European Network of Public Employment Services

Opportunities of AI within PES processes and services

PES Network Report exploring PES experiences, best practices and emerging business value

Written by ICF

Dr Willem Pieterson
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Unit E.1 — Labour Mobility, Public Employment Services, ELA

Contact: Polina Mosheva

E-mail: EMPL-PES-SECRETARIAT@ec.europa.eu

European Commission
B-1049 Brussels

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2025

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ABBREVIATIONS

AA	Advanced analytics
AGI	Artificial general intelligence
AI	Artificial intelligence
ANI	Artificial narrow intelligence
ASI	Artificial super intelligence
AUC	Area under the curve
DevOps	Development operations, methodology to streamline development cycles and moving development to production
DL	Deep learning
ETL	Extraction, transformation & loading
GenAI	Generative AI
KPI	Key performance indicator
LLM	Large language model
LMI	Labour market information
ML	Machine learning
MLLM	Multimodal large language model
MLOps	Machine learning operations (i.e. putting machine learning into production)
NLP	Natural language processing
NN	Neural network
PES	Public Employment Service
PII	Personal identifiable information
PoC	Proof of Concept
ToR	Terms of Reference

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EXECUTIVE SUMMARY

Background and purpose

Over the past decade, artificial intelligence (AI) has garnered increasing attention, particularly with the advent of the Big Data movement in the mid-2010s. This has prompted organisations, including Public Employment Services (PES), to explore its potential application. Recently, PES across Europe have been increasingly exploring AI possibilities, ranging from pilots and Proof of Concepts (PoC) to integrated applications in daily operations, such as competency-based matching engines. While PES are forming a better understanding of the concept of AI and its influencing factors, the value of AI in PES needs to be further explored and understood. More literature and evidence will help PES to measure their AI initiatives' outcomes against inputs and help to define AI more concretely.

This report focuses on the growing adoption of AI by PES across Europe and its potential impact on their operations. AI offers promising benefits for PES, such as improved service delivery, effectiveness, and efficiency. Assessing the full business value of AI is important, although this can be difficult because of the rapid evolution of AI technology.

This report presents an overview of AI practices in European PES, analyses their impact and reviews the contextual factors influencing implementation and PES' experiences. It also outlines the opportunities that AI offers within PES processes and services.

Through qualitative research, including desk research and interviews with 11 selected PES[1], the report explores AI applications in PES operations and business processes such as jobseeker profiling, career guidance and matching. Its findings should help to guide PES practitioners towards understanding the potential benefits and challenges of adopting AI, using insights from promising practices and lessons learned from early adopters.

AI and PES

The European Commission's definition of AI, as per Regulation (EU) 2024/1689 (AI Act) published on 12 July 2024, encompasses systems designed for autonomous operation with varying levels of adaptiveness[2]. Based on the approach of the Organisation for Economic Co-operation and Development (OECD)[3], this definition emphasises the analysis and creation of data-based outputs with a certain level of autonomy.

At the time of developing this report in 2023, a categorisation of AI was needed to understand the diverse nature of AI applications that build on more traditional ways of analysing data. For the purposes of this report, AI was categorised into three main types, building on historical approaches:

- Artificial narrow intelligence (ANI): Designed for specific tasks, such as recommender systems or modern chatbots. Most current AI applications in use fall into this category.
- Artificial general intelligence (AGI): Aims to approach human intelligence in more general areas.
- Artificial super intelligence (ASI): Hypothetical AI surpassing human intelligence.

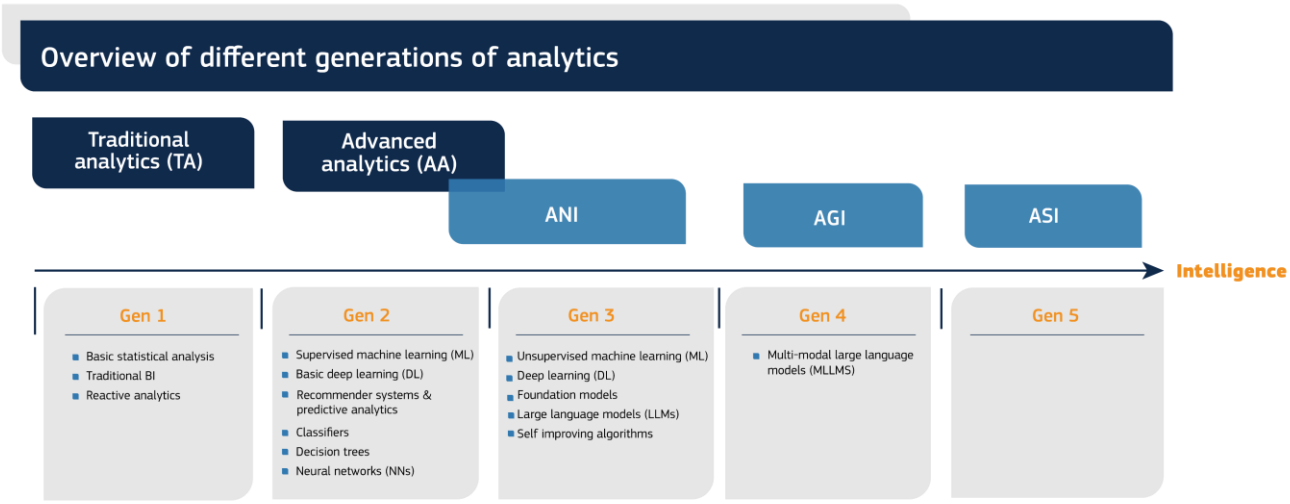
[1] AT, BE-Actiris, BE-VDAB, EE, FI, FR, LT, LUX, NL, SE and SI, selected based on their plans and/or experiences with AI

[2] The research for this report was carried out in late 2023-early 2024. Since then, the European AI Act was launched on 1 August 2024. This context is acknowledged in this report.

[3] Taking into account the OECD Recommendation of the Council on Artificial Intelligence, last amended on 30 May 2024 OECD Legal Instruments

These are a logical evolution from traditional analytics (such as basic statistical analysis) and advanced analytics[4] that deploy basic forms of machine learning (ML) and deep learning (DL). Many applications that were considered AI 5 to10 years ago are now considered advanced analytics (AA) (generation 2 analytics). The report focuses on algorithms that can be classified as generation 2 analytics or beyond (as this blurs the lines between AA and AI)[5].

Figure 1. Overview of different generations of analytics

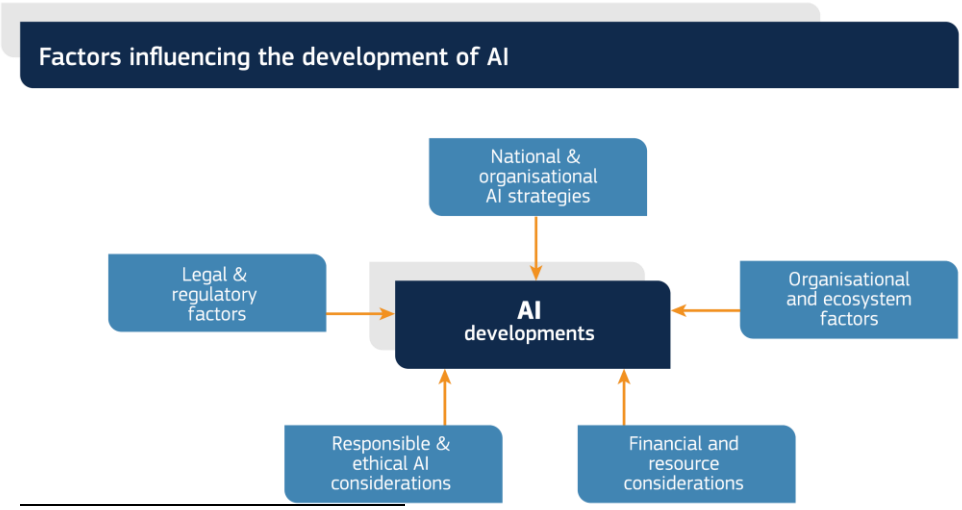


Factors influencing AI deployment and success

At the time of publishing, AI advancements in analytics raise questions for PES on AI testing, explainability, ethical deployment, and transparency. Responsible AI emphasises ethical and transparent development and deployment. Trends in AI also highlight the rise of Generative AI (GenAI), bigger multimodal large language models (MLLMs, which could be the first instance of AGI), raising questions about AI risks and possible mitigations.

Finally, the success of AI hinges on a range of variables, each contextually, environmentally and structurally different, depending on the PES. The analysis in this report is guided by a framework of factors influencing the development of AI (Figure 2).

Figure 2. Factors influencing the development of AI



[4] See European Commission, Thematic Paper *Digital technologies and advanced analytics in PES*, European Network of Public Employment Services, 2019

[5] The overview in Figure 1 is meant as a classification for the broader nature of applications covered in this report. Most of the applications included in this report likely fall within the definition of the AI act, however it is not assessed fully within the scope of this study

AI practices in the network

The report focuses on initiatives within PES classified as Generation 2 (Gen 2) and beyond. The 11 PES identified yield 34 distinctive and relevant initiatives, which are analysed and organised as described below.

1. Status of development

The first approach is to look at the status of development of the applications. Are they in early development stages or already used in production environments? The majority of the applications (22) are currently 'in production', which means they are open to general target groups (e.g. jobseekers, employers, counsellors). Most of the remainder are under development. PES typically fall into one of three groups:

A. More developed PES

Some PES have been working on AI for many years and have many practices in production (SE, FR, and BE-VDAB account for 17 of 22 practices in production).

B. Starting PES

Most PES are early in their AI work. A large group is working on one initiative, typically in development or just entering production. For example, Austria's *Berufsinfomat* (see Example 2) entered production in January 2024. These PES typically take a cautious route, seeking to learn from AI and explore ways of putting it into production, but sometimes lacking the resources or capabilities to work on multiple initiatives.

C. Ambitious PES

Several PES are developing a multitude of initiatives that are either part of a bigger project (e.g. Slovenia's My Labour Market) or a broader strategy to rebuild/revamp the entire PES (e.g. Luxembourg's eADEM strategy). Drivers for this approach are external (e.g. Slovenia has capitalised on Horizon 2020/Horizon Europe funding and collaborations through the HECAT project) or stem from the need to modernise more drastically (where AI is a natural component of a comprehensive new (digital transformation) strategy).

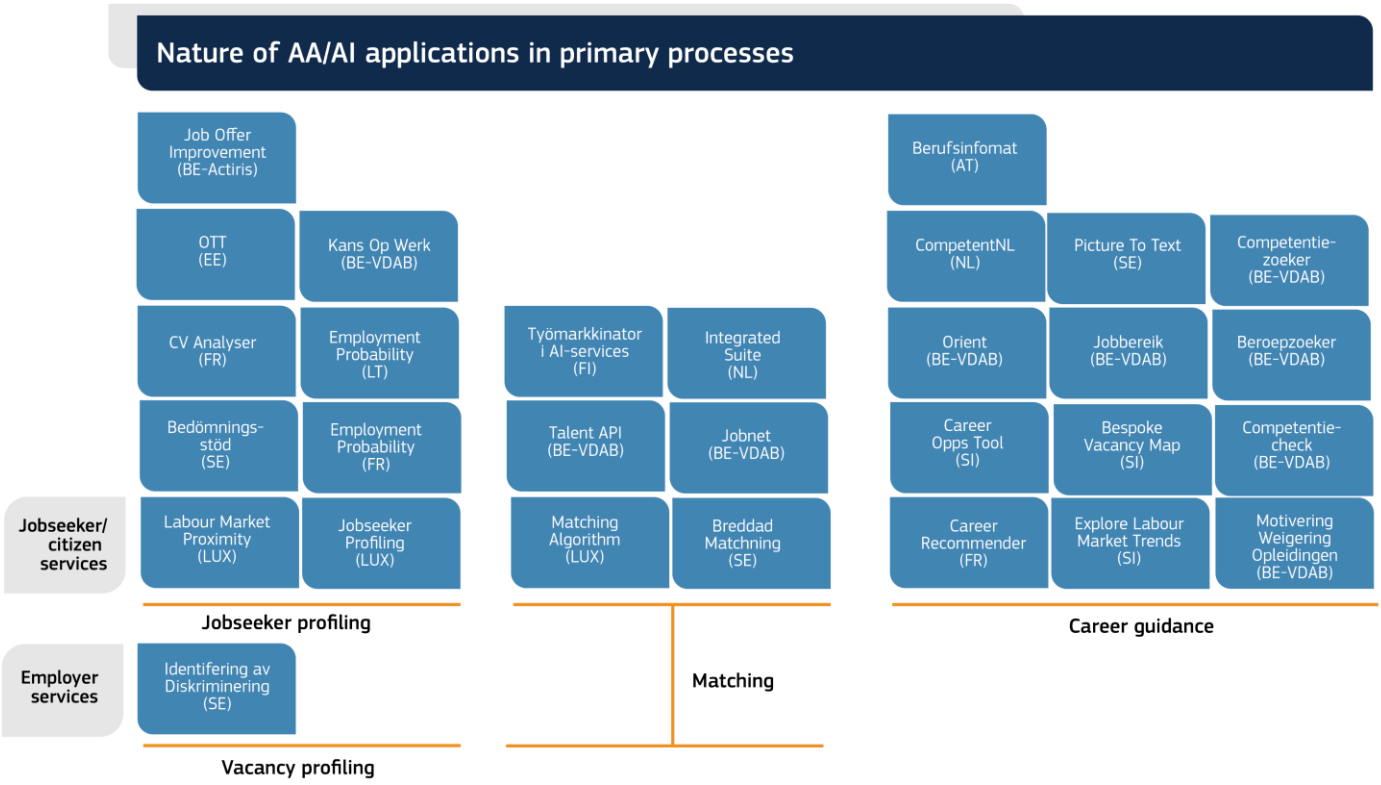
Lessons can be drawn from both development experiences, as well as operational experiences from PES.

2. Application area in PES processes

The second approach is to look at where AI initiatives are applied within PES processes (e.g. profiling, matching, customer support). The report differentiates between the primary processes of PES (e.g. profiling, matching, career guidance) and secondary processes, such as customer support. The majority of PES applications focus on PES' primary processes (see Figure 3).

A large group of relatively straightforward (AA) applications from many PES focus on profiling jobseekers or vacancies. From an analytics viewpoint, profiling is mostly a relatively simple application. Many statistical and AA approaches can be used to profile jobseekers and/or applications and relatively few variables are needed to calculate employment probability scores (e.g. EE, BE-VDAB, LT, SE, FR). As profiling metrics are typically used internally and are a decision support rather than a decision-making tool, the PES interviewed for this report mentioned it as a logical gateway application into the use of AI. Matching is an important category, as is career guidance, and both feature more advanced types of analytics. Customer support applications are less prevalent.

Figure 3. Overview of the nature of AA/AI applications in primary processes



3. Maturity of applications

The third approach is to look at the data by generation of analytics (see Figure 1). Most applications straddle the line between AA (Gen 2) and AI (Gen 3, ANI). Most use ML to classify data and sometimes create a set of recommendations based on rules. This applies to most of the profiling tools developed or used by PES and many of the rule-based matching applications. DL applications are more advanced and the most common type involves natural language processing (NLP). These tend to be DL because they typically use neural networks (NN) with many layers to process the data. Examples are those used in France (CV Analyser), Sweden (picture-to-text application) and Finland (*Työmarkkinatori* AI-services). True AI applications (e.g. those that use GenAI) remain fairly scarce, but do exist, such as Austria's *Berufsinfomat* and France's Information Retrieval tool.

Key learnings

A deeper dive into the nature of the applications, as well as PES' experiences and the factors influencing their development reveals 10 key observations and recommendations:

1. Rapid growth and maturation of AI

AI adoption in PES is relatively new but expanding rapidly. Most applications are at the AA level, but AI applications are on the rise (e.g. PES using large language models (LLMs) and/or GenAI). As AI initiatives progress swiftly, many are already in production. PES are developing organisational practices to support AI implementation, including data protection, security, and ethical considerations. It is important for PES to align technical AI improvements with organisational processes, including legal and ethical considerations. PES will benefit from collaborating with peers to share expertise and avoid common mistakes in AI implementation. The PES Network can facilitate dedicated forums for PES professionals to exchange insights and advance their AI knowledge.

2. **Learning focus over business value**
   Currently, PES aim to learn and gain experience from AI initiatives rather than focusing on their immediate business value. This explains their relative focus on softer objectives such as innovation. In future, well-defined processes will help to align PES-led AI investments with PES business outcomes.

3. **Positive results based on soft indicators**
   PES report positive outcomes from AI initiatives, often based on qualitative, softer indicators. Defined goals and measurable outcomes will be important to secure future funding and present business cases for AI. Defining measurable goals, establishing key performance indicators (KPIs) and conducting evaluations will help PES here.

4. **Prevalence of profiling and career guidance**
   Profiling applications are prevalent, being simpler from an analytics perspective and lower risk in the context of PES (analysis is more straightforward and relies on smaller datasets). Career guidance applications are next most common, driven by the increasing role of PES in this area. Matching applications are less common, given the complexities of data and ethical considerations. Over time, PES expect to assess where and how investments in AI yield the most value and consider how initial (often profiling) applications connect to broader workflows.

5. **Focus on standalone applications**
   PES tend to develop standalone applications for specific tasks. Where applications are developed independently, there is a risk of siloed implementation and limited workflow integration. Considering optimal integration and end-to-end workflows will be important for future PES investment.

6. **AI as a supplement to staff**
   PES view AI as useful to supplement rather than replace staff. AI tools are support aids for various tasks, such as career guidance and profiling, and provide inputs into decision-making. PES prioritise trust and acceptance levels, positioning AI tools as supplements to human judgement. While the long-term relationship between AI and PES staff is unclear, the current focus is on leveraging AI to free staff to dedicate their time to supporting complex cases. In the future, AI's role will be defined by business analyses to assess its impact.

7. **Stakeholder involvement for success**
   Stakeholder involvement, including leadership, staff and end-users, is crucial to the success of AI initiatives. Leadership drives AI adoption, staff input ensures that AI tools align with operational needs, and end-user feedback helps to refine AI applications. Recommendations for PES include considering stakeholder needs during the development of AI initiatives and involving stakeholders in initiative development.

8. **Explaining AI is challenging**
   Explaining advanced AI is challenging, which impacts ethical considerations. PES interviewed for this report manage this by interpreting complex models, deploying less critical models in non-critical environments, and avoiding complex models for critical decisions. PES should continue to balance (business) priorities and legal/ethical requirements, and experiment with approaches while prioritising explainability.

9. **Challenges in moving AI to production**
   Transitioning from experimental AI to production-ready systems poses challenges for PES. Technical complexities, legal requirements, and organisational readiness require robust procedures and resource allocation. PES need to consider wider organisational implications and available resources, while developing organisational procedures for the development and implementation of AI.

10. **Positive outlook on AI's future**
    Despite these challenges, PES are optimistic about AI's potential to positively transform business processes such as profiling and career guidance. National strategies and leadership within PES recognise AI's possibilities, urging PES to develop capabilities to fully harness AI's benefits. PES should incorporate the development of (more) holistic AI strategies that are aligned with national agendas and consider contextual factors in AI strategy development.

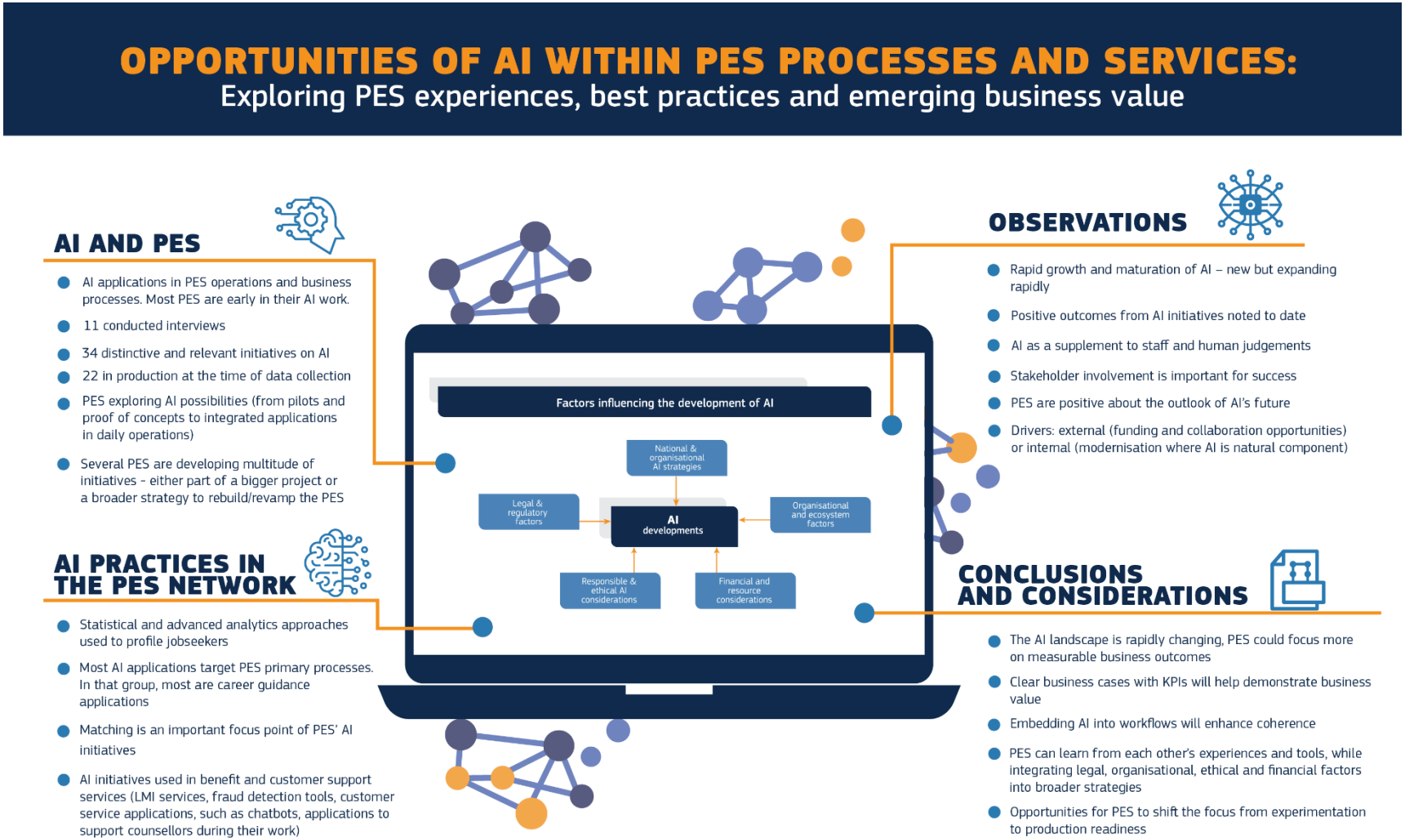
General conclusions and considerations

The report outlines the evolving landscape of AI in PES, emphasising rapid changes and the need for contextual understanding. The experiences of 11 PES show a diverse landscape that is often focused more on learning from (technical) solutions and AI in general, than on factors influencing the development of AI: a) legal factors, b) responsible and ethical AI considerations, c) financial and resource considerations, d) organisational and ecosystem factors and e) the relationship with wider (national) strategies.

