

In Pursuit of AI Excellence in Public Employment Services: Identifying the Requirements

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Abstract: The modern labor market faces complex challenges stemming from various factors, such as demographic shifts, the far-reaching impacts of digital and technological evolution, changing job profiles, and job losses due to automation and the green-economy transition. As labor market challenges escalate, it becomes increasingly vital for public employment services (PES) to gain a deeper understanding of their clients and the specific labor markets in which they operate. Although, in their current form, these services often help only unemployed people, implementing AI technologies has the potential to significantly broaden PES support for the wider public. Unfortunately, the EU's PES sector has been slow to implement AI technologies to support clients with services such as skills extraction from CVs and job offers, jobseeker matching, and recommending relevant jobs or training. This study examines the perspectives of a PES' external

user groups and internal stakeholders to establish a baseline for implementing such technologies into existing self-services. The findings emphasize that while AI has transformative potential, deploying it effectively necessitates a holistic understanding of the existing PES ecosystem and a strategic approach to requirement gathering.

Keywords: *AI, digital transformation, modern labor market, public employment services, public sector innovation, requirements gathering*

1. Introduction

As the fourth industrial revolution (Schwab, 2023) is emerging, we stand at the threshold of unprecedented technological advancements. This new era is reshaping the labor market, increasing the demand for novel skills while making traditional ones obsolete. The EU policy level identifies skills as crucial for sustainable competitiveness and social fairness (European Commission, 2020).

Recent crises like COVID-19, high energy prices, and Russia's aggression against Ukraine have heightened labor market uncertainty. An OECD (2022) study showed that at least one in six business-sector workers are in concentrated labor markets, limiting their negotiation power for better conditions. Despite a better-than-expected rebound from COVID-19, labor market improvements remain inconsistent, which is particularly challenging for low-skilled workers (Causa *et al.*, 2022). Significantly, the Member States of the EU have supported the EU 2030 social objectives, which include a goal for at least 60% of adults to engage in training each year to achieve an employment rate of no less than 78% by 2030 (European Commission, 2022a). Additionally, the 2030 Digital Compass establishes further ambitions, aiming for at least 80% of all adults to have basic digital skills by the same year (Decision (EU) 2022/2481). Demographic trends like the shrinking working-age population highlight the need to unlock the potential of the labor force and invest in skills across all age groups (Park, Shin & Kikkawa, 2022). In the EU-28 Member States, Iceland, and Norway, an estimated 128 million adults could benefit from upskilling and reskilling (Cedefop, 2019). Addressing skill shortages is crucial, especially for underrepresented groups like women, people with disabilities, older

individuals, and youth not in education, employment, or training (Rajnai & Kocsis, 2017). Public employment services (PES) play a key role in connecting the unemployed with job and training opportunities, but their approaches vary widely (Sienkiewicz, 2022).

A 2017 global report identified six obstacles to developing skills in intelligence systems in the PES sector: lack of knowledgeable human resources, funds, coordination, statistical infrastructure, policymaker support, and credibility of previous analyses (ILO, 2017). More academic research is needed on the self-services' requirements and functionalities of PES (Wallinder & Seing, 2022; Danneels & Viaene, 2015; Leinberg, 2016). The study aims to determine an approach for gathering the requirements for AI-enabled career-support services within PES, posing two research questions:

RQ1: What are the needs of external user groups for a modern PES self-service in Estonia?

RQ2: What internal implementation requirements should be considered before building AI-enabled solutions for PES in Estonia?

Estonia serves as a compelling subject for this study due to its achievements in e-governance and its high ranking in the 2022 *eGovernment Benchmark* study (European Commission, 2022b). Estonia's national AI strategy, initiated in 2019, has propelled AI-enabled services in the public sector (Estonian Government, 2019). Subsequent *Kratikava* action plans for 2019–2021, 2022–2023, and 2024–2026, developed by the Ministry of Economic Affairs and Communications, continue to direct the adoption of AI (Ministry of Economic Affairs and Communications, 2019; 2021; 2024). Additionally, the *Data and Artificial Intelligence White Paper 2024–2030*, created by the Ministries of Economic Affairs and Communications, Justice, and Education and Research with the Government Office, outlines strategic goals for developing a data-driven governance and economy, transforming Estonia into a state empowered by AI, while emphasizing trust and human-centric approaches (Ministries of Economic Affairs and Communications, Justice, and Education and Research & Government Office, 2024). The Estonian PES have introduced new AI tools and created cooperative opportunities, enhancing internal service efficiency.

