avoid actions that may be unintended or unwanted	Wirtz et al. (2022)		✓	N/A

NB: N/A, not applicable.

Source: *JRC own elaboration.*

5.5 Relational practices

Relational practices have typically included complementary, but equally important, aspects of governing technology that are concerned with the types of links between and within important stakeholder groups. In the context of AI governance in public organisations, such practices include **stakeholder education and training** (Criado and de Zarate-Alcarazo, 2022; World Bank, 2022). Such training can take on different forms, as one respondent notes: 'So what I helped them with is how to develop their own sense of how to make a moral justification about your work. So we have certain techniques and workshops and working methods that I guide them through. And this is, this is mandatory for every project, uh, that we have reserved time and space for every project and we're going to look at the fundamental moral reason why this project exists' (C6INT2). Similarly, it is equally important that there are approaches for **educating users to develop trust towards AI**, to minimise resistance to adopting these technologies (Kleizen et al., 2023; Yigitcanlar et al., 2023). A key aspect of achieving such results is to **promote collaborative efforts between various stakeholders** in projects so that the requirements and concerns from each stakeholder group are voiced (World Bank, 2022; Zuiderwijk et al., 2021), as one respondent mentioned: 'We are starting up a group that consists of selected people from around the whole organisation from the departments' (C2INT3).

A dimension of relational practices that was consistently noted as being important to AI success in public organisations was that of **experimentation and idea generation**. This finding was highlighted in the workshop and mentioned by several respondents in the case studies, with one respondent mentioning that 'we do have the experiment team to make sure that we have a fair understanding of which expectations of AI are fair and just and which ones are maybe a little bit inflated' (C6INT1). Although such approaches are needed for internal development of projects, it was also noted that it is important that public organisations are capable in **negotiating and contracting/sourcing with vendors**, with one respondent indicating that ' ... the gathering of data supporting the development of applications is sometimes outsourced ... So then a specific assignment is given to a company to collect this kind of data in the city to be used in such a project' (C6INT1).

For many public organisations, especially those of a smaller size, it was noted that it was critical for them to **establish communities of practice**, by either forming informal networks or joining alliances to gain know-how around AI (Zuiderwijk et al., 2021). Similarly, reaching out to the public and **promoting society-in-the-loop activities** was highlighted as critical, as it enables challenging input from end users about improvements that need to be made in AI applications. Finally, to be able to learn from projects and reduce the time to deliver, **fostering knowledge transfer from AI projects** is regarded as critical, and organisations should attempt to develop formal and informal channels of knowledge exchange among individuals and departments (Sharma et al., 2022).

Table 9.

Relational governance practices.

Governance practice	Description	Source			Exemplary quotes from the interviews
		Academic literature	Policy/grey literature	Expert workshop	
Strategic level					
Establishing communities of practice	Developing communities of best practices and alliances to gain know-how around AI				'Usually municipalities look outward, when we need something, when we need a problem solved or a new procurement or something like that. So it's always good to have friends in the other municipalities because we don't procure in the same sort of sequence. So sometimes somebody have had an idea before you or built upon your own idea or you've had a dialogue with some company that produces this kind of product and you pass it along' (C2INT4)
Stakeholder education and training	Educating stakeholders about new skills and ensuring that they foster specialisations and are up to date in relevant know-how	Criado and de Zarate-Alcarazo (2022); Wirtz et al. (2022)		✓	'And with this tool we also combined an AI which can help looking at the profile of an employee and his or her competences and the aims they want to develop; so what are the next specific competence, building blocks or teaching lessons they need to undergo' (C1INT1)
Experimentation and idea generation	Allocating enough time and resources for bottom-up initiatives to emerge			✓	'But when it comes down to what we actually do, it's still based on some people having a good idea such as this, work planning tool that that came from below, it didn't come from above' (C4INT1)
Fostering knowledge transfer	Establishing formal and informal channels of knowledge exchange so that lessons learned from past AI projects are transferred to future initiatives	Sharma et al. (2022); Yigitcanlar et al. (2023); Zuiderwijk et al. (2021)			N/A
Tactical level					
Negotiating and contracting with vendors	Developing a capacity to understand AI requirements and specifying them in contract agreements				' ... people in the municipality approaching external companies end up in a very unbalanced situation, where the company they're talking to has much more knowledge about the technology and the ability to agree on a contract that is to their benefit, compared to the buyer in the municipality' (C2INT1)