PES are predominantly in early AI adoption stages, focusing on AA and developing their understanding of AI. Trends like GenAI are emerging and PES are eager to embrace more advanced types of AI (e.g. AGI). However, PES have yet to demonstrate significant business value from AI initiatives, largely due to a limited focus on actual and measurable business outcomes. This leads to a number of general recommendations:

1. **Develop clear business cases**
   Articulate AI goals with defined KPIs to demonstrate business value and justify investments.
2. **Integrate AI into workflows**
   Embed AI into end-to-end workflows for enhanced value and coherence, avoiding siloed applications.
3. **Encourage knowledge-sharing**
   Use the PES Network to facilitate sharing of experiences and tools between PES, learning from others and fostering collaboration.
4. **Prioritise production readiness**
   Shift the focus from experimentation to production readiness, addressing complexities early to ensure smooth transitions.
5. **Consider holistic factors**
   When planning AI initiatives, consider integrating legal, organisational, ethical, and financial factors into broader strategies.

Executive summary – key messages from this report



1 INTRODUCTION

Artificial intelligence (AI), as a branch of advanced data analytics, is a rapidly evolving field. The release of Chat Generative Pretrained Transformer (ChatGPT) in 2022 and the many tools and applications using Generative AI (GenAI) highlight new possibilities. Many governments and public sector agencies are interested in how AI can transform their processes and client services – Public Employment Services (PES) are no exception. An Organisation for Economic Co-operation and Development (OECD) study in 2022[6] suggests that most PES are now showing concrete interest in adopting AI: nearly 40% of PES are looking into AI tools or tools using other types of advanced analytics (AA) to support jobseeker profiling, while more than 40% see the potential of AI for job matching or career services, such as identifying skill gaps.

This interest in AI is understandable, as the potential of AI to add value to PES has long been acknowledged[7]:

- To improve services for PES clients (e.g. through better customer services);
- To increase effectiveness of PES processes (e.g. more accurate matching and profiling);
- To improve the efficiency of PES processes (e.g. through better decision support tools for counsellors or other staff employees);
- To expand on PES' ongoing interest in the use of data and analytics to improve their processes and services[8].

While promising, the actual business value of AI for PES is more ambiguous, for several reasons. Firstly, while PES have been working on AI for roughly a decade, few (if any) complete evaluations that connect current AI investments to return on investment (ROI) and PES goals/key performance indicators (KPIs). Secondly, the field is moving so rapidly that any lessons from the past are unlikely to still hold value today. Thirdly, the context in which AI is being deployed is changing the playing field. Legal and ethical developments are catching up, privacy and transparency issues are increasingly important, while technical progress is making deployments of AI easier than ever. This evolving context will shape any opportunities for PES in the near future.

Currently there is no complete overview of PES AI practices, of how those practices are embedded in this changing context, or what PES gain from using AI. Partial overviews and studies in adjacent areas can provide insights, but these tend to be limited in scope. Examples include:

- The work of the OECD to collect relevant practices, including within PES[9]);
- The work of the European Commission to create overviews of national AI strategies that provide a context for the work of PES and sometimes include specific examples and/or objectives pertaining to PES (e.g. AI Watch[10]);

[6] OECD, *Harnessing digitalisation in Public Employment Services to connect people with jobs*, 2022, https://www.oecd.org/els/emp/Harnessing_digitalisation_in_Public_Employment_Services_to_connect_people_with_jobs.pdf.

[7] For example: European Commission, Analytical Paper *Modernising PES through supportive data and IT strategies*, Publications Office of the European Union, Luxembourg, 2016; European Commission, *Practitioner's toolkit: Being smart with data, using innovative solutions*, Publications Office of the European Union, Luxembourg, 2017.

[8] European Commission, *Practitioner's toolkit: Being smart with data, using innovative solutions*, Publications Office of the European Union, Luxembourg, 2017.

[9] OECD, *AI and employment*, OECD Policy Observatory, n.d., https://oecd.ai/en/dashboards/policy-areas/PA8; Brioscú, A. et al. (OECD), *A new dawn for public employment services: Service delivery in the age of artificial intelligence*, OECD Artificial Intelligence Papers, No. 19, OECD Publishing, Paris, 2024 OECD, *A new Dawn for Public Employment Services*, 2024, A new dawn for public employment services | OECD

[10] European Commission, *AI Watch*, n.d., https://ai-watch.ec.europa.eu/index_en.

- The work of (academic) research projects supported by the European Commission's Horizon 2020 research and innovation programme) that focus on specific areas of PES work (e.g. the HECAT project[11], which looks at personalised assistance to labour market decision-making).

There is a clear need to create more complete overviews and deeper analyses. For example, an internal PES Network document[12] highlights PES' interest in diving deeper into AI to see how it could benefit their work.

1.1 Report objectives

This report compiles a more complete overview of existing and planned AI practices across European PES. It analyses their outcomes, the challenges PES face, and the context in which these developments take place. More specifically, it:

1. Describes the background and development in AA and AI and frames these in the context of PES processes and services, as well as the wider context, such as ethical and organisational factors. This provides the input for the framework(s) that guides the empirical part of the report.
2. Creates an overview of the current applications of AA (and AI) within European PES to understand their status, application area and focus.
3. Analyses the impact of AI on PES processes and services, with an emphasis on business value and outcomes, framed in the wider context of AI developments.

The focus of this report is on (AI). While definitions of the concept are ambiguous and sometimes contradictory, they are also rapidly evolving (see Chapter 2). This report adopts a broad perspective, viewing AI as a logical extension and evolution of more advanced types of analytics (AA) based on machine learning (ML) and deep learning (DL) approaches. Accordingly, the report sometimes uses AA/AI in the context of the practices analysed. By looking at past, current and future lessons, beyond the application of AI in 11 sample PES, the report is focused on lessons for PES practitioners within a defined scope of cases.

1.2 Report approach

A multi-step research approach was used to achieve the report objectives. As the objectives were qualitative, a qualitative research approach was chosen, comprising several steps:

1. Desk research:
   - To gain insights into relevant developments in the AA and AI space and the context surrounding PES' AA and AI implementation;
   - To identify relevant PES and their AA and AI practices, based on previous PES Network publications and references.
2. Interviews with participating PES:
   In total, 11 PES were interviewed, each with some experience of AA and AI. This could be very early stages (e.g. doing a Proof of Concept (PoC) or pilot) or more advanced (e.g. with several practices in production).
3. Analysis of practices and follow-up:
   The interviews were analysed and the data used to create the insights in this report. Additional information was requested in some cases[13]. Practices were included based on a set of criteria:
   - Above a first generation of analytics (see Section 2.3);

[11] HECAT, *Disruptive technologies supporting labour market decision-making*, n.d., https://hecat.eu/.

[12] European Commission, Heylen, J. and Gaelle-Crépin, D., *Study to support scoping of Working Group PES 4.0 Task Force*, Luxembourg, Publications Office of the European Union, 2022.

[13] This report was completed based on information available at the time of writing.

- Had a business orientation (i.e. could be used for actual PES processes and/or services). This excluded practices with a research and development (R&D), academic or theoretical orientation;
- Components of a bigger application were not analysed separately if that application was also mentioned. For example, an algorithm to check for bias in a profiling or matching algorithm was not analysed separately. This also applied to such elements as application programming interfaces (APIs) that open AI applications, data preparation and extract, transform and load (ETL) applications, database and storage applications, or ML or development operations (DevOps) (methodology to streamline development cycles and moving development to production).

The nature of the report is qualitative, with a focus on (business) value. The observations in the empirical chapters provide reflections from the empirical stages, embedded in the analyses from earlier chapters, and interpret those points (e.g. their implications).

1.3 Report overview

This report is structured as follows:

- **Chapter 2** discusses the background of AI and current trends/developments in the AI space, as well as the broader context in which these developments take place;
- **Chapter 3** provides an overview of the practices collected and analysed in the report. It discusses various approaches to plotting these practices along relevant dimensions, such as status, type and maturity;
- **Chapter 4** discusses the main observations from the interviews, providing qualitative insights into PES AI practices, their goals and contexts;
- **Chapter 5** presents overall conclusions and recommendations for PES, building on the observations of earlier chapters.

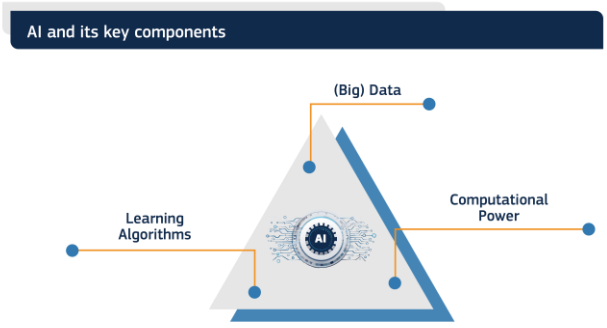
2 ADVANCED ANALYTICS AND ARTIFICIAL INTELLIGENCE

This second chapter discusses the concepts of AA and AI. It starts with a short overview of history of AA and AI in the PES Network, which helps to frame the background of this report (Section 2.1). Section 2.2 shifts the focus to definitions of AI and AA, while Section 2.3 looks at the different generations of analytics that culminated in AI, followed by an overview of the latest trends and developments in AI (Section 2.4). The current and future role of AA and AI within governments (and PES) is discussed in Section 2.5. Section 2.6 closes with a framework that incorporates the main contextual factors that enable or hinder the implementation of AA and AI.

2.1 AI in the PES Network

AI has gained interest in recent decades. While the concept has been around for some time, the arrival of the Big Data movement in the mid-2010s prompted organisations (including governments) to begin exploring their use to create AI applications.

Figure 4. AI and its key components



The PES Network started focusing on AI in 2016/2017. Two publications[14] described the concept in more general terms, discussed its potential, and analysed the first experiments within EU PES. This happened largely in the context of discussions of data usefulness within PES, which had created a new set of challenges and opportunities for PES. The development of AI applications hinges on three elements (Figure 4):

- Learning algorithms and models developed by scientists to analyse data;
- The Big Data needed to train and validate these models. Big Data depends on information technology (IT) for collection and storage. Recent developments have enabled Big Data to become useful;
- The computational power needed to process Big Data. Only relatively recently have computers become powerful enough to analyse large amounts of data fast enough (and, increasingly, in real time).

In the last 5 to 10 years, PES have explored the possibilities of AI. This ranges from pilots and PoCs, to laboratories where experiences with AI can be gained in a safe and isolated environment (e.g. Swedish AI lab), application in daily operations (e.g. BE-VDAB matching engine), and other PES that use AI to provide better, more accurate, competency-based matches.

Within the wider context of public administrations, however, AI's value has yet to be researched extensively. Little is known about the outcomes of the use of AI, with a scarcity of literature objectively measuring the outcomes of AI initiatives against their inputs in public sector or AI contexts.

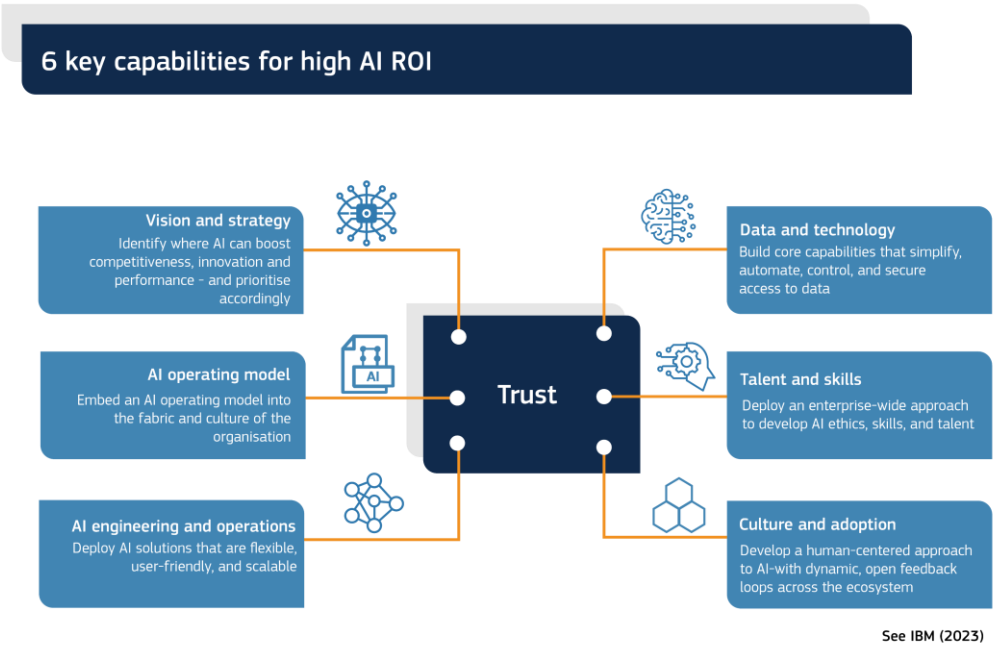
[14] European Commission, Analytical Paper *Modernising PES through supportive data and IT strategies*, Luxembourg, Publications Office of the European Union, 2016; European Commission, *Practitioner's toolkit: Being smart with data, using innovative solutions*, Luxembourg, Publications Office of the European Union, 2017.

Several publications point to the potential ROI. For example, Microsoft claims that every dollar invested in AI yields USD 3.50 in return[15]. PWC[16] suggests the following 'hard' ROI from AI deployments:

- Time savings: AI will automate repetitive manual and cognitive tasks, reducing the time needed to complete those tasks;
- Productivity increase: AI can support more effective and efficient decision-making;
- Revenue increase: AI will create new services and improve existing services. Although this does not directly apply to PES, revenue increase could hypothetically be transposed into increased customer satisfaction or improved service delivery for public sector clients.

IBM (2023) adds the capabilities needed in the organisation to achieve this ROI (see Figure 5).

Figure 5. Capabilities for high AI ROI



See IBM (2023)

In summary, European PES have paid increasing attention to AI in recent years, in the context of digitalisation and analytics, and prompted by publications citing the potential value of AI for governments and PES alike. However, that value can only be assessed if there is a concrete, universally agreed definition of AI.

2.2 Definitions and interpretations of AI

To date, there is no universally accepted definition of AI, with many definitions varying in their scope and focus. For example, OpenAI, the company behind ChatGPT, takes a very narrow and output-focused approach, defining AI as: 'highly autonomous systems that outperform humans at most economically valuable work'[17]. Henman[18] defines it more broadly: 'AI is typically used to refer to (systems developed with) machine learning

[15] Estrada, S., *What is the ROI for AI? A Microsoft expert explains how companies are making $3.5 for every $1 invested*, Fortune website, 6 November 2023, accessed 09 September 2023, https://fortune.com/2023/11/06/roi-for-ai-microsoft-expert-explains/.

[16] Rao, A., *Solving AI's ROI problem. It's not that easy*, PWC website, 20 July 2021, accessed 28 August 2023, https://www.pwc.com/us/en/tech-effect/ai-analytics/artificial-intelligence-roi.html.

[17] OpenAI, *OpenAI Charter*, OpenAI website, n.d., accessed 09 September 2023, https://openai.com/charter.

[18] In Henman, P., *Improving public services using artificial intelligence: possibilities, pitfalls, governance*, Asia Pacific Journal of Public Administration, Vol. 42, Issue 4, 2020, pp. 209-221.

algorithms that self-organise their internal variables and values to achieve desired outcomes'.

These definitions not only vary in their scope (e.g. whether AI is narrow/broad), but also in nature. While some emphasise how it works (e.g. ML background), others compare it to human intelligence and how AI makes decisions compared to humans.

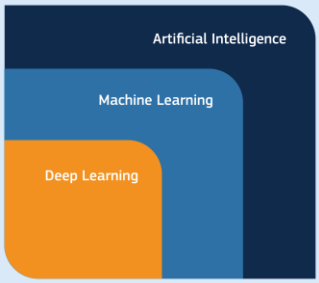
In the recently approved AI Act[19], the European Commission proposes a definition of AI systems: 'a machine-based system designed to operate with varying levels of autonomy and that may exhibit adaptiveness after deployment and that, for explicit or implicit objectives, infers, from the input it receives, how to generate outputs such as predictions, content, recommendations, or decisions that can influence physical or virtual environments.'

This is a broader view that emphasises both the processing and creation of data-based outputs. The AI Act definition aligns with the approach proposed by the OECD[20] in that it does not stress the link to ML and the creation of (intelligence-oriented) outcomes (see Explainer 1).

Explainer 1. Relationship between AI, ML and DL

Artificial intelligence (AI), machine learning (ML) and deep learning (DL)

AI, ML and DL are related concepts. AI is the broadest and refers to the creation of machines with human-like intelligence (also European Commission definition above). The creation of AI applications often relies on ML, which refers to the training of software (e.g. recognising patterns) based on models and large datasets. DL is a sub-set of ML in which the analysis of highly unstructured data has a central place (e.g. recognising elements or people in photos).



During the conceptual phase of this study in early 2023, pending adoption of the AI Act, a categorisation of AI was required to understand the diverse nature of AI applications that build on more traditional ways of analysing data.

2.3 Different generations and types of analytics

One way to do this is by looking at how AI evolves over time. Several models look at these generations. NTT Data (2018) describes three different generations of AI that move from being rule-based, via statistical approaches, to models that resemble the human brain[21].

[19] Proposal for a Regulation of the European Parliament and of the Council laying down harmonised rules on artificial intelligence (Artificial Intelligence Act) and amending certain union legislative acts, COM(2021) 206 final / 2021/0106 (COD), https://eur-lex.europa.eu/legal-content/EN/HIS/?uri=celex%3A52021PC0206.

[20] Council of the European Union, *Artificial Intelligence Act: Council and Parliament strike a deal on the first rules for AI in the world,* Press release, 9 December 2023, accessed 01 February 2024, https://www.consilium.europa.eu/en/press/press-releases/2023/12/09/artificial-intelligence-act-council-and-parliament-strike-a-deal-on-the-first-worldwide-rules-for-ai/.

[21] NTT Data, *What is AI*?, NTT Data website, 9 October 2018, accessed 23 September 2023, https://www.nttdata.com/id/en/digital/ai/2018/september/what-is-ai.

The distinction between different generations of AA (including AI)[22] provides another perspective on different types of analytics that culminate in AI:

- **Analytics 1.0**
  Dominated by more traditional business intelligence approaches and the use of descriptive analytics.
- **Analytics 2.0**
  Focused on the use of analytics in the context of Big Data developments.
- **Analytics 3.0**
  Traditional organisations started to use Big Data and analytics, with products developed based on data and analytics.
- **Analytics 4.0**
  AI technologies adopted on a wider scale within organisations and analytics become increasingly smart.

These categorisations tend to date quickly because they do not include newer developments in AI (such as GenAI) or categories that look to the future. It thus makes sense to look at newer subdivisions of AI[23]:

- **Artificial narrow intelligence (ANI)**
  Also known as weak AI, ANI is designed to perform specific and narrowly defined tasks. Examples are recommender systems (e.g. Netflix), self-driving cars, and modern chatbots (e.g. ChatGPT). Most current advanced AI applications fall into this category, such as those based on natural language processing (NLP; see Explainer 2) and/or large language models (LLMs; see Explainer 5) and those that focus on GenAI (see Glossary in Section 7.2).
- **Artificial general intelligence (AGI)**
  AGI aims to approach human intelligence by a) analysing and processing data in human ways, and b) creating complex and human like outputs. Multimodal large language models (MLLMs) are a first step towards AGI.
- **Artificial super intelligence (ASI)**
  ASI is a type of AI where machines are smarter than humans in (potentially) every field of knowledge and work. While these do not exist yet and there is considerable debate about their (potential) nature, they nevertheless provide future perspectives on the development of AI.

Explainer 2. NLP

Natural language processing (NLP)
NLP is the field of computer science and analytics concerned with giving computers the ability to understand, interpret and manipulate human language. This implies that: • Human language in different forms (e.g. written or spoken) needs to be converted to binary formats that computers understand. This involves such approaches as speech-to-text where spoken words are converted into written text; • These texts are then analysed to understand them. Large language models (LLMs) are one such approach (see Explainer 5), often building on neural networks (NNs) as their analytical approach (see Explainer 4); • NLP is often used within GenAI (e.g. ChatGPT), where computer language is transformed back into language that humans can understand.

