

Older workers, digitalization and inequality

A conceptual framework

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1. Introduction

The topic of Working Group 1 in Digi-NET is social inequalities among older workers and how these are transformed, exacerbated, or mitigated by digitalisation. With a globally ageing population, it is increasingly recognised that individuals will need to participate in the workforce for longer than before. Digitalisation is rapidly transforming the labour market and the nature of employment on a global scale. Age and digital skills are two of the social factors that shape labour market participation at individual, institutional, and societal levels. (OECD, 2025) Understanding how these elements interact and intersect is essential for identifying and addressing emerging inequalities. Policy responses have already been implemented in some countries to sustain pension systems, and more are expected to follow (Pilipiec, Groot, & Pavlova, 2021).

There is no consensus on the definition of `older workers` and the concept may vary among different national contexts (Eiffe *et al.*, 2025). The research on occupation safety and health uses different thresholds, from the age of 40 to the aged of over 65 (Peng and Chan, 2019). This text understands older workers as those at age 50+ doing some paid work. The 50+ is present in many studies, policy documents, as well as some large-scale data collections, such as the Survey of Health, Ageing and Retirement in Europe (Börsch-Supan *et al.*, 2013). Such strict and arbitrary cutoff could be considered ageist as a possible source of stereotyping or even policy and workplace impact, but we also admit pros of having an unambiguous definition.

Digitalisation should be understood not only as a technical or economic process but as a socially embedded transformation, shaped by and shaping pre-existing social inequalities. While it may open opportunities for enhanced participation in work and society, particularly through flexible work arrangements and remote employment, these benefits are not equally distributed. Older individuals, in particular, face structural and systemic barriers to digital inclusion, including limited access to training, lack of workplace support, and persistent ageist assumptions regarding their capacity to adapt (Naegele, De Tavernier, & Hess, 2018; Taylor & Earl, 2016).

In the context of labour market change, digital skills have become a precondition for employability and career mobility. Yet digital literacy is unequally distributed, often mirroring broader patterns of gender inequalities, educational attainment, socioeconomic status, and geographic location (Fang *et al.*, 2019). Urban–rural divides, along with regional disparities in infrastructure and access to digital services, further deepen digital exclusion (European Commission, 2020; Feurich, Kourilova, Pelucha, & Kasabov, 2023). These layered inequalities illustrate the importance of approaching digital transformation through an intersectional lens that accounts for how multiple axes of inequality—such as age, gender, education, and migration background—interact. A comprehensive understanding of how age and digitalisation intersects with social inequality therefore requires a multidimensional approach (Helsper, 2021). The following sections are based on the available sources, covering structural factors (education, income, gender, age, migrant status), institutional practices (e.g., employer-based training, recruitment), and broader socio-political contexts that influence access to and participation in digitalised labour markets.

This conceptual framework builds on an expanding body of empirical and theoretical literature, drawing on qualitative, quantitative, and experimental approaches to examine how digitalisation shapes inequality across different population groups, with a particular focus on older workers. The framework introduces the conceptual and theoretical foundations used for its development, and then outlines to capture both experiences and structural patterns of digital inequality. The section Analytical dimensions explores the intersection between age and other relevant

dimensions such as ethnicity, gender, region, and socio-economics, its effects on digital inequalities in the workplace and the further implications for social inequalities. Then, the text presents a newly developed framework that captures the dynamics of digital transformation and social inequality across European labour markets. Finally, the section Implications and applications outlines the framework's practical applications across policy, society, organisations, and digital tools. By identifying the mechanisms through which digitalisation can reinforce or mitigate exclusion, the framework aims to support evidence-based policymaking and socially just digital transitions.

2. Theoretical foundations

Studies on the relations between older workers, digitalisation and inequality fit well within three broad theoretical approaches: the life course perspective (2A), workforce adaptation models (2B), and intersectional inequality approaches (2C).