Governance practice	Description	Source			Exemplary quotes from the interviews
		Academic literature	Policy/grey literature	Expert workshop	
Promoting society-in-the-loop activities	Establishing forums that allow members of the public to provide input and insight concerning AI applications	Kleizen et al. (2023); Wirtz et al. (2022)	World Bank (2022)	✓	N/A
Operational level					
Educating users to develop trust towards AI	Developing approaches that target end users of AI applications, with the goals of enabling end users to understand how AI applications operate and minimise resistance to adopt	Kleizen et al. (2023); Yigitcanlar et al. (2023)	World Bank (2022)	✓	'Let them [users] play with a robot. Let them play with a chatbot. Let them play with the learning management software so that they are not scared any more that they learn the understanding and that they actually learn how to use it' (C1INT1)
Promoting collaborative efforts between stakeholders	Establishing mechanisms to ensure that all relevant stakeholders collaborate in an effective way for AI development and requirements from the different groups are considered	Zuiderwijk et al. (2021)	World Bank (2022)	✓	'And then they [vendors] had some meetings along and we used the system in small departments first, and then rolled it out more and more as time goes' (C2INT3)

NB: N/A, not applicable.

Source: *JRC own elaboration.*

5.6 Discussion

5.6.1 General considerations

In addition to the specific practices highlighted by the interviewees, a number of important points concerning the challenges of governance of AI were also raised. In particular, two main issues that emerged in the interviews revolved around alignment with national strategies, and adherence to regulations and directives. These considerations were also identified in the literature review as well as during the online expert workshop.

The first main challenge highlighted concerned **alignment with national strategies**. Specifically, several respondents indicated that it was challenging for them to establish a formalised governance scheme for AI projects because of the lack of a coherent and supportive national strategy. In several instances, respondents noted that formulating a complete AI governance scheme for their organisation was not possible due to the lack of direction concerning what types of applications should be prioritised, as well as how proactive they should be in the provision of AI-based services. This point was illustrated by one respondent: 'I guess though that there is kind of national strategy around AI, as you mentioned. This is a map or strategy … around AI without saying anything about what are the priority areas and what is the timeline looking like in terms of like areas that should be particularly focused' (C3INT3). In this regard, respondents noted that they are expecting some national directives or guidelines to help them identify priority areas for their AI deployments.

The second important challenge highlighted by many respondents concerns the impact that different **regulatory frameworks and directives** will have on how to govern AI projects. At the time of conducting the interviews, the AI Act was still in the development stage, so there was a lot of uncertainty about its content and how it would affect future decisions surrounding AI. One respondent highlighted that: 'That is a big problem, and that is one of the problems we are addressing through the project data-driven organisation, making a data platform. But then, even if we would have all data available, and machine readable. And it is at a good enough granularity then still there might be some law saying that you cannot do this, so it's quite annoying' (C4INT2). Findings such as these indicate that there is a lack of clarity regarding which frameworks and laws apply in each case, as well as that comprehending how such frameworks and laws can be implemented in governance practices is at an early stage. Such regulations and directives have a very important influence on how AI governance practices are developed and implemented. In addition, as many regulations and laws, such as the AI Act (European Parliament, 2023), have only recently been introduced, public organisations are under considerable pressure to continuously monitor, interpret and correctly implement them. This can be challenging, especially for smaller or more decentralised public organisations that lack the necessary resources to do this, making the issue of AI governance increasingly more complex to navigate. Understanding how different levels of public administration and the respective organisations that represent these levels address this issue is important for establishing best practices for how to effectively develop and continuously update AI governance practices.

In addition to the issues highlighted above having a direct impact on how governance practices are developed and enacted, the interviewees also reported that several governance practices around AI have been identified in prior studies. These are further discussed in the subsection that follows.