2. Literature review

2.1 Digital transformation and AI in the public sector

The scientific community has yet to agree on a single definition of AI. A report on a longitudinal study titled *Artificial Intelligence and Life in 2030*, released by Stanford University in 2016, examined the influence of AI on diverse sectors of society. The report argued that the absence of a clear, universally-agreed-upon definition of AI might have contributed to the field's rapid expansion and progress (Stone *et al.*, 2016). A more recent report, completed by the same standing committee and published in 2021, argued that, compared to governing bodies of other countries worldwide, the EU has been the foremost governmental body in introducing specific regulatory measures for AI (Stone *et al.*, 2022). The EU defines AI systems as

software (and possibly also hardware) systems designed by humans that, given a complex goal, act in the physical or digital dimension by perceiving their environment through data acquisition, interpreting the collected structured or unstructured data, reasoning on the knowledge, or processing the information, derived from this data and deciding the best action(s) to take to achieve the given goal (AI HLEG, 2019).

As this comprehensive definition indicates, the EU seeks to capture the multifaceted nature of AI, emphasizing both its data-driven decision-making processes and its overarching human-designed objectives. This underscores the EU's vision for AI and aligns with the discussion of digital transformation and its relationship with AI.

Although the private sector has shown significant progress in adopting AI and developing digital transformation strategies, the public sector still faces challenges in this regard (Fatima, Desouza & Dawson, 2020). Thus, the adoption of AI technologies has become increasingly important for the public sector in recent years. Wirtz *et al.* (2019) proposed a 4-AI model that identifies the main challenges related to AI implementation; these challenges involve the main dimensions of society, technological implementation, law and regulations, and ethics. Each dimension consists of multiple subaspects of which the implementers are advised to be aware while considering the implementation of specific applications. In this regard, the implementation of AI in the public sector is a complicated issue requiring a wider understanding of the internal and external aspects of the organization. Mergel, Edelman and Haug (2019) conducted comprehensive

research on digital transformation, stressed the importance of external drivers, and proposed a procedural pattern map. Given the emphasis on stakeholders in this research, this pattern map comprehensively addresses the nuances of the public sector. Based on this, organizations such as those providing PES are under pressure to undergo digital transformation to stay relevant, be responsive to the changing demands, and respond to external pressures. Typically, the transformation involves digitizing artifacts and processes, transforming bureaucratic culture, and developing digital competencies and mindsets. The utilization of open data plays a pivotal role in these transformations, enabling the digitization of artifacts and processes, the transformation of bureaucratic culture, and the development of digital competencies. In the PES sector, a focus on data accessibility is crucial to create AI-enabled services that experiment with different models for improved service delivery. Tropp, Hoffmann and Chochia (2022) emphasize that the strategic management of open data is essential for facilitating these changes, highlighting its impact on streamlining operations and enhancing service delivery within the public sector. Although the private sector has made significant efforts to adopt AI and implement digital-transformation plans, these efforts are not directly transferable to the public sector (Zuiderwijk *et al.*, 2021).

According to Mikalef, Fjørtoft and Torvatn (2019), when it comes to the implementation of AI, before suggesting the most effective methods for deploying AI solutions and facilitating their adoption, it is essential to identify the areas in which AI will play a central role. For example, a PES could implement components using AI technologies into multiple internal or external services; however, the overall service-delivery architecture might require a more centralized strategy to offer combined services that provide value to all stakeholders, such as employers seeking applicants, employees of the PES, and jobseekers. Kesa and Kerikmäe (2020) highlight the inherent challenges posed by AI technologies to GDPR compliance, emphasizing the need for public employment services to consider these challenges when implementing AI-enabled services to ensure adherence to the legal standards of transparency and data protection. Moreover, Chochia, Kerikmäe and Skvarciany (2023) emphasize the integration of sustainable practices within organizational management, emphasizing the need for public employment services to adopt AI solutions that are not only technologically advanced but also socially responsible and environmentally sustainable.

