Upskilling Older Employees in the Artificial Intelligence Era

Tinkara Žabar[1] 🆔 ✉ , **Aleksander Janeš** [2] 🆔

[1] University of Primorska, Faculty of Management, tinkara.kodelja@fm.upr.si ✉

[2] University of Primorska, Faculty of Management, aleksander.janes@fm.upr.si

Abstract

Research Question (RQ): What is the effect of new technologies, with an emphasis on artificial intelligence (AI), on the need to upskill older employees (50+ years).

Purpose: The purpose of the research was to carry out a systematic literature review of existing research in the field of the effect of AI on the upskilling needs of older employees.

Method: We performed a systematic literature review across six academic search engines: ProQuest, Emerald, Sage Journals, Springer, Research Gate, and Google Scholar.

Results: Artificial intelligence is significantly transforming the labor market, as it requires constant adaptation to new skills and knowledge. AI has a significant effect on older employees, who are exposed to greater challenges due to a possible lack of digital skills and sensitivity to change. In this context, training and further education are key mechanisms to ensure that skills match the requirements of the work environment and the labor market. Organizations must quickly adapt to changing requirements by creating a culture of lifelong learning that encourages seniors and other employees to improve. Training programs must be based on the specific needs and challenges faced by older employees.

Organization: The research emphasizes the importance of training older employees in the age of AI and encourages organizations to create a culture of lifelong learning as part of the organization's strategic directions and goals.

Society: The importance of research for society is reflected in the insight into the involvement of all age groups in the possibility of improving knowledge, skills, and attitudes towards the use of modern technologies. Organizations and society itself bear the social responsibility to enable older employees to successfully integrate into the work environment in the AI era.

Originality: The research addresses the need to improve the skills of a specific age group in the age of AI, where it simultaneously highlights the importance of fostering a culture of lifelong learning in a rapidly changing world. The research findings provide guidelines for policymaking in the field of training on the national level in the context of an aging workforce and new technologies.

Limitations/further research: The literature review was limited to six publicly available databases. In the article, older employees were considered as people in the labor process older than 50 years. We must emphasize that older employees differ from each other in terms of education, economic, social, and other circumstances. Further research should investigate the effect of new technologies regarding the specific circumstances mentioned in this age group.

Keywords: knowledge society, upskilling, knowledge management, retraining, older employees, artificial intelligence, lifelong learning.

1 Introduction

Technological advances, particularly artificial intelligence (AI), are profoundly reshaping job roles and work structures. Organizations are integrating AI technology into their business to stay competitive. However, the introduction of such technologies into business processes contributes to the exposure to inequalities such as digital skills, employment volatility, the impact of automation and robotics, in parallel with processes of job destruction and creation (Cramarenco et al., 2023, pp. 732). These transformations underscore a pressing imperative for large-scale workforce upskilling, with projections indicating that by 2050, approximately 50% of all employees will require upskilling as a result of the use of emerging technologies in the workplace. To ensure meaningful employee engagement, organizations must provide learning opportunities that equip workers for these transitions. Such efforts contribute to the development of an inclusive and resilient knowledge-based economy in which all individuals can participate meaningfully (Li et al., 2023, pp. 1697).

New technologies often have a stronger impact on older workers, as they tend to have less developed digital competencies needed to manage AI in comparison to their younger colleagues. In the literature, older employees are generally defined as individuals who are active in the labor market. The age at which someone is defined as an older employee is not universally agreed upon. Most studies refer to those aged 50 and above (Novak, 2023, pp. 23), with definitions typically starting between age 45 and 55, and with the upper age limit often left unspecified (Krašovec, 2015, pp. 30). In our work, we refer to older employees as those who are over 50 years of age and are actively participating in the labor force.

Despite the valuable professional experience that older workers possess, many of them lack digital skills necessary to effectively engage with AI systems, making targeted retraining and upskilling efforts essential (Tiku, 2023; Chetty, 2023). A common misconception is that older people are disinterested in training. However, participation many times correlates with the right training format. When learning formats are adapted to meet older employees' preferences, they are significantly more inclined to engage in further education (Zwick, 2015, pp. 146). Many researchers point out that creating a culture of lifelong learning in the workplace is crucial for fostering skills development in a rapidly changing world and labor market demands (Tiku, 2023; Li et al., 2023; Vuorenkoski et al., 2018; Pradhan et al., 2023).

Based on a systematic literature review, we aimed to answer the following research question: What is the effect of AI on the need to upskill older workers? In the fourth section, the main results will be outlined based on the articles included in the literature review.

2   Theoretical framework

Digital technologies, particularly AI, commonly defined as computer programs capable of performing tasks that typically require human reasoning, represent a key advance in technological development (Bruun and Duka, 2018, pp. 1). With these characteristics, AI plays a transformative role and significantly reshapes the nature of work by influencing job structures, business operations, and employee monitoring (Classen et al., 2018, pp. 23). One of the key contributions of AI is that it enables the automation of certain processes, such as repetitive, everyday tasks that do not require expert knowledge. This, in turn, allows employees to focus on tasks that require human attention and understanding (Haizir, 2022, pp. 7). Parallel to technological advances in the workplace, the workforce is also declining. Therefore, the adoption of new technologies is more significant in countries with rapidly aging populations, where innovation is often driven by the need to compensate for a shrinking workforce (Acemoglu and Restrepo, 2021).

As digital technologies continue to evolve and become more integrated into the workplace, active participation in the labor market increasingly depends on the possession of advanced digital competencies (Komp-Leukkunen et al., 2022, pp. 37–38). The integration of AI into companies also introduces challenges, such as creating new tasks and threatening job losses for employees with limited digital skills, which causes a change in the needs for skills or competencies in the labor market (OECD, 2024). As a result of the integration of AI into work processes, digital literacy has become one of the most desirable characteristics that an employee can have (Bokek-Cohen, 2018, pp. 21).