2A Life course perspective

A growing body of evidence utilises different life-course approaches to understand inequalities in later life. Life-course frameworks explore patterns of change over time, providing insights into how we should grasp the ageing process. Regarding later-life inequalities, as argued by Fullerglesias et al. (2009), life-course approaches play a crucial role in shaping influences on health inequalities and well-being in older age at both micro- and macro-levels (Scharf et al., 2017). The life course perspective provides the opportunity to get a better understanding of the different factors that influence the retirement decision-making of older workers through the digitalization of work structures in digitalising workplaces (Komp-Leukkunen et al., 2022; Marshall, 2011). From this perspective, it is suggested that when people shift roles, such as moving from work to retirement or vice versa these transitions are connected to various interdependent trajectories such as health, work, family, and leisure (De Wind et al., 2016). Given the fact that retirement is not a standard life course, life-course research gives an explanation of how people's lives unfold over time. It is often used to figure out how older individuals, 50 years and older, transition through their last years of work into retirement (Komp-Leukkunen, 2023; Madero-Cabib et al., 2023).

The concept of cumulative advantage/disadvantage [CAD] has gained recognition for shedding light on critical yet overlooked aspects of individual and cohort ageing. This approach echoes popular folk sayings such as "success breeds success." and "the rich get richer; the poor get poorer." However, CAD extends beyond these notions, explaining how trends often occur irrespective of merit and, in some cases, with mathematical precision. This phenomenon, applicable to collectivities, holds significance for individuals, addressing age-specific differences and fairness in resource distribution. Rather than relying on age-based generalisations, CAD directs attention to the intra-cohort distribution of key characteristics, their trajectories over time, and the underlying forces shaping them. It prompts an exploration of the systemic processes contributing to observed age differences and age-related variability (Dannefer, 2003).

Bourdieu's Social Reproduction Theory explores how societal structures perpetuate social inequalities over time, expanding economic capital for social, cultural and symbolic capital. It highlights the role of education and other institutions in maintaining class distinctions across generations (Bourdieu, 1990). The CAD theory aligns with Social Reproduction Theory by

emphasising the accumulation of advantage or disadvantage during childhood and schooling. It suggests that social stratification occurs early in life based on educational and socialisation opportunities, resonating with the idea of cumulative advantage (Dannefer, 2003).

Apart from the aforementioned perspectives, concepts of digital divide (Van Deursen & Van Dijk, 2011; Van Dijk, 2017), security and precarity (Grenier et al., 2020) ageist attitudes (Solem, 2016) and gendered ageism (Moen, 2011) are used for interpretation of specific inequalities. The concept of active ageing is mostly developed by public policy bodies in order to justify raising retirement age, but do not reflect any inequalities in labour market opportunities or threats possessed by digitalisation (Lakomý, 2023; Walker & Maltby, 2012).

2B Labour market theories

In the context of ageing populations, extended working lives, rapid digitalisation, and persistent social inequalities, three workforce adaptation models stand out for their relevance in addressing these intersecting challenges: the Skills-Based Workforce Model, the Workforce Planning Model, and Job Demands-Resources Model.

The Skills-Based Workforce Model shifts emphasis from formal qualifications and occupational roles to individuals' actual competencies, irrespective of their source—education, work experience, or self-directed learning. This is particularly relevant for older workers, who often hold extensive experience and tacit knowledge but may lack current credentials or digital skills required in today's labour markets. Skills-based strategies support older adults in acquiring specific, in-demand skills through short, targeted training, such as micro-credentials and modular courses. These formats reduce the time, cost, and disruption associated with traditional retraining, making it more feasible for individuals later in their careers to meet new job requirements or shift roles (ILO, 2003; CEDEFOP, 2006; OECD, 2019; OECD, 2023). The model also addresses barriers such as age-related hiring biases and limited access to employer-sponsored training. Hiring decisions may reflect assumptions about older workers' adaptability, while training is often directed toward younger staff, seen as a longer-term investment (Loretto & White, 2006; Taylor & Earl, 2016). By focusing on demonstrated skills and tailor-made training, the model promotes fairer hiring and internal mobility. It also recognises non-linear careers and diverse learning paths common in later working life (Colardyn & Bjornavold, 2004; Billett, 2014).