2.2 AI in the PES sector

In recent years, there has been a growing interest in exploring the potential of AI technologies in the PES sector (Desiere & Struyven, 2021; Flügge, 2021; Körtner & Bonoli, 2021; Urquidi & Ortega, 2020). According to Broecke (2023), the implementation of AI in job matching is still in the early stages of development, and it faces two main barriers: (1) a lack of preparedness among organizations and associated individuals to utilize these tools, and (2) doubts, risks, and concerns about the technology and its potentially negative consequences. Based on the available scientific and industry resources, only a few PES in Europe have implemented AI technologies to assist jobseekers. Firstly, the *Vlaamse Dienst voor Arbeidsbemiddeling en Beroepsopleiding* (VDAB) in Flanders has integrated AI into its services with the Competency-Seeker tool, which analyzes resumes to suggest implicit skills, and the Jobbereik app, which recommends alternative jobs and required training for career moves. Secondly, France's *Pôle Emploi* has implemented the *Analyse Automatique* of CVs (AACV) tool to identify unmentioned skills on CVs based on job history, achieving a 68% satisfaction rate. Lastly, the Switch to Sweden project exemplifies a successful private-public partnership utilizing AI for efficient matchmaking between jobseekers and organizations (Linköping Science Park, 2023).

2.3 The PES in Estonia

The Estonian Unemployment Insurance Fund (Est. *Töötukassa*; EUIF) is a quasi-governmental organization that provides labor market services to various segments of the Estonian population. These segments include the unemployed, jobseekers, employees, employers, and youth. Though independent of the Estonian government, the EUIF operates based on the Unemployment Insurance Act and the Labor Market Services and Benefits Act. These laws outline the unemployment insurance system of Estonia, employment mediation, and other related services. The EUIF's primary mission is to mitigate unemployment and its duration in Estonia, foster economic transitions, enhance the quality of labor supply, and improve cost-effectiveness (EUIF, 2022b). It accomplishes these objectives by implementing active labor market policies, providing subsidies, and performing work-capability assessments. These three categories encapsulate a variety of services, including but not limited to employment mediation, career guidance, the provision of labor market training, and the administration of degree-study allowances, business startup subsidies, unemployment insurance benefits, and unemployment allowances (EUIF, 2022a).

2.3.1 AI in the EUIF

In accordance with Estonia's national AI strategy (Estonian Government, 2019), the machine-learning-based tool OTT (Estonian abbreviation for a decision support tool) was designed to assist the EUIF (E-Estonia, 2021). OTT is accessible only to consultants working in the EUIF. It predicts the likelihood of jobseeking individuals to find work and identifies factors affecting this probability. It helps EUIF consultants provide personalized recommendations to clients, streamlines workflow, and enhances overall efficiency. It categorizes clients into different groups based on risk assessments, allowing consultants to prioritize their cases and create bespoke recommendations. Utilizing AI, particularly the random forest machine-learning algorithm, OTT was developed and validated using five years' worth of unemployment data. The model takes into account 60 unique attributes and indicators to assess each jobseeking individual and compute their probability of securing new employment (Nortal, 2021). The EUIF has been involved in two other substantial AI-focused initiatives: MALLE (Estonian abbreviation for machine learning in labor economics) and MAITT (Estonian abbreviation for machine learning and AI supported services). MALLE assesses the impact of labor market services on the likelihood of reemployment among the unemployed, thereby facilitating more efficient resource allocation for such services (EUIF, 2022b). Conversely, MAITT, a project undertaken by the University of Tartu (2022), employs machine learning and AI to calculate the risk of unemployment among those currently employed. Thus, it can be inferred that the EUIF's participation in the Estonian national AI strategy has augmented its AI capabilities, introduced new AI tools, and created opportunities for collaboration, enabling it to deliver services with greater efficiency. However, since these existing AI services are designed mainly for consultants, they are only remotely helping the actual end-users, such as the unemployed, jobseekers, employees, employers, and youth.