Integration of new technologies also presents a big shift in the labor market. Bruun and Duka (2018, pp. 3) have researched the impact of the level of automation on the labor market and how the economy will adapt to it by 2038, where they used cheese terminology. Based on this, they have developed three scenarios:

- Stalemate: The AI revolution will be much smaller than expected and will not change the nature of work. The economy does not need to adapt; employment in 2038 will look the same as today. In this scenario, there is no cause for concern, and governments can continue business as usual.
- Check: Despite the wave of automation, the economy can move and adapt, allowing new jobs to be created to replace those lost. The transition may cause some initial chaos in the labor market, but after a period of discomfort, stability will follow.
- Checkmate: The AI revolution will lead to rapid job losses as the economy, governments, and individuals will fail to keep up. The main concern is that the economy might not adapt quickly enough. Reflected in the increased risk of technological unemployment and social instability.

It is difficult to determine which of these scenarios will occur in the future. According to Bruun and Duka (2018, pp. 5), it is best to prepare for the worst-case scenario, namely the checkmate scenario. One of the finest strategies to prepare for unknown scenarios is investing in upskilling and skills development programs to keep people competitive, as AI shapes the functioning of the labor market. These programs would enable the current working-age generation, who are most affected by AI, to acquire the relevant skills to be more confident in operating in the labor market. It is assumed that future generations will need to be retrained several times in their working lives in order to keep pace with technological progress. Learning will therefore not end after tertiary education but will continue throughout an individual's life course (Bruun and Duka, 2018, pp.10).

Digital technologies are not only transforming the economy and sectors but also creating new jobs and demanding new skills. As a result, employers are seeking individuals who possess technical and digital skills, as well as skills that automation has not yet been able to replicate, such as cognitive and social skills (Lincoln, 2017, pp. 7). Taking the uncertainty of the impact of AI on jobs into account, the most effective response lies in developing systems that promote both individual capabilities and societal learning. A good level of basic skills and a broad knowledge base will thus be reflected in citizens' learning opportunities. However, in a rapidly changing economy, it is necessary to understand that skills that currently ensure high wages may soon lose their relevance (Vuorenkoski et al., 2018, pp. 39–40). The present workforce is not yet ready to embrace new technology due to a lack of relevant skills. Consequently, organizations must invest in upskilling and encourage workers to incorporate AI into their everyday tasks (Pradhan and Saxena, 2023, pp. 181).

New technologies impact age groups in distinct ways. Younger individuals generally possess stronger capabilities for understanding and adapting to technological developments compared to older age groups (Tiku, 2023, pp. 3). Older workers, particularly low-skilled, are often defined as having lower digital competencies. This can lead to a sense of threat from advances in automation, creating a skills mismatch and even leading to earlier retirement (Aisa et al., 2023, pp. 9). Besides the lack of digital skills, older workers also face age discrimination, which affects their employability (Lee et al., 2008). As a response to these intersecting challenges, upskilling programs represent a key component of broad workforce strategies. Employees are generally interested in training programs, but they do not attend them due to various socio-economic barriers such as the cost of education or family commitments (Bianco, 2021, pp. 9). Older population in the workplace has greater difficulties in transitioning to new job roles due to automation, while the adult learning participation is generally lower, making it harder to pursue upskilling and re-training for this age group (Nedelkoska and Quintini, 2018). There is also a lack of incentives for employers to invest in the training of older employees, affected by low participation rates (Alcover et al., 2021).

It should be emphasized that the workplace has a significant impact on older workers in the process of digitization, through the implementation of information and communication technologies (ICT), the possibility to work remotely, the training offered, and the attitudes of employers and managers towards employees (Komp-Leukkunen et al., 2021, pp. 49). It is crucial to ensure an inclusive work environment for older employees by allowing them to develop skills, career development, flexible education, training programs (Cramarenco et al., 2023, pp. 747), and intergenerational cooperation (Waligóra, 2024, pp. 103). However, the lack of basic skills remains a key barrier to the uptake of AI and poses a challenge for adults with limited digital skills. It reflects the need for tailored skills policies, as this age group, together with low-skilled workers and people living in rural areas, face the lowest participation rates in training programs (OECD, 2024). Upskilling older employees enhances their competitiveness in the labor market (Trunkina et al., 2019, pp. 522). At the same time, organizations also benefit from investing in their employees. A failure to support older employees in adapting to new technologies risks the loss of valuable knowledge, experience, and perspective that this demographic brings to the workplace (Zwick, 2015, pp. 146).

Adult education trainers must take into account the specific motivations of older employees that affect their participation in such programs. While this age group wants flexible training programs that provide practical and immediately relevant knowledge (Zwick, 2015, pp. 146). In the case of specific training for the use of AI, this training should include specific knowledge that can be applied in the workplace of the current employer, while developing critical thinking and meta-cognitive skills (Chetty, 2023, pp. 9).

Given the fast-paced evolution of skill requirements in the labor market due to technological advancement, fostering a culture of lifelong learning within organizations should be considered a strategic priority and integral to their long-term objectives (Lincoln, 2017; Bianco, 2021; Li et al., 2023). Embedding continuous learning into organizational culture supports workforce adaptability and enhances resilience in rapidly changing environments.

3   Method

The research is based on a systematic literature review, which allows a structured and comprehensive analysis of existing research on the chosen topic. The scientific research articles were retrieved from the following databases: ProQuest, Emerald, Sage Journals, Springer, Research Gate, and Google Scholar. The keywords used to search the databases were "older employees" OR "older workers" AND "upskilling" OR "skills" AND "artificial intelligence" OR "AI" OR "artificial intelligence era". The data collection took place between November 2024 and January 2025. The total number of articles found by keyword was 15.888.