5.6.2 Contextuality of artificial intelligence governance

Another important element of AI governance in public organisations is that many practices and approaches may not be applicable to all types of bodies. Within the public organisation domain, there exist different levels of authority, including central ones, such as governments and ministries, and local ones, such as municipalities and local governments. As each type of organisation is responsible for different services for citizens and society, it is also likely that the corresponding AI applications will be of a different nature, thus requiring a context-specific approach to governance.

For instance, large numbers of key citizen and business data are stored centrally and at corresponding component authorities, where more decentralised public organisations only have access rights to query such data (Medaglia et al., 2023). Thus, governance of how these data are handled and used for the development of AI applications will differ substantially, and different facets of governance practices may be relevant to the varying organisations involved. Similarly, as the scale of use of different AI applications is different for national and local public organisations, user involvement in the design and evaluation of the solution may be approached in radically different ways. It is also important to understand how AI governance is developed at the national level and how it is enacted and distributed to the local and regional levels to avoid duplicate or overlapping practices that might impede progress with AI implementation.

6 Recommendations

Based on the empirical findings of this study and drawing on the proposed frameworks for competences and governance practices for AI in the public sector, we propose a set of key recommendations for public administrations, to help them move towards scouting, developing and nurturing competences in public organisations that work with AI projects, and foster ways in which deployment and diffusion of AI can be accelerated through effective AI governance.

6.1 Recommendations on competences

We propose a set of three recommendation for the future development of competences for AI in the public sector in Europe. Each recommendation is articulated in three actions that operationalise it.

Table 10 illustrates each recommendation and the corresponding actions.

Table 10.

Recommendations on competences for AI in the public sector.

Recommendation	Action
1. Develop focused, interdisciplinary AI competence training programmes	1a. Incorporate AI modules into existing public sector training programmes
	1b. Create specialised AI training pathways for different public sector roles
	1c. Collaborate with academic and industry partners for AI training
2. Promote applied interdisciplinary research on AI competences	2a. Fund applied interdisciplinary research projects focusing on competences for AI in the public sector
	2b. Establish research consortia to investigate competences for AI in the public sector
	2c. Promote knowledge exchange and dissemination of research findings on competences for AI in the public sector
3. Establish dedicated hiring processes and devote additional resources to attracting specialists with AI competences	3a. Develop a public sector AI talent recruitment strategy
	3b. Create AI fellowship and internship programmes for young professionals
	3c. Enhance collaboration with AI research centres and innovation hubs

Source: *JRC own elaboration.*

6.1.1 Develop focused, interdisciplinary artificial intelligence competence training programmes

The findings of the study suggest that there is a need for individuals who combine competences in three dimensions – namely the technology, management, and policy, legal and ethical dimensions – in a **multidisciplinary** approach. Governments and public agencies are thus encouraged to invest in developing interdisciplinary AI competence training programmes that cut across dimensions and, at the same time, have a **specific focus** on critical competences.

For example, as the findings of this study suggest, competences related to **AI procurement** are highlighted as crucial and hard to find in the labour market and hard to develop in-house for public organisations. According to the framework presented in this report, AI procurement literacy competences are part of a cluster of literacy competences, as they relate to knowledge of what procurement contracts are in public administration, what the requirements for AI projects are in a public organisation, etc. However, such literacy competences also inform other competences at the operational level; for example, literacy in AI procurement supports the operational competence of collaborating with domain experts, as highlighted in this study. In turn, this operational competence is supported by an attitudinal competence such as 'critical technology assessment', that is, being able to understand the limitations of data-driven technologies and choose whether to focus on augmenting experts or replacing them. This example highlights how a programme focused on developing AI procurement competences would need to span across the different clusters of literacy, operational and attitudinal competences, as well as needing to be multidisciplinary in nature.

The recommendation to develop focused, interdisciplinary AI competence training programmes can thus be operationalised in the following three actions.