3. Methodology

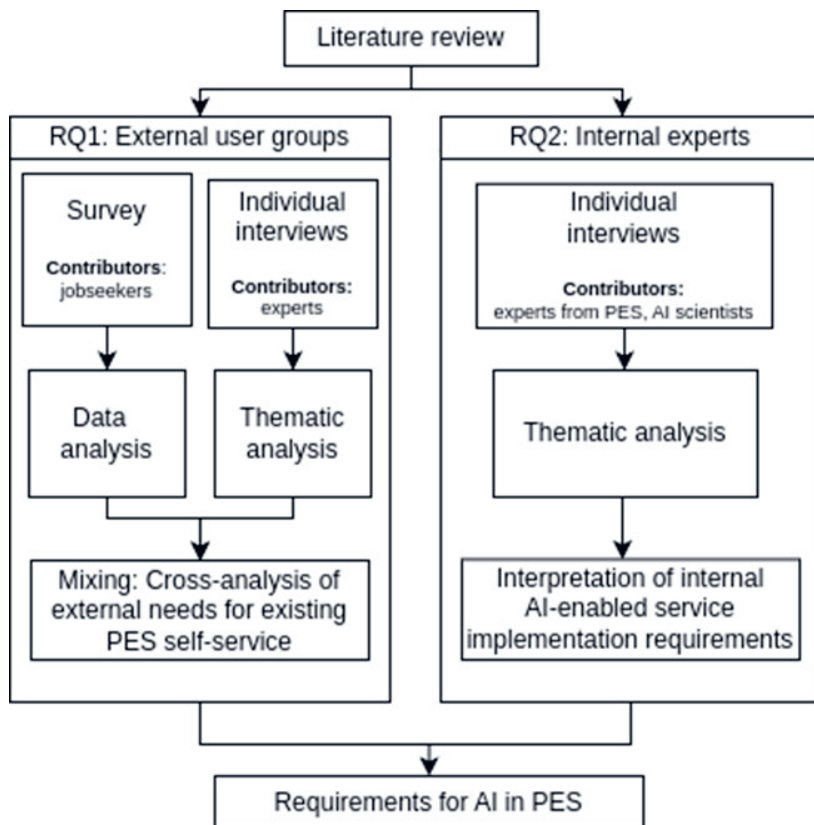
To select appropriate data collection methods, we considered digital transformation as the end goal, which encompasses concentrating on fulfilling user needs, introducing novel modes of service delivery, and enlarging the user base (Mergel, Edelmann & Haug, 2019). When defining requirements for PES, taking this goal into account not only establishes

the need to consider both internal and external stakeholders but also requirements for the methods themselves, because different target groups require tailored methods of engagement for data collection; for example, conducting interviews to reach a significant number of jobseekers would pose a challenge. Section 2.1 elaborated on how the disciplines of technology, public administration, and legal studies shape our approach, ensuring a holistic view that spans multiple disciplinary perspectives. Therefore, to comprehensively address the research questions and fulfill the study's aim, we selected a mixed-methods approach that combines qualitative and quantitative data collection methods. According to Venkatesh, Brown and Bala (2013), combining these two data collection methods can enable information systems researchers to draw more precise and informed conclusions.

To fulfill the aim of this study, a literature review was undertaken to establish a theoretical framework. Given the absence of robust frameworks that focus on the requirements for PES services, this study designed a framework for empirical investigation (Fig. 1).

