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GENERATIONAL PERSPECTIVE OF DIGITAL TECHNOLOGIES AT WORK: A TOPIC MODELLING APPROACH

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The advent of digital technologies has revolutionised the modern workplace, reshaping how work is performed, communicated, and conceptualised across generations. This paper examines cross-generational perspectives on digital technologies at work, employing topic modelling (LDA) to analyse an extensive body of academic literature. Our aim is to uncover the intellectual structure of the field and explore how different generations engage with digital technologies, highlighting shared and unique experiences, challenges, and opportunities. Topic modelling has uncovered the intricate relationship between digital technologies and the workforce. Our analysis highlights the complexity of workplace digital integration and how generational groups adapt to and are influenced by these changes. This study stresses the importance of generational perspectives in the digital transformation of the workplace and provides valuable insights for managers, policy makers, technology designers, educators, and healthcare providers. Ultimately, digital technologies serve as drivers of innovation while posing ethical, inclusivity, and sustainability challenges in a multigenerational workforce.

Keywords: generational perspective, digital technologies, workplace, topic modelling

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INTRODUCTION

The emergence of Industry 4.0 and digitalisation has significantly changed the work environment, attracting great scientific interest (Jiwasiddi et al., 2024). While digital technologies enable many improvements in the work process, such as increasing job satisfaction, work-life balance and employee autonomy (Cijan et al., 2019), they also present challenges, particularly for older generations who often struggle to adopt new technologies due to a lack of digital skills (Köttl et al., 2021). In addition to barriers to adoption, difficulties in navigating digital systems can lead to frustration, stress, and feelings of exclusion, particularly among older individuals, highlighting the need for balanced approaches to technology integration (Pirhonen et al., 2020).

The concept of the digital divide, broadly defined as the gap between digital technology "haves" and "have-nots", where the latter refers to socially disadvantaged groups with limited access to digital technologies (Lam & Lee, 2006), has been extensively explored in the literature. Research consistently highlights widening gaps between age groups, with younger adults demonstrating greater access to and proficiency in new technologies (van Dijk & Hacker, 2003). Longitudinal studies (e.g., Gilleard & Higgs, 2008; Lam & Lee, 2006; van Dijk & Hacker, 2003) further support this trend, showing that younger generations are more likely to develop superior digital skills (Hunsaker & Hargittai, 2018). Interestingly, digital skills appear to be cultivated more effectively in the workplace than at school or home (van Dijk & Hacker, 2003). Moreover, computer use prior to retirement has been identified as a significant predictor of post-retirement technology adoption (Hunsaker & Hargittai, 2018). These findings suggest that the workplace serves as a critical context for bridging the digital divide, enabling skill development and reducing disparities in digital technology use across generations.

Existing research has begun to unravel the complex web of generational differences in the use of digital technologies (Tolbize, 2008), but it shies away from a comprehensive examination of generational perspectives on digital technology at work. To our knowledge, there is currently no overview of how different generations perceive digital technologies at work. Understanding these generational perspectives is crucial for assessing technological transitions and enhancing workplace environments (Crooks et al., 2020).

Our paper therefore seeks to fill this identified gap in the existing literature by providing comprehensive insights into digital technologies at work through a generational lens, contributing to the development of inclusive and efficient work environments. Using topic modeling, we analyse large data sets and uncover patterns and themes in generational interactions

with digital technologies at work (Blei et al., 2003). The main research question is, "What is the intellectual structure of the emerging literature on generational differences in interactions with digital technologies at work?" In line with the research question, we aim to understand the common and different experiences, challenges, and opportunities that arise in this context.

We strive to contribute to research and practice on digital technology in the workplace for the ageing population in two ways. First, we intend to analyse the existing literature on the topic. Numerous literature reviews examine digital technologies in the workplace, mainly focusing on successful implementation (Fauzi et al., 2023; Lane et al., 2023) or adoption benefits and drawbacks (Miele & Tirabeni, 2020). For instance, Fauzi et al. (2023) and Zhang et al. (2021) explore the integration of big data analytics into HR, while Lane et al. (2023) investigate the role of digital technologies in enhancing team collaboration. Although these findings provide valuable insights, they largely overlook the generational perspective. Conversely, reviews examining digital technology use among older adults exist (e.g., Hunsaker & Hargittai, 2018), but they do not address the workplace context. We argue that to successfully adopt new technologies in the work environment, the implementation process must be tailored to different groups of employees. Thus, our paper contributes to the literature by bridging the two research streams of digital technology adoption and generational differences of employees.

Second, by exploring these topics, we highlight key distinctions between younger and older generations in their preferences and challenges. Building on Sheng et al. (2022), who link digital technologies to successful ageing in the workplace, our study explicitly addresses generational differences that are often overlooked in prior research. By integrating insights from digital technology adoption literature with a generational lens, we offer a nuanced view of how different age groups engage with technology in organisational settings. This perspective is crucial, as few studies examine the differential impacts of digital technologies on generations, paving the way for targeted, generation-specific digital solutions that enhance workplace inclusivity and effectiveness.