1. **Incorporate AI modules into existing public sector training programmes.** This first action aims to draw on existing initiatives in public sector training, at both the Member State level and the EU level. This action thus aims to integrate new interdisciplinary, focused modules on AI within ongoing professional development programmes for public sector employees. The modules would reflect a multiplicity of areas within the proposed framework – managerial operational competences, technology literacy competences, and policy, legal and ethical attitudinal competences – which can then be combined according to the specific needs of a Member State, region or specific public agency. This integration can be supported via the creation of an online platform to host and share training modules.

   This action would require the involvement of a number of actors, in different roles. Member State governments should be responsible for the overall integration and implementation of the training modules into their existing training frameworks. Public sector training agencies should manage and deliver the training programmes to public sector employees. Functional specialists in AI within the Member States' public agencies will be needed to design the content and ensure that it meets the requirements of competence frameworks. Technical teams should develop and maintain the online platform for hosting and sharing training modules.

2. **Create specialised AI training pathways for different public sector roles.** This second action consists of creating targeted training pathways that address the specific needs of different public sector roles, such as policymakers, data analysts and IT professionals. These pathways should be multidisciplinary, include practical exercises and case studies, and cover multiple areas within the proposed competence framework. A preliminary step in this action is assessing workers' training needs, for example by auditing existing AI competences and competence gaps.

   The actors involved in this action would be diverse. Public agencies' human resources departments should be responsible for identifying specific training needs for different roles and facilitating the participation of employees. Role-specific representatives (e.g. policymakers, IT professionals and data analysts) should provide input on the specific competences and skills required for their roles.

3. **Collaborate with academic and industry partners for AI training.** This third action consists of establishing partnerships with universities, research institutions and private sector companies to co-develop and deliver the AI training programmes and modules needed. These collaborations can help ensure that the training content is up to date and relevant.

   This action would require the involvement of an array of different actors. Universities and research institutions should act as academic partners to co-develop and validate the training content, ensuring that it is research based and up to date. Private technology companies should act as industry partners to provide practical insights, case studies and potentially cutting-edge technology and tools. Public sector representatives should collaborate with academic and industry partners to ensure that the training aligns with public sector needs.

6.1.2 Promote interdisciplinary research on artificial intelligence competences

Our findings show that the stack of competences considered relevant for the use of AI in the public sector is swiftly growing, and its complexity is increasing accordingly. In addition to classic competences that are well established in relation to digitalisation efforts, such as change management, new competences are emerging, also following the latest developments in the area of AI. For instance, as highlighted in the case study interviews, the recent boom in generative AI applications calls for novel competences that were not required until very recently, such as prompt engineering for public servants interrogating large language models to enhance document drafting, respond to citizen queries or develop educational content for the public organisation workforce.

As a result, there is a need to invest resources in research on competences for AI in the public sector, not only to continuously update our understanding of the stack of competences needed, but also to better understand the relationships between competences, as indicated in the proposed framework.

Research in this area should follow an engaged scholarship approach (Van de Ven, 2007), involving the widest possible range of stakeholders, to include not only academic institutions, but also civil society organisations and private businesses such as technology vendors.

The recommendation to promote interdisciplinary research on AI competences can thus be operationalised in the following three actions.

1. **Fund interdisciplinary research projects focusing on competences for AI in the public sector.** Existing funding schemes at the European level, such as Horizon Europe, should be integrated with national grants from Member States and funding schemes by private enterprises focused on research on identifying, updating and developing competences for AI in the public sector in Europe. Such schemes can include industrial doctoral positions, dedicated university professorships and research exchange programmes to stimulate knowledge co-creation and sharing in the research area of competences for AI in the public sector.

   This action would require the involvement of a number of different actors, in different roles. The European Commission should set priorities to ensure that funding is available for projects relating to competences for AI in the public sector. National research funding agencies should provide grants and financial support for national-level research projects. Private enterprises should co-fund research projects and provide in-kind contributions.

2. **Establish research consortia to investigate competences for AI in the public sector.** This second action consists of creating consortia comprising public sector entities, research institutions and private companies to conduct in-depth studies on identifying, updating and developing competences for AI in the public sector in Europe.