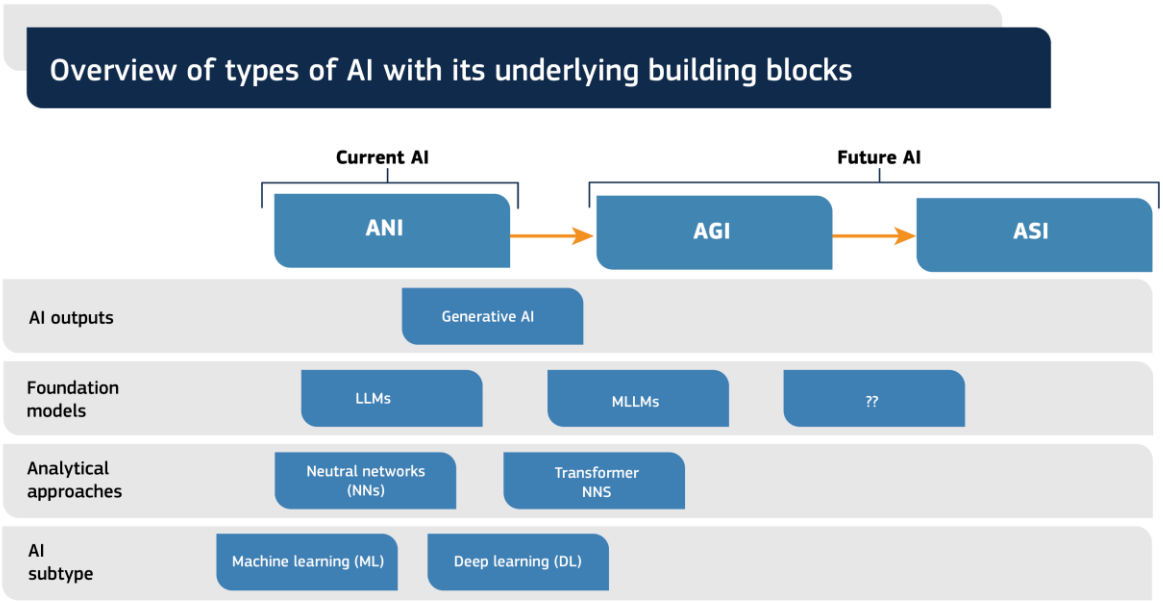
Figure 6 presents an overview of the building blocks of these types of AI. It looks at: a) the AI subtype dominant in the application; b) the types of analytical approaches used in

[22] Davenport, T. H., *From analytics to artificial intelligence*, Journal of Business Analytics, Vol. 1, Issue 2, 2018, pp. 73-80.

[23] University of Wolverhampton, *What are the different types of artificial intelligence*, University of Wolverhampton website, 7 June 2023, accessed 10 August 2023, https://online.wlv.ac.uk/what-are-the-different-types-of-artificial-intelligence/.

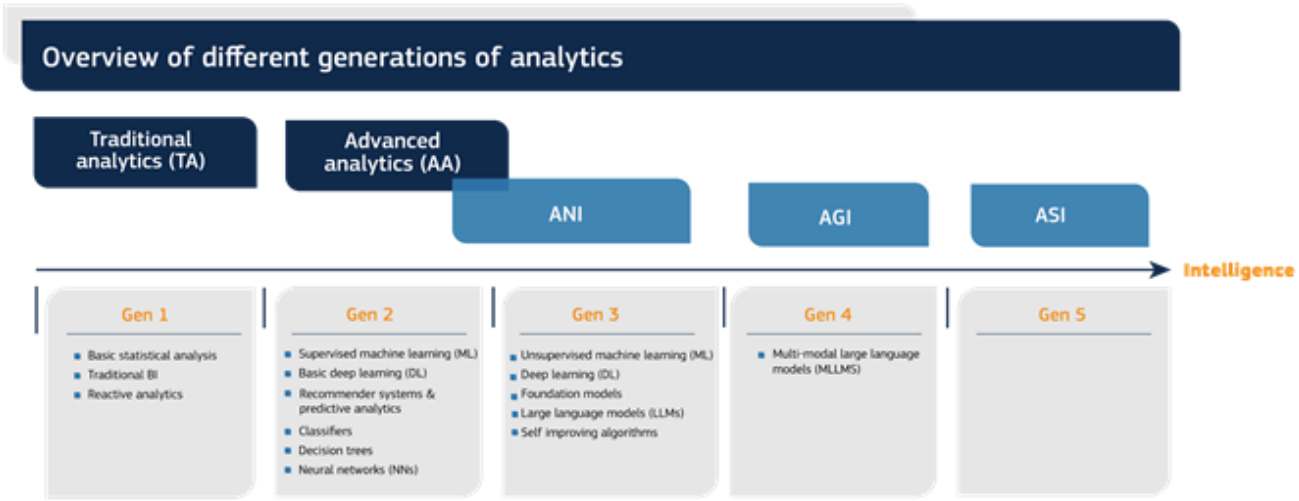
the AI; c) the foundation models built on these analytical techniques; and d) the AI outputs generated in the application (see Glossary in Section 7.2).

Figure 6. Types and building blocks of AI



This overview links many of the relevant terms and is useful in interpreting their relative positions and relationships. It also highlights how the nature of AA and AI is shifting – what was considered a form of AI 5 to 10 years ago is no longer considered AI in the tripartite division ANI/AGI/ASI. Accordingly, this report proposes a framework in which different forms of analytics are combined in a generational overview. To denote the differences, the term AA is applied for those types of analytics that use various analytical methods (including ML). Figure presents this framework, showing the different generations identified for this report. This first analysis framework is used to plot the nature of practices identified in the report.

Figure 7. Analysis framework 1: Generations of AA and AI



While newer generation of analytics use more sophisticated approaches, they are not necessarily better at producing the desired results.

2.4 Trends and developments in AI

The field of AI is evolving rapidly. The recent release of ChatGPT[24], for example, has led to significant interest in the possibilities of such LLM-based applications, including in the public sector[25]. Five of the latest trends and developments are relevant here.

2.4.1 GenAI

The launch of ChatGPT generated considerable discussion of the possibilities of GenAI, a type of AI characterised by its capabilities to generate new data and outputs. GenAI chatbots such as ChatGPT, BARD and Copilot can generate new text-based outputs (where traditional chatbots simply use predefined texts). GenAI is also used to generate images (e.g. DALL-E from OpenAI; Firefly from Adobe) or music (e.g. MusicLM by Google or AIVA).

In addition to its potential, the literature raises several issues with ChatGPT:

- It struggles with more complex reasoning and mathematics (Qin et al., 2023);
- It still makes up information;
- Its built-in safety features on undesired content can be circumvented[26].

2.4.2 Testing and explaining AI

The popularity and increase in more complicated forms of AI are accompanied by several concerns, including: a) the ability to test how models work; and b) being able to explain these complex models. Two trends are relevant here. Firstly, there are calls to conduct independent testing of AI algorithms used by governments[27]. Some countries, such as the United Kingdom (UK), are conducting model evaluations and testing work on government algorithms (e.g. the UK's new AI Safety Institute[28]; the United Arab Emirates (UAE) AI Ministry). Scientists are also developing algorithms to explain how AI generated a decision in specific cases[29]. While these are in their infancy, they provide an interesting perspective on how AI might be used to test AI.

2.4.3 Bigger LLMs and the rise of MLLMs

LLMs are a type of foundation model that process large amounts of data. The size of the LLMs is growing rapidly. The number of parameters (the term used to show the number of variables present in LLMs) of several GPT models developed by OpenAI has grown as follows:

- GPT-2 (launched in 2019): 2 billion;
- GPT-3 (launched in 2020): 175 billion;
- GPT-4 (launched in 2023): 1 trillion.

The number of parameters is important, as they determine how many (language) elements the model can understand and thus its effectiveness in providing realistic, human-like, language. While it is expected that these LLMs will continue to increase, a newer type of LLM has also emerged: MLLMs do not just process text-based data, but work with multiple

[24] ChatGPT, *Get started*, ChatGPT website, n.d., accessed 03 November 2023, https://chat.openai.com/auth/login.

[25] Council of the European Union, *ChatGPT in the public sector: Overhyped or overlooked?*, Luxembourg, Publications Office of the European Union, 2023, https://www.consilium.europa.eu/media/63818/art-paper-chatgpt-in-the-public-sector-overhyped-or-overlooked-24-april-2023_ext.pdf.

[26] Christian, J., *Amazing "jailbreak" bypasses ChatGPT's ethics safeguards*, Futurism website, 4 February 2023, accessed 11 July 2023, https://futurism.com/amazing-jailbreak-chatgpt.

[27] Henman, P., *Improving public services using artificial intelligence: possibilities, pitfalls, governance*, Asia Pacific Journal of Public Administration, Vol. 42, Issue 4, 2020, pp. 209-221.

[28] Government of the UK, *Introducing the AI Safety Institute*, Policy paper, 2024, https://www.gov.uk/government/publications/ai-safety-institute-overview/introducing-the-ai-safety-institute.

[29] Samek, W., Wiegand, T. And Müller, K.-R., *Explainable artificial intelligence*, arXiv, Preprint, 08296, 2017, https://arxiv.org/abs/1708.08296.

modalities (e.g. audio, video) as inputs and can create combined modalities based on these inputs. For example, Microsoft's Kosmos can generate movies with dialogue and sound based on a) text, b) audio files, and c) pictures[30]. Some consider these MLLMs the first step towards AGI (also Section 2.3).

2.4.4 Responsible AI

The rise of more advanced types of AI raises questions of transparency and the ethical deployment of AI, prompting interest in the new area of responsible AI (see Explainer 3). In 2023, Gartner named responsible AI as a key trend[31]. An important component of responsible AI is to adopt risk-appropriate approaches to AI, where the 'black box'[32] nature is weighed against the need for openness.

Explainer 3. Responsible AI

Responsible AI

Responsible AI is the ethical and transparent development and deployment of AI technologies. It emphasises accountability, fairness, and inclusivity[33,34]. The goal of responsible AI is to ensure that AI systems are developed, assessed and deployed in a safe, trustworthy, and ethical way. This approach can help to proactively guide decisions toward more beneficial and equitable outcomes by keeping people and their goals at the centre of system design decisions and respecting enduring values such as fairness, reliability, and transparency. Microsoft has developed a 'Responsible AI Standard', which is a framework for building AI systems according to six principles: fairness, reliability and safety, privacy and security, inclusiveness, transparency, and accountability. These principles are the cornerstone of a responsible and trustworthy approach to AI, especially as intelligent technology becomes more prevalent in products and services that people use every day. The Responsible AI Standard can help developers and data scientists to implement and operationalise these six core principles.

Source: Generated by Microsoft's CoPilot AI Chat application.

Ethical AI can be viewed as a subset of responsible AI and is concerned with the development of AI that emphasises fairness and respect for human values. The International Organization for Standardisation is working on technical standards for ethical AI[35], which could be useful to PES (see Example 10).

2.4.5 Increasing concerns

Newer trends and developments in AI are examined more closely for flaws and ways to mitigate concerns. Henman[36] lists four key concerns:

1. Accuracy, bias, discrimination, and symbolic power;
2. Legality, due process, and administrative justice;
3. Responsibility, accountability, transparency, and explainability;

[30] See https://www.youtube.com/watch?v=A7qBbBkLkns for an illustration of Microsoft's Kosmos-2 MLLM.

[31] Perri, L., *What's new in artificial intelligence from the 2023 Gartner hype cycle*, Gartner website, 17 August 2023, accessed 27 October 2023, https://www.gartner.com/en/articles/what-s-new-in-artificial-intelligence-from-the-2023-gartner-hype-cycle.

[32] A 'black box' is where it is difficult to derive how final outputs follow from the initial inputs.

[33] Microsoft, *What is responsible AI?*, Microsoft website, 13 September 2024, accessed 11 November 2023 https://learn.microsoft.com/en-us/azure/machine-learning/concept-responsible-ai?view=azureml-api-2.

[34] Singh, A., *What is responsible AI?*, Global Tech Council website, 21 October 2024, accessed 05 March 2024 https://www.globaltechcouncil.org/artificial-intelligence/responsible-ai/.

[35] International Organization for Standards, *ISO/IEC JTC 1/SC 42: Artificial intelligence*, ISO, 2017, www.iso.org/committee/6794475.html.

[36] Henman, P., *Improving public services using artificial intelligence: possibilities, pitfalls, governance*, *Asia Pacific Journal of Public Administration*, Vol. 42, Issue 4, 2020, pp. 209-221.

4. Power, compliance, and control.

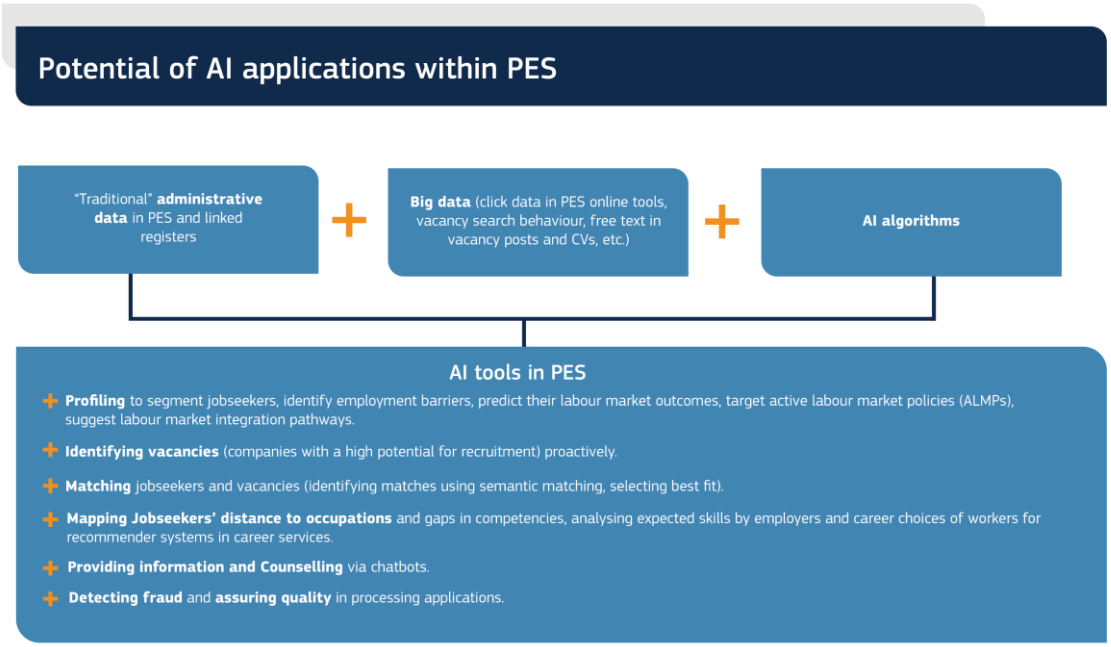
Proper security processes and responsible AI can mitigate many of these concerns.

2.5 Potential and use of AI within the public sector and PES

Most of the trends and developments in AI are aimed at all types of organisation, with many publications focusing on the private sector. However, some initiatives target PES specifically.

Firstly, the OECD has published guidelines for governments on working with AI[37]. These guidelines include: a) principles for responsible stewardship of trustworthy AI; and b) national policies and international cooperation for trustworthy AI. It has also published overviews of potential AI applications areas in PES[38] (Figure 8). The OECD AI Policy Observatory[39] contains useful resources for public sector agencies planning to work with AI, such as tools for implementing trustworthy AI[40] and the possibilities of GenAI[41]. The OECD has undertaken a large-scale, OECD-wide study of PES and AI in the context of digitalisation[42]. The PES Network has collaborated with the OECD on this study and the associated report[43].

Figure 8. Overview of potential AI applications in PES



Secondly, a European Skills, Competences, Qualifications and Occupations (ESCO) initiative provides an important asset in PES digitalisation, with its multilingual taxonomy of skills and occupations. Structured relationship between skills and occupations can be

[37] OECD, Recommendation of the Council on artificial intelligence, OECD Legal Instruments website, n.d., accessed 15 November 2024, https://legalinstruments.oecd.org/en/instruments/OECD-LEGAL-0449.

[38] OECD, *Harnessing digitalisation in Public Employment Services to connect people with jobs*, 2022, https://www.oecd.org/els/emp/Harnessing_digitalisation_in_Public_Employment_Services_to_connect_people_with_jobs.pdf.

[39] OECD, *Policies, data and analysis for trustworthy artificial intelligence*, OECD AI Policy Observatory website, n.d., accessed 15 November 2024, https://oecd.ai/en/.

[40] OECD, *From principles to practice: tools for implementing trustworthy AI*, OECD AI Policy Observatory, 2021, https://oecd.ai/en/tools-report.

[41] OECD, *Generative AI*, OECD AI Policy Observatory website, n.d., accessed 15 November 2024 https://oecd.ai/en/genai.

[42] Brioscú, A. et al., *A new dawn for public employment services: Service delivery in the age of artificial intelligence*, OECD Artificial Intelligence Papers, No. 19, OECD Publishing, Paris, 2024 A new dawn for public employment services | OECD

[43] One joint interview (with LU PES) and information shared throughout the process.

used to enrich CVs and job vacancies and broaden the options for match between the two. ESCO argues that 'Artificial intelligence (AI) offers the potential to support, scale up, semi-automate, or automate the various steps that are manually performed today to maintain and extend ESCO'[44]. More frequent updates and extensions to ESCO could be very useful for PES, reducing the need for their own additions and changes. It creates various use cases:

- ESCO skill and occupation identification from free text such as work history and job description;
- Linking learning outcomes to skills and occupations;
- Finding close occupations and skills.

For example, Europass uses both ESCO classification and the European Centre for the Development of Vocational Training (Cedefop)'s AI-driven skills intelligence to enrich users' CVs and gain insight into the demand for specific occupations and skills across the Member States.

Thirdly, the HECAT project[45], funded by Horizon 2020, aimed to improve profiling algorithms across PES, tackle the challenge of black-box profiling algorithms in PES, and provide recommendations for PES. It analysed current profiling applications, concluding that there is a lack of reporting standards for profiling algorithms[46].

Finally, several activities take place in the field of labour market information (LMI) and several publications replace 'information' with 'intelligence' in LMI when AI is involved. Mezzanzanica and Mercorio[47] suggest that these activities 'design, define and implement AI-based framework and algorithms to derive knowledge from labour market information'. The European Training Foundation (ETF) defines LMI as 'the design and use of artificial intelligence (AI) algorithms and frameworks to analyse data related to the LM [Labour Market Information] for supporting policy and decision-making'. It has also published an introductory guide that could be useful to PES in this respect[48].

The Council of the European Union published a more general discussion of the potential of AI for the public sector[49]. It looks at the general application areas of AI that are relevant to PES:

- Chatbots and virtual assistants;
- Document and text analysis;
- Decision making (e.g. evaluating grant proposals or permit applications);
- Financial insights;
- HR processes and creation of LMI;
- Support of legal practices through analysis of (large volumes of) legal materials.

The Council concludes that AI has considerable potential for the public sector and interest from public agencies is likely to lead to an explosion in AI applications in the future.

[44] European Commission: European Skills, Competences, Qualifications and Occupations, *Leveraging artificial intelligence to maintain the ESCO occupations pillar,* Luxembourg, Publications Office of the European Union, 2021; European Commission: European Skills, Competences, Qualifications and Occupations, *Information note: Using artificial intelligence for maintaining and improving ESCO*, Luxembourg, Publications Office of the European Union, 2021.

[45] HECAT was funded under the EU's Horizon 2020 research and innovation programme (grant no 870702).

[46] HECAT (2023). Algorithm Profiling in Public Employment Services (PES) Reporting Standards Policy Brief. Brussels: HECAT/European Commission

[47] Mezzanzanica, M. and Mercorio, F., *Big Data enables labour market intelligence*, *Encyclopaedia of Big Data Technologies*, 2018, pp.1-11, 10.1007/978-3-319-63962-8_276-1.

[48] ETF, *Big Data for labour market intelligence: An introductory guide*, European Training Foundation, 2018, https://www.etf.europa.eu/en/publications-and-resources/publications/big-data-labour-market-intelligence-introductory-guide.

[49] Council of the European Union, *ChatGPT in the public sector: Overhyped or overlooked?*, Luxembourg, Publications Office of the European Union, 2023, https://www.consilium.europa.eu/media/63818/art-paper-chatgpt-in-the-public-sector-overhyped-or-overlooked-24-april-2023_ext.pdf.

However, it notes the specific impact of LLMs on the main principles of public administrations, including risks and drawbacks such as transparency, accountability, equality, the predictability of outcomes and trust[50].

This overview highlights several areas where AI could create efficiency and effectiveness gains for PES:

- Profiling and/or segmenting jobseekers;
- Vacancy matching;
- Creation of individual action plans (IAPs);
- Counselling and/or support services;
- Training and career guidance;
- Fraud detection (if unemployment benefits are provided through the PES);
- Labour mobility (including cross-border) and the creation of LMI;
- Labour market analysis and (skills) forecasting;
- Disbursement of unemployment benefits and conditionality checks.

To date, there is no complete overview of actual applications, with few publications looking at the value of AI within the complicated context of PES. This wider context is explored in the next section and forms the basis for the analytical framework guiding the empirical work.