METHODOLOGY

Search strategy and selection criteria

We conducted a topic modelling approach focusing on the intersection of generational differences and the adoption of digital technologies at work. The analysis was performed in February 2024 through a detailed literature search of the Web of Science (WoS) database using a combination of generational terms

and keywords (see below) related to digital technologies and the workplace. The review process is shown in Figure 1.

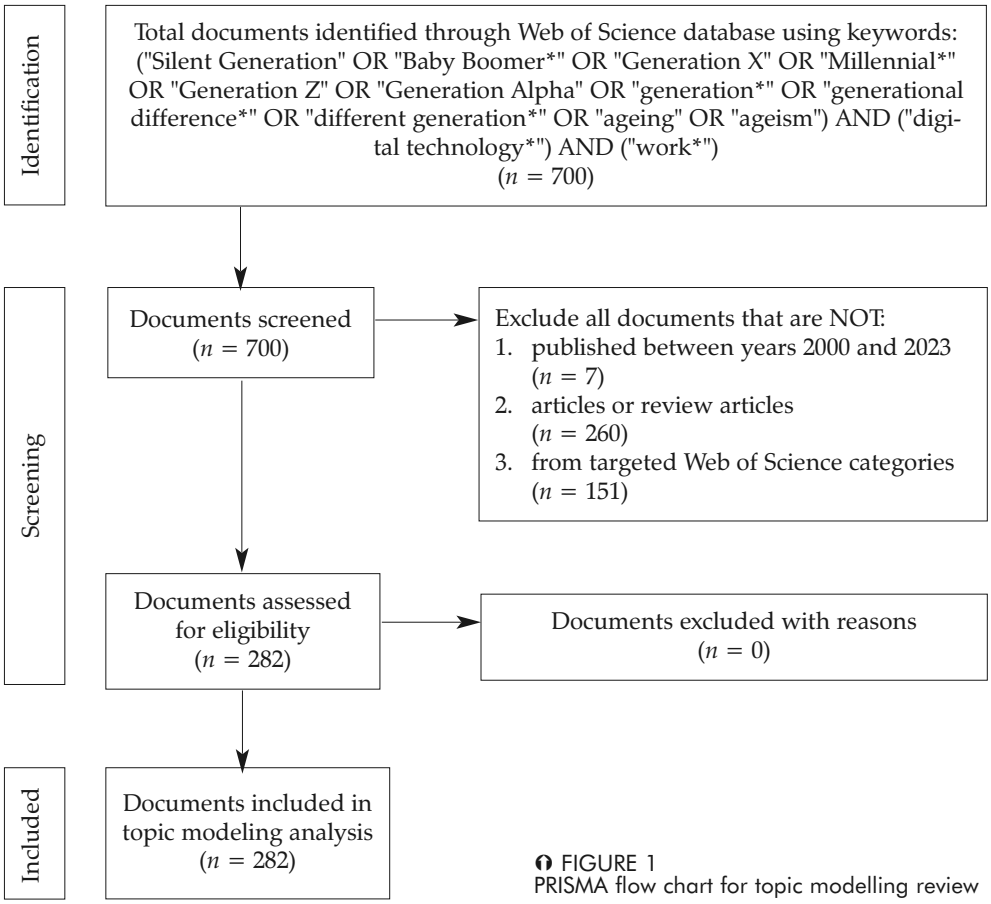


FIGURE 1
PRISMA flow chart for topic modelling review

The final search query at WoS was the following: ("Silent Generation" OR "Baby Boomer*" OR "Generation X" OR "Millennial*" OR "Generation Z" OR "Generation Alpha" OR "generation*" OR "generational difference*" OR "different generation*" OR "ageing" OR "ageism") AND ("digital technology*") AND ("work*"), from all fields.