To address the first research question (*RQ1*), we used two data collection methods. In March 2023, an online survey, distributed through two prominent Facebook groups widely used by locals and expatriates in Estonia, was used to gather quantifiable data from jobseekers. The first group, Expats in Tallinn/Estonia, had approximately 19,900 members and served as an active platform for sharing everyday life information. The second, Jobs in Estonia, included about 29,700 members and focused on the Estonian job market; it was anticipated that these groups would provide a diverse and unbiased sample of the Estonian population. In April 2023, semi-structured interviews with industry experts, those in higher education, and public authorities representing employers were conducted. For the interviews, experts who were well experienced and knowledgeable in the field of skills development were chosen based on their years of experience in the industry. Statistical analyses of the survey data and thematic analysis of the interviews identified six key themes: technological issues, workforce and skills, collaboration and integration, platform improvement, language and translation, and awareness level. For the second research question (*RQ2*), we interviewed experts with an EUIF-related AI project experience in May 2023. This thematic analysis helped interpret the EUIF's internal requirements for AI-enabled service implementation. In essence, the combination of these methods provided a more holistic and nuanced

Figure 1. Mixed-methods research design for empirical investigation.



understanding of the research subject. This understanding benefited from the breadth of the survey data and the depth and context specificity of the interviews.

The survey, designed for jobseekers, focused on modern PES, avoiding technical AI details to ensure clarity. Conducted in both Estonian and English, it included 26 questions and gathered 176 responses from a diverse geographic distribution.

Seven individual semi-structured interviews were conducted in April 2023 with experts from different industry sectors, higher education, and public authorities, all with over ten years of recruitment experience (Table 1).

Table 1. Main characteristics of interviewees.

ID	Expert’s position	Expert’s organization
A	Senior manager, information security	Leading software development company, Estonia
B	Head of recruitment, career center	Leading financial organization, Estonia
C	Team manager-BI analytics team	Leading financial organization, Sweden and the Baltic countries
D	Recruiter	Leading software development company, Estonia
E	Recruitment specialist	Leading software development company, Estonia
F	Associate professor	Leading university, Estonia
G	CEO and HR consultant	HR management consulting company, Estonia

In May 2023, eight AI development experts associated with the EUIF were interviewed to address the *RQ2*. These semi-structured interviews provided detailed insights into the AI implementation requirements for PES (Table 2).

Table 2. Main characteristics of interviewees (*RQ2*).

ID	Expert’s position	Expert’s organization
I1	Early-stage researcher	University
I2	Development expert	EUIF
I3	IT development manager	EUIF
I4	Head specialist	EUIF
I5	Head of department	EUIF
I6	Analyst	AI development organization
I7	Senior researcher	AI development organization
I8	Junior research fellow	AI development organization

The selection of these experts was guided by their association with the EUIF and their contributions to various AI projects such as OTT, MAITT, and MALLE within the organization.

4. Results

4.1 External user group needs

The analysis of 176 survey responses revealed that 65.9% (116 respondents) had never used the e-Töötukassa self-service, while 34.1% (60 respondents) had used it at least once. Among the users, 31 were employed and 16 were unemployed. The employed users showed interest in job finding (48.9%) and training opportunities (42.6%). Of the 60 users, 17 had used the service once, and 43 had used it repeatedly. Only 20 participants engaged in training programs, and 39 did not. Additionally, 32 did not submit applications, while 21 did. Half of the users regularly updated their CVs, and 21 logged in for job search weekly or daily. Feedback to the survey highlighted several issues: limited job posting diversity, platform design and usability problems, information overload, outdated information, poor translation, frequent session expirations, and a slow login process. Users suggested more training opportunities, better language accessibility, developing a mobile app, improved interface, and more personalized features.

Based on the thematic analysis of the data collected from the individual interviews with the employers, three common themes were identified: workforce challenges, PES challenges, and expectations for improving the PES (Table 3). Employers face significant challenges in finding skilled candidates, especially in IT, where demand for the latest technologies is high. This issue is compounded by the influx of irrelevant applications that do not match the required qualifications or skills. To address these challenges, employers recognize the need to upskill and reskill their current workforce. The impact of demographic changes, such as an aging population and fewer young workers, further exacerbates the workforce challenges. Additionally, relocation issues due to extended visa-processing times and lack of support for families were noted. The current PES solution, e-Töötukassa, faces several issues. The job advertisements' publication process is burdened with excessive manual steps and is time-consuming. The platform lacks headhunting capabilities and suffers from poor public awareness and limited use among HR departments. Technical issues, such as difficulties with keyword usage for CV promotion and weak translation services, were also highlighted. Employers suggested several improvements for the e-Töötukassa platform. Increasing its popularity through career fairs and collaboration with schools could help connect employers and candidates. Enhancing the platform's features, such as adding extended filtering tools, providing guidance services, and integrating with HR portals, would make it