The Workforce Planning Model draws on demographic trends, skills forecasting, and labour gap analysis to inform long-term planning (OECD, 2019; Eurofound, 2021). This is particularly relevant for an ageing workforce, where extended participation is increasingly needed to maintain labour supply (UK Government Office for Science, 2016). The model also helps to identify digital literacy and skills shortages and highlights groups at risk of exclusion—such as older adults, low-skilled workers, and women—along with the structural barriers they face, including limited access to training, age-based discrimination, and occupational segregation (ILO, 2003; European Commission, 2023). By making these disparities visible, it supports the design of targeted interventions, including phased retirement, reskilling initiatives, and job redesign (ILO, 2003).

The Job Demand-Resources (JD-R) model (see Figure 1; Bakker & Demerouti, 2014) is one of the most popular and influential models of work stress addressing the topics of employability, workforce inclusion and job quality. The JD-R model posits that all occupations include elements that either hinder or enhance worker well-being and performance, categorized as job demands and job resources. Job demands refer to physical, interpersonal, or organizational aspects requiring sustained effort and leading to physiological or psychological costs (Demerouti et al., 2001). These are distinct from challenging yet beneficial tasks that foster development (Schaufeli

& Taris, 2014) and may include unpredictable schedules or stressful interactions. Digitalisation arguably changes these demands, for instance by having to be always available via digital tools. Conversely, job resources are factors that help achieve work goals, reduce demands, or promote growth—ranging from managerial support and transparent policies to personal traits like resilience and communication skills (Demerouti et al., 2001; Xanthopoulou et al., 2007). Digitalisation can also offer resources, by automating straining or boring tasks or providing digital support. The framework explains how excessive demands and limited resources trigger exhaustion and disengagement, leading to burnout and its negative outcomes. Thus, the JD-R model offers a practical lens for improving work conditions through reducing demands, enhancing resources, and fostering job crafting (Roskams et al., 2021).

2C Intersectional inequality theories

Intersectionality is defined as an inclusive, justice-oriented analytic framework, rooted in Black feminist thought (Crenshaw, 1997), that examines how multiple axes of identity, such as race, gender, class, sexuality, nation) intersect to produce unique and compounded forms of marginalisation. Crenshaw’s legal scholarship shows how laws and policies often fail when they treat race and gender separately. It operates both as an academic tool, identifying interlocking, process-driven categories of difference, and as critical praxis aimed at remedying complex social inequalities, emphasizing not only differences between groups but also differences within them to inform coalition building and transformative social change (Al-Faham et al., 2019). Intersectional dynamics are shaped by historical, cultural, political, and legal contexts. Identities and power relations are fluid, relational, and context-dependent. These imply both micro and macro levels of analysis, where the former is focused on individual identities and experiences, while the latter covers structural and systemic inequalities.

Holman and Walker (2021) indicate that gerontology and ageing research have rarely integrated intersectional insights, even though inequalities in later life are profoundly shaped by how people’s multiple social characteristics (age, gender, ethnicity, socio-economic status) combine while affecting lived experiences, power, and resources. Intersectionality theory is highly relevant for ageing research, as systems of oppression, such as ageism, sexism, racism, and classism are interlocking (“matrix of domination” (Collins, 2000)), and affect health and wellbeing in old age. Norms and stereotypes, for example perceptions of older adults as weak or burdensome, can overlap with racial or gender stereotypes, compounding disadvantage. Discrimination can operate interpersonally, institutionally, or societally, with age interacting with other axes to influence outcomes such as employment, retirement, caregiving, and health. Treating “older people” as a homogenous group misses subgroup differences, and obscure complex challenges faced by older adults of different socio-demographic characteristics. Holman and Walker (2021) propose integrating intersectionality with life course perspective, which would generate strong mutual benefits. Such an approach would allow for capturing people’s dynamic social positions, intersectional subgroup membership changing over time, as well as timing of role transitions. Institutional discrimination affects people of various characteristics differently at various life stages. Combining intersectionality with life course would enable tracking when and how discriminatory exposures occur, and their cumulative effects.