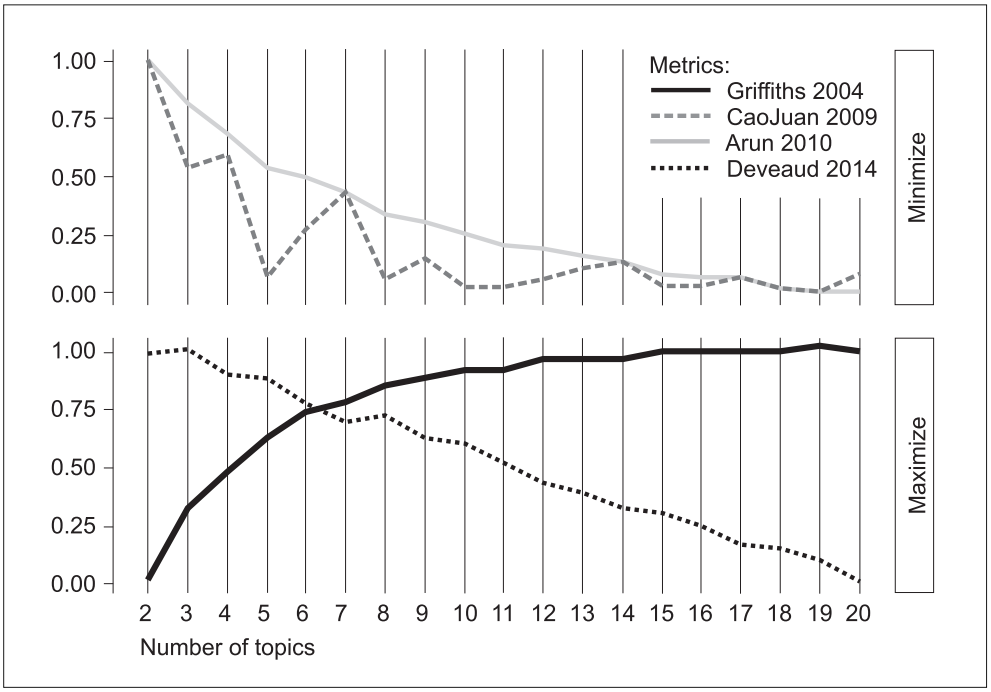
This preliminary search produced a total of 700 documents, which were then refined to include articles published up to the end of 2023, yielding 693 documents. A further refinement, selecting only articles and review articles relevant to business, economics, and ICT, yielded 433 documents. The final refinement step excluded unrelated areas and focused the study specifically on the intersection of generational differences, digital technology, and workplace dynamics. The final count of relevant documents stood at 282, which were further categorised into 259 articles and 23 review articles.

Analysis and synthesis

The pre-processed data was analysed using topic modelling, a machine learning approach for identifying themes in document collections (Blei et al., 2003). Latent Dirichlet Allocation (LDA), recognised as the predominant topic modelling technique (Blei, 2012), was applied to reveal thematic structures within the literature. LDA, a Bayesian generative model, identifies topics by analysing the co-occurrence of words in texts, treating each document as a mixture of latent topics, with each topic characterised by a distribution of words (Blei, 2012). Thus, LDA facilitated the identification of clusters that represent key topics related to generational differences in the use of digital technologies in the workplace.

The LDA technique was applied to the titles, keywords, and abstracts of 282 documents using the R programming environment. Data pre-processing involved several steps: confirming the presence of abstracts, converting all words to lowercase, removing numbers and punctuation, excluding stopwords (e.g., "can", "the"), and eliminating research-specific terms (e.g., "study", "journal" names). A Document-Term Matrix (DTM) was then constructed, which was essential for LDA implementation in the *topicmodels* package, which organises documents in rows and terms in columns, representing the frequency of terms across the documents. The *ldatuning* package generated four coherence metrics to help determine the optimal number of topics, leading to the identification of 11 key topics (see Figure 2).

FIGURE 2
Determining the optimal number of topics, using the ldatuning package in R



Traditional review papers rely on manual processes that can be time-consuming and subjective (Zupic & Čater, 2015). In contrast, bibliometric reviews offer more objective syntheses by analysing citation relationships and keyword co-occurrences. However, advances in text-mining algorithms, such as LDA topic modelling, enable the analysis of actual content within abstracts and full texts, uncovering latent themes and patterns (Schmiedel et al., 2018). These analyses follow transparent and reproducible methodologies, allowing for deeper, nuanced insights that extend beyond traditional review methods (Schmiedel et al., 2018).

Topic modelling enabled us to analyse the yearly topic distribution using the *tm* package, where the weight of a topic depended on the number of articles published that year, reflecting its popularity. To interpret the topics, we first examined the top 20 terms per topic to establish approximate labels, then reviewed the top 20 documents, starting with abstracts and then full texts, to finalise the labels. Both authors collaborated to ensure objectivity. Additionally, we analysed the most relevant topics by year.

FINDINGS

Secondary data descriptives

The analysis of documents from WoS resulted in 282 total publications, including 259 articles and 23 review articles. Publication trends show a steady increase since around 2018, with a peak in 2023. The research spans multiple disciplines and examines how generations, from the Silent Generation to Generation Alpha, use digital technologies in their professional lives, affecting various fields. The distribution of documents reveals significant academic interest and the complex, multilayered nature of generational differences in digital technology use at work. The Education & Educational Research category leads with 32 documents (11.3%) focusing on digital literacy, followed by Engineering, Electrical & Electronic Studies with 26 documents (9.2%), emphasising technical expertise. Computer Science, Information Systems, and Environmental Science each contribute 23 documents (8.2%), while Gerontology Research, with 22 documents (7.8%), highlights the need for support structures to help older workers adapt to digital tools.

Identified topics

Topic modelling revealed 11 critical topics (see Table 1) that capture the essence of digital transformation's influence across generational lines in the workplace.