more user-friendly. Improving the design to be simple, clear, and attractive is also crucial. Public awareness campaigns and more training programs, developed in collaboration with educational institutions, were recommended to address skill gaps.

Table 3. Themes from individual interviews with the external user groups.

Theme	Details
Workforce challenges	Skills shortages, especially in IT (B, E, G), Need for upskilling/reskilling (A, B, E, F, G), Demographic changes impacting workforce (F)
PES challenges	Excessive manual processes (E, F, G), Lack of headhunting support (A), Low awareness and popularity (A, C, D, E, G), Technical issues with keywords and translations (C, F, G)
Expectations for improvement	Increase platform popularity via career fairs and collaboration with schools (A, C, E, G), Enhanced features and better design (A, B, C, D, E, F, G), Public awareness campaigns (A, C, E), More training programs in collaboration with educational institutions (A, D, E, F)

4.2 Cross-analysis of external needs

The cross-analysis examined the current state of the PES in Estonia, focusing on the needs of jobseekers and employers. Both groups provided crucial perspectives: the jobseekers highlighted usability, limited job opportunities, quality of information, language translation, and insufficient training. The employers pointed out skill shortages, upskilling needs, and demographic changes. The analysis identified six key overlapping themes: technological issues, workforce and skills, collaboration and integration, platform improvement, language and translation, and the level of awareness. Both groups emphasized platform usability, translation problems, and the need for more training opportunities. Unique concerns included the jobseekers’ issues with login processes and a lack of relevant jobs, and the employers’ focus on demographic changes and skill shortages. The summary of categorized findings for the external user group is presented in Table 4.

Table 4. PES self-service needs of external user groups.

	Jobseekers	Employers
Technological issues	Usability concerns, session expirations and login inconveniences, demand for a mobile application	Excess manual steps, unavailability of experts, poor user experience
Workforce & skills	Limited job opportunities, insufficient training opportunities, request for more training courses and workshops	Skills shortage, need for upskilling and reskilling, demographic changes
Collaboration & integration	Desire for integration with other employment platforms	Collaboration with schools and employers, integrating with HR portals
Platform improvement	Need for functional enhancement before adding new features, improved visualization, personalized user interface, more refined search features, displaying users who have viewed their CVs, addition of salary details in job postings, resources on CV and cover-letter crafting, introduction of an e-newsletter	Fair representation of career, competitive designs and services, descriptive soft-skill analysis, extended filtering, guidance, and consultancy including forecasts, personality evaluations, strong awareness campaigns
Language & translation	Language translation issues, call for broader language accessibility, more English-language content	Weaknesses in translations
Awareness level	Relatively low	Negative publicity

This comprehensive understanding allows for a more nuanced inclusive approach to designing improvements for the PES and ensures that interventions will address the most critical and common needs reported by the jobseekers and the employers.

Table 5. Requirements for AI implementation.