In our literature review, we set inclusion criteria that guided our research collection. For the inclusion criteria, we considered that:

- The article was published between 2014 and 2024,
- The text was published in English,
- The availability of the full text; and
- The article focused on the topic of upskilling older workers in relation to new technologies, with a focus on AI.

The systematic literature review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) principles (Page et al., 2021). The keywords mentioned above were entered into the databases, where duplicate records (n=658) were removed from the search. This was followed by a screening of titles and abstracts based on the topic under consideration. Publications that did not address our research objective were excluded, and we continued reading the full texts. 13 publications were included in the final analysis according to the inclusion criteria and the research question. The publication collection procedures are shown in Figure 1.

Figure 1
The process of systematic selection of publications according to PRISMA
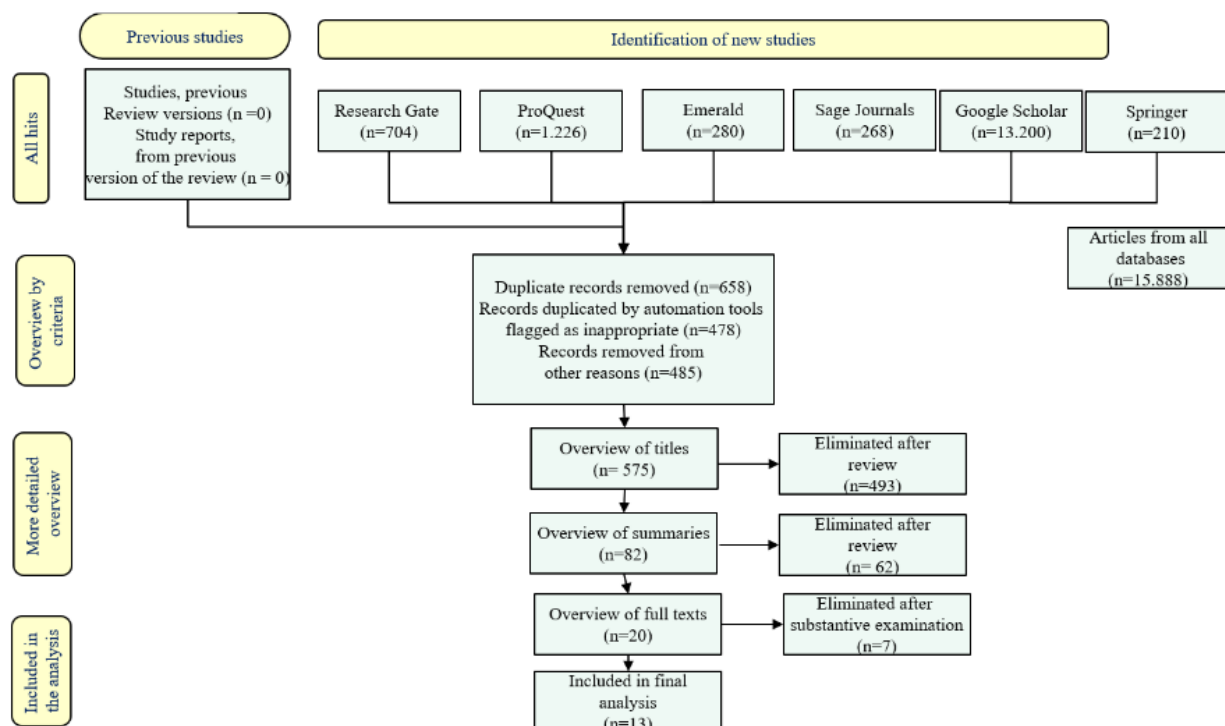
4 Results

Tabel 1 provides a synthesis of the findings from 13 articles that met the inclusion criteria. The first column lists the authors and year of publication, followed by columns detailing the (original) title, methodology, research region, publication type, and a summary of key findings.

Tabel 1
Author and year of publication, title, methodology, research region, publication type, and key findings

| Author and year of publication	Title	Methodology	Research region	Publication type	Key findings
Alcover et al., 2021	Aging-and-Tech Job Vulnerability: A Proposed Framework	Literature review and concept development	Europe	Journal Article	-Older workers may lose their jobs or have their job quality reduced due to the interaction between ageing and job automation. -Both the individuals and the organizations are responsible for reducing the vulnerability of older employees.
Bianco, 2021	Ageing Workers and Digital Future	Literature review and secondary data analysis	Europe	Journal Article	-Two simultaneous processes in developed countries - ageing populations and technological innovation. -Higher educated workers are more willing to participate in training programs. -Lifelong learning to keep older workers competitive in the labor market.
Bokek-Cohen, 2018	Conceptualizing Employees' Digital Skills as Signals Delivered to Employers	Literature review - Spence's signaling theory	Israel	Journal Article	-Digital skills as a signal to the employer, informing them of the (future) employee's capabilities, adaptability, and potential within the organization. -Older employees need to compensate for their proportionally higher age by learning new skills.
Casas and Román, 2024	The Impact of Artificial Intelligence in the Early Retirement Decision	Quantitative-secondary data from the European Survey on Health, Ageing and Retirement	Europe	Journal Article	-AI has a dual impact on the decision to retire early, depending on the education of workers and the nature of the occupation. -More educated workers are more able to adapt to technologies.