Label	Keywords
Intergenerational equity and digital sustainability	technologies, digital, social, future, potential, sustainability, processes, innovation, opportunities, human, challenges, work, science, methods, attention, risks, literature, capital, big, sustainable
Digitalisation of cultural heritage	heritage, virtual, cultural, society, communication, world, information, reality, content, generations, experience, political, values, global, create, project, context, general, rapid, historical
New work strategies across generations	management, skills, firms, practices, green, knowledge, technological, managers, development, literature, strategies, employees, national, increasing, response, countries, market, change, universities, context
Age-inclusive digital empowerment	technology, older, adults, design, digital, age, process, pandemic, studies, covid-, negative, ageing, approach, analysis, people, persons, years, support, important, remote
Digital infrastructure	technologies, framework, network, smart, factors, key, industry, manufacturing, information, including, systems, challenges, service, industrial, production, internet, integrated, support, IoT, critical
Optimisation models and methodologies	proposed, model, approach, time, methodology, features, work, dynamic, method, accuracy, cost, step, performance, optimisation, robust, channel, electricity, loss, problem, quality
Digital learning environment	learning, students, education, educational, technologies, online, teaching, current, environment, teachers, children, generation, school, focus, analysis, digitalization, high, games, young, interviews
Digital economy and societal impact	digital, technology, development, transformation, literacy, impact, economy, relevant, economic, higher, aspects, individual, generation, professional, people, scientific, theory, behaviour, impacts, large
Advancements and applications of digital systems	system, systems, energy, control, developed, applications, existing, performance, consumption, case, review, modelling, process, power, radio, material, considered, application, applied, processing
Generational dynamics in evolving work environments	generation, work, media, business, social, technologies, organisations, model, working, models, significant, services, practical, differences, result, relationship, sector, identify, workers, traditional
Digital health in vulnerable populations	care, health, participants, life, cognitive, support, identified, aged, workers, methods, individuals, survey, conducted, home, provide, access, users, living, outcomes, experience

TABLE 1
Identified topics

DISCUSSION

Discussion of findings

Research shifts over the years

When examining topic development over the years, notable shifts emerge. In 2000, the most prevalent topics were digital learning and new work strategies across generations. By 2002, the focus shifted to digital systems and infrastructure, and in 2006, to the digitalisation of cultural heritage and the digital

economy. In 2009, optimisation models and new work strategies dominated, while in 2010, optimisation models and digital learning took centre stage. The years 2011 and 2012 focused on digital infrastructure, optimisation models, digital learning, and intergenerational equity. From 2013 to 2016, digital learning, work strategies, and infrastructure were prominent. In recent years topics like digital sustainability, health, and cultural heritage have become dominant, with age-inclusive digital empowerment emerging as the top topic in 2023.

The digital learning environment is the most prominent topic overall, followed by digital infrastructure and optimisation models. This reflects the importance of digital skills for workplace efficiency and the need for evolving education systems. Digital infrastructure and optimisation models are critical for adopting digital technologies and maximising their benefits. Notably, age-inclusive digital empowerment gained prominence only in recent years, becoming the top topic in 2023, signalling a growing emphasis on integrating the ageing population into the digital workplace.

While shifts in digital topics highlight progress, they also reveal challenges, particularly in bridging the digital divide. The rapid pace of digital transformation can leave older generations struggling with access, literacy, and usability issues (Hunsaker & Hargittai, 2018; Pirhonen et al., 2020). Despite increased internet use, disparities in digital confidence and accessibility persist, requiring targeted policies and training to ensure equitable access and inclusion across all age groups.

Key insights and synthesis of core findings

Digital sustainability. The need for age-inclusive digital ecosystems is evident, ensuring equitable access and sustainability. Policies addressing the digital divide are crucial for fostering generational inclusion. Millennials lead sustainable digital practices due to their tech affinity and environmental awareness (Sparviero & Ragnedda, 2021). Digitising cultural heritage bridges generational gaps, fostering a shared identity (Ch'ng et al., 2020; Mantzou et al., 2023). However, without addressing accessibility barriers, these technologies risk reinforcing digital divides rather than alleviating them. While digital inclusion efforts show progress, they often reiterate findings without critically assessing the deeper causes of disengagement. Research highlights the need to move beyond access metrics and consider social, economic, and psychological barriers (Nunan & Di Domenico, 2019). Older adults face exclusion not just due to lack of access but also due to unintuitive platform design, privacy concerns, and usability challenges, which further hinder adoption.

Age-inclusive digital empowerment. Digital strategies in the workplace create both opportunities and challenges across generations. While younger employees adapt quickly, older workers often need additional support, making accessibility and usability crucial in digital design (Park & Shintaku, 2022; Mannheim et al., 2023a). However, assuming all older workers require extensive assistance risks reinforcing stereotypes rather than recognising their capacity to adapt with adequate training (Mannheim et al., 2023b). Inclusive digital infrastructures in smart cities and healthcare must prioritise accessibility for all generations (Arora et al., 2023; Wang et al., 2023). Yet, overreliance on automation could reduce critical thinking and problem-solving skills in the workplace (Pirhonen et al., 2020). Furthermore, digital inclusion is not just about access; socio-economic disparities, usability challenges, and concerns about privacy remain significant barriers (Nunan & Di Domenico, 2019). Additionally, AI-driven hiring systems may unintentionally reinforce biases against older applicants, exacerbating workplace discrimination rather than reducing it (Mannheim et al., 2023b).