2.6 The context of AI: a framework of enabling and hindering factors

While the (technological) developments in the field of AI move rapidly, so too do the surrounding areas, such as new laws and regulations to guide AI implementation. This section describes various contextual factors that could stimulate or hinder AI initiatives within PES. Although there are no conclusive overviews on the types of variables that are most relevant, other areas yield useful insights, such as overviews of relevant variables for digital government transformation (e.g. Misuraca[51]). Several publications also focus on individual elements of AI that are important in various areas (e.g. AI Watch, 2022a[52]; Alsheibani et al., 2018[53]; Tjebane et al., 2022[54]; Jacovi et al., 2021[55]; Schaefer et. al, 2021[56]). The following factors appear to be most important for PES: a) Legal and regulatory factors b) AI strategies at national or organisational level c) Responsible and ethical AI; d) Organisations and ecosystems; e) financial and resource considerations.

This leads to a (second) analysis framework (see Figure 9). Each of the factors in the framework is discussed in subsequent sections.

[50] Council of the European Union, *ChatGPT in the public sector: Overhyped or overlooked?*, Luxembourg, Publications Office of the European Union, 2023, https://www.consilium.europa.eu/media/63818/art-paper-chatgpt-in-the-public-sector-overhyped-or-overlooked-24-april-2023_ext.pdf.

[51] Misuraca, G., *Exploring Digital Government transformation in the EU. Analysis of the state of the art and review of literature*, Luxembourg: Publications Office of the European Union, 2019.

[52] European Commission, Joint Research Centre, AI Watch, *AI Watch: Revisiting technology readiness levels for relevant artificial intelligence technologies,* 2022a.

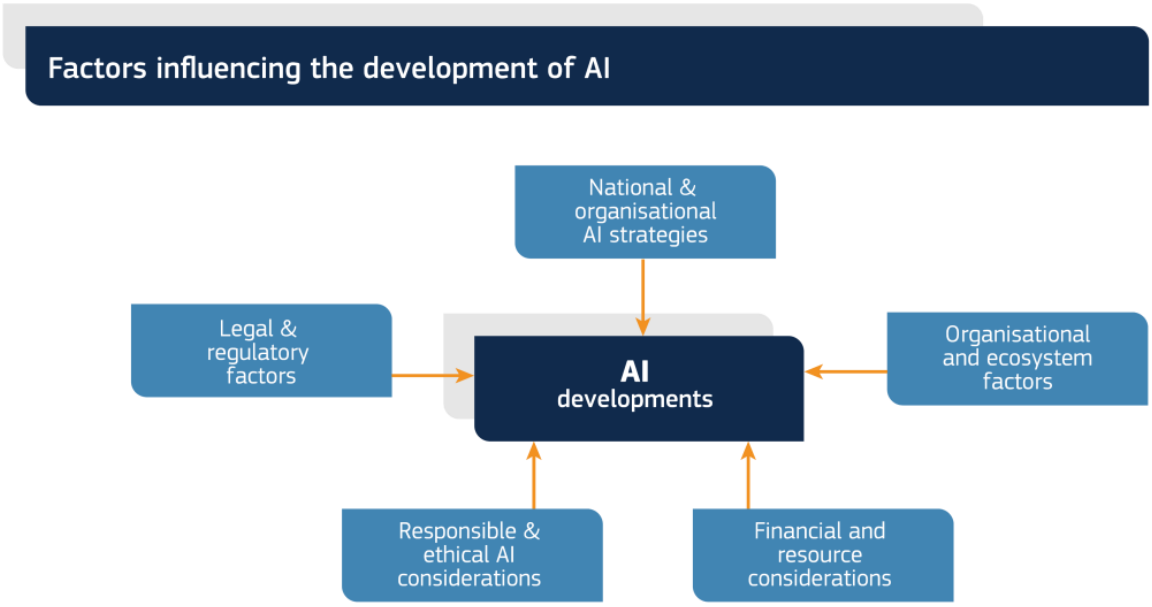
[53] Alsheibani, S., Cheung, Y. and Messom, C. H., *Artificial intelligence adoption: AI-readiness at firm-level*, PACIS, Vol. 4, 2018, pp. 231-245.

[54] Tjebane, M. M., Musonda, I. and Okoro, C. S., *A systematic literature review of influencing factors and strategies of artificial intelligence adoption in the construction industry*, Materials Science and Engineering, Vol. 1218, Issue 1, 2022, p. 012001.

[55] Jacovi, A., Marasović, A., Miller, T. and Goldberg, Y., *Formalising trust in artificial intelligence: Prerequisites, causes and goals of human trust in AI*, Proceedings of the 2021 ACM conference on fairness, accountability, and transparency, 2021, pp. 624-635.

[56] Schaefer, C., Lemmer, K., Samy Kret, K., Ylinen, M., Mikalef, P. and Niehaves, B., *Truth or dare? How can we influence the adoption of artificial intelligence in municipalities?,* Hawaii International Conference on System Sciences (HICSS), January 2021, DOI:10.24251/HICSS.2021.286.

Figure 9. Analysis framework 2: Factors influencing AI development



2.6.1 Legal and regulatory factors

PES AI initiatives are inherently impacted by legal and regulatory constraints. These exist at two levels: supranational laws and regulations; and national laws and regulations.

The EU AI Act is the first (supranational) regulatory framework in the world. It has several specific objectives:

- To ensure that AI systems placed on the Union market and used are safe and respect existing law on fundamental rights and Union values;
- To ensure legal certainty to facilitate investment and innovation in AI;
- To enhance governance and effective enforcement of existing law on fundamental rights and safety requirements applicable to AI systems;
- To facilitate the development of a single market for lawful, safe and trustworthy AI applications and prevent market fragmentation.

The EU AI Act is closely linked to other EU regulations, including the Data Governance Act[57], the Open Data Directive[58] and other initiatives under the EU strategy for data[59]. PES have time to familiarise themselves and assure compliance before the Act comes into effect in 2026.

In addition to EU legislation, several countries are developing their own national laws and regulations. For example, Germany's Standardisation Roadmap for AI (NRM KI)[60] focuses heavily on the security/safety of AI systems, as well as testing and certification of applications, while the Netherlands is creating oversight mechanisms to ensure compliance with new and existing regulations[61].

[57] Regulation (EU) 2022/868 of the European Parliament and of the Council of 30 May 2022 on European data governance and amending Regulation (EU) 2018/1724 (Data Governance Act), OJ L 152, 3.6.2022, p. 1–44.

[58] Directive (EU) 2019/1024 of the European Parliament and of the Council of 20 June 2019 on open data and the re-use of public sector information (recast), OJ L 172, 26.6.2019, p. 56–83.

[59] European Commission, *A European strategy for data,* n.d., https://digital-strategy.ec.europa.eu/en/policies/strategy-data, page last updated 10 October 2024.

[60] Germany, *Standardisation Roadmap for AI (NRM KI),* 2023, https://www.din.de/resource/blob/916798/ed09ae58b60f0d3a498fa90fa5085b7c/nrm-ki-engl-2023-final-web-250-neu-data.pdf.

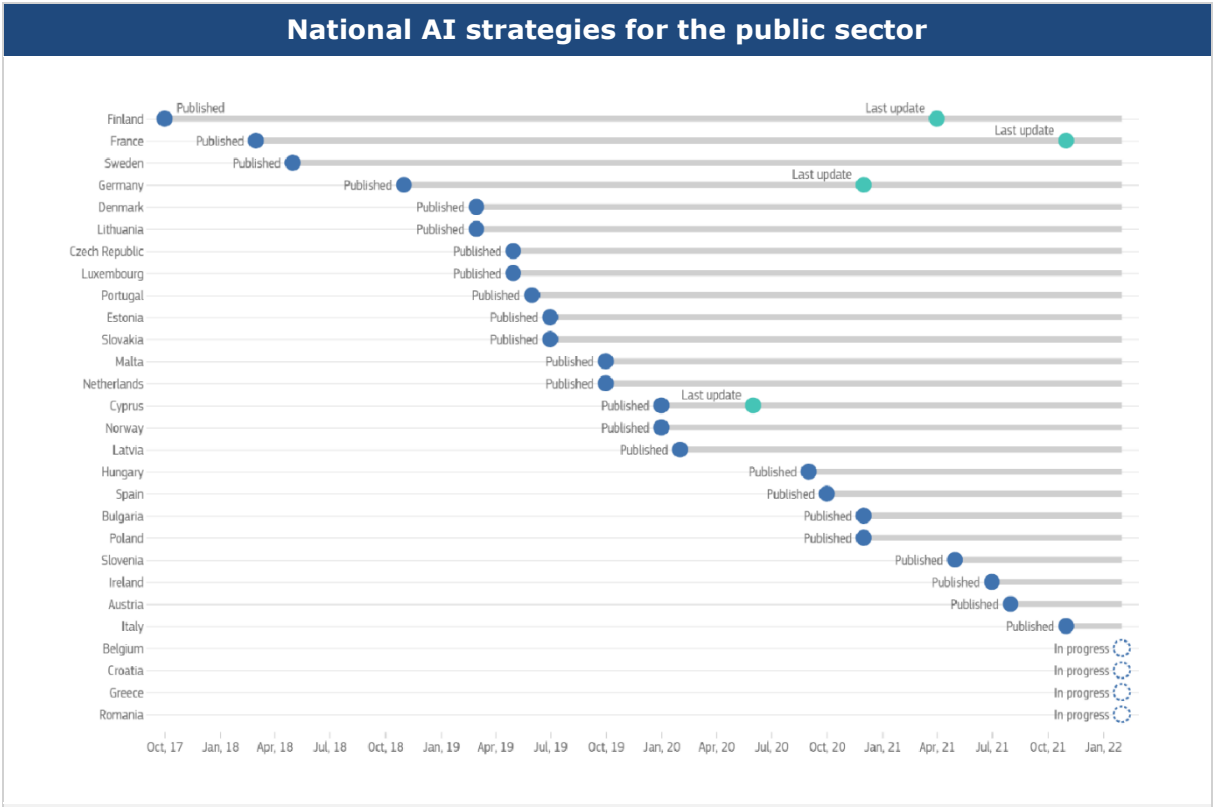
[61] Government of the Netherlands, Ministry of Economic Affairs, *Artificial Intelligence Regulations*, State Inspectorate for Digital Infrastructure website, n.d., accessed 11 February 2024, https://www.rdi.nl/onderwerpen/kunstmatige-intelligentie/regelgeving-kunstmatige-intelligentie-ai

A rapidly changing legal landscape creates a complicated context for PES, with different Member States dealing differently with compliance mechanisms and national frameworks. PES should monitor these changes closely to ensure that they become and remain compliant.

2.6.2 AI strategies at national and organisational level

PES are impacted, and sometimes bound, by (national) AI strategies that set out objectives for AI development and collaboration across government agencies. AI Watch monitors the use of AI across the Member States with a special focus on trustworthy AI[62]. As part of its most recent (2021) review of the use of AI in the public sector in the EU, it inventoried whether Member States have a national AI strategy guiding the use of AI in the public sector[63]. The inventory shows that most Member States have an AI strategy, revised and updated in some cases (see Figure 10).

Figure 10. Presence of national public sector AI strategies across the EU



Source: AI Watch (2022b).

The inventory also shows that these AI strategies differ substantially in scope and content. Some countries focus heavily on stimulating AI development in industry (e.g. through research and development (R&D) subsidies), while others focus on the impact of AI on areas such as education and care, or the functioning of government. Few national AI strategies focus directly on the functioning of PES. Examples include France (through the creation of the 'Labour AI', a public laboratory on the future of work), and Ireland (a review is underway of employment criteria for critical AI-related skills). In most cases, indirect impacts are the focus, e.g. through education-related measures.

[62] European Commission, Joint Research Centre, *Trustworthy artificial intelligence (AI),* 2023, https://joint-research-centre.ec.europa.eu/jrc-science-and-knowledge-activities/trustworthy-artificial-intelligence-ai_en.

[63] European Commission, Joint Research Centre, AI Watch, *National Strategies on Artificial Intelligence: A European Perspective*, 2022b.

2.6.3 Responsible and ethical AI

Responsible and/or ethical AI are umbrella terms for aspects such as accountability, explainability, transparency, trust, fairness, inclusion, and acceptance (see Section 2.4). Responsible AI strategies can ensure that AI is used ethically.

Ethical AI refers to the values and norms that should be followed when deploying AI, while responsible AI refers to the ways in which this is done. It has garnered considerable interest and substantial development.

The European Commission[64] defines four principles of **ethical AI**:

1) **Respect for human autonomy**
   Humans interacting with AI systems must be able to keep full and effective self-determination.
2) **Prevention of harm**
   AI systems should neither cause nor exacerbate harm or otherwise adversely affect human beings.
3) **Fairness**
   AI needs to ensure equal and just distribution of both benefits and costs. It also entails the ability to contest decisions made by AI systems and the humans operating them.
4) **Explicability**
   Processes need to be transparent and must be explained.

As a subset of ethical AI, the European Commission[65] has created guidelines for trustworthy AI. The guidelines reflect the European motto ('united in diversity') and take a human-centric approach, seeking to improve human welfare and freedom. Trustworthy AI has three components, which should be met throughout the system's entire lifecycle:

- It should be lawful, complying with all applicable laws and regulations;
- It should be ethical, ensuring adherence to ethical principles and values;
- It should be robust from both a technical and social perspective, as, even with good intentions, AI systems can cause unintentional harm.

The Netherlands' Scientific Council for Government Policy[66] provides a number of recommendations for governments to ensure the responsible deployment of AI. These include the stimulation of general AI awareness and knowledge among the general public, enhancing the skills and critical abilities of individuals working with AI, and establishing educational training and forms of certification to qualify individuals. This highlights the importance of AI strategies focusing on implementation and education.

2.6.4 Organisations and ecosystems

Organisational aspects are relevant to the successful implementation of AI within PES. Berndtsson et al[67] review several studies analysing barriers to the use of data and (advanced) analytics within organisations. Their analysis reveals three main groups of obstacles:

[64] European Commission: High-Level Expert Group on Artificial Intelligence (AI HLEG), *Ethics guidelines for trustworthy AI*, 2019, https://ec.europa.eu/futurium/en/ai-alliance-consultation.1.html.

[65] European Commission: High-Level Expert Group on Artificial Intelligence (AI HLEG), *Ethics guidelines for trustworthy AI*, 2019, https://ec.europa.eu/futurium/en/ai-alliance-consultation.1.html.

[66] Netherlands Scientific Council for Government Policy, *Mission AI: The new system technology*. The Hague: Netherlands Scientific Council for Government Policy, 2021.

[67] Berndtsson, M., Lennerholt, C., Svahn, T. and Larsson, P., *13 Organisations' attempts to become data-driven*, International Journal of Business Intelligence Research, Vol. 11, Issue 1, 2020, pp. 1–21, https://doi.org/10.4018/IJBIR.2020010101.

- **Aligning analytics vs the organisation:** a lack of knowledge and skills about analytics within the organisation, as well as employee resistance;
- **Management:** lack of management capabilities, support, adoption and understanding.
- **Data:** difficulty assessing relevant data in the organisation.

Organisational factors typically play an important role in the success of analytics initiatives and these are likely to permeate into AI. These include:

- **Involvement of key stakeholders across the organisation in developing AI.** Acceptance and adoption of analytics applications tend to depend on the degree to which resistance is mitigated. This can typically be done by engaging early with stakeholders and seeking their input into the design and development process;
- **Dealing with organisational constraints, such as silos.** These can create both operational impacts (e.g. making it difficult to collect and combine relevant data sources across organisational units) and implementation issues (e.g. different parts of the organisation have different requirements).

Several attempts have been made to develop ways to deal with these constraints, including principles of how organisations can adapt, or the values that should be deployed. Andersen et al.[68] (2018) describe the SCALE framework, which provides principles for AI-oriented data-driven organisations:

- **Sense:** ability to observe and register (developments in) the external and internal environment;
- **Comprehend:** use data from sensing activities to create context, detect patterns and draw inferences;
- **Act:** decision-making capabilities based on data;
- **Learn:** ability to gain knowledge and skills based on experiences to adapt and improve;
- **Explain:** ability to show and tell how and why something works.

As AI is still quite new, it is too early to fully understand its organisational impact. Nevertheless, as it is recognised to have some impact, PES should consider organisational factors when developing AI applications. This increasingly applies to the wider ecosystems in which PES operate. To date, very little information is available on these ecosystems, for example how PES could develop AI applications in conjunction with public and/or private sector partners, as well as international initiatives.

2.6.5 Financial and resource considerations

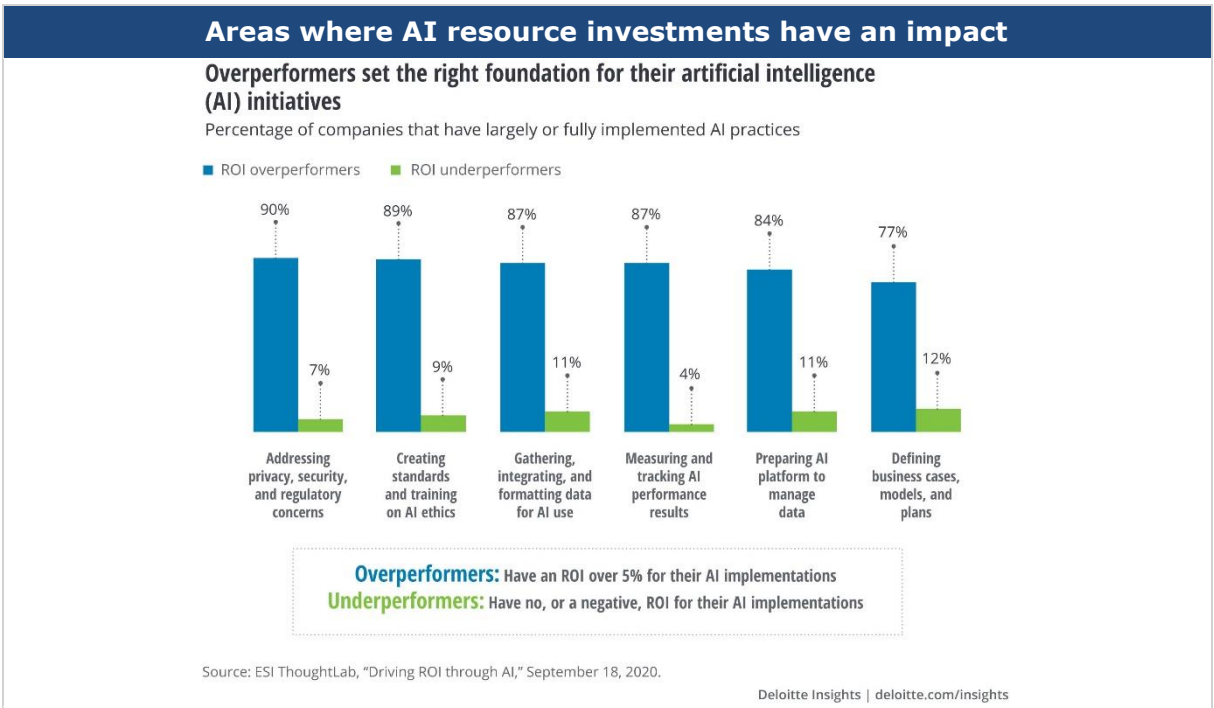
The resources needed to deploy AI could impact the feasibility of AI initiatives. As yet, very few studies evaluate the ROI of AI; while some cite the revenue generated by AI, they typically do not look at the financial resources needed to put AI into production and any effects achieved by those investments.

There are some insights into the resources needed and their associated successes. For example, Deloitte[69] compares over- and underperformers in AI and where they invest (see Figure 11).

[68] Andersen, E., Johnson, J. C., Kolbjørnsrud, V. And Sannes, R., *The data-driven organisation: Intelligence at SCALE*, in: Sasson, A. (ed.), *At the Forefront, Looking Ahead*, Universitetsforlaget, 2018, pp. 23–42, https://doi.org/10.18261/9788215031583-2018-03.

[69] Deloitte, *Driving ROI through AI*, ESI Thoughtlab, Deloitte Insights, 2020.

Figure 11. Impact of AI resource investments



Source: Deloitte (2020).

The analysis suggests that investments in addressing privacy, security and regulatory concerns have the biggest pay-off. It also gives PES a general overview of the areas in which they should expect to invest.

In practice, this has two implications for PES. Firstly, getting started with AI is relatively easy and cheap. For example, running a PoC or pilot on AI platforms such as those offered by major tech companies can be achieved quickly and cheaply. Secondly, AI then entails investment (financial and human) in most of the areas discussed here and presented in Figure 11. Moving to a production-ready state that complies with all of the relevant variables, will quickly escalate the resources needed, and PES are advised to take these considerations into account.

3 AI PRACTICES IN THE PES NETWORK

This section presents an overview of the practices included and analysed in the report. Section 3.1 provides a short description of all of the practices included and the PES' using them (a longer overview is available in Section 7.1). Section 3.2 gives an overview of the practices and their maturity (e.g. generation of AI), Section 3.3 gives a perspective on the development status of the practices. Section 3.4 describes the areas of PES processes in which the AI practices take place.

3.1 Overview of PES AI practices

Over 50 different AI practices were mentioned during the 11 interviews (and follow-up), but these were not all included in the analysis. The criteria for including a practice were:

- Above Gen 1;
- Clear business orientation (no research and development, academic or theoretical applications);
- No components or elements of bigger applications (if that application itself is included).

This yielded a total of 34 applications, distributed across the 11 PES (see Table 1).

Table 1. Overview of included PES AI practices as of October-November 2023

Number of PES AI practices			
PES	**Number of practices**	**PES**	**Number of practices**
BE-VDAB	9	LT	1
SE	5	AT	1
FR	5	EE	1
LUX	4	FI	1
SI	3	BE-Actiris	1
NL	3	**TOTAL**	**34**

Five PES refer to one AI practice, while BE-VDAB is responsible for more than 25% (nine) of all current AI applications. This skews the distribution of data, as a small number of PES are responsible for most applications. The Belgian-Flemish PES (VDAB), Sweden (*Arbetsförmedlingen*) and French PES (*France Travail*) have been working on AI for longer and therefore have the most applications and further-developed AI practices. All three have:

- AI and/or datalabs where they can experiment with data applications, and develop and test these with their users;
- Protocols and procedures to guarantee a) safety and security of systems, b) protect privacy of data and confidentiality of user information and c) ethical application of AI;
- Mechanisms to move AI initiatives into production after developing and trialling an idea (through PoC or pilot).