Chetty, 2023	AI Literacy for an Ageing Workforce: Leveraging the Experience of Older Workers	Literature review	South Africa	Journal Article	-The development of the digital economy has encouraged companies to train employees in AI literacy. -Older employees are at a disadvantage compared to younger employees who have more advanced knowledge of the latest technologies. -AI can enable older workers to participate strategically in the digital economy. -Training programs for working with AI for older employees should consider that they contain specific knowledge for their job.
Cramarenco et al., 2023	The Impact of AI on Employees' Skills and Well-being in Global Labor Markets: A Systematic Review	Literature review	Europe	Journal Article	-Technological advancement is affecting jobs, leading to (digital) skills gaps and job volatility. -Key solutions include continuous skills upgrading, financial support for lifelong learning, tax incentives for employers, grants for flexible training programs, and international partnerships to promote mobility.
Cros et al., 2021	Is the Obsolescence of the Skills of Older Employees an Inevitable Consequence of Digitalization?	Literature review	Europe	Book Chapter	-Digital technology is reforming the organization of workplaces and requires employees to develop new skills. -This development is not given to a vulnerable group.
Hughes et al., 2019	A Hiring Paradigm Shift through the Use of Technology in the Workplace	Literature review and panelist interviews	America	Book Chapter	-The "greying" of workplaces is forcing a paradigm shift in workplace policies. -The ageing workforce is forcing organizations to better understand the acceptance and retraining of an older workforce. -Strategies to meaningfully engage an ageing workforce: learning and development, knowledge transfer, and career path development. -Lifelong learning is becoming a growing trend across all ages.
Li et al., 2023	Does Artificial Intelligence Promote or Inhibit On-the-Job Learning? Human Reactions to AI at Work	Quantitative data from the China General Social Survey (CGSS)	China	Journal Article	-The impact of AI on workplace learning affects the older workers, women, and those with lower levels of education, as well as those without employment contracts and with less job autonomy and work experience.

					-Based on this, companies and governments should pay more attention to these employees and consider providing them with more opportunities for training and job protection.
Lincoln, 2017	An Ageing Workforce in The Digital Era: Older Workers, Technology and Skills	Quantitative and qualitative	Europe	Report	-Elderly people are exposed to stereotypes and discrimination. -Employers should provide more training and development for older people, create a lifelong culture, and tailor training programs for the older age group.
Morandini et al., 2023	The Impact of Artificial Intelligence on Workers' Skills: Upskilling and Reskilling in Organisations	Literature review	Europe	Journal Article	-The age-related digital divide affects how individuals perform their jobs and how they upskill and reskill. -Organizations that do not invest in upskilling older employees may lose the necessary skills, experience, and perspectives.
Tiku, 2023	AI-Induced Labor Market Shifts and Aging Workforce Dynamics: A Cross-National Study	Qualitative case study	Japan, USA, and India	Journal Article	-Older employees can acquire and improve their digital skills under the right conditions. -Upskilling and AI can lead to longer working lives for older employees. -The USA, Japan, and India are trying to bridge the digital divide with strategies such as intergenerational cooperation, creating inclusive workplaces, and creating opportunities for lifelong learning.
Trunkina et al., 2019	Increasing the Competitiveness of Older Age Groups in the Digitalization Environment	Literature review – secondary analysis of statistical data	Russia	Conference Paper	-Increasing the competitiveness of older people requires a system of training and retraining. -Upskilling of the older generation can lead to a paradigm shift in ageism, which creates a perception of older people as a productive part of society.

The number of relevant publications analyzing the upskilling of the older workforce concerning newer technologies, such as AI, has been increasing over the years. No relevant articles were found from 2014 to 2016. An increased number of publications was noted in 2023 that can be linked to the launch of one of the most well-known generative AI engine - Chat GPT, in 2022. The number of articles by year of publication is shown in Figure 2.

Figure 1
Number of publications based on the publication date
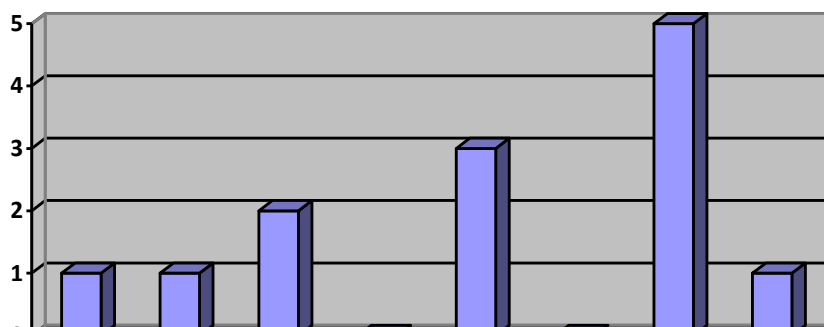
The relevance of the topic is reflected in the two simultaneous processes, an ageing population and new technological innovations entering the workplace (Alcover et al., 2021; Bianco, 2021; Nedelkoska and Quintini, 2018). Older employees often have less developed digital competencies, which can hinder their effective use of new technologies (Tiku, 2023, pp. 3). This increases the digital divide, which widens the gap between individuals in terms of access and use of ICT (Dolničar et al., 2002, pp. 83). Upskilling older workers is crucial to maintain their competitive advantage in the labor market (Trunkina et al., 2019, pp. 522) and to reduce the chances of early retirement (Casas and Román, 2024) by enhancing their adaptability to technological changes. The introduction of new technologies in the workplace encourages organizations to create a culture of lifelong learning, which is key to adapting to the new labor market (Tiku, 2023; Li et al., 2023; Vuorenkoski et al., 2018; Pradhan et al., 2023).

5   Discussion

AI can be understood as a socio-technical construct, shaped through the dynamic between users and machines or technology (Orr and Davis, 2020). Despite these findings, researchers, academics, and practitioners have also raised concerns about the lack of methods to incorporate accountability in socio-technical systems (Verdiesen et al., 2021). To address awareness about this gap, there is a need to link the design, production, and implementation phases of AI development, including its governance initiatives (Birkstedt et al., 2023, pp. 154).