Older workers’ experiences are shaped not only by age, but also, among others, intersections with gender, race, class, disability, and sexuality, which change over time. Intersectionality can reveal how ageism interacts with other biases in hiring, promotion, and workplace culture. It

helps examine how institutional structures and workplace norms sustain inequalities for older employees, not only through age discrimination but also through layered disadvantages. Interventions for older workers should be context-specific recognising historical labour market exclusion, pension inequities, and occupational segregation. Adopting an anti-oppressive, intersectional research lens in ageing studies can shift focus from individual “deficits” to systemic barriers, advocating for structural change in retirement systems, retraining programs, and workplace inclusion (cf. Ruiz et al., 2021).

3. Analytical dimensions

Five key dimensions to understand inequality are age, ethnicity, gender, region, and socio-economics.

3A Age

Older workers seem to benefit less than younger ones from the digital transformation of jobs. Some of the explanations reside in the following: older workers are less incentivized to invest in human capital due to the prospects of retirement, their roles as mentors and knowledge transmitters may decline because of the adoption of new technologies, and they may be disadvantaged in jobs that require high work intensity and impose physical constraints, such as gig jobs (Valls *et al.*, 2024). Differences by age even among older workers can be expected, but the digital divide between the "Young-Old" and "Old-Old" workers is understudied.

3B Ethnicity / migrant

For **ethnic minorities**, digitalisation and remote work can also present employment opportunities. However, in the US, Hispanics and Blacks – defined as ethnic minorities in this country - are overrepresented in low and medium-digital level jobs, and underrepresented in high-digital level ones, indicating that initial inequalities are at least perpetuating, if not amplifying (ILO, 2022). Digital inequalities by ethnicity are also confirmed in a systematic literature review on the topic, which includes countries from the EU (Verwiebe *et al.*, 2023). Due to the interaction of vulnerabilities, **older migrants** face specific challenges (Stypińska and Gordo, 2028), different from those encountered by older non-migrants and younger migrants. Among those specific barriers are: atypical career paths difficult to track, lack of formal qualifications, low English skills abilities, minimum access to social support institutions, such as employment services and trade unions (Flynn and Wong, 2022). The literature on how digital inequalities in the labour market impact older migrants is scarce. However, based on the previous studies on older migrants and rooted in intersectionality theory, it is expected that older migrants benefit less from digitalization in the workplace compared with younger migrants or older non-migrants, perpetuating inequalities between this social group and other social groups.

Regarding **refugees and irregular migrants**, many countries have both legislative backgrounds (eg. United Nations 1951 Refugee Convention) and practical initiatives (eg. initiatives and broad pathways to digital work) that support these disadvantaged groups' integration into the digital economy. However, barriers such as digital infrastructure and internet access, lack of identification documents impede their integration into the formal digital economy (ILO, 2022). Valls *et al.* (2024) show that while productivity and complementarity effects of digitalisation manifest for natives, the displacement effects of digitalization seem to manifest for immigrants. The research on digital inequality at work and its impact on older refugees is scarce. However, reports such as UNHCR (2020) point to the risk that existing inequalities may be reinforced and enhanced by unequal access to digital technologies and the internet. According to the report,

specific groups of migrants, like **older migrants** and women have limited access to information, education, and work opportunities available through digitalization, which deepens the gap between these groups and other social groups.

3C Gender

Older male and older female workers may have different relations with digitalization. It is found that gender differences with regard to technology are larger among older than among younger workers; for instance, older women's use of technology is more strongly influenced by social pressures, compared to older men's use (Morris et al 2005). This could be due to younger cohorts being socialized in less gender different ways; alternatively, certain gendered patterns take time to mature. Longitudinal research is needed to assess which is most true.