Theme	Requirements
Infrastructure	Upgrade the existing infrastructure to support AI integration (I2, I3, I4, I5, I6).
Personnel	1. Engage experienced specialists, particularly in data analysis, for AI implementation (I1, I2, I3, I4). 2. Consider partnering with an external organization for specialist resources while ensuring that the organization understands PES culture, goals, and processes (I1, I2, I3, I4).
Data	1. Ensure availability of sufficient quantities of high-quality data for AI training and implementation (I3, I6). 2. Address challenges related to limited sample sizes due to the country’s small population (I3, I5, I6).
Legal compliance	1. Safeguard data privacy and compliance with GDPR and other relevant laws, especially when partnering with external entities (I1, I5, I8). 2. Develop strategies to prevent potential AI-enabled discrimination due to low-quality or biased data (I4). 3. Consider legal frameworks before initiating the development and deployment of AI solutions (I2, I3, I4, I6). 4. Ensure that the activities of the Estonian PES are in accordance with laws such as the Unemployment Insurance Act and the Labor Market Services and Benefits Act (I4).
Change management	1. Manage acceptance of AI among stakeholders (I6). 2. Foster trust in AI solutions among development partners and end users (I2, I6). 3. Prepare the organization for the AI-induced transformation, including potential changes in work roles and tasks (I1, I3, I4, I6, I7, I8).
Funding	Secure adequate funding for the implementation of AI, keeping in mind the unique challenges of financing in the public sector (I1, I2, I4, I5).

4.3 Internal requirements for AI

Through deductive coding, we identified the following as the main themes of the interviews: infrastructure, personnel, data privacy and security, legal compliance, change management and funding. Upgrading the existing infrastructure is crucial for AI integration, involving more than just hardware and software updates. It requires competent IT systems, well-planned data architecture, sufficient IT capabilities, effective data exchange mechanisms, backup availability, and strong relationships with hosting partners. The Estonian X-Road data exchange layer and the EUIF's data warehouse are particularly significant. Experienced personnel, especially in data analysis, are essential for AI development in PES. This includes internal team members and potential collaborations with external specialists who align with PES' culture and goals. Legal challenges include ensuring data safety and privacy compliance, especially with external developers. Development often precedes the completion of the legal framework, posing an issue. Legal compliance is imperative for the EUIF, which is a public sector organization. GDPR compliance, such as obtaining client's consent and depersonalizing data, is necessary but may affect system accuracy. Change management involves managing AI acceptance among stakeholders, fostering trust in AI solutions, and preparing for AI-induced transformation. Involving end users, especially career counselors, early in the implementation process is crucial. This transformation requires careful planning and communication. Funding is a significant challenge, with a need for a long-term budget for the EUIF, contrasting with fixed-term public sector financing. Adequate funding is crucial for successful AI implementation. The requirements for AI implementation identified from the thematic analysis are summarized according to identified main themes in Table 5.

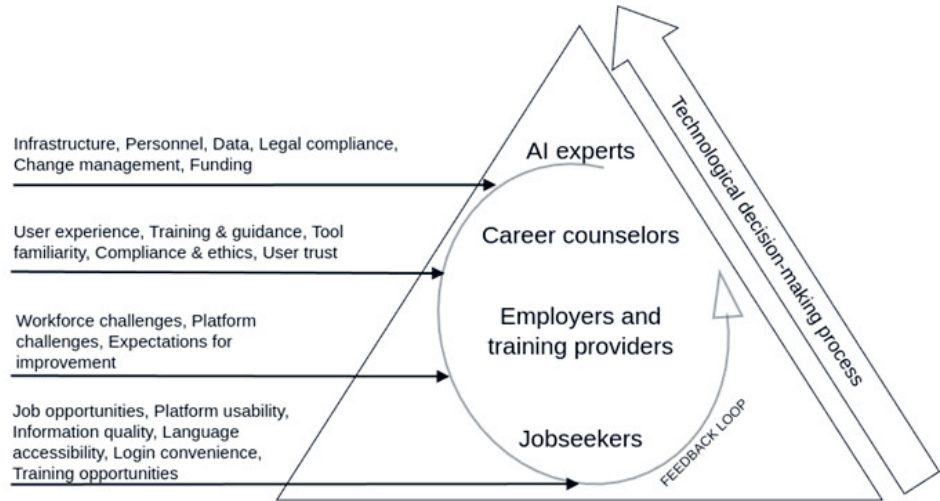
5. Discussion

This section discusses the data gathered to create the requirements pyramid for AI-enabled services in the PES sector, as illustrated in Figure 3. The comprehensive analysis of the perspectives of jobseekers, employers, and AI experts provides a holistic view of the current state and future needs of PES. The jobseekers emphasized the need for improved job opportunities, usability, information quality, language translation, enhanced features, broader language accessibility, training opportunities, and a more user-