Digital skills and literacy. The pandemic accelerated digital learning, affecting all age groups but posing unique challenges for older learners. While accessibility improvements help, motivation, self-efficacy, and prior exposure to digital tools are also critical factors (Havrilova et al., 2021). Many platforms assume technological familiarity, making them less intuitive for older adults (Nunan & Di Domenico, 2019). Expanding digital literacy is crucial to prevent exclusion in the evolving digital economy (Queiroz et al., 2020). While automation enhances efficiency in sectors like manufacturing and healthcare (Isa et al., 2018), it also raises job displacement concerns, particularly for older workers, necessitating reskilling initiatives (Mannheim et al., 2023b). Digital health technologies promise improved care for older adults (Buchman et al., 2020), yet adoption is hindered by trust issues, usability challenges, and privacy concerns (Pirhonen et al., 2020). Moreover, availability alone does not guarantee usage-confidence and digital literacy must be addressed. Younger generations, particularly Millennials and Gen Z, dominate digital entrepreneurship (Reuschke et al., 2022), leveraging connectivity and data-driven platforms (Jantavongso & Fusiripong, 2021). However, assuming younger users are inherently proficient and older users resistant oversimplifies the issue. Digital literacy is shaped by socioeconomic factors, not just age (Nunan & Di Domenico, 2019). The digital divide among older consumers limits access

to services, requiring inclusive strategies (Nunan & Di Domenico, 2019). An intergenerational approach is vital, with Millennials playing a key role in promoting sustainable digital practices through their tech fluency (Sparviero & Ragnedda, 2021).

Digital culture. Research highlights how digital innovations are reshaping cultural heritage engagement across generations. Younger generations, with strong digital literacy and a preference for interactive platforms, drive the adoption of VR, mobile apps, and digital archives, making cultural heritage more accessible and engaging. Meanwhile, older generations contribute historical context and lived experiences, ensuring authenticity and continuity in these digital representations (Mantzou et al., 2023; Ch'ng et al., 2020). This intergenerational collaboration fosters inclusive educational experiences that preserve cultural narratives while bridging generational gaps.

National culture also plays a crucial role in technology adoption. In multinational corporations, organisational culture shaped by national norms can create collaborative tensions among diverse employees (Leidner & Kayworth, 2006; Cramton & Hinds, 2014). Digital work environments extend beyond corporate settings, as digital nomads introduce cultural diversity to local communities, sometimes causing friction in traditional societal structures (Jiwasiddi et al., 2024).

Generational and cultural factors interact in digital adoption, with some studies emphasising significant cultural differences (Hartzel et al., 2016), while others find minimal variation (Ashraf et al., 2014). Younger workers are often influenced by attitudes towards technology, while older workers' adoption is shaped by social norms and perceived behavioural control (Morris & Venkatesh, 2000). However, shared experiences and attitudes can sometimes bridge generational divides (Fristedt et al., 2021). Regardless of generational or cultural background, perceived ease of use, usefulness, and general attitudes towards technology remain key drivers of adoption (Ashraf et al., 2014; Hartzel et al., 2016), reinforcing the need for user-centred design rather than broad generational stereotypes.

Digital economy. Research highlights the interplay between technological advancements and human adaptation, emphasising the need for digital literacy across generations to ensure workplace resilience (Wang et al., 2023; Arora et al., 2023). While technological shifts improve efficiency, they also present challenges, particularly for older workers, who may face digital skill gaps. Digital literacy programmes and participatory design approaches can support their adaptation, fostering inclusivity in digitally evolving workplaces (Mannheim et al., 2023b). Op-

timisation models enhance efficiency across multiple sectors, including management (Danilova et al., 2023) and education (Agarwal et al., 2023), benefiting employees of all ages. Digital transformation also impacts workplace safety, with advancements in automation contributing to safer environments (Isa et al., 2018). However, automation introduces job displacement risks, particularly for older workers, necessitating proactive reskilling initiatives (Mannheim et al., 2023b).

Generational shifts in the digital economy highlight evolving work strategies. Generation Z, often referred to as "digital natives", approaches work with different expectations and digital fluency compared to older generations (Chang & Chang, 2023). While these differences create workplace challenges, studies suggest that engagement and adaptation strategies – such as mentorship programmes – can bridge generational gaps (Tutar et al., 2022). Meanwhile, Generation X has played a crucial role in the transition to remote work, challenging traditional generational stereotypes (de Barros et al., 2021). Social media and digital branding shape professional identities, particularly among younger generations (El-Menawy & Saleh, 2023). However, digital inclusion efforts must extend beyond younger workers, ensuring accessibility in smart cities and healthcare infrastructures for older adults (Arora et al., 2023; Wang et al., 2023). Without such considerations, digital transformation risks reinforcing generational inequalities rather than fostering inclusion.