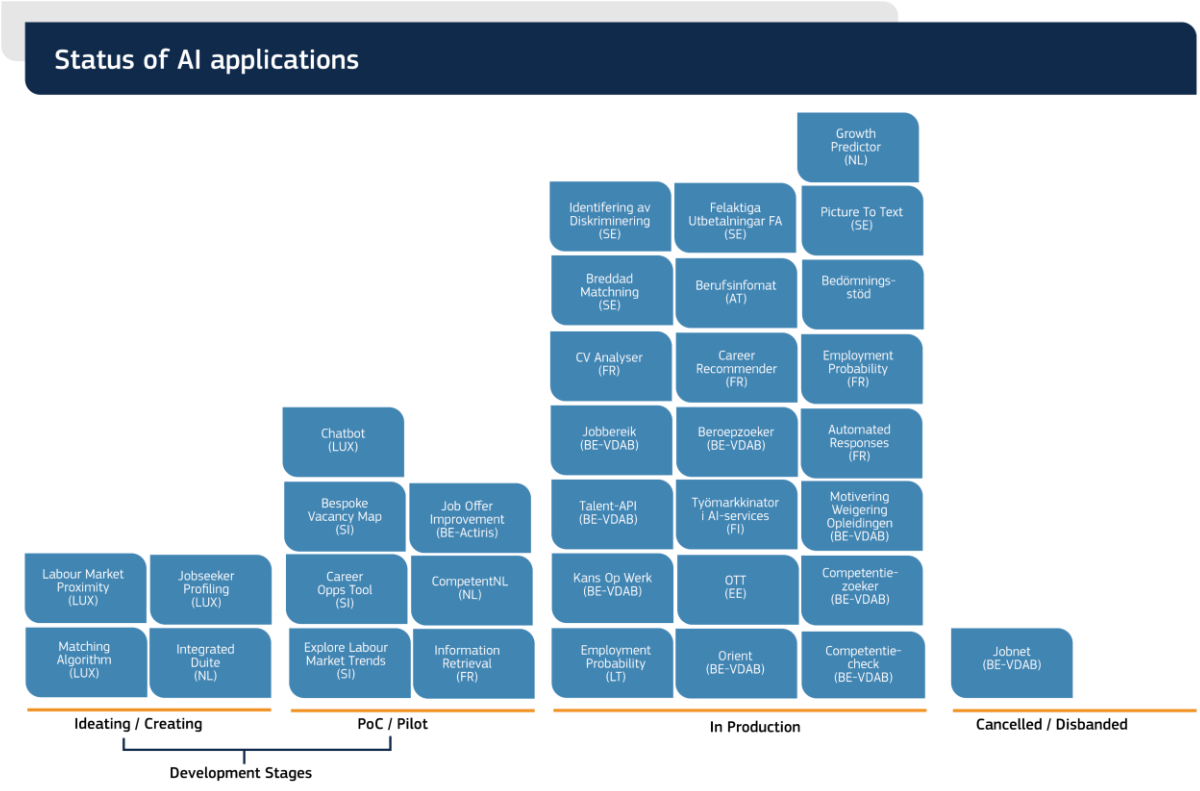
These aspects likely indicate PES' development in conceiving, developing and producing AI initiatives, typically using continuous learning and developing mechanisms as they progress. The PES interviewed describe overcoming obstacles as they arise, with valuable lessons for those PES that are less far along or just starting their AI work (see Section 4.9).

3.2 Status of AI development

There are numerous ways of looking at the nature of AI applications across the PES Network. This report focuses on three of these, beginning with where the applications are in their development process (Figure 12 presents an overview of all practices collected and their status). This generates insights into whether applications are in use or in development. The report clusters the applications in four stages, the first two of which are considered development stages:

- **Ideating/creating**
  This refers to applications that are currently being developed, but are in the early stages. For example, PES that are planning to use AI for a certain application and have design teams creating the specifications or Terms of Reference (ToR) for a tendering process. For instance, the Netherlands' PES is developing a new integrated suite of applications (primarily for matching) from a private vendor and is seeking input from support staff such as case workers.
- **PoC/pilot**
  Here, the development is more concrete, with ideas fleshed out in a PoC or tested by user groups in a pilot. This includes applications being deployed to a limited number of user groups or offices. For example, Actiris in Belgium is developing a PoC to develop new, data-based methods to create new job offers for jobseekers.
- **In production**
  This points to applications targeting general user populations, such as jobseekers, employers, and/or support staff. For example, the Austrian *Berufsinfomat* tool moved from pilot to production (see Example 2).
- **Cancelled/disbanded**
  Not every initiative is successful and applications that do not fulfil their expectations are disbanded, including for reasons such as obsolescence[70]. The analysis includes cancelled/disbanded initiatives where they provide useful insights for the PES Network (e.g. the cancellation of the BE-VDAB Jobnet matching tool; Example 1).

Figure 12. Overview of the status of AI applications



[70] The only application in this category is Jobnet (BE-VDAB) which was abandoned because it did not fulfil its expectations for reasons that were not fully clear or explicable.

The majority of applications (22) are currently in production, while 11 are in various stages of development, and only one has been cancelled (see Example 1). The distribution yields several interesting observations. The first is that PES AI initiatives tend to fall into one of three categories:

1. **More developed PES**
   Some PES have been working on AI for many years and have many practices in production (SE, FR, BE-VDAB account for 17 of 22 practices in production).
2. **Starting PES**
   Most PES are early in their AI work. A large group are working on one initiative, typically in development or just entering production. For example, Austria's *Berufsinfomat* entered production in January 2024 (see Example 2). These PES typically take a cautious route, seeking to learn from AI and explore ways of putting it into production, but sometimes lacking the resources or capabilities to work on multiple initiatives.
3. **Ambitious PES**
   Several PES are developing a multitude of initiatives that are part of a bigger project (e.g. Slovenia's My Labour Market) or a broader strategy to rebuild/revamp the entire PES (e.g. Luxembourg's eADEM strategy). Such initiatives can be facilitated by external developments (e.g. Slovenia capitalised on Horizon Europe/Horizon 2020 funding and collaborations through the HECAT project) or stem from the need to modernise more drastically, with AI viewed as a natural component of a comprehensive new (digital transformation) strategy.

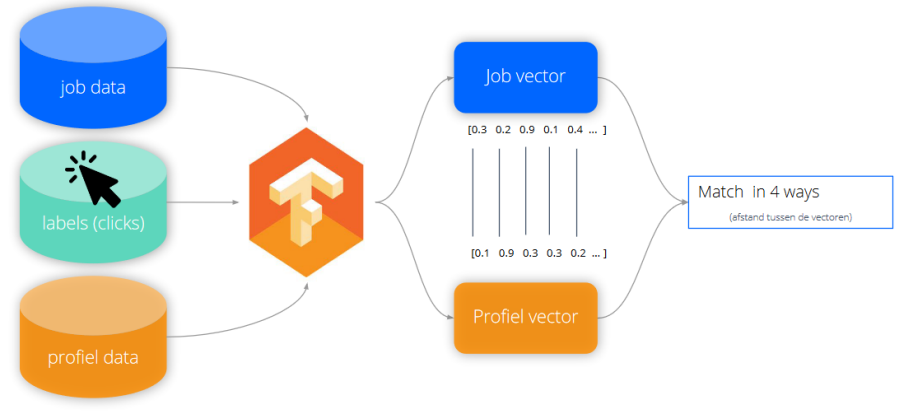
Example 1. BE-VDAB: Jobnet initiative

Jobnet (BE-VDAB)

Jobnet was BE-VDAB's new matching engine, developed in the late 2010s and subsequently cancelled. Its aim was to provide more accurate matches in four different directions:

1. Jobseekers to vacancies;
2. Jobseekers to jobseekers (e.g. to see what jobs similar jobseekers were looking at);
3. Vacancies to jobseekers;
4. Vacancies to vacancies (e.g. to explore similar vacancies).

Jobnet was developed using DL and deployed NNs to derive the most accurate matches.



It could also perform fuzzy semantic matching (content and context) in four different languages. While Jobnet performed well compared to other solutions, a key drawback was that its sophistication and multiple layers of NN made it virtually impossible to determine *how* certain matches were made and which variables contributed to which outcome. This had two main effects:

1. Explainability of the model became a challenge, leading to trust and transparency issues;
2. It became difficult to provide recommendations at the variable level (e.g. how CVs could be improved to generate better matches) when individual variable contributions were unknown.

VDAB decided not to proceed with the development of Jobnet, but instead opted for an ensemble approach that generated high-level matches while enabling greater transparency.

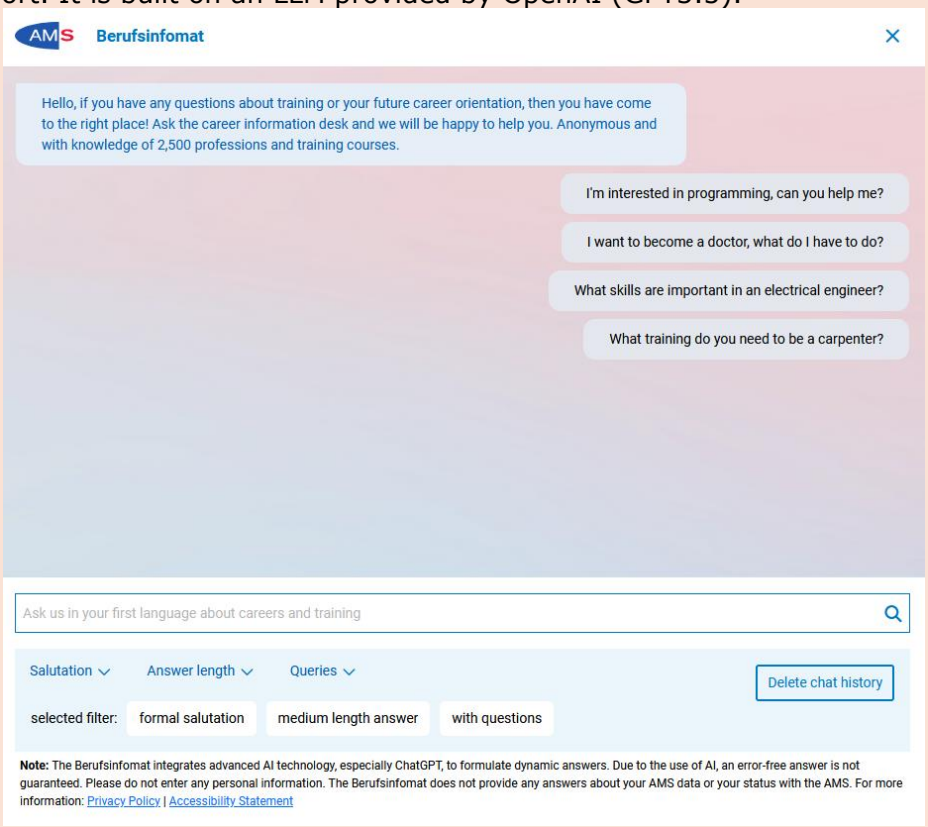
The majority of AI initiatives are in production, implying considerable appetite among PES, many of which began their AI work more recently. For example, Austria's *Berufsinfomat* moved into production in less than six months (see Example 2).

Example 2. Austria: *Berufsinfomat*

Berufsinfomat (AT)

The Austrian PES (AMS) has one AI application in production. *Berufsinfomat*[71] was developed by the Austrian PES together with an Austrian vendor in less than six months, and aims to provide career guidance to the Austrian public.

This example is the most technologically advanced application in production identified by this report. It is built on an LLM provided by OpenAI (GPT3.5).



Berufsinfomat allows jobseekers and people interested in furthering their careers to discover career opportunities. It suggests training opportunities and career orientation information, which are then refined through a text-based interaction. It will answer in any language in which ChatGPT is available and provides for several filters based on characteristics such as the length of the responses and user greeting.

Source: AMS (n.d.).

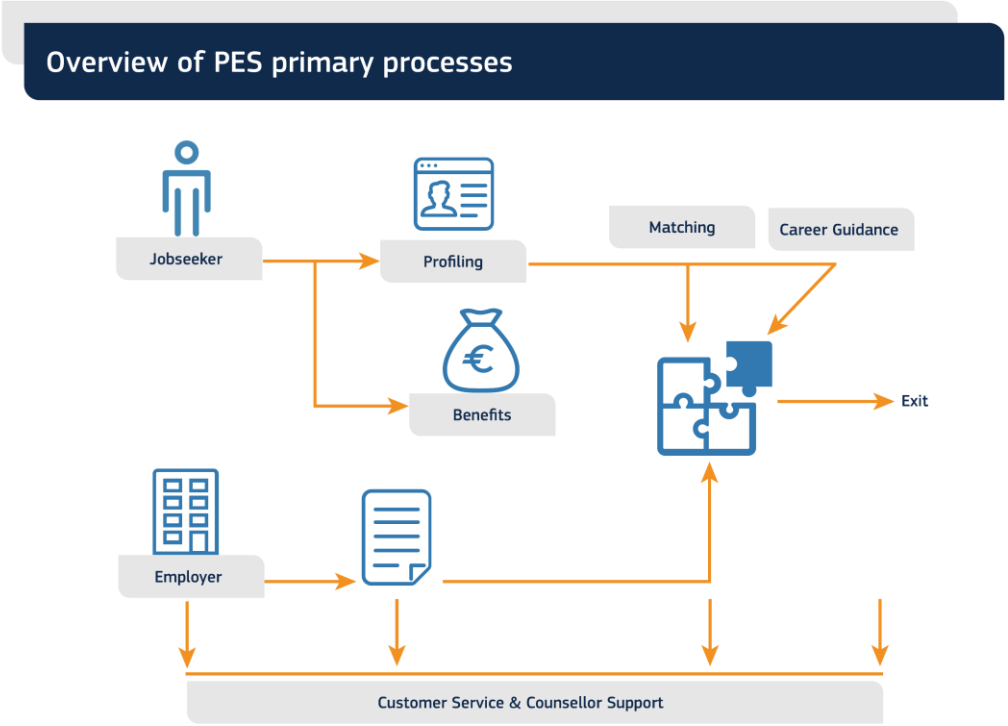
[71] AMS, 'Berusfinfomat', n.d., https://www.ams.at/arbeitsuchende/aus-und-weiterbildung/berufsinformationen/berufsinformation/berufsinfomat?open=berufsinfomat.

The majority of PES practices in production come from a limited number of PES, with most PES working on their first initiative. This implies that the use of AI across the PES Network is at a reasonably early stage, but maturing rapidly.

3.3 Nature of AI applications

Plotting the initiatives reveals the nature or focus of PES AI applications. Figure 13 presents PES' primary processes, each usually comprising various stages.

Figure 13. Overview of typical PES processes



Jobseekers typically have to register and provide information (e.g. their CV), while employers must provide information on vacancies. The following processes then tend to happen:

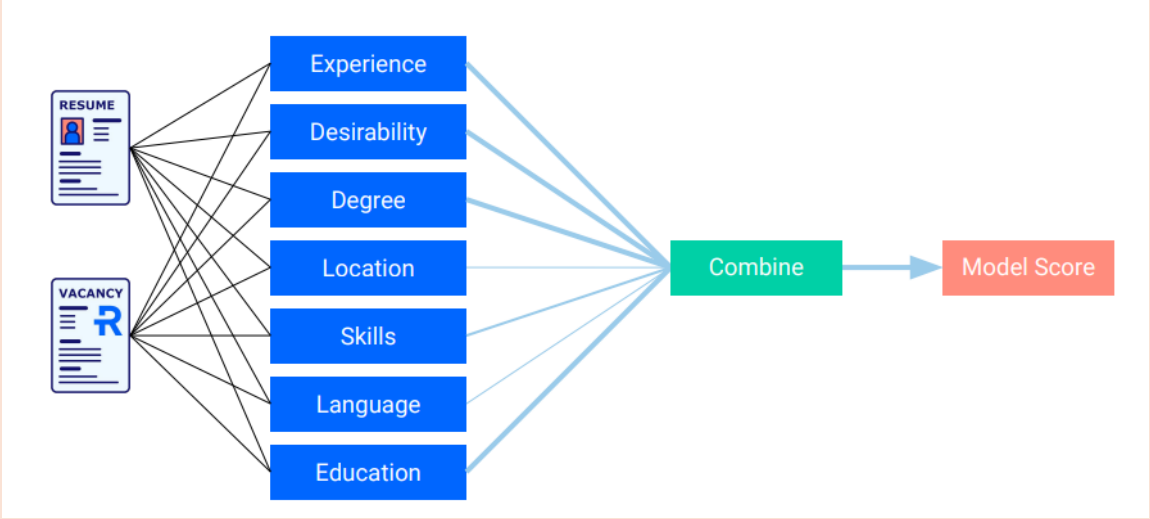
1. **Profiling**
   PES profile their clients to tailor their services to the needs of the individual jobseeker or vacancy. These profiling activities may lead to segmented or individual approaches. Depending on the data collected, profiling activities also feed into next steps, such as whether clients need to self-serve or receive support, or directly into matching or career guidance.
2. **Matching**
   Matching is a core PES activity. Successfully mediating between jobseekers, employers and vacancies is a critical component of a healthy labour market, and PES typically play a role in this process. Matching is thus an important focus point of PES' AI activities, with several relevant initiatives. For example, the Luxembourg PES is investigating how matching can be improved for a) jobseekers looking for jobs, b) the general population looking for career opportunities, and c) employers looking to fill vacancies. It has drawn inspiration BE-VDAB (among others), which is deploying an ensemble model that combines various 'mini models' to create a matching score (see Example 3).

Example 3. VDAB ensemble model: a new matching approach

Matching approach within VDAB

After deciding that an advanced NN-based matching approach was insufficient in explainability and transparency (see Explainer 4), VDAB explored the use of an ensemble model that combines the results of various mini models in one matching result.

For example, one mini model could look at matches based on location, while another looks at the quality of the match based on skills. By simply combining these different models and assigning them a different weight in the overall score, VDAB created a simple, transparent and explainable approach to matching.



3. **Career guidance**
   Where a match cannot initially be made, jobseekers are typically moved into a stage where they achieve guidance to improve their employability prospects. This often includes the development of interventions (such as training) recorded in an IAP. This broad category encompasses a number of activities, from specific tools supporting IAPs to more general tools that allow people to explore their labour market opportunities and obtain guidance on their future career. The reason for this broad category is that most applications are general in nature and/or provide simple guidance rather than specific recommendations.

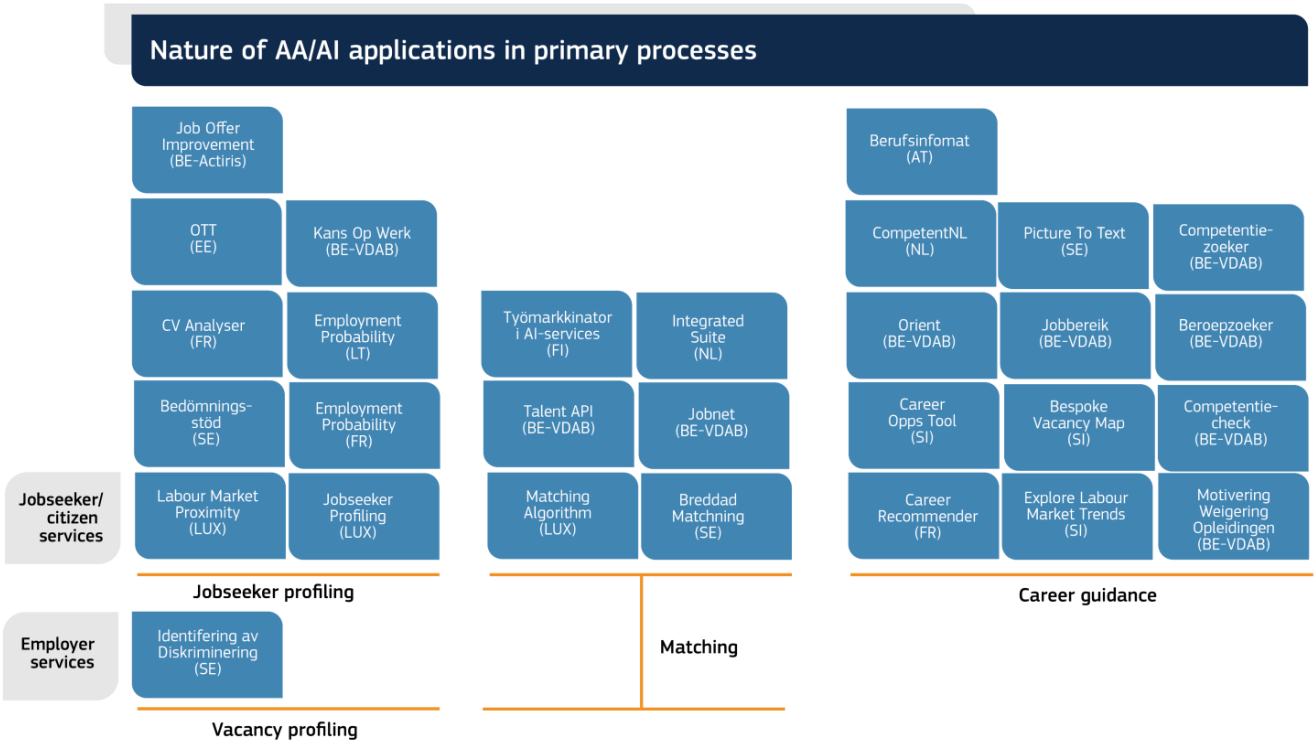
Some applications also provide other roles, forming part of benefit services or customer support functions (see Figure 13):

4. **Benefit and customer support services**
   This consists of a number of other applications, such as a) LMI services, b) fraud detection tools, c) customer service applications, such as chatbots, and d) applications to support counsellors during their work.