friendly interface. The employers highlighted challenges such as skill shortages, platform limitations, and expectations for improvements. Both groups converge on the critical areas of usability, information quality, and training opportunities, indicating key focus areas for AI enhancement. Career counselors emerged as pivotal users, interacting daily with PES systems and witnessing external user challenges firsthand. Their role in collecting requirements and acting as change agents is vital for bridging technological innovation and user experience, fostering trust and acceptance among stakeholders. AI experts identified the essential internal needs, including upgrading infrastructure, engaging experienced data analysts, ensuring high-quality data access, safeguarding privacy, legal compliance, managing change, and securing funding. These insights provide a strategic view that encompasses both technical and socio-organizational aspects of AI implementation.

Figure 2 presents the requirements pyramid, illustrating the continuous refinement process of PES services. The feedback loop visualizes the dynamic nature of AI-enabled service development, where user requirements are filtered and contextualized by AI experts. This ensures that the needs are feasible and optimally addressed in the AI solutions, emphasizing the critical role of AI experts in aligning technological capabilities with user demands.

Figure 2. The pyramid of iterative requirements for building AI-enabled PES.



6. Conclusion

While some researchers have explored aspects of PES e-services (Danneels & Viaene, 2015; Wallinder & Seing, 2022; Leinberg, 2016) from a theoretical perspective, there remained a notable gap in robust methodological approaches in the existing literature that focus on defining the requirements for services offered by PES. Hence, we created a mixed-methods research design for an empirical investigation specifically for the list of requirements from external user groups and internal experts of PES (Fig. 2). Our study illustrates the complex set of requirements for a successful implementation of AI-enabled services in the PES sector. Our findings underscore the importance of including a variety of stakeholders in the requirement-collection process; each stakeholder group contributes unique insights and poses different challenges. This aligns with our first contribution, in which our comprehensive mixed-methods analysis integrates the perspectives of these diverse groups, providing a holistic view of the requirements for AI-enabled services in PES. Jobseekers, employers, AI experts, and the overlooked stakeholders—career counselors and training providers—all play vital roles in shaping the future of AI in PES.

Through the use of a mixed-methods methodology, this study successfully highlights the intersections and divergences in the needs of these stakeholders. The distinct needs of jobseekers and employers constitute the foundation of our conceptual pyramid, which focuses on usability, language, and accessibility concerns. The insights of career counselors add a layer between AI experts and employers. This directly ties into our second contribution, emphasizing the overlooked role of career counselors as intermediaries who understand both the technological and human aspects of the PES ecosystem. Furthermore, AI experts contribute a more technical layer of requirements, ranging from infrastructure upgrades to data quality and legal compliance. This multifaceted view of the requirements for AI implementation in the PES sector, visualized as a pyramid with feedback loops, provides a roadmap for PES organizations initiating similar transformations. Our third contribution is evident here: the study promotes iterative requirement gathering and highlights the need for PES organizations to adapt continually, echoing the feedback loops in our model. By systematically addressing these requirements, PES can maximize the potential of AI to enhance services, improve user experience, and ultimately better serve the needs of jobseekers.

Although our study provides valuable insights of various stakeholders into the set of requirements for building modern PES services, it is not without limitations. First, the study focuses on Estonian PES, and while the insights obtained are valuable, they might not be wholly applicable to countries with a different level of technological maturity, different socioeconomic contexts, and different labor market conditions. To develop an EU-wide perspective, future research could include countries with varying levels of e-governance maturity. Second, we interviewed a limited number of participants, especially on the employers' side. Hence, their opinions may not be fully representative of the concerns and expectations associated with the Estonian labor market. Third, during the primary data collection, it was discovered that two additional target groups should be added to the process of mapping the requirements: career counselors and training providers. Including and considering their perspectives in future research will be of great benefit to the design and deployment of AI-enabled services in the PES sector.

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