These developments are not occurring in isolation, rather, they are profoundly reshaping the nature of work as technological advancements are raising the necessity for the acquisition of new

and more complex skill sets across the workforce (Lincoln, 2017; Alcover, 2021). In this context, the development of digital competencies emerges as a critical precondition for the effective adoption and management of technological tools and systems (Cramarenco et al., 2023). However, some vulnerable groups, such as older workers, are many times left out of such training (Cros et al., 2021). This can even widen the digital divide, while this age group has, on average, less developed digital competences compared to their younger counterparts (Tiku, 2023; Janeš et al., 2023). Older employees are in the context of digital transformations defined as 'digital immigrants' who had to learn how to use digital technologies later in life (Bokek-Cohen, 2018). Conversely, younger employees are often characterized as 'digital natives' due to their early exposure to technology, which is assumed to result in more advanced digital competencies (Tiku, 2023). Furthermore, they are expected to possess more up-to-date knowledge of digital tools and systems, giving them a relative advantage compared to older employees in the labor market (Chetty, 2023).

Moreover, digital competences serve as a signal of adaptability and employability in the labor market for employers (Bokek-Cohen, 2018; Alcover et al., 2021). Komp-Leukkunen et al. (2022) have framed digital competencies as a crucial part of general labor market access. It is important to recognize that the disadvantaged position of older employees in the labor market cannot be attributed solely to lower levels of digital competences (Chetty, 2023; Cros et al., 2021; Morandini et al., 2023; Li et al., 2023), but also to challenges in accessing training, due to various prejudices, stereotypes, bias, and discrimination related to age (Alcover et al., 2021; Lincoln, 2017).

Therefore, new digital technologies in the workplace encourage older employees to upskill to remain competitive in the evolving labor market (Alcover, 2021). Acquiring digital competencies not only enhances their employability but also serves as a signal to employers, indicating capabilities, flexibility, and the potential of the worker for the organization (Bokek-Cohen, 2018). Based on that, older employees need to 'compensate' for their age by investing in learning new skills that may not have been previously needed. On the other hand, the ageing of the workforce is forcing organizations to better understand the needs of this age group and to empower them (Hughes et al., 2019). Companies and policymakers need to consider providing more experiences to vulnerable groups such as older employees, women, and those with less autonomy. However, people who are highly educated are more willing to adapt and train in the use of new technologies (Bianco, 2021; Casas and Román, 2018). Training should also be tailored to the needs of the older age group (Chetty, 2023), as this is the only way to ensure that skills do not become obsolete (Cross, 2021). If older employees are going to upskill, they will be able to participate in the digital economy as strategic decision-makers (Chetty, 2023). It is crucial to develop suitable systems for training and retraining employees, which include programs for the development and implementation of appropriate programs aimed at the active inclusion of the older population in the digital economy and knowledge society (Trunkina et al., 2019). Older

employees are at a disadvantage in comparison to younger ones looking for a new job (Morandini et al., 2023). If some adjustments were taken, this could lead to advanced skills and appropriate knowledge, resulting in prolonging the working life of adults (Tiku, 2023). However, this relationship appears to be influenced by workers' educational backgrounds. Casas and Román (2018) emphasize that exposure to AI reduces the likelihood of early retirement of more educated workers, suggesting that education plays a mediating role in how digital transformation affects labor market participation in later life (Casas and Román, 2018). Based on that, there is a need for more structured and systematic research on how organizations can effectively adapt to technological changes in the workplace and support the continuous upskilling of older employees, considering their special needs and backgrounds. Firstly, there should be rigorous empirical research about older employees and their attitudes toward AI and AI training, which would give practical guidelines for employers on how to design and implement training programs effectively for the ageing workforce. Further research should prioritize longitudinal studies that explore the participation and experiences of older employees in the workplace and training based on suggested guidelines from previous studies. The study mentioned offers a critical insight into the long-term effectiveness of age-sensitive interventions.

As a key strategy for promoting the development of people in the knowledge society and competitiveness in the labor market, researchers (Bianco, 2021; Cramarenco et al., 2023; Huges et al., 2019) suggest lifelong programs. Meanwhile, Tiku (2023) also highlights the importance of intergenerational cooperation and the creation of inclusive workplaces as a strategy for bridging the digital divide. It should be emphasized that intergenerational cooperation has two sides of the value. Firstly, older employees can gain skills in using modern technologies from younger colleagues, which can significantly contribute to supporting work in organizational processes. Secondly, younger employees can gain important insight and knowledge about the content of work that older employees have developed and mastered over the years. The adoption of such approaches and strategies holds the potential to challenge the "age paradox", fostering a shift in how older employees are perceived, not as passive or obsolete, but as active and valuable contributors to society (Trunkina et al., 2019). Despite the emphasis on the importance of adjusted strategies, none of the articles included in the literature review research on the personal views of older employees on new technologies. Based on that, we suggest a qualitative study that assesses the personal views of older employees about managing AI systems in the workplace.

The literature review has enabled us to answer our research question: what is the impact of AI on the training needs of older employees? New technologies such as AI encourage older employees to constantly improve their skills, as upskilling remains one of the most effective strategies for maintaining competitiveness in the labor market. Companies are introducing new technologies into their operations, which can be understood as pressure on competitiveness, forcing companies to update their work processes with modern technologies; if not addressed, this could threaten the organization's continued viability. Moreover, with demographic changes,

prolonged working lives, and integration of AI in the workplace, training is particularly crucial for older employees, as they generally have less developed digital skills to manage new technologies. This can also help them to overcome fears, mistrust, and resistance when integrating modern technologies into the workplace and serve as a strategy to prolong working lives. To sum up, cultivating the culture of lifelong learning is an imperative, as it supports continuous skill development among employees of all ages in response to the evolving nature of work. Furthermore, training programs should be tailored to the specific needs of participants, considering factors such as age, existing digital competencies, and the nature of their work.