   This action requires the involvement of a number of actors, in different roles. Relevant EU institutions should coordinate and support the formation of research consortia. Universities should lead research consortia (or co-lead, together with independent research organisations) and ensure academic rigour. Member States' government departments and agencies should provide access to real-world problems and data for research projects. Consulting firms specialising in AI should offer insights and methodologies for competence research.

3. **Promote knowledge exchange and dissemination of research findings on competences for AI in the public sector.** Knowledge created through the first two actions should be disseminated to the widest possible array of stakeholders. This third action thus consists of, for example, organising workshops, conferences and webinars to facilitate the exchange of knowledge and best practices among researchers, policymakers and public sector practitioners. These events can help disseminate research findings and promote the identification, updating and development of competences for AI in the public sector.

   This action would involve different actors. EU institutions should support and promote knowledge exchange initiatives and events, for example by promoting 'AI competence days', disseminating online contents related to competences in the public sector and organising public webinars. Member States' research institutions should ensure open access to important research outcomes, and produce summaries, reports and infographics to make research accessible.

6.1.3 Establish dedicated hiring processes and devote additional resources to attract specialists with artificial intelligence competences

Findings from this study highlight that one of the major obstacles in leveraging the potential of AI in public organisations is the difficulty of attracting talent with the competences needed. This is due to two main obstacles. First, public organisations are unable to offer salaries and job conditions that are competitive in the job market. Compared with more attractive offers from private businesses, the salary levels, prospects of career growth and other job benefits offered by public sector organisations are simply insufficient in many cases. Second, public organisations are often tied to hiring procedures that follow slow protocols, and are impeded by bureaucratic red tape.

To remove these obstacles, governments and public agencies should, on the one hand, devote additional resources to specific job profiles, for example to support higher salary levels, while, on the other hand, focusing on developing dedicated hiring processes for AI specialist positions that are more agile and thus speedier in attracting talent on the very competitive market of AI competences.

The recommendation to establish dedicated hiring processes and devote additional resources to attract specialists with AI competences can thus be operationalised in the following three actions.

1. **Develop a public sector AI talent recruitment strategy.** At the European level, strategic plans on how to attract and retain AI specialists in the public sector should be formulated, for example in alignment with the Commission's Digital Decade initiatives. In addition, Member States also need to develop appropriate national strategies. These strategies should include competitive salary packages, career development opportunities, and incentives for AI professionals to work in government roles.
2. **Create AI fellowship and internship programmes for young professionals.** This second action involves establishing fellowships and internship programmes that provide young professionals and recent graduates with hands-on experience in AI projects within the public sector. At the European level, a blueprint for such programmes would be the Erasmus+ programme, which offers opportunities for education and training exchanges. These programmes can help build a pipeline of skilled AI talent for future public sector roles.
3. **Enhance collaboration with AI research centres and innovation hubs.** The third action involves partnering with AI research centres and innovation hubs to access cutting-edge AI expertise and technologies. Synergies could be created by drawing on with the European Digital Innovation Hubs network at the European level. These collaborations can help the public sector stay updated on the latest AI developments and attract talent through joint projects and initiatives.

6.2 Recommendations on governance

Extending on the results of this research, a set of three main recommendations that can be used to enable the implementation and deployment of appropriate AI governance practices in public organisations, which can both speed up adoption and deployment, and help realise the organisational objectives, has been identified. For each recommendation, a set of actions is also proposed.

Table 11 illustrates each recommendation and the corresponding actions.

Table 11.

Recommendations on governance practices for AI in the public sector.