Most PES AI applications (29 out of 34) target PES primary processes. Within that group, most are career guidance applications (13 out of 29) (see Figure 14).

However, the 'career guidance' category is broad, consisting of broader exploratory tools (e.g. Slovenia's Explore Labour Market Trends) vs more bespoke tools (e.g. BE-VDAB's *Jobbereik*). In addition, nearly half of these 13 applications (six) are being developed by BE-VDAB, with two PES (VDAB and SI) accounting for nine of the 13 applications. In view of these caveats, profiling appears the most popular application of AI.

Figure 14. Overview of the nature of AA and AI applications in PES' primary processes



The following section looks more closely at the use of AI/AA in jobseeker profiling. Nine profiling applications are being developed or used by seven PES across the PES Network. These predominantly fall into three categories:

1. **Applications that calculate employment probability**
   These applications usually take data from the jobseeker and calculate their chances of finding a job, typically within a certain timeframe. One example is Estonia's OTT application, which was developed by comparing different analytical approaches (see Example 4).
2. **Applications that improve profiles**
   These are applications that help jobseekers in their journey and provide suggestions to improve their profiles, e.g. by scanning their CVs or providing suggestions based on comparative analysis. An example is the CV analyser from France, which provides recommendations to improve CVs (e.g. by adding skills).
3. **Tools that segment the population**
   These applications create segments in the population that help PES support staff to tailor follow-up interventions. For example, the employment probability score calculated in Lithuania helps PES counsellors to tailor IAPs for jobseekers.

According to the PES interviewed for this report, profiling is something of a logical gateway application into the use of AI. Firstly, it is typically an application used by PES staff rather than end users, as a support tool rather than a decision-making tool. This puts AI into an auxiliary role, with the ultimate decision still made by a human, minimising the risks. Secondly, most of the profiling applications are relatively straightforward. These are often AA applications, such as ML decision trees or random forest models (see Glossary in Section 7.2). Software packages to implement these models are widely available and there are techniques to help with explainability (e.g. Shapley values). Thirdly, the data required to create and run these models are generally available within PES. Jobseeker surveys, coupled with existing data extracted from systems, usually suffice to create a profiling tool, which means that large datasets can be gathered and trends can be analysed (for which AI can be very useful).

Example 4. Estonia: comparison of different profiling models

Analysis of different models in Estonia

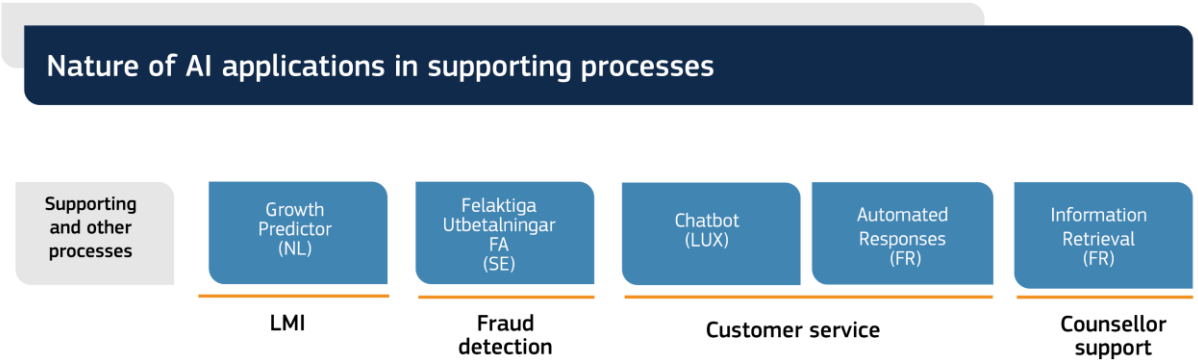
During the development of OTT, Estonia's profiling application, the team examined the performance of various approaches. By looking at the Area Under the Curve (AUC), they gained insights in the degree to which the models correctly classify data. This revealed that a gradient boosted decision tree performed (slightly) better than the more advanced NN. Neither performed much better than a statistical logistic regression.

MODEL CLASS	AUC *(evaluationed on test data)*
Logistic regression	0.7025
randomForest (randomForest)	0.7085
randomForest (ranger)	0.7092
Tabnet (neural net)	0.7100
lightGBM (gradient boosting)	**0.7173**

A number of AI applications are used in support, as well as other processes (see Figure 15). These include LMI, fraud detection and counsellor support applications. The Netherlands uses an algorithm to predict the growth of the labour market, the Swedish PES analyses patterns in benefit applications to detect fraud, and the French PES has built tools to help counsellors to find information more easily. Customer service applications are also gaining ground and are likely to continue to do so. There is considerable interest in the use of generative pre-trained LLMs, such as those offered by large technology companies, with PES in France and Luxembourg considering developing a chatbot.

While PES are very interested in LLMs and GenAI, they may not be ready to commence work. Such work requires financial resources, the right data readily available, and the appropriate infrastructure. Nevertheless, more chatbots based on LLMs were expected to become available across European PES in 2024.

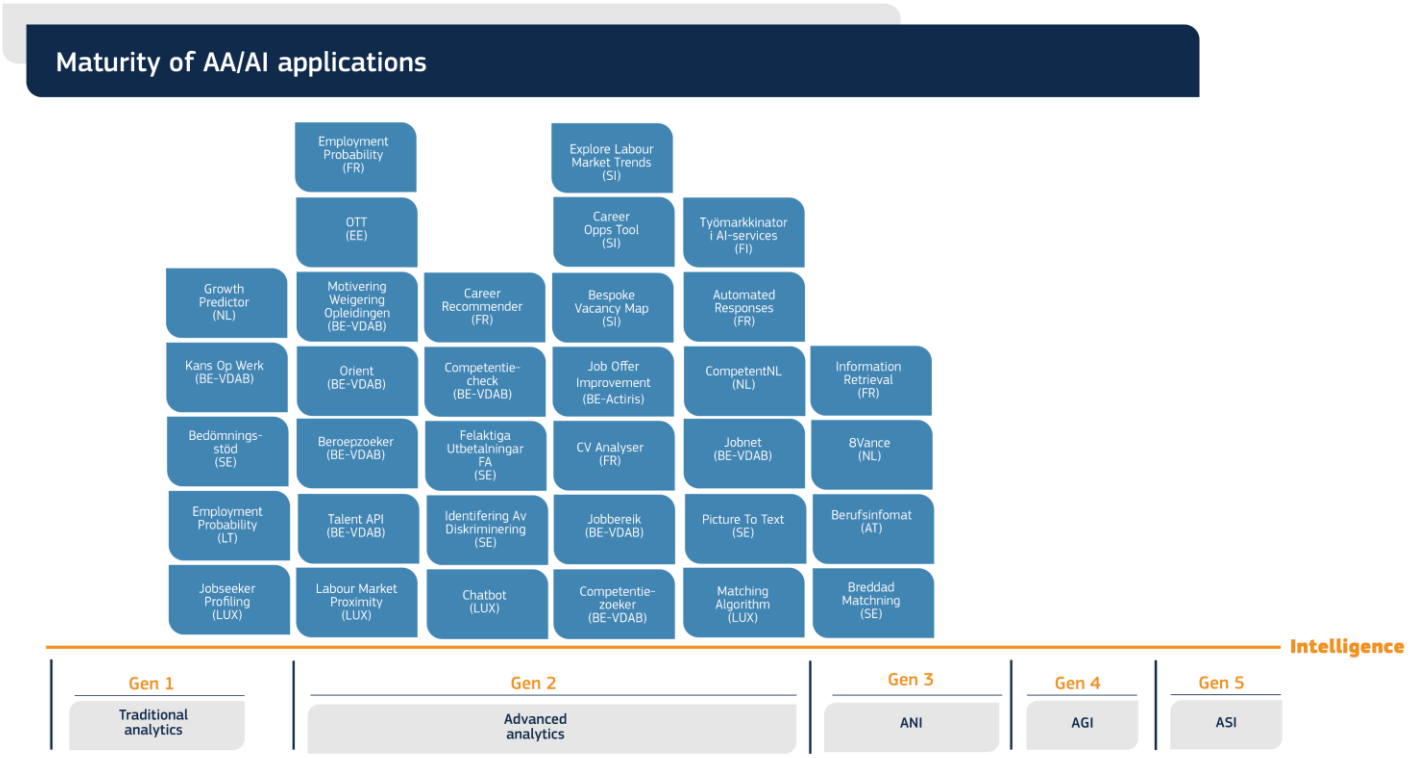
Figure 15. Overview of the nature of AI applications in supporting/other processes



3.4 Maturity of AI applications

The final way to plot AI initiatives is by maturity. This refers to the generation of analytics used (see Section 2.3), with Gen 2 bridging AA and AI applications. Figure 16 presents an overview of PES practices and their maturity.

Figure 16. Overview of the maturity of AA/AI applications

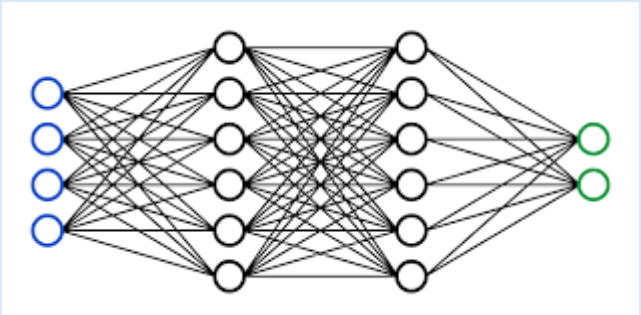


Most of the initiatives are AA applications, typically using some form of ML, and they are often classifiers (e.g. random forests or gradient boosted decision trees). This applies to many of the profiling applications, such as those that create 'scores' to indicate distance to the labour market or the probability of finding a job (see Figure 7, left-hand side). Next are applications that still rely heavily on ML but add DL elements and use NNs to analyse the data (see Explainer 4).

Explainer 4. Neural networks

Neural networks (NNs)

NNs are models rooted in ML. They are inspired by how the brain functions and the idea that data can be processed in different 'layers', where each layer looks at similarities between certain values and their correlations with other values. In simplest terms, if a picture of an animal is uploaded, one layer could look at the colour of the picture and determine if it is a uniform colour or a pattern, with the next layers looking at the size of the animal, its shape, etc. The aim is to establish relations (and correlations) between different inputs. This helps the NN to recognise the data inputs (the picture of the animal) and map these to certain output values (e.g. animal class, species). In this case, the model can be told to look for animals, which is part of training the model, where annotated pictures are fed to the system so that the model knows what it is looking for.



The more layers the NN has, the more complex it becomes (the increase in number of layers is often used to define DL). NNs main advantage is that, when trained properly, they can provide highly accurate outputs. The biggest challenge is that the functioning of the layers is largely a black box because exactly what happens in each layer is unknown, and models can learn and self-correct, which changes how data are processed and inputs for subsequent layers are generated, i.e. it is very

hard to derive how final outputs are following from the initial inputs, thus creating a black box. This can be partially overcome by correct training, analysis, and interpretation processes, but these add costs to running the model, with no certainty that the higher accuracy is worth the investment and the (still) limited explainability of the model. NNs are a fundamental analysis technique in LLMs (see Explainer 5).

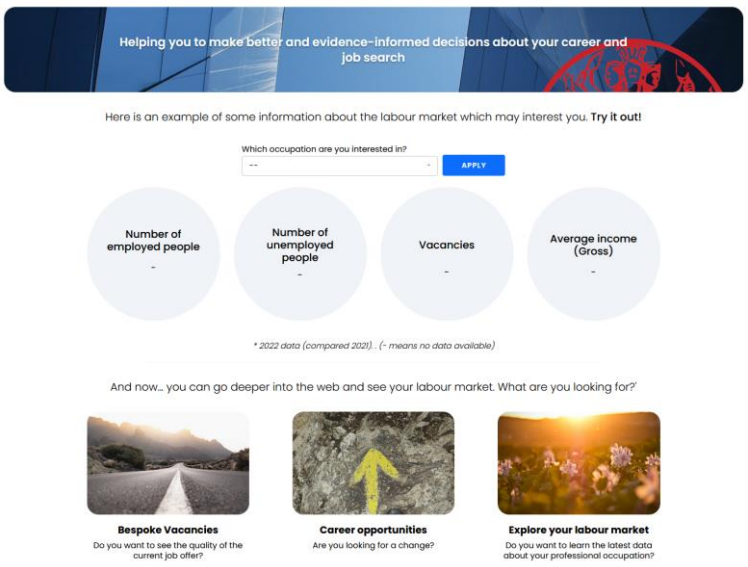
DL applications are more advanced, with the most common type involving NLP. These tend to be DL because they typically use NNs, with many layers to process the data. Examples include: France's CV Analyser, where uploaded CV's are processed, analysed and recommendations are made for improvements using NLP; Sweden's picture-to-text application, which converts scanned documents or pictures to text for analysis; Finland's *Työmarkkinatori* AI services provide matching and skill/occupation recommendations based on a variety of NLP techniques in different languages (Finnish, Swedish, English); and Slovenia's My Labour Market application (see Example 5). These applications are often used in career guidance settings (see Section 3.3), which tend to be more advisory and subject to scrutiny by support staff, such as PES counsellors. The explainability of NNs is thus less of an issue, provided that counsellors are aware of the biases in NNs and have been trained to use NNs as one of several inputs guiding their decision-making.

Example 5. Slovenia: My Labour Market

My Labour Market (Slovenia)

The Slovenian PES is working on three different AI offerings:

1. Bespoke vacancies map: users can explore vacancies on a map based on a variety of search criteria;
2. Career opportunities tool: users can see and simulate labour market opportunities based on their profile and any changes to that profile;
3. Explore your labour market: users are given insights into developments in the labour market and can compare various professions.



These offerings are publicly available at http://www.mylabourmarket.com.

The most advanced AI applications can be classified as ANI because they take the step from 'simply' analysing data to generating outcomes and new data through GenAI. The applications are based on foundation models, specifically LLMs, that process large amounts of text-based data to generate new outcomes. For example, Austria's *Berufsinfomat* creates new language (using GenAI) based on the analysis and interpretation of large datasets from the Austrian PES (see Example 2). The information retrieval application for support

staff developed by the French PES (*France Travail*) uses different LLMs (e.g. ChatGPT 3.5 and 4.0; BARD) to allow users to compare outcomes and assess their validity. This application is still in development and France's PES applies a continuous learning process to improve it.

In conclusion, most PES applications are more accurately classified as AA, and most are supervised, trained ML tools. Few applications explored here fit the ANI criteria.

4 KEY OBSERVATIONS: BUSINESS VALUE AND LESSONS LEARNED

This chapter presents 10 key observations across all PES in the report, grouped into four clusters:

a) **Overall lessons** learned (1-3);
b) Observations on the **nature of AI applications** (4-6);
c) **Challenges** faced by PES while working with AI (7-9);
d) Observations on **the future** (10).

Each observation is accompanied by conclusions and recommendations for PES.

4.1 AI use is developing and maturing rapidly

AI use across the PES Network is relatively new, but growing and maturing rapidly. In total, 34 applications were identified and analysed across the 11 participating PES. The nature and distribution of the practices reveal that:

- The largest group of PES began to work with AI more recently (within the last three years) and they have quickly developed applications into production;
- Most applications can be classified as AA, rather than AI, applications, but the number of real AI applications is rising rapidly;
- Most have a longer history among PES, such as profiling applications that use a number of variables to calculate employment probability scores.

There are fewer more advanced applications, usually within the PES that have been working on AI for a longer period of time and have established organisational practices to enable and facilitate its development.

The conclusion is that the field of AI is progressing rapidly, supported by two observations:

- Most of the applications moved rapidly from initiation to more concrete development stages. Many tools are in production and others are in later stages of development; often, this happened in relatively short periods of time;
- Many PES are developing the organisational and procedural practices that surround the implementation (putting in production) of AI practices. This includes procedures such as:
  1. Data protection impact assessments (DPIAs) that consider privacy aspects and General Data Protection Regulation (GDPR) compliance[72];
  2. Security (risk) assessments that analyse the safety of systems and processes using data (e.g. Liu et al.[73]);
  3. Ethical AI procedures that check for the ethical deployment of AI (see Example 10);
  4. Production teams that focus on development operations (DevOps) and/or ML operations (MLOps) and are tasked with putting AI practices into production;
  5. Stakeholder involvement practices, such as developing and testing ideas with key target groups, including leadership, support staff and client groups (see Section 4.7).

While more experienced PES tend to have several of these elements in place, there is further work to do. Certain PES that are earlier in their AI work, or that have ambitious plans for AI (e.g. Luxembourg's ADEM), apply ethical practices whereby an Ethical Commission (comprising experts from the government and beyond) tests each data initiative for fairness, accountability, transparency and explainability. The Commission's

[72] European Commission, *When is a data protection impact assessment required?*, European Commission website, n.d., accessed 25 September 2023 https://commission.europa.eu/law/law-topic/data-protection/reform/rules-business-and-organisations/obligations/when-data-protection-impact-assessment-dpia-required_en.

[73] Liu, C., Tan, C.-K., Fang, Y.-S. and Lok, T., *The security risk assessment methodology*, *Procedia Engineering*, Vol. 43, 2012, pp. 600–609, https://doi.org/10.1016/j.proeng.2012.08.106.

consent is needed to start development of a practice. Many PES have these practices partly in place. DPIAs are relatively common because of the legal requirements set out in the GDPR, but security assessments are less common, and ethical practices are scarcer still. Stakeholders are frequently involved, either as part of a predefined process or throughout the development journey (see Example 6).

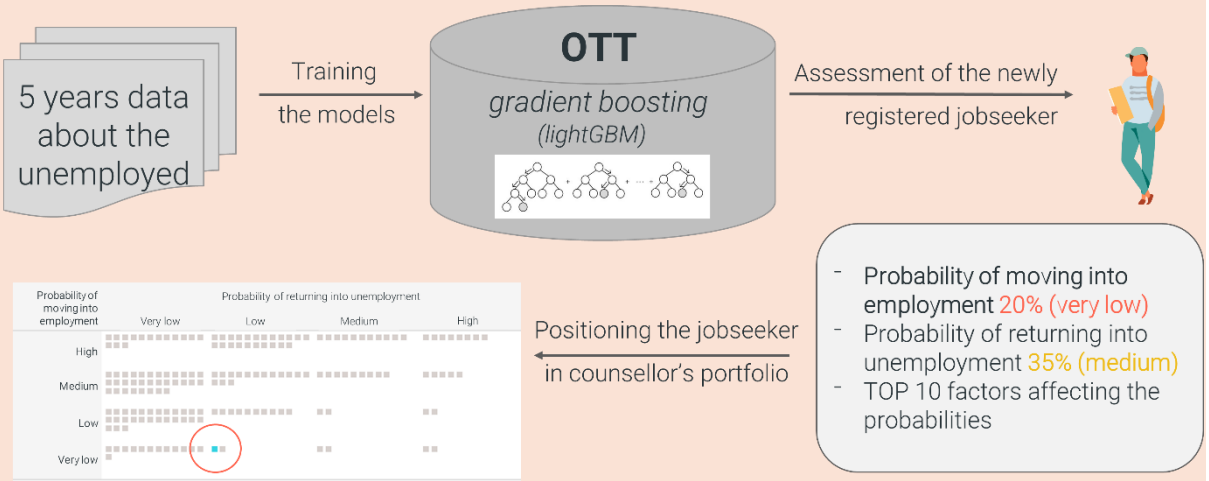
Example 6. Estonia: the development of OTT

Development of Estonia's OTT

OTT is Estonia's profiling application, developed by the Estonian PES (ESS). The PES is experiencing a continuous inflow of new jobseekers, some of whom will easily transition to a new job without any support, while others need intensive counselling and guidance. Counsellors need time to determine the needs of every individual, creating potential for:

- Excessive support and services for those who would have found a job anyway;
- Lack of support for, or late notice of, individuals who need extra guidance.

Profiling can help to assess jobseekers' situations and needs, helping the counsellor to decide the best possible intervention. OTT calculates the probability of moving into employment and returning into unemployment for each jobseeker, together with the top 10 factors affecting these probabilities.



While OTT performs well (statistical quality of the model), it was not immediately used by all counsellors. After six months, it was used by approx. half of the counsellors, sometimes only rarely. This was partly because counsellors did not fully understand the tool and/or needed more information and guidance, and partly because more experienced counsellors believed they did a better job themselves and did not trust its outcomes. More guidance and training for counsellors proved key to its successful take-up. Future projects should involve users in the early development phase and in creating a careful implementation plan. OTT is now widely used across the Estonian PES.

The main recommendations are:

1. PES could benefit from pairing technical developments (i.e. the use of their algorithms) with organisational developments (legal, ethical and security processes) to further develop their AI approaches;
2. PES should reach out to their peers with more advanced knowledge and experiences to advance their knowledge and learn from others' mistakes;
3. The PES Network should facilitate more learning opportunities for PES to gain knowledge, for example creating dedicated spaces or meetings for IT professionals to meet.

4.2 PES focus on learning, but not business value (yet)

The relative novelty of PES practices is reflected in their expected outcomes. Most PES interviewed mentioned the goals of learning from their applications and gaining experience from developing and deploying their initiatives.