6   Conclusion

Nowadays, two processes are taking place simultaneously: rapid technological development and the aging of the workforce. This article investigates the impact of new technologies, with an emphasis on AI, on older employees and the need to upskill them. Generally, older employees have less developed digital competencies needed to manage new technologies, which are transforming jobs and creating new demands. Without upgrading their knowledge and skills, they may become uncompetitive in the labor market, face early retirement, or even job loss. Based on that, older employees must adapt to new forms of work and engage in upskilling or retraining initiatives.

Older employees are not a homogeneous age group, as they differ in education, social, economic, and other circumstances. Higher-educated older employees tend to be more willing to participate in training programs. However, it is essential to emphasize that training programs must be tailored to the needs of older employees, as their effective participation depends on such adaptation. Moreover, investing in the training of older workers can significantly contribute to organizational efficiency and overall success. If organizations do not invest in training older employees, they may lose important knowledge and information that older employees possess. Additionally, training enables older employees to participate strategically in the digital economy and increase their competitiveness within the labor market. Consequently, it is imperative for organizations to foster a culture of lifelong learning that extends beyond the older generation due to rapid technological progress to equip the workforce with the relevant skills. Furthermore, fostering intergenerational cooperation and cultivating inclusive workplaces are also important components in the knowledge society. The development of digital skills and knowledge of AI management can enable older employees to extend their working lives, increase competitiveness in the labor market, and play a strategic role in decision-making.

A systematic literature review focuses on the impact of new technologies on a specific age group. The relatively low number of articles included in the research and the increase in the number of publications after 2022 indicate the relevance of the topic and the need for further research in this area. It should be emphasized that in the article, we consider older employees as people who are over 50 years of age. However, older employees are not a homogeneous group defined solely

by chronological age. Building on these considerations, further research should study older employees in relation to their educational structure, social, economic, and other factors that might influence their capacity to adapt to technological change. In parallel, further studies should examine how workplaces and training programs can be more effectively adapted to the specific needs of an ageing workforce within rapidly evolving technological environments. This would enable researchers to formulate practical guidelines for employers seeking to support digital inclusion across all age groups. In addition, qualitative research focusing on the personal experiences of older employees when they are managing new technologies would offer valuable insights into their coping strategies, perceptions, and barriers faced by a specific age group.

The article has an important contribution for managers, as it emphasizes the importance of creating a culture of lifelong learning to bridge the digital divide among employees and empower the workforce with the essential skills in the modern labor market. Older employees bring a wealth of experience and knowledge that can greatly benefit both organizations and society. By providing targeted training, their competitiveness and value in the labor market can be significantly enhanced. The research also raises the question of how training programs for this generation should be designed to effectively support their adaptation to new technologies. Furthermore, the findings have broader implications for policymakers, offering guidance for shaping national training strategies in response to the dual challenges of workforce ageing and technological advancement.

The research also has some limitations. Firstly, we were limited to articles published only in the English language. Secondly, we have defined older employees as a homogenous group, where we did not include the possible variables in this age group, which opens up a new research area.

References

1. Acemoglu, D., & Restrepo, P. (2021). Demographics and automation. *The Review of Economic Studies*, *89*(1), 1–44.
2. Aisa, R., Cabeza, J., & Martin, J. (2023). Automation and aging: The impact on older workers in the workforce. *The Journal of the Economics of Ageing*, *26*, 1–12.
3. Alcover, C.-M., Guglielmi, D., Depolo, M., & Mazzetti, G. (2021). Aging-and-Tech Job Vulnerability: A proposed framework on the dual impact of aging and AI, robotics, and automation among older workers. *Organizational Psychology Review*, *11*(2), 175–201.
4. Bianco, A. (2021). Ageing workers and digital future. *Rivista trimestrale di scienza dell'amministrazione*, *3*(3), 1–22.
5. Birkstedt, T., Minkkinen, M., Tandon, A., & Mäntymäki, M. (2023). AI governance: themes, knowledge gaps and future agendas. *Internet Research*, *33*(7), 133–167.
6. Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T., Mulrow, C.,... Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *British Medical Journal*.

7. Bokek-Cohen, Y. (2018). Conceptualizing employees' digital skills as signals delivered to employers. *International Journal of Organization Theory & Behavior, 21*(1), 17–27.

8. Bruun, E.P.G., & Duka, A. (2018). Artificial Intelligence, Jobs and the Future of Work: Racing with the Machines. *Basic Income Studies, 13*(2), 1–15.

9. Casas, P., & Román, C. (2024). The impact of artificial intelligence in the early retirement decision. *Empirica, 51*, 583–618.

10. Chetty, K. (2023). AI literacy for an ageing workforce: Leveraging the experience of older workers. *OBM Geriatrics*, *7*(3), 1–17.

11. Classen, J., Wegemer, D., Patras, P., Spink, T., & Hollick, M. (2018). Anatomy of a Vulnerable Fitness Tracking System: Dissecting the Fitbit Cloud, App, and Firmware. In T. Ploetz & L. Mamykina (Eds.), *Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies, 2*(1), (pp. 1–24). ACM digital Library.

12. Cramarenco, R. E., Burcă-Voicu, M. I., & Dabija, D.-C. (2023). The impact of artificial intelligence (AI) on employees' skills and well-being in global labor markets: A systematic review. *Oeconomia Copernicana, 14*(3), 731–767.