Digital solutions in modern healthcare. While digital health technologies primarily target older adults, research stresses the importance of inclusivity in addressing diverse needs within this population (Poli et al., 2023). Although these technologies enhance care accessibility, their benefits extend to all age groups. Baby Boomers, traditionally seen as slower adopters of digital tools, are increasingly engaging with digital healthcare solutions. However, disparities persist due to socioeconomic factors and varying levels of prior technology exposure (Pirhonen et al., 2020). Accessible design alone is insufficient – comprehensive digital literacy programmes and policy interventions are necessary to ensure equitable adoption. Despite the promise of digital healthcare, barriers remain, including concerns over usability, data privacy, and the digital divide (Poli et al., 2023). Additionally, over-reliance on digital solutions may alienate individuals who prefer traditional in-person care, highlighting the need for hybrid healthcare models that balance technological advancements with patient comfort (Nunan & Di Domenico, 2019).

Generational perspective

The existing literature on generational differences in interactions with digital technologies at work indicates a clear divide in adoption, literacy, and the values driving technology use among generations. Younger generations are leading in digital adoption and innovation, while older generations face challenges in digital literacy and access.

Generation X acts as a bridge between non-digital and digital work environments. They are key players in workplace digital upskilling, balancing technological efficiency with human oversight (Marston et al., 2020; Arora et al., 2023; Wang et al., 2023). Their approach prioritises functionality, integrating new tools while maintaining traditional business values. Millennials drive digital collaboration and sustainability, favouring platforms that enable flexible work environments (Jantavongso & Fusiripong, 2021; Sparviero & Ragnedda, 2021). Their digital engagement aligns with their emphasis on ethical technology use, environmental responsibility, and workplace equity.

Generation Z, referred to as digital natives, expect seamless technology integration in the workplace. While they leverage social media for networking and career development, studies highlight risks such as digital fatigue, anxiety, and reliance on instant feedback (Chang & Chang, 2023; Nunan & Di Domenico, 2019). Organisations must balance these benefits with strategies that promote digital well-being and in-person collaboration. Their strong commitment to diversity, equity, and inclusion shapes their workplace expectations (Mantzou et al., 2023).

Baby Boomers face the most significant digital adaptation challenges due to lower digital literacy and limited early exposure to technology (Nunan & Di Domenico, 2019). However, structured training and hands-on learning improve their engagement with digital tools (Pirhonen et al., 2020). Unlike younger generations, who prefer self-directed learning and gamified platforms, Baby Boomers benefit from step-by-step guidance and clear instructions (Pirhonen et al., 2020).

While all generations engage with digital technologies, their adoption rates, preferences, and challenges differ significantly. Studies show that Millennials and Gen Z are digital natives, seamlessly integrating digital tools into their work and social lives, whereas Gen X and Baby Boomers require more structured learning and support to adopt these technologies (Marston et al., 2020; Nunan & Di Domenico, 2019). For instance, Generation X is known for its adaptability, having transitioned from a non-digital to a digital workplace. This group demonstrates strong upskilling behaviour, often bridging the gap

between older and younger employees by integrating new tools while valuing traditional business processes (Marston et al., 2020). They are more selective in their use of digital platforms, prioritising efficiency and reliability over trend-driven adoption (Arora et al., 2023; Wang et al., 2023). In contrast, Millennials and Generation Z embrace digital-first work environments, leveraging collaborative technologies such as Slack, Trello, and Zoom to foster flexible work arrangements (Jantavongso & Fusiripong, 2021). Millennials tend to balance digital engagement with professional needs, while Gen Z relies heavily on social media platforms for workplace engagement and career development, sometimes leading to challenges such as digital fatigue and overreliance on instant feedback (Chang & Chang, 2023; Mantzou et al., 2023). Meanwhile, Baby Boomers face the greatest barriers to digital adaptation, primarily due to lower digital literacy levels and less exposure to technology during their formative years (Nunan & Di Domenico, 2019). However, workplace training and structured digital education programmes can significantly enhance their engagement with digital tools (Pirhonen et al., 2020). Studies emphasise that Baby Boomers benefit from step-by-step guidance and hands-on training, as opposed to the self-learning strategies favoured by younger generations (Pirhonen et al., 2020).

Table 2 shows some of the main findings divided by identified topic clusters and different generational perspectives.

TABLE 2
Summary of key findings divided by identified topic clusters and different generational perspectives

	Young vs older generations
Intergenerational equityand digital sustainability	Potential rise in female digital entrepreneurship with generational shift, indicating digital technology's role in reducing gender gap in entrepreneurship (Reuschke et al., 2022). Older consumers face digital adoption challenges, contrary to the presumed digital proficiency of younger generations like Millennials and Generation Z (Nunan & Di Domenico, 2019). Millennials, characterised by a keen interest in privacy and privacy-conscious behaviour, are the primary contributors to big data generat ed on social media (Jantavongso & Fusiripong, 2021). Millennials, as described by Jantavongso and Fusiripong (2021), are digital natives who exhibit traits such as multitasking, mission-driven attitudes, individualism, achievement orientation, and financial savvy.
Digitalisation of cultural heritage	Mantzou et al. (2023) suggest that dynamic, interactive, and immersive open--air museum tours utilising digital tools can facilitate intergenerational engagement with cultural heritage, fostering contributions and interaction across different age groups. Ch'ng et al. (2020) emphasise the significance of VR experiences in museums and cultural institutions for meeting the interests and expectations of younger generations.