This implies that:

- Often, initiatives are not started as ways to improve business processes nor triggered by a concrete and clearly defined business problem. The reasons to start using AI are manifold, such as the desire to experiment or tap into newer, innovative technological developments. For example, Austria's *Berufsinfomat* (as yet the main LLM/GPT practice in production) was initiated by the Director General of the PES, who believed that ChatGPT could provide better services;
- AI initiatives are often developed as smaller discretionary tools or form part of bigger programmes, such as digital transformation initiatives or PES/national digital strategies. This means that no business cases discuss the objectives of the initiative or weigh the pros and cons of different ways to achieve those objectives;
- PES rarely have defined specific business goals and/or KPIs[74] when starting AI initiatives. Objectives tend to be 'softer', such as the desire to be innovative or tap into newer trends and developments. In most cases, goals are not formalised and/or quantified (e.g. matching accuracy should be xx% higher using an AI application vis-à-vis other applications). PES with more experience in AI have these goals in place (e.g. BE-VDAB, FR, LU, SE).

Focusing on learning rather than on business value is not necessarily a negative aspect, but the lack of a formalised process around learnings could prove problematic in the future. While PES are eager to learn, experiment and/or innovate, it will be more difficult for PES to judge a learning experiment in the absence of defined criteria to evaluate success.

Financial and resource considerations do not feature strongly in decision-making on AI practices. In some cases, funds come from external subsidies (e.g. Slovenia's My Labour Market application was funded by the EU Horizon 2020 programme), from discretionary development budgets (e.g. Austria's *Berufsinfomat*), or from institutionalised funds (e.g. BE-VDAB's data and innovation lab has a dedicated budget to develop AI applications). However, none of the PES interviewed here mentioned financial and/or other resources as a key consideration when developing their practices.

The conclusion is that PES are not yet focused on the business value of their AI investments; a more rigorous focus on outcomes would support better planning of resource allocation.

PES could benefit from more rigorous processes for their data practices:

1. Develop business cases for initiatives that include an analysis of the underlying business problem and the ways in which the solution will address that problem;
2. Implement clear goals and KPIs that define and measure the success of the initiative;
3. Carry out thorough evaluations of practices that reflect on their outcomes and evaluate their efficacy.

4.3 Positive results based on 'soft' indicators

All PES interviewed felt positively about their AI initiatives and their experiences, and each reported positive results. However, these results tended to be based on 'soft' indicators of impact, i.e. they are qualitative and based on non-defined goals. Examples included:

- Positive feedback from users, such as support staff and jobseekers (e.g. through incidental feedback-seeking activities);

[74] See Pieterson (2019) for a guide on the use of KPIs for PES.

- Limited data gathering, such as 'thumbs up' feedback from certain groups of users during a limited timeframe;
- Positive impressions from developers, e.g. analysis of data snapshots (usage date in a certain period);
- Positive feedback from leadership and/or decision makers that have had positive experiences using the application or personal feedback on the use of the tool.

With funding decisions in governments increasingly based on tangible outcomes, a lack of (hard) outcomes could become a challenge for PES in the future.

'Hard' outcomes would be preferred, such as: a) effectiveness of applications; b) efficiency of processes; or c) evaluation of outcomes by clients (e.g. satisfaction). Nevertheless, soft indicators, such as unstructured feedback and impressions, also have value. They are particularly useful in early-stage development processes and for more experimental approaches. However, when a PES intends to implement an initiative, it becomes more important to move into the realm of hard indicators that allow for more objective measurement.

The conclusion is that PES could benefit from more rigorous processes and 'hard' indicators that are objectively measurable.

The main recommendations are:

1. PES should attempt to define measurable goals when developing AI initiatives;
2. KPIs should be developed to measure progress towards these goals, and the appropriate data should be collected;
3. Evaluations should assess both qualitative and quantitative success factors.

4.4 Profiling is dominant across PES, closely followed by career guidance

Profiling is typically the first application that PES develop in the AI space, for two reasons:

- Most profiling applications have a longer history and broader knowledge base among PES (see Section 3.3);
- These applications tend to be advisory rather than decision-making tools. They are often used by support staff (such as PES counsellors) and have more limited organisational risk.

Profiling applications can be considered gateway applications into the use of AI. Being able to segment the population and provide appropriate services to each segment in the population is in keeping with PES priorities (e.g. BE-VDAB, EE, LT, SE) (see **Figure 14).**

Career guidance applications are the next most popular, although many of the applications in this space are created by a small number of PES. There are two reasons for this focus:

a) Career guidance is increasingly important for PES, which are pivoting from being mediators in the labour market to being career guiders that support a broader population. Applications are therefore often open to the wider population (e.g. BE-VDAB tools; Slovenia's My Labour Market);
b) Career guidance is a relatively risk-free area for PES. No personal identifiable information (PII) is needed to develop these applications, reducing the impact on the organisation (e.g. procedures that have to be followed).

Matching applications, which form the heart of PES processes, are less common, reflecting the complexities of this process such as a) higher requirements in terms of ethics, privacy, transparency, and accountability, b) data dependencies, and c) complexities of the models involved. PES need to research these implications thoroughly before using AI in operational matching systems. Some PES do focus on matching and some provide various matching related services (e.g. Finland's *Työmarkkinatori* AI services, see Example 7).

Example 7. Finland: suite of matching services (*Työmarkkinatori* AI services)

Finland's Työmarkkinatori AI services

The Finnish PES is working on a large project (TE-Digi) to revamp all job market-oriented services for jobseekers, employers and counsellors. The *Työmarkkinatori* AI services form part of this initiative and support matching-related services. The initiative supports four different functions:

1. Recommendations for skills and occupations (based on ESCO) as derived from the (NLP) analysis of any free text;
2. Matching in two ways (profile to vacancy; vacancy to profile) based on the analysis of (free text) profiles and vacancy descriptions;
3. Detection of language skill requirements based on the analysis of vacancy descriptions;
4. Classification of services for jobseekers based on descriptions of services (written by employers) to aid the matching process.

Development of these applications began in 2016 and the Finnish PES continuously updates and integrates its workflows to reflect updates.

The conclusion is that PES tend to focus on profiling, but should consider whether this is where AI yields greatest benefit and how it connects to later stages of the PES customer journey.

The main recommendations are:

1. When considering AI initiatives, PES should assess and analyse where investments yield greatest value;
2. When investing in profiling applications, PES should consider how they connect to the broader customer journey.

4.5 Focus is on individual standalone applications

PES tend to focus on applications that stand alone. This implies that:

1. Applications are designed to focus on one task or a limited set of tasks (e.g. matching or profiling);
2. Applications are implemented in a somewhat siloed fashion – they use their own tooling, data infrastructure, development platform and methodology.

Nearly all applications followed this pattern for a number of reasons:

- Many PES have one initiative in development or in production and they select the environment best suited to this application, rather than choosing a more general or enterprise architecture that would also serve other applications. If the goal is to develop a profiling application, this can be done locally by using Python on a Linux machine. However, building a chatbot on an LLM is sometimes quicker and easier in the cloud using tailored applications from the chatbot vendor[75];
- Applications are not produced fully in house by the PES. Applications can be co-produced (e.g. Estonia's OTT application was developed in cooperation with the University of Tartu), part of a bigger consortium (e.g. Slovenia's My Labour Market was part of the HECAT project), or PES can partner with vendors to

[75] For example, Microsoft offers 'Copilot Studio' as an application to implement custom AI bots; Hugging Face (huggingface.co) is an open-source repository of AI models, including LLMs that can easily be put into production.

develop and implement tools (e.g. the Netherlands' collaboration with a private vendor to develop its new matching platform). This creates a degree of dependency, as well as a strict focus on the individual application in development. This is also an indicator of the ecosystem from the analysis framework (see Section 2.6) playing an important role in the development of AI applications. If universities, private sector parties or other potential collaborators in the country have knowledge and expertise, this augments the successful development of AI applications.

Developing standalone applications means that most applications work independently, risking poor integration. For example, BE-VDAB has developed several career guidance applications (Jobbereik; Competentiecheck, see Section 3.1) that work slightly differently, but largely overlap in functionality. Jobbereik gives suggestions for occupations based on a set of skills, while Competentiecheck breaks jobs into competences and gives suggestions for competence development. While these exist as separate applications, with different designs and user experiences, there are plans to integrate them, which would be valuable from a customer journey perspective.

No PES were fully considering their end-to-end workflows and how (connected and integrated) AI applications could play a role in this workflow[76]. For example, a profiling application could directly feed a matching application or recommender tool to improve the profile (e.g. giving training suggestions), and once the recommendations are completed, profiles could be automatically updated and new matching processes could start. Such end-to-end customer journeys make sense from the customers' perspective and PES may well move in this direction. Current exceptions are the Netherlands, which is designing a new application suite that integrates profiling and matching in one platform (with matching being the core focus) (see Example 9), and Luxembourg, which is completely revamping entire PES workflows, likely towards tighter integration of the different applications. One way to address the siloed nature of AI development is to have an overarching AI strategy that provides guidelines and principles for all AI initiatives. The French PES has such an AI strategy (see Example 8).

Example 8. France: AI strategy

France Travail's AI strategy

France Travail (formerly *Pôle emploi*) was one of the first European PES to start using AI a decade ago. In 2019, it launched a comprehensive AI strategy, *Intelligence Emploi*. Initially funded by the French government's Fund for the Transformation of the Public Sector, this ambitious programme aims to deploy AI across most of the PES' business processes. It currently has over 30 projects in development, with six already launched (and included here). These projects are organised in line with five objectives:

1. Improve working conditions
   France Travail aims to enhance the working conditions of its staff by leveraging AI technologies effectively;
2. Strengthen performance and quality
   The focus is on improving performance and quality of services provided by *France Travail* through the implementation of AI;
3. Offer personalised services
   Using AI, *France Travail* aims to provide increasingly personalised services for users and agents;

[76] The situation has since changed in some PES, notably Luxembourg, at the time of publishing the report.

4. Enhance accessibility and simplicity
   France Travail wants to transform the relationship between agents and users, making it more accessible and simpler for everyone;
5. Increase internal efficiency
   A key objective is to improve the efficiency of internal actions by harnessing the power of AI.

The core component of the AI strategy is the so-called AI Factory, a physical lab located in Montreuil and supported by a virtual counterpart. Within the AI Factory, members from the Statistics, Studies and Evaluation Directorate, the Data Services Agency, and the AI Support Service can collaborate and cooperate on the many AI initiatives.

The conclusion is that applications remain quite siloed and, given the level of development, PES may not yet be in a position to integrate applications in seamless workflows. It may make sense for PES to consider AI applications' role in their overall customer journeys, easing integration and preventing overlaps and/or fragmentation.

The recommendations are:

1. PES should consider their end-to-end workflows, even when planning just one AI initiative, to ensure that their initiative connects to their broader processes in the future;
2. PES could consider developing an AI strategy that provides guidelines for individual applications, which could prevent siloing in the future.

4.6 AI is seen as a supplement, often for staff

Recent decades have seen automation and AI-driven robotisation cited as posing risks to labour markets, with jobs replaced by machines (e.g. Frey and Osborne, 2013; Zinkula and Mok, 2024)[77]. These concerns about job replacement are not shared by the PES interviewed for this report, all of which see AI as a supplement rather than a way to replace (staff) positions. AI tools are seen as tools for various types of staff – career guidance and profiling tools for counsellors and knowledge tools for contact centre staff. These tools provide inputs for these workers, i.e. applications are developed as decision support tools rather than decision-making tools. By their nature, this applies to the career guidance applications, which often provide insights and guidance and may create recommendations rather than decisions.

A key difference for profiling tools is that these applications are decision support tools and are thus used by PES' support staff rather than end users. For most PES, this is a deliberate decision. Firstly, profiling applications' outputs are typically only one of several inputs that inform the ultimate decision. Jobseekers' circumstances can be highly individual and a level of discretion is needed for support staff to deviate from any recommendations created by an AI application. Secondly, PES want to ensure high trust and acceptance levels for their AI tools. In many cases, it is easier (and better) to train support staff to use their tools rather than educating the wider population. This ensures that applications are used correctly and helps to increase trust levels. Positioning tools as supplements rather than replacements also increases adoption rates among PES staff.

The future here seems more uncertain (also Section 4.10). While PES seem committed to AI, their role and the degree to which they could replace staff is uncertain. Several PES

[77] Frey, C. B. and Osborne, M., *The future of employment*, Oxford, University of Oxford, 2013; Zinkula, J. and Mok, A., *ChatGPT may be coming for our jobs: Here are the 10 roles that AI is most likely to replace*, Business Insider website, 6 March 2024, accessed 05 April 2024, https://www.businessinsider.com/chatgpt-jobs-at-risk-replacement-artificial-intelligence-ai-labor-trends-2023-02?r=US&IR=T.

are investing heavily in their (digital) self-service applications and most see the potential of AI to improve these applications. This does not imply that PES should leave vulnerable clients behind (i.e. those who without digital skills/access, or those needing more support) and (responsible) AI applications could ensure that these groups receive the support they need (see Section 2.6.3). Nevertheless, a shift in service channel usage could result in the need for fewer staff, even if not planned or foreseen by PES in the short term. PES are more likely to see AI tools as a way to free up support staff time by automating and augmenting basic tasks, so that staff can focus on more complex cases (e.g. activation and support for employed clients at risk of losing their jobs and harder to place individuals). While this focus makes sense, PES do not always measure the success of their AI initiatives and thus do not have mechanisms in place to track whether support staff are indeed freed-up to focus on complex cases (see Section 4.3 above).

While the longer-term potential for AI applications may target clients directly, the biggest potential in the short-term is in supporting staff. This leads to the conclusion that PES should consider where the best short-term and long-term value of their AI investments lie.

This leads to the following recommendations:

1. PES need to consider the target groups and best use of their AI applications. Business cases and business analysis could assess the impact of AI;
2. PES staff are the key users of AI applications for now, thus PES should focus on the role of AI as a tool to support staff. This implies staff engagement throughout the development process to ensure buy-in and acceptance of the application;
3. Organisations should plan for both the short- and long-term. While the short-term seems logically geared towards staff, the longer term is more uncertain, and PES should consider change management plans.

4.7 Stakeholder involvement is crucial to success

The role of PES stakeholder involvement in developing new applications is long recognised[78] and the findings of this report reiterate their importance. The interviews highlighted three crucial types of stakeholder involvement:

1. **Leadership**
   PES leadership is an important driver in various ways. In BE-VDAB, for example, the former Chief Information Officer (CIO) and Chief Executive Officer (CEO) were driving forces behind the formation of the data lab and the transformation of the PES into an innovation and data-driven organisation a decade ago. In Austria, the Director General of AMS took the initiative to start working with ChatGPT and has been a driving force behind its rapid implementation. In other cases, leadership support is more nuanced, but still a critical success factor. In Luxembourg, the Netherlands and Sweden, the PES leadership recognises the importance of AI and incorporates it on the strategic agenda.
2. **Support staff**
   Staff across PES play a central role in the success of many AI initiatives, especially those where staff (such as caseworkers and counsellors) are the application users. Several PES have implemented stringent processes where staff involvement is a key part of the design process of any application (e.g. SE). In other cases, staff are involved in the application roadmap, rather than a standard process. For example, staff in the Netherlands are actively involved in developing the new comprehensive suite of applications (see Example 9). In other cases, PES staff are involved in evaluation processes. For example, six months after the implementation of OTT in Estonia (see Example 6), the PES held seminars with counsellors to learn about their

[78] European Commission, *Practitioner's toolkit: Being smart with data, using innovative solutions*, Publications Office of the European Union, Luxembourg, 2017; European Commission, *Creating Digital Strategies*, Luxembourg, Publications Office of the European Union, 2018.

user experience. The seminars revealed that more training was needed to increase adoption and use, and experienced counsellors were hesitant to use the application, trusting their own judgement more than its outputs. These issues could likely have been prevented by involving staff earlier in the process.

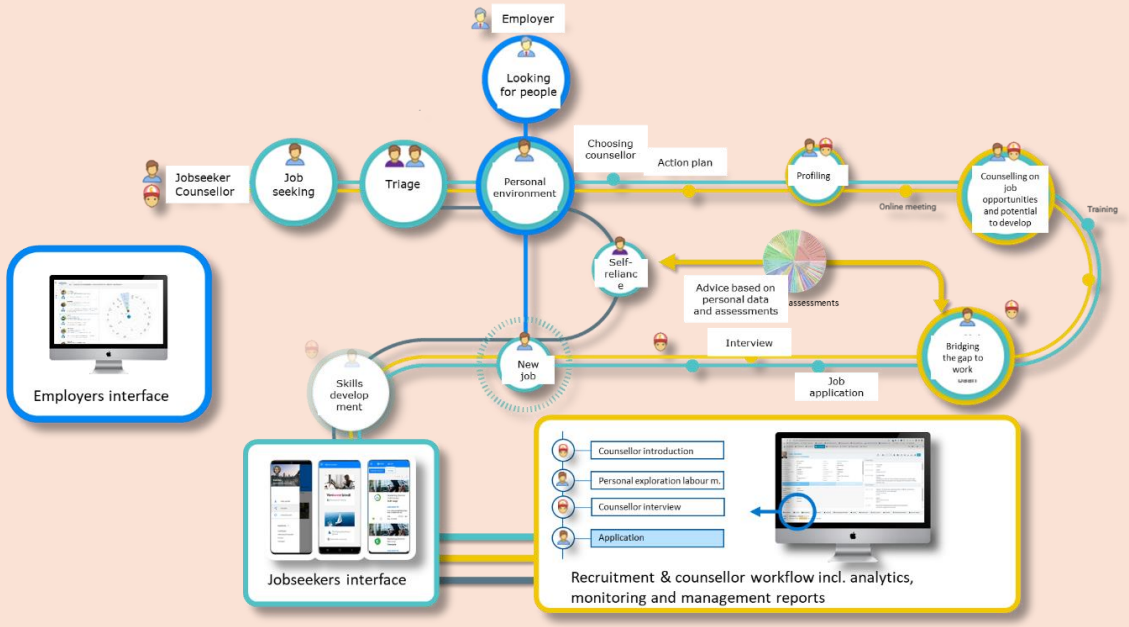
3. **End users/clients**

   The last category of stakeholders is the ultimate clients of PES, mostly jobseekers, employers and (sometimes) benefit seekers/recipients. The involvement of end users in the development of AI applications is relatively uncommon, with counsellors usually acting as a proxy to collect information about end users. An exception is the Swedish PES (*Arbetsförmedlingen*), which carries out pilot studies to test the impact of PoCs. The overall results of surveys (e.g. appreciation for the service) support decisions for the future, while specific feedback (e.g. use of features) is used to develop and refine services. Other PES use ad hoc user feedback, such as analysis of user appreciation data (e.g. 'thumbs up or down' about the quality of a recommendation).

Example 9. The Netherlands: staff involvement in new application suite

Development of the Netherlands' PES new integrated suite

The Netherlands' PES (UWV) is working to resolve legacy IT problems. Over the years, the application landscape has grown to a typical 'legacy spaghetti', with over 20 systems connected in a complicated and tangled way. Several years ago, the PES began to work to simplify its IT landscape, centering on a new integrated suite of applications developed by a private company. In this application suite, jobseekers, employers, and support staff can access relevant tools and applications.



Matching is a core component of the new suite and the PES uses DL to gather and interpret relevant information and provide matches. The application integrates profiling and matches and allows both jobseekers and employers to change their CV/vacancy profiles to simulate better matches. The suite is developed using extensive input and feedback from counsellors. Counsellors attend regular feedback sessions to provide input and make requests.

More AI-experienced PES tend to have more sophisticated ways of involving stakeholders and using their input in development processes. These may prove useful for less AI-experienced PES, which can work to engage stakeholders early and on different levels, thereby increasing the likelihood of successful AI approaches.

The main conclusion is that PES need to focus on their intended stakeholders to ensure buy-in and invite their input to design initiatives to maximise potential.

This leads to the following recommendations:

1. PES need to consider their main stakeholder groups when developing their initiatives (e.g. leadership, staff, and/or clients) as they could have different needs or requirements;
2. PES then need to involve these groups in the development of these initiatives.

4.8 Black box nature of advanced AI creates explainability challenges

There is some tension between the more sophisticated nature of (increasingly) advanced types of analytics and explainability. This is particularly the case for newer approaches such as NNs and LLMs, where layers and probabilistic tokenisation[79] (see Explainer 5) create difficulties in tracing how certain inputs lead to certain outputs. In traditional statistical approaches, such as (logistic) regression models, it is possible to see exactly which input variable has a significant effect on the output variable, as well as the impact (regression coefficient) of each predictor variable. By contrast, more advanced AI models tend to be more black box in nature, creating certain challenges.

Explainer 5. LLMs, tokens and vectors

Artificial intelligence (AI), machine learning (ML) and deep learning (DL)
Large language models (LLMs) are powerful AI models designed to understand and generate human language. They analyse vast amounts of text data to learn the patterns and relationships between words and phrases. They do this by breaking words and sentences into (numerical) elements called vectors. These vectors can then be used for mathematical calculations, e.g. whether the words 'apple' and 'fruit' are often used in similar contexts (implying they are probably related). These vectors can be mapped to tokens, which are the linguistic elements that these vectors represent. For example, the word 'apple' could be a token, as could certain phrases, or even individual letters. Mapping tokens to vectors can represent text and perform manageable calculations that lead to understanding the text. For example, the word 'apple' could be represented by a vector with elements related to fruit, taste, and context. This enables meaning to be derived from tokens (e.g. what is an apple?) and to be connected to other elements (e.g. 'apple' will be more closely connected to 'fruit' than 'vegetable'). The more data that are processed, the better the model understands language. Big breakthroughs in this field stem from very large models, hence the term LLM.