Recommendation	Action
1. Develop communication and collaboration networks	1a. Create connections with relevant stakeholders
	1b. Deploy digital platforms for communication and collaboration with involved entities
	1c. Finance synergy grants for private and public collaborations and knowledge exchange
2. Foster an active learning and capacity building environment for responsible AI governance	2a. Develop educational material on how to integrate responsible AI practices into governance
	2b. Organise thematic seminars on aspects that are important to consider during AI governance
	2c. Create a toolbox of best practices that is readily available to practitioners
3. Enable stakeholders-in-the-loop processes	3a. Facilitate forums to involve relevant stakeholders
	3b. Require that public bodies include relevant stakeholders in AI projects
	3c. Finance projects on co-creation of AI projects in critical areas of public administration

Source: *JRC own elaboration.*

6.2.1 Develop communities of practice

The results of our analysis indicate that many public organisations, especially those of a smaller size, struggle with early adoption of AI. This is often because they lack expertise in the processes needed to effectively develop and deploy AI applications, particularly in aligning them with the relevant regulatory and legal frameworks that are applicable. As a result, many public organisations do not have the capacity to initiate projects.

A way in which policymakers can alleviate some of these barriers for public organisations is by enabling and strengthening communities of practice and associations where knowledge exchange and best practices are discussed. Such efforts require financial and administrative support from governments and policymakers, but can serve to rapidly accelerate the update of key AI governance practices that will allow public organisations to deploy AI in their service offerings.

In addition to the above, such communities of practice can enable better coordination over procurement and sourcing efforts, and create more effective mechanisms for acquiring key technological infrastructure needed to implement AI. In addition, communities of practice can serve as forums for tackling important challenges with regard to responsible and ethical use of AI technologies, and the best ways in which to implement the suggested principles that comprise them.

The recommendation to develop communities of practice can be distilled into the following three main action points.

1. **Create associations with relevant stakeholders.** The first action point is focused on drawing attention to the need to establish formal associations with stakeholders in different levels of public administration. Such approaches and associations can be considered at the national and EU levels, and are aimed at creating integrative and collaborative forums for knowledge exchange. The associations would also enable better synergies between different organisations and allow the sharing of best practices about how to overcome important barriers to AI governance deployment and alignment with all relevant directives and laws.
2. **Deploy digital platforms for the communication and collaboration of involved entities.** The second action point focuses on providing digital platforms on which different stakeholders can co-create value and exchange information and knowledge. The deployment of digital platforms can also allow for sharing of relevant data files and key resources, and act as a knowledge hub for organisations that are just beginning their AI deployment and others that are more advanced.
3. **Finance synergy grants for private and public collaborations and knowledge exchange.** This third action point is complementary to the previous two action points and aims at creating knowledge exchange pathways between private and public entities. Such funding can allow for joint ventures and alleviate the issues of limited know-how and expertise around AI governance deployment and how to assimilate AI into the public organisations operations. Funding projects on low technology readiness levels can facilitate exchange of knowledge and best practices for designing and implementing AI governance practices in the public sector.

6.2.2 Provide guidelines for responsible artificial intelligence governance

A key hurdle for many of the organisations surveyed during this study was how to navigate the relevant guidelines and directives that are proposed at the European and national levels. Many organisations highlighted that they were not up to date in terms of the latest developments in legislation, and it was often difficult to interpret the legislation in daily operations. Therefore, a policymaking suggestion to facilitate more effective AI governance in the public sector is to provide a dedicated service/division on a national level that can provide insight and education to public organisations on how to effectively implement and adhere to all relevant regulations.

Support in this direction can be in many different forms, including, but not limited to, educational material and seminars, dedicated personnel who can provide input on a case-by-case basis, illustrations of best practices or approaches to be compliant, as well as toolboxes for specific types of applications and/or data analysis approaches.

The provision of such types of guidelines and services around how to ensure responsibility and compliance with all the relevant directives can massively accelerate the uptake of AI, and particularly aid in informing strategic-level governance practices.

The recommendation to provide guidelines for responsible AI governance can be divided into the following three main action points.