(Continues)

(Continued)	Young vs older generations
New work strategies across generations	Park & Shintaku (2022) propose the use of artificial intelligence machine learning methods, including deep learning with neural networks, as tools to bridge the gap resulting from retiring workers and facilitate skill transfer to younger employees. The pandemic has led younger social work professionals to quickly adopt digital solutions and new communication strategies, contrasting with older generations' reliance on traditional face-to-face methods. This reflects a generational shift in the approach to social work in aged care facilities (Dias et al., 2023). Generation Y's leadership style shifts away from traditional hierarchies, preferring flexibility and use of digital tools in the workplace (Tutar et al., 2022).
Age-inclusive digital empowerment	Meaningful involvement of older individuals in digital technology design is crucial, emphasising partnerships that value their insights (Mannheim et al., 2023a; Mannheim et al., 2023b). Training on digital technologies positively impacts older workers' intentions to stay in a company, particularly when perceived as useful in their work context (Xie et al., 2023). More socially active, educated, and wealthier older adults are more successful in engaging with the digital world compared to their less affluent peers (Pirhonen et al., 2020).
Generational dynamics in evolving work environments	Generation Z's remote work performance perception is below average. Surprisingly, Generation X reports the highest performance, challenging assumptions. Generation Y performs above average but not as well as Generation X, indicating a complex picture of remote work adaptation (de Barros et al., 2021). Millennials prioritise teamwork and decentralised decision-making, contrasting with the centralised models favoured by Baby Boomers and Gen Xers (Seth et al., 2023). Strong social media branding influences Generation Z's job application intentions. Employers should maintain a positive online presence to attract young talent (El-Menawy & Saleh, 2023). Digital media significantly shapes Generation Z's perceptions of jobs more than previous generations (Chang & Chang, 2023).

Notes: Only key findings are included.

Theoretical contributions

This paper advances the literature on digital technology at work through a generational perspective, making two key contributions. First, we review existing literature using topic modelling (Blei, 2012) to uncover the hidden thematic structure at the intersection of digital technology, work, and ageing. This alternative method complements prior reviews on digital technologies in the workplace (Fauzi et al., 2023; Lane et al., 2023; Miele & Tirabeni, 2020) by offering deeper insights into their impact across diverse work environments. Our analysis identifies challenges in different settings, highlighting both solu-

tions and inherent limitations. Thus, this paper systematically explores how principles of ageing and work can inform the design and deployment of digital technologies in the workplace.

Second, we enrich the discourse on digital technology and ageing by building upon research by Sheng et al. (2022). While Sheng et al. provide a framework for successful ageing in work and non-work domains, our study emphasises how generational perspectives shape technology adoption. This approach offers valuable insights for researchers and promotes intergenerational inclusion, arguing for a nuanced integration of digital technologies in the workplace that ensures accessibility and relevance for all ages.

Practical implications

This study provides actionable insights for managers, policy-makers, technology designers, educators, and healthcare providers, helping them leverage digital technologies while addressing generational differences.

Managers should implement targeted training programmes and intergenerational mentoring to enhance digital literacy across age groups, fostering productivity and innovation (Marston et al., 2020). Older employees, such as Baby Boomers and Generation X, may benefit from basic digital skills workshops, while Millennials and Generation Z should receive advanced training in AI and data analytics. Intergenerational mentoring can bridge knowledge gaps by pairing tech-savvy younger employees with senior colleagues, fostering collaboration and digital adoption.

Policymakers must ensure equal access to digital tools by promoting age-friendly technologies to close the digital divide (Agarwal et al., 2023; Seth et al., 2023). Initiatives such as digital skills training programmes for older employees and expanding public access to technology through libraries and community centres can foster intergenerational equity. Additionally, policies should encourage age-inclusive technology design, incorporating simplified interfaces and accessibility features. Collaboration between public and private sectors, supported by tax incentives or grants, can drive innovation in workplace technology.

Technology designers should integrate intergenerational collaboration through co-design workshops, allowing diverse age groups to contribute to usability improvements (Mannheim et al., 2023a). Features like customisable interfaces with adjustable text size and contrast enhance accessibility (Pirhonen et al., 2020). Reverse mentoring, where younger employees assist older colleagues with digital skills while learning strategic insights, fosters mutual growth (Marston et al., 2020). AI-dri-

ven personalisation can further enhance engagement, tailoring digital experiences to different learning styles (Chang & Chang, 2023). Organisations should establish age-diverse design teams to create inclusive, user-friendly solutions (Mannheim et al., 2023b).

Education systems must develop flexible digital literacy curricula catering to learners of all ages (Ch'ng et al., 2020). Modular learning programmes should accommodate varying proficiency levels, from introductory courses for older learners to advanced modules for younger students. Practical, hands-on training with real-world applications can enhance learning, while a focus on ethical digital practices ensures responsible technology use.