13. Cros, F., Bobillier Chaumon, M.-E., & Cuvillier, B. (2021). Is the obsolescence of the skills of older employees an inevitable consequence of digitalization? In M.-E. Bobillier Chaumon (Ed.), *Digital transformations in the challenge of activity and work: Understanding and supporting technological changes* (pp. 169–181). Retrieved 23 March 2024 from https://doi.org/10.1002/9781119808343.ch13.

14. Dolničar, V., Vukčevič, K., Kronegger, L., & Vehovar, V. (2002). Digitalni razkorak v Sloveniji. *Družboslovne razprave, 18*(40), 83–106.

15. Hughes, C., Robert, L., Frady, K., & Arroyos, A. (2019). A Hiring Paradigm Shift through the Use of Technology in the Workplace. In E. Parry (Ed.), *Managing Technology and Middle- and Low-skilled Employees: Advances for Economic Regeneration*, 49–59. Retrieved 19 January 2024 from https://doi.org/10.1108/9781789730777.

16. Janeš, A., Madsen, S. S., Saure, H. I., Lie, M. H., Gjesdal, B., Thorvaldsen, S., ...Klančar, A. (2023). Preliminary Results from Norway, Slovenia, Portugal, Turkey, Ukraine, and Jordan: Investigating Pre-Service Teachers' Expected Use of Digital Technology When Becoming Teachers. *Education Sciences*, *13*(8), 783.

17. Komp-Leukkunen, K., Poli, A., Hellevik, T., Herlofson, K., Heuer, A., ... Motel Klingebiel, A. (2022). Older workers in digitalizing workplaces: A systematic literature review. *The Journal of Aging and Social Change*, *12*(2), 37–59.

18. Krašovec, S. J. (2015). Izobraževanje in usposabljanje starejših delavcev–mednarodna primerjava. *Andragoška spoznanja, 21*(2), 29–46.

19. Lee, C. C., Czaja, S. J., & Sharit, J. (2008). Training older workers for technology-based employment. *Educational Gerontology*, *35*(1), 15–31.

20. Li, C., Zhang, Y., Niu, X., Chen, F., & Zhou, H. (2023). Does artificial intelligence promote or inhibit on-the-job learning? Human reactions to AI at work. *Systems*, *11*(114), 1–26.

21. Lincoln, J. (2017). *An Ageing Workforce in The Digital Era: Older Workers, Technology and Skills*. Business in the Community, *A Business in the Community report, supported by Tata Consultancy Services*. UK: The Prince's Responsible Business Network, Tata Consultancy Services.

Retrieved 30 January 2025 from https://www.bitc.org.uk/wp-content/uploads/2022/12/bitc-report-age-ageing-worforce-digital-era-march20.pdf.

22. Morandini, S., Fraboni, F., De Angelis, M., Puzzo, G., Giusino, D., & Pietrantoni, L. (2023). The impact of artificial intelligence on workers' skills: Upskilling and reskilling in organisations. *Informing Science*, *26*, 39–68.

23. Nedelkoska, L., & Quintini, G. (2018). *Automation, skills use and training* (Vol. 202). Paris: OECD Publishing.

24. Novak, V. (2014). Izzivi dolgožive družbe: staranje prebivalstva, trg dela in ravnanje s starejšimi zaposlenimi. In M. Bernik (Ed.), *Transformacija kadrovskega managementa* (pp. 19–44). Maribor: Univerza v Mariboru.

25. OECD. (2024). *Training Supply for the Green and AI Transitions: Equipping Workers with the Right Skills*, *Getting Skills Right*. Paris: OECD.

26. Orr, W., & Davis, J. L. (2020). Attributions of ethical responsibility by Artificial Intelligence Practitioners. *Information, Communication and Society*, *23*(5), 719–735.

27. Pradhan, I.P., & Saxena, P. (2023). Reskilling workforce for the artificial intelligence age: Challenges and the way forward. In *The Adoption and Effect of Artificial Intelligence on Human Resources Management, Part B* (pp. 181–197). Emerald Publishing Limited.

28. Tiku, S. (2023). AI-Induced Labor Market Shifts and Aging Workforce Dynamics: A Cross-National Study of Corporate Strategic Responses in Japan, USA, and India. *SSRN Electronic Journal*.

29. Trunkina, L. V., Kipervar, E. A., & Mizya, M. S. (2019). Increasing the competitiveness of older age groups in the digitalization environment. In *International Scientific and Practical Conference on Digital Economy (ISCDE 2019)* (pp. 236–239). Atlantis Press.

30. Verdiesen, I., Tubella, A. A., & Dignum, V. (2021). Integrating comprehensive human oversight in drone deployment: a conceptual framework applied to the case of military surveillance drones. *Information (Switzerland)*, *12*(9), 1–13.

31. Vuorenkoski, V., Lehikoinen, A., Hakola-Uusitalo, T., & Urrila, P. (2018). Learning and skills in transition. In O. Koski & K. Husso (Eds.), *Work in the age of artificial intelligence: Four perspectives on the economy, employment, skills and ethics. Work in the age of artificial intelligence* (pp. 37–46). Publications of the Ministry of Economic Affairs and Employment.

32. Waligóra, Ł. (2024). *Employees' age diversity - between supportive workplaces and organizational outcomes*. Katowice: University of Economics in Katowice.

33. Zwick, T. (2015). Training older employees: what is effective? *International Journal of Manpower*, *36*(2), 136–150.

***

Tinkara Žabar is a junior researcher and a doctoral student in the Management program at the Faculty of Management, University of Primorska. She completed her undergraduate studies in pedagogy and obtained a master's degree in sociology, specializing in human resources, knowledge, and organizational management. Before joining the Faculty of Management, she gained practical experience in human resource management by working in HR departments of various organizations as a student, deepening her understanding of HR processes.