1. **Develop educational material on how to integrate responsible AI practices into governance.** The first action point focuses on providing key educational material on how to integrate responsible AI practices at different phases of the project life cycle and at different levels of the organisation. An issue that emerged during the study was that many respondents were aware of but not familiar with the details included in responsible AI frameworks, and thus had little knowledge on how to integrate associated practices into their applications. Educational material can be provided in the form of short asynchronous courses with interactive material and videos, developed and co-designed with academics and practitioners.
2. **Organise thematic seminars on aspects that are important to consider during AI governance.** The second action point complements the previous action point by providing up-to-date seminars on important and emerging issues. Such seminars can be launched at the national or EU levels, where insight from different stakeholders is presented and there is opportunity for discussion and knowledge exchange. Specifically, the thematic seminars can focus on the practices and approaches of dealing with emergent and important phenomena, such as how to interpret new guidelines or how to approach and manage novel technological developments from a governance perspective.
3. **Create a toolbox of best practices that is readily available to practitioners.** The third action point involves the creation of a centralised information and knowledge base of best practices for practitioners when developing AI governance practices and how to be responsible when doing so. The toolbox can be developed as a collaborative effort of practitioners at different levels of public organisations and serve as an important knowledge source for other related projects in public organisations.

6.2.3 Enable stakeholders-in-the-loop processes

One of the main issues that was highlighted in the findings when it comes to development and diffusion of AI-based services in the public sector is the need to incorporate input from various stakeholders. Several prior studies, as well as findings form the primary data collection, highlight the importance of being able to develop trust with end users, as well as fostering an approach where requirements and input are incorporated in the developed solutions.

Nevertheless, it is often challenging for public organisations to develop such interfaces and create interactions with end users and other stakeholders due to high fragmentation. Therefore, centralised approaches in collecting feedback and creating communication channels that can enable stakeholders-in-the-loop processes are vital for ensuring that AI applications are successful.

Central governments and other national bodies can facilitate coordinated actions and development of appropriate interfaces with different stakeholder groups to ensure that they are appropriately connected with the relevant public bodies that are developing AI-based services. In turn, such communication channels will substantially affect how AI governance is coordinated in public organisations, and the priority areas that are highlighted.

The recommendation to enable stakeholders-in-the-loop processes can be promoted by the following three main action points.

1. **Facilitate national-level forums to involve different stakeholders.** The first action point involves the creation of national-level forums where stakeholders representing different parts of society can actively participate and shape emerging AI projects of public administration. Such forums can be considered in different forms, either as synchronous or asynchronous, and operationalised either on digital platforms or through discussion colloquia. Policymakers can require that any new initiative has a certain period of time in which input and perspective from the broader society can be voiced and incorporated into the developed solutions.
2. **Require that public bodies include relevant stakeholders in AI projects.** The second action point extends the first by opening the debate concerning what types of AI projects and for what purposes would necessitate input by relevant stakeholders. Requiring that public bodies include relevant stakeholders at different phases of an AI project's life cycle will ensure that the AI project is more readily utilised and that it conforms and aligns with the needs of the different user groups.
3. **Finance the co-creation of AI projects in critical areas of public administration.** The third and final action point concerns providing sufficient financial resources so that such AI projects can be realised in practice. Establishing financing schemes for co-creation of projects among public bodies and other relevant stakeholders who have the know-how and will be active stakeholders in the process can simultaneously facilitate more rapid deployment of AI in critical areas of public administration and ensure that the projects are executed in accordance with the needs and considerations of the stakeholders.

7 Conclusions

The successful integration of artificial intelligence (AI) in the public sector depends on **developing the right competencies and establishing effective governance practices**. To harness AI as a force for good, it is critical to redefine current competencies and governance structures. However, there remains uncertainty about which specific competencies and governance practices are necessary.

This report advances the conversation by systematically identifying the **competencies and governance practices required to drive value through AI in the public sector**. It introduces two comprehensive frameworks: one for the key competencies and one for the governance practices needed.

The **competence framework** is structured around three core dimensions: technical, managerial, and policy, legal, and ethical competencies. It also highlights three cross-cutting clusters: attitudinal, operational, and literacy competencies. The **governance practices framework** is organised into three dimensions: procedural, structural, and relational practices, with three corresponding levels of governance: strategic, tactical, and operational.

Based on these frameworks, the report presents **six key recommendations**, broken down into **18 actionable actions** to develop the necessary competencies and governance practices for AI in Europe's public sector.