Explainability particularly impacts the ethical considerations around AI (see Section 2.6.3), with ethical charters typically requiring explainability and transparency of the approach used. Several PES are developing their own ethical charters, guidelines, or approaches that guarantee responsible AI. Notable examples are the French ethical charter (see Example 10) and Luxembourg's PES, which has national AI ethical guidelines.

[79] Sharvil, *Tokenisation algorithms explained*, Towards Data Science website, 3 August 2021, accessed 25 July 2023, https://towardsdatascience.com/tokenization-algorithms-explained-e25d5f4322ac.

Example 10. France: ethical charter of *France Travail*

France Travail's ethical charter

The French PES, *France Travail*, developed an ethical charter to guide the development of AI and ensure that all AI deployments are up to ethical standards. It is based on various initiatives and consists of seven commitments for trustworthy AI:

1. Purpose and legitimacy;
2. Human-centric;
3. Fairness and non-discrimination;
4. Freedom of choice;
5. Transparency;
6. Security;
7. Environmental impact.

An Ethics Committee assesses each AI project within the PES against these commitments. The Committee comprises 10 representatives from diverse fields within and outside the PES. Additionally, a National AI Investment Committee ensures adherence to these guidelines and evaluates the value of all PES AI projects.

The PES interviewed for this report tend to deal with explainability in three (usually complementary) ways:

- **Making sense of and explaining complicated models**
  One approach is to interpret and explain the results of more complex models. The French PES (*France Travail*) tasks data scientists with transparency and explainability, reasoning that every model is a mathematical operation and is thus traceable. Having the correct language around the use of the model can help users to understand and accept its inner workings.
- **Deploying black box models in non-critical environments**
  If an application has a purely advisory role and provides suggestions rather than prescribing actions, the need to be explainable is naturally lower, given that there is no decision-making involved. Many of the career guidance applications in this report fall into this category and their nature allows for more advanced models.
- **Complex models not used in critical situations**
  The final approach is to avoid using complex models in more important (typically decision-focused) operations. Several PES indicated that they will not use models they cannot explain to profile or match jobseekers. The lack of explainability was the main reason for BE-VDAB's reason not to move forward with its advanced matching solution (Jobnet; see Example1).

While the approaches are not mutually exclusive, PES tend to prefer one or two rather than a combination of all approaches. The interviews for this report revealed that no PES will try to explain complex models in experimental settings, steering away from them in production settings until explainability issues are resolved.

A combined approach may be suitable for PES. Being able to experiment (with anonymised datasets) could be appropriate to assess the impact of AI models, while also trying to find ways to analyse, understand and explain their inner workings. Protocols may be needed that: a) describe the type of AI (currently) acceptable to use in which situation, b) allow for experimentation in certain situations using certain types of datasets (accompanied by

consent procedures, where appropriate), and c) have protocols around explainability and when certain (experimental) practices are sufficiently explainable to move into production.

PES could benefit significantly from sharing knowledge and developing these protocols jointly.

The conclusion is that explainability and transparency are important considerations when deploying AI to prevent their implementation from becoming a black box. This is a key consideration to establish trust and buy-in from key stakeholders.

This leads to the following recommendations:

1. PES need to balance their priorities and consider their requirements as laid out in the analysis framework (e.g. legal and ethical) when developing their initiatives;
2. PES should experiment with different approaches, but adopt a combined approach where they experiment, while keeping in mind the need to explain their workings.

4.9 Exploring is easy, moving to production is hard

PES face certain hardships when moving from more experimental AI approaches towards a) something that is ready to put in production, and b) something that can be kept in production over time. A lesson shared by several PES is that experimenting with and exploring the capabilities of AI is easy. For example, creating a custom version of an AI/LLM chatbot can be done within hours using LLM providers[80] and open-source models[81]. However, putting these models into a production environment and keeping them working in these production settings represent very different challenges.

Both the ease of experimentation and the difficulty of putting these into production were key lessons learned by the Swedish PES in working with AI:

1. See the whole picture in your organisation and understand your eco-system;
2. Establish good metadata management, data and information management;
3. Establish a cross-functional team;
4. Creating an AI solution is easy! Creating and nurturing an AI solution with the right data (over time) is difficult;
5. Do not underestimate the time it takes to go from an idea to a production-ready AI solution;
6. Looking at the Swedish labour market is not enough; you must also look beyond at the international context.

Three reasons underpin these challenges. Firstly, the technical requirements are much more complicated in a production environment than in more experimental settings. Obtaining a (test) dataset, anonymising this or simulating it is relatively simple. Integrating a model into production is hard and involves:

- Development, testing and integration of data pipelines;
- Deployment of these pipelines into the production environment;
- Developing and testing triggers and testing of data streams;
- Development and implementation of monitoring systems.

These activities are infinitely more complicated where no application programming interface (API) exists in current systems, when new contracts need to be agreed with vendors to develop these APIs, or when the legacy nature of the system is such that the original vendor or developer no longer exists and the platform does not lend itself to API development (e.g. legacy Cobol systems).

[80] For example, Google, OpenAI, Meta and Microsoft.

[81] For example, Bloom, MosaicML, Falcon and OpenLM.

Secondly, legal, transparency and trust issues are far more important in production settings than in experimental environments, requiring several procedures to be developed and put in place:

- DPIAs;
- Security (risk) assessments;
- Ethical AI procedures.

In ongoing practices, these activities may well need to be repeated periodically, requiring the organisation to commit continuous resources.

Thirdly, solid organisational mechanisms need to be in place. This includes ongoing stakeholder involvement, as well as a) the development of new features and modernising practices, b) organisational commitment to long-term resource allocation, c) inclusion of the practice in future plans, and d) training and feedback mechanisms that feed into future development plans.

Overall, many more resources are needed to move an initiative into production and keep it there, compared to the relative ease with which something experimental can be developed.

For example, BE-VDAB started as a small data lab, but the team has now grown so large that it is responsible for the development and maintenance of multiple AI initiatives. There are now discussions to integrate this data practice into the operational hierarchy of the organisation, while simultaneously creating a new space to experiment with new developments. This process necessitates a formalisation of data activities and a recognition that many data practices are now a mature part of the organisation. However, this contrasts with the requirements of a data lab, which is usually more independent and can work (somewhat) outside the organisational regimen

This observation is crucial and leads to the conclusion that PES need to consider the wider organisation and ecosystem when developing and deploying their AI initiatives.

The recommendations are:

- PES should consider the implications of their AI initiatives in the wider organisation, including the human and financial resources available to move towards successful production;
- PES need to develop robust organisational procedures (e.g. privacy, legal and security compliance) to guide AI development and implementation.

4.10 The future is bright and the potential is significant

This report indicates that the subject of AI is in flux – PES AI developments are moving very quickly, necessitating several changes in status and practices even during the compilation of this report. In addition, it is a complicated field, as the ethics of AI create serious (and rightful) obstacles to AI developments. PES are trying to learn and stay abreast of this quickly evolving field, as well as meeting the challenges of moving promising developments into their production environments.

Despite these challenges, PES are positive and excited about the future. All of the PES interviewed for this report are positive about their experiences and achievements to date and plan to continue their work in the AI space.

Equally importantly, PES genuinely recognise the possibilities of AA. All interviewees are experts in their domain and fully recognise the potential of AI to transform the processes in their organisations and, ultimately, have a positive effect on the labour market. The excitement about AI is recognised by PES leadership, with countries increasingly putting in place AI strategies with positive outlooks on AI potential.

The conclusion is that the future is bright. PES recognise that AI has potential and that they need to develop their capabilities to fully benefit.

The recommendations are that PES should:

- Develop AI strategies that take a holistic view;
- Embed these into national strategies;
- Consider the various contextual factors outlined in the framework presented in Figure 9.

5 GENERAL CONCLUSIONS AND RECOMMENDATIONS

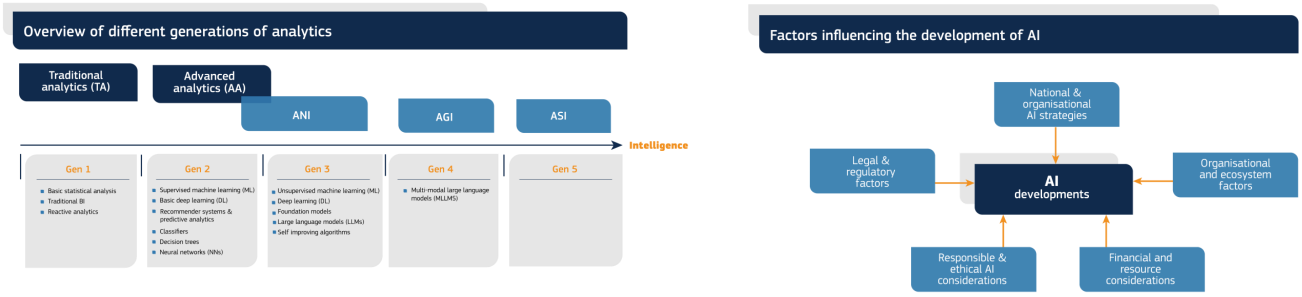
This chapter presents the main conclusions of the report, linked to its objectives. While Chapter 4 provided conclusions and recommendations on specific key observations, this chapter reflects on the broader landscape, AI framework (Section 2.3) and adoption framework (Section 2.6). Overall recommendations provided here, are based on these conclusions.

5.1 General conclusions

This report had three objectives: a) to discuss trends and developments in AI, focused on PES processes and services, to develop the analytical framework(s) that guides the report; b) to create an overview of the state of play of AI, with a special focus on the business value PES derive from their initiatives; and c) to frame the developments within the rapidly changing landscape (e.g. technological developments, ethics, organisational factors, wider governmental ecosystems).

Two frameworks guide the analysis. The first is the different generations of AI, which help to plot the different initiatives. The second looks at the factors influencing the development and successful implementation of AI applications. Figure 17 presents condensed versions of both.

Figure 17. Analysis frameworks guiding the report



Drawing general conclusions about the AI landscape is complicated by the speed of change in the field. What is considered 'AI' today is not the same as 10 years ago and, even now, there is no unified definition of what AI is, how it works, and where it can be applied. The broader contextual landscape is working hard to keep up with rapid technology changes. For example, the EU AI Act will not come into effect until 2026, creating a possibility that newer AI technologies will exist that are not covered by the Act[82]. Similarly, there are many uncertainties around the impact on organisations (and organisational design), systems and processes in organisations, and the impact on PES. Accordingly, any conclusions drawn should be viewed in the context of today, the current state of AI, and the ambiguity of the subject matter.

One conclusion that is certain is that the field of AI is moving rapidly. The arrival of foundation models (e.g. LLMs) and GenAI can be seen as the latest technological trend. The fact that GenAI is moving the field from simply analysing data and providing extrapolations based on comparisons (e.g. recommender systems) to creating new output indicates entry into a new generation of AI, ANI. Newer MLLMs that can perceive (and generate) different modalities of data (e.g. image, audio, video) are a first step towards AGI. GenAI is likely to remain popular for the foreseeable future as companies work to

[82] See, for example, Broughel, J., *EU's sweeping new AI Act could be an innovation killer*, Forbes website, 15 December 2023, accessed 15 April 2024, https://www.forbes.com/sites/jamesbroughel/2023/12/15/eus-sweeping-new-ai-act-could-be-an-innovation-killer.

integrate it into their products and services. Governments are somewhat trailing this trend. Many PES are interested in GenAI, with implementation continuing to grow and expected to increase further, given the potential to use the latest technology for PES gains.

PES recognise the potential, but are not yet demonstrating business value using hard data and showing clear outcomes (e.g. effectiveness or efficiency of services/processes or client satisfaction). While PES sometimes carry out evaluations or pilot studies to measure certain impacts, they do not always demonstrate that the AI solution works best. This likely reflects the relatively early stage of many AI applications within PES. In addition, PES have yet to develop business cases in which they outline their AI plans and clear goals.

Most PES AI practices can be classified as AA applications, which are part-AI, according to the broad definition used here. Many PES use ML and well-established approaches. Typically, these applications provide recommendations (e.g. career guidance), create 'distance to labour market' scores (profiling applications) or, to a lesser extent, focus on matching. More advanced types of AI (ANI), such as GenAI applications, are still relatively scarce in the PES Network. Many PES are still developing their AI applications, with a smaller number having multiple applications in production and working towards more advanced AI practices (BE-VDAB, FR, SE).

The final objective was to frame the developments in the wider context of PES and the rapid developments in AI. To date, PES are aware of these developments, but may not be taking all the steps to maximise the outcomes from AI. For example, stakeholders are not always formally involved in the development process, potentially hindering the successful deployment of AI applications. In addition, while legal, ethical and security-oriented processes are in place in some PES, others have yet to put in place ethical guidelines on the use of AI.

Most PES are developing standalone applications rather than as part of a wider strategy or end-to-end workflows. There are notable exceptions among more AI-experienced PES, such as Belgium-VDAB, France, Luxembourg and Sweden. PES could learn more from other PES' experiences or from reusing applications rather than building applications from scratch. For example, a number of applications create 'distance to labour market' scores, often serving the same purpose and using the same ML approach and comparable input data. PES could thus gain from further collaboration and knowledge-sharing.

The overall conclusion is that many PES are in the early stages of using AI, with a strong focus on learning and experimenting, rather than business value. However, the area is developing rapidly, with PES gaining substantial experience and building their practices. Importantly, PES are excited for the future, based on their experiences and developments in the space.

5.2 General recommendations

Based on the overall conclusions, some higher-level recommendations can be made, focusing on overarching or general elements.

1. **Use of business cases and evaluations**
   PES could benefit from developing clear AI business cases that outline their goals and develop KPIs to measure success. This could help to justify the investment in AI, prove its success, and make real business value visible. They could also benefit from evaluating the success of their AI initiatives. Formative evaluations could be used to evaluate the process while summative evaluations could assess overall success. These evaluations could also serve to prove the success of the original business case.

2. **Work towards optimal integration of AI**
   Rather than developing standalone applications, PES could gain from embedding AI into their entire workflows. Developing integrated AI solutions would add more

value than standalone applications and help to prevent a siloed and fragmented AI landscape. More experienced PES with more mature AI applications are beginning to do this, but could place stronger focus on integration. PES could benefit from a broader vision of the impact of AI on their processes and services.

3. **Focus on sharing knowledge and tools**
   PES could benefit from sharing experiences and perhaps even existing tools (e.g. developed code). This would remove unnecessary building of 'similar yet different' applications and create synergies across the PES Network. This could be a useful area of focus for the PES Network Digitalisation Working Group.
4. **Shift the focus towards production**
   PES recognise the value of learning and experimenting, as well as the challenges of bringing applications into production. To do this well, PES need better levers and a clearer understanding of the complexities. PES should pay more attention to production considerations early in the process to guarantee a smooth transition from development to production.
5. **Focus on all factors impacting AI development**
   Although technical in nature, AI will ultimately be successful when it is embedded well in PES practices. The framework developed in this report (see Figure 17) provides an overview of the main factors influencing AI that should be included in any PES AI initiative. When developing plans, initiatives or strategies, PES should embed these in higher-level strategies (e.g. at national level) and include: a) legal and regulatory factors; b) responsible and ethical AI; c) organisational and ecosystem variables; and d) financial and resource considerations.

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7 APPENDICES

7.1 Practices overview

Table 2. Overview of all the practices included in the report (34 in total)

Country	Name/description	Area	Goal	User	Approach	AA/AI generation	Status
AT**	*Berufsinfomat* (Chatbot)	Career guidance	Provide jobseekers and counsellors with advice on career advancement	Jobseekers and support staff	Generative AI/ LLM (ChatGPT)	Gen 3	In production
BE-Actiris	Job offer improvement	Profiling (V)	Improve quality of vacancies	Support staff, employers	ML/NN	Gen 2	In development (PoC)
BE-VDAB***	*Kans op werk* (probability to work)	Profiling (JS)	Calculate probability to enter employment in x time	Support staff	ML classifier (random forest)	Gen 1.5	In production
BE-VDAB***	Jobnet	Matching	Matching jobseekers to vacancies	Support staff	DL, NN, graph analysis	Gen 2	Disbanded
BE-VDAB***	Talent API	Matching	Matching jobseekers to vacancies	Jobseekers/ support staff	Ensemble	Gen 2	In production

Country	Name/description	Area	Goal	User	Approach	AA/AI generation	Status
BE-VDAB***	*Jobbereik*	Career guidance	Giving citizens insights into adjacent/similar competencies to improve their profile	General public	DL/NN, graph analysis	Gen 2	In production
BE-VDAB***	Orient	Career guidance	Helps jobseekers to orient themselves on the labour market through a survey and ML recommendations	Jobseekers/ general public	DL	Gen 2	In production
BE-VDAB***	*Beroepzoeker*	Career guidance	Allows people to look for an occupation based on a free text description	General public	DL	Gen 2	In production
BE-VDAB***	*Competentiecheck*	Career guidance	Give insight into skills of current occupation of the user and calculate skill gap between the user and the skills necessary for the current occupation,	General public	DL, NLP	Gen 2	In production

Country	Name/description	Area	Goal	User	Approach	AA/AI generation	Status
			recommending training to stay up to date with current occupation				
BE-VDAB***	*Competentiezoeker*	Career guidance	Search for competences based on free text and text extraction)	General public	DL, NLP	Gen 2	In production
BE-VDAB***	Motivering weigering opleidingen	Career guidance/ IAP	Analysing if motivation for refusing training is correct or not	Support staff	DL	Gen 2	In production
EE	OTT	Profiling (JS)	Calculate probability to enter employment in x time	Support staff	ML (gradient boosted decision tree)	Gen 1.5	In production
FI	*Työmarkkinatori* AI services	Matching	Improve matching through NLP	Jobseekers	NLP/LLM	Gen 2.5	In production
FR	Automated responses	Customer service (email)	Improve effectiveness and efficiency of call answering	Support staff	NLP	Gen 2	In production

Country	Name/description	Area	Goal	User	Approach	AA/AI generation	Status
FR	Career recommender	Career guidance	Providing personalised recommendations to jobseekers	Jobseekers	ML/NLP	Gen 2	In production
FR	Information retrieval	Process support	Simplified access to information	Support staff	LLM/NLP	Gen 3	PoC/pilot
FR	CV analyser	Career guidance	Automatic CV analysis	Jobseekers	NLP	Gen 2	In production
FR	Employment probability	Profiling (JS)	Calculate probability to enter employment in x time	Support staff	ML, ?	Gen 1.5	In production
LT	Employment probability	Profiling (JS)	Calculate probability to enter employment in x time	Support staff	ML classifier (random forest)	Gen 1.5	In production
LU	Matching algorithm	Matching	Improve matching, based on ESCO	Jobseekers	NLP → Word2Vec / rule-based + fuzzy matching	Gen 2	In development (pilot/ restart)
LU	ML proximity	Profiling (JS), matching, career guidance	Calculate distance to occupations and recommend training and jobs	Support staff	Tbc	Gen 2 (tbc)	In development

Country	Name/description	Area	Goal	User	Approach	AA/AI generation	Status
LU	Chatbot	Customer service (email)	Improve effectiveness and efficiency of call answering	Support staff	NLP	Gen 2	In development (PoC)
LU	Jobseeker profiling	Profiling (JS)	More accurate profiling	Support staff	ML classifier (random Forest or naïve bayes)	Gen 1.5	In development
NL*	Growth Predictor	LMI, employer guidance	Provide insights into employee development for employers	Employers/ support staff	Tbc	Gen 1.5	In production
SI	Career opportunities tool	Career guidance	Assess job opportunities based on profile and job opportunities	General public	DL/NN	Gen 2	In development (pilot)
SI	Explore your labour market trends	Career guidance	See data on professional occupations	General public	DL/NN	Gen 2	In development (pilot)
SE	*Bedömningsstöd*	Profiling (JS)	Profiling to calculate distance to getting a job	Jobseekers	ML survivor (survival model)	Gen1.5	In production

Country	Name/description	Area	Goal	User	Approach	AA/AI generation	Status
SE	*Identifering av Diskriminering*	Profiling (V)	Understanding vacancies and whether they include discriminatory factors	Employers	DL (various)	Gen 2	In production
SE	*Felaktiga Utbetalningar FA*	Fraud detection benefit recipients	Identifying fraudulent behaviours	Support staff	DL, NN	Gen 2	In production
SE	Picture to text	Career guidance	Identifies text and object in pictures	Jobseekers	DL (tbc)	Gen 2	In production

Notes

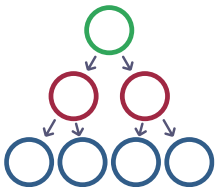
* Not all 'algorithms' used by UWV are included, e.g. *klantapplicatie WW* pre-fills existing data but is excluded because it does very few calculations.

** https://www.ams.at/arbeitsuchende/aus-und-weiterbildung/Berufsinfomationen/Berufsinfomation/berufsinfomat?open=berufsinfomat

*** Only 'main' applications listed. Components or auxiliary systems are not included separately.

7.2 Glossary

- **Foundation models**
  A foundation model is any model trained on broad data (generally using self-supervision at scale) that can be adapted (e.g. fine-tuned) to a wide range of tasks (Bommasani et al., 2022).
- **Large language model (LLM)**
  An LLM downstream is a deep learning (DL) algorithm based on knowledge gained from massive datasets. This includes recognition, summarising, translation, prediction and generation of text and other content.
- **Generative AI (GenAI)**
  This is an umbrella term for transformers, large language models (LLMs), diffusion models and other neural networks (NNs) that can create text, images, music, software and more.
- **Gradient boosting (or gradient boosted decision trees)**
  This is an approach to improve (or enhance) the ways decision trees work. In a decision tree, data are being broken into (logical) clusters. For example, a population can be divided into female/male/neutral. In gradient boosting, the model looks at those factors that cause the biggest split in the data and gives those a larger model weight. This enhances differences between groups and typically creates stronger (and clearer) results.



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