She actively participates in the development of Erasmus+ Sport programs, through which she has attended numerous international conferences. Additionally, she has enhanced her professional competencies through further education, including the HR Starter program and the Leadership Academy. Her research focuses on the impact of artificial intelligence on employees, analyzing changes in the work environment as well as the challenges and opportunities brought by digital transformation.

Tinkara Žabar je mlada raziskovalka in doktorska študentka na programu Management na Fakulteti za management Univerze na Primorskem. Dodiplomski študij je zaključila na področju pedagogike, magistrirala pa iz sociologije s specializacijo iz upravljanja človeških virov, znanja in organizacij. Pred zaposlitvijo na Fakulteti za management je kot študentka pridobivala praktične izkušnje na področju upravljanja človeških virov z delom v kadrovskih službah različnih organizacij, kjer je poglobila razumevanje kadrovskih procesov.

Aktivno sodeluje pri razvoju programov Erasmus+ Sport, v okviru katerih se je udeležila številnih mednarodnih konferenc. Svoje strokovne kompetence je dodatno nadgrajevala z nadaljnjim izobraževanjem, med drugim v programih HR Starter in Akademija vodenja. Njeno raziskovalno delo je usmerjeno v proučevanje vpliva umetne inteligence na zaposlene, pri čemer analizira spremembe v delovnem okolju ter izzive in priložnosti, ki jih prinaša digitalna preobrazba.

***

Aleksander Janeš is a Professor in the fields of Operational Management, Quality Management, and Business Excellence at the Faculty of Management, University of Primorska. As an experienced expert and researcher, he serves as the Program Director of the Master's in Management program, bringing over 29 years of professional experience. His research expertise and interests encompass various perspectives on project management systems and performance measurement, (green, blue, and sustainable) business models, business process management, as well as management tools in the fields of digitalization and process management, inclusive education and skills, and youth and media (https://orcid.org/0000-0001-5678-0737).

Aleksander Janeš je profesor na področjih operativnega managementa, managementa kakovosti in poslovne odličnosti na Fakulteti za management Univerze na Primorskem. Kot izkušen strokovnjak in raziskovalec deluje tudi kot direktor magistrskega študijskega programa Management ter ima več kot 29 let delovnih izkušenj. Njegova raziskovalna strokovnost in interesna področja obsegajo različne vidike sistemov projektnega vodenja in merjenja uspešnosti, (zelene, modre in trajnostne) poslovne modele, management poslovnih procesov ter managerska orodja na področjih digitalizacije in procesnega managementa, vključujočega izobraževanja in razvoja kompetenc ter mladih in medijev.

***

Povzetek
Izpopolnjevanje starejših zaposlenih v dobi umetne inteligence

Raziskovalno vprašanje (RV): Kakšen je učinek novih tehnologij, s poudarkom na umetno inteligenco (UI), na potrebo po izpopolnjevanju starejših zaposlenih (50+ let).

Namen: Namen raziskave je bil opraviti sistematični pregled literature dosedanjih raziskav s področja učinka UI na potrebe po izpopolnjevanju starejših zaposlenih.

Metoda: Opravili smo sistematični pregled literature v šestih akademskih iskalnikih in sicer ProQuest, Emerald, Sage Journals, Springer, Research Gate ter v Google Učenjaku.

Rezultati: Umetna inteligenca pomembno preoblikuje trg dela, saj zahteva nenehno prilagajanje novim spretnostim in znanju. Pomemben učinek ima UI na starejše zaposlene, ki so zaradi morebitnega pomanjkanja digitalnih veščin in občutljivosti na spremembe izpostavljeni večjim izzivom. V tem kontekstu sta izpopolnjevanje in dodatna izobrazba ključna mehanizma za zagotavljanje skladnosti spretnosti z zahtevami delovnega okolja in trga dela. Organizacije se morajo hitro prilagajati spreminjajočim se zahtevam z oblikovanjem kulture vseživljenjskega učenja, ki spodbuja starejše in ostale zaposlene k izpopolnjevanju. Ključno je, da izobraževalni programi temeljijo na specifičnih potrebah in izzivih, s katerimi se soočajo starejši zaposleni.

Organizacija: Raziskava poudarja pomen izpopolnjevanja starejših zaposlenih v dobi umetne inteligence in organizacije spodbujanja k ustvarjanju kulture vseživljenjskega učenja, kot dela strateških usmeritev in ciljev organizacije.

Družba: Pomen raziskave za družbo se odraža v vpogledu vključenosti vseh starostnih skupin v možnosti izpopolnjevanja znanja, veščin in odnosa do uporabe sodobnih tehnologij. Organizacije in družba sama je namreč nosilec socialne odgovornosti, da starejšim zaposlenim omogočijo uspešno vključevanje v delovno okolje v dobi UI.

Originalnost: Raziskava naslavlja potrebo po izpopolnjevanju specifične starostne skupine v dobi UI, kjer sočasno osvetljuje pomen ustvarjanja kulture vseživljenjskega učenja v hitro se spreminjajočem svetu.

Omejitve/nadaljnje raziskovanje: Pregled literature je bil omejen na šest javno dostopnih baz podatkov. V članku so bili starejši zaposleni obravnavani kot vse osebe v delovnem procesu starejše kot 50 let. Pri tem je potrebno izpostaviti, da se starejši zaposleni med seboj razlikujejo glede na izobrazbo, ekonomske, socialne in druge okoliščine. Primerno bi bilo, da bi učinek novih tehnologij raziskali tudi glede na omenjene okoliščine pri tej starostni skupini.

Ključne besede: družba znanja, izpopolnjevanje, management izobraževanja, prekvalifikacija, starejši zaposleni, umetna inteligenca, vseživljenjsko učenje.