In doing so, this report makes a significant contribution to existing knowledge, offering **new theoretical insights and a practical framework** to guide AI adoption. Moreover, it provides policymakers and practitioners with **concrete recommendations and actionable steps** to implement and scale AI solutions in the public sector.

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List of abbreviations and definitions

Abbreviations	Definitions
AI	Artificial Intelligence
CAS	Crime Anticipation System
CEDEFOP	European Center for the Development of Vocational Training
DG	Directorate-General (as in EU DG DIGIT)
DigComp	Digital Competence Framework
EU	European Union
GAO	Government Accountability Office
JRC	Joint Research Centre
INNPULSE	Innovation of Public Services and Digital Transformation of Governance
INPS	Istituto Nazionale di Previdenza Sociale (National Institute for Social Security
IRCAI	International Research Centre on Artificial Intelligenc
IT	Information Technology
ML	Machine Learning
ODK	Object Detection Kit
PEC	Posta Elettronica Certificata (certified electronic mail)
PSTW	Public Sector Tech Watch
TSI	Technical Support Instrument
UNESCO	United Nations Educational, Scientific and Cultural Organization

List of figures

List of tables

Appendix Interview protocol

The interview protocol used in the case studies comprised four parts. The first part was aimed at collecting information about the interviewees' education, work background and level of knowledge and experience of AI in the public sector. The second part focused on the perceived relevance of and difficulty in obtaining competences related to AI in the public sector. The third part focused on the governance practices of AI in the interviewees' organisation. The fourth part was aimed at collecting additional information and feedback for the interviewer, and sought to solicit potential contacts for additional interviewees, following a snowball approach.

Competences and governance practices for managing AI in the public sector

Interview protocol

The following is an interview protocol to collect data on individual competences and governance practices for managing AI in the public sector.

The interview is designed to be carried out by an expert interviewer to a public manager who has at least some awareness of the use of AI in the public sector.

The parts of this document that are in italic are not to be communicated to the interview participant.

***

Interview number: _____

Date: _____

Location: _____

Script

Thank you for agreeing to do this interview. My name is ... and I work for ...

This interview is part of a study that is carried out as part of research activities of the Joint Research Centre of the European Commission.

We are interested in understanding what competences and what governance practices public servants like you see as relevant in managing the design, implementation and use of AI in the public sector.

The interview will last approximately 30 minutes. Although the findings of this study may be published, no information that can identify you will be included. To ensure the accuracy of our understanding of your answers, I would like to record this interview. If at any time during the interview you wish to discontinue the use of the recorder or the interview itself, please feel free to let me know.

Do you have any questions or concerns before we begin?

Then with your permission we will begin the interview.

If participant wishes to discontinue study, ask if they would be willing to share why.

Questions

A. Respondent profile

1. What is your education and work background?
2. What is your role in your organisation? What are you responsible for?

B. Knowledge of the technology

3. What do you know about the use of AI in the public sector?
4. Do you have any personal experiences with the use of AI in the public sector?

C. Relevance of competences related to AI in the public sector

5. In your opinion, what are the competences that are most important to have for an individual working in or with the public sector in relation to AI?
6. Why do you indicate these competences?

D. Difficulty in obtaining competences related to AI in the public sector

7. In your opinion, what are the competences that are most difficult to obtain for an individual working in or with the public sector in relation to AI?
8. Why do you indicate these competences?

E. Governance of AI in the organisation

9. Has your organisation adopted any governance scheme for the uptake of AI? Can you elaborate on how it functions?
   - *Probe into structures, processes, roles and practices that might be employed.*
10. Are you familiar with the term trustworthy or responsible AI? How has your organisation approached this topic when deploying AI solutions?
11. Does the external environment influence how you manage AI? In which ways?
    - *Ask about other government agencies, private bodies, citizens, etc.*

12. Is there anything unique about managing AI compared with other digital technologies? What would you say is the main challenge of governing AI projects?

F. Other

13. Is there anything else you would like to share?

G. End

14. Could you suggest other persons in your network that you think we could interview about the topic of AI in the public sector?
15. Thank you for your useful contributions to our research. We will reflect carefully on your answers. Do you have any questions for me?

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