Healthcare providers should integrate telehealth and wearable health devices while involving older patients in co-designing digital health solutions (Agarwal et al., 2023; Poli et al., 2023). Telehealth platforms should feature simplified appointment scheduling, larger fonts, and accessible instructions to enhance usability for older patients. Wearable health devices must prioritise easy-to-read displays and intuitive functionality. Engaging older adults in focus groups or pilot testing can improve alignment with user needs, fostering trust and better health outcomes.

Limitations and future research directions

This study provides valuable insights into generational perspectives on workplace technology through topic modelling, but it has several limitations. Topic identification remains subjective, influenced by researcher interpretation. Additionally, reliance on specific keywords and databases may have excluded key studies, while the search strategy struggled to differentiate between technological and human generational cohorts, leading to off-topic inclusions. Addressing these limitations is essential for a clearer understanding of the impact of digital technologies on intergenerational workplace dynamics.

Future research should expand its scope by incorporating additional keywords such as "technology inclusion", "digital ecosystems", and "multigenerational workplace dynamics". Including databases like Scopus, PubMed, IEEE Xplore, and ProQuest can enhance comprehensiveness. Improved search strategies should use Boolean operators to refine queries, combining generational terms (e.g., "Generation X" AND "workplace technology") with specific themes like "accessibility" and "digital literacy".

Next, cross-cultural and longitudinal studies can offer global perspectives and insights into evolving digital dynamics. Investigating the role of collectivist versus individualist cul-

tures in digital equity can inform global organisations (Hartzel et al., 2016; Leidner & Kayworth, 2006), while tracking employees over time can identify trends in digital literacy development, helping organisations tailor interventions for different age groups (Hunsaker & Hargittai, 2018). Additionally, combining qualitative methods, such as interviews and focus groups, with topic modelling can provide a richer understanding of generational interactions with technology.

Another unexplored area is intergenerational collaboration in technology development. Examining how different age groups co-create and influence digital tools can enhance participatory design and bridge generational gaps. Pairing older workers with younger digital natives in participatory design projects can foster mutual learning and innovation (Mannheim et al., 2023b).

Next, future research should explore sector-specific studies that could reveal unique challenges and opportunities related to digital technology adoption. For instance, industries like healthcare and education may require tailored solutions to address generational differences in digital skill sets and attitudes towards technology (Poli et al., 2023). Lastly, future research should investigate policy interventions that promote digital literacy and equitable access across generations. For example, examining the effectiveness of government and organisational policies in bridging the digital divide can guide future initiatives (Agarwal et al., 2023).

CONCLUSION

This paper investigates the generational perspective on digital technology in the workplace using topic modelling to identify eleven key areas where digital transformation shapes intergenerational dynamics. It demonstrates how digitalisation is reshaping work strategies, learning environments, and health interventions, with an emphasis on equity, sustainability, and cultural heritage digitisation. The study reveals significant disparities: younger generations integrate digital tools more naturally, while older workers adapt more gradually, underscoring the need for tailored support and training to bridge the digital divide.

Our findings offer actionable insights for organisations seeking to create inclusive digital environments and enhance productivity. Future research could explore the long-term effects of digital transformation on intergenerational collaboration, sector-specific dynamics, and workplace equity. As digitalisation continues to permeate both work and life, these insights will help refine strategies to ensure that technological advancements benefit all generations.

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Generacijska perspektiva digitalnih tehnologija na radnom mjestu: pristup modeliranja tema

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Dolazak digitalnih tehnologija donio je duboke promjene u suvremenom radnom okruženju, transformirajući način na koji se rad obavlja, komunicira i konceptualizira među različitim generacijama. Ovaj rad istražuje međugeneracijske perspektive o digitalnim tehnologijama na radnom mjestu, primjenjujući modeliranje tema (LDA) na opsežnu akademsku literaturu s ciljem otkrivanja intelektualne strukture ovog područja. Analizom se nastoje identificirati načini na koje se različite generacije prilagođavaju digitalnim tehnologijama, uz naglasak na zajednička i specifična iskustva, izazove i mogućnosti. Rezultati istraživanja ukazuju na složenu dinamiku integracije digitalnih tehnologija u radnom okruženju te na različite načine na koje generacijske skupine usvajaju i koriste ove tehnologije. Nalazi ovog istraživanja pružaju vrijedne uvide menadžerima, kreatorima javnih politika, dizajnerima tehnologije, edukatorima i zdravstvenim djelatnicima, nudeći smjernice za učinkovitiju implementaciju digitalnih rješenja u multigeneracijskom radnom okruženju. Digitalne tehnologije služe kao pokretači inovacija, ali istovremeno donose izazove vezane uz etiku, inkluzivnost i održivost, što zahtijeva daljnja istraživanja i prilagodbu politika kako bi se osigurala njihova uspješna integracija u suvremeni radni kontekst.

Ključne riječi: generacijska perspektiva, digitalne tehnologije, radno mjesto, modeliranje tema