In Europe, digitalisation risks deepening social inequalities where age and gender intersect. Evidence shows that older women face a "double disadvantage" in digital participation, as they are both less likely than men to use digital technologies and more likely to encounter structural barriers. For example, across the EU, only 39% of women aged 55–74 reported using internet banking compared with 46% of men, illustrating persistent gendered gaps in essential digital skills (AGE Platform Europe, 2023). Recent research highlights that women in later life are particularly vulnerable to exclusion because they are more likely to have experienced interrupted employment histories, lower lifetime earnings, and less access to workplace-based ICT training opportunities (Ojala et al., 2021). Moreover, European comparative studies show that digital exclusion among older women is often compounded by lower confidence and safety concerns in online environments, which can further deter their digital engagement (Barbosa Neves et al., 2024). The economic consequences of these gaps are significant: the European Commission has warned that the digital gender divide contributes to labour market segregation and reduces older women's opportunities to remain in employment as digitalisation accelerates (European Commission, 2022). Without targeted interventions such as gender-sensitive digital skills training, investment in accessible technologies, and workplace support mechanisms, workplace digitalisation risks reinforcing long-standing gender inequalities in Europe's ageing workforce.

3D Region: rural to urban

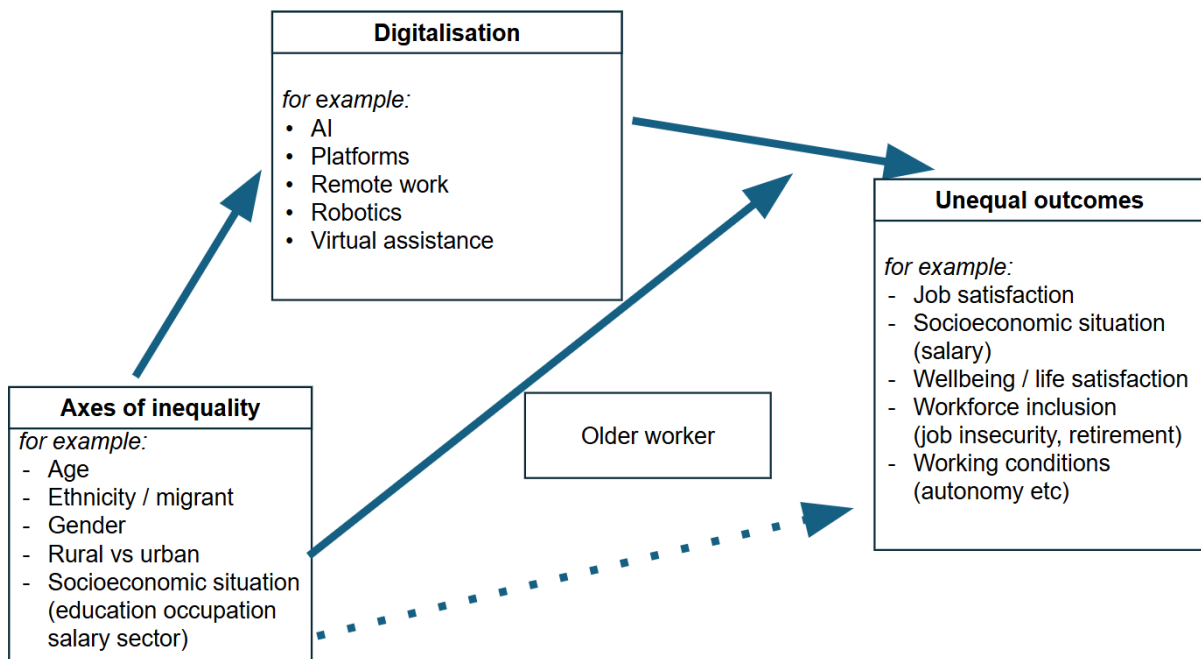
Another key dimension is the urban versus rural divide, which significantly influences digitalisation's impact on social inequalities. In urban areas, high-speed internet and advanced infrastructure often facilitate greater access to digital services, education, and employment opportunities (European Commission, 2020). Conversely, rural regions tend to face limited connectivity, exacerbating disparities in access to information and social participation (Feurich et al., 2023). Peri-urban areas often experience transitional challenges, with some infrastructure development but persistent gaps. Digitalisation can thus either mitigate inequalities by expanding access or deepen them if infrastructure remains uneven across these areas. Understanding these spatial differences is essential for designing inclusive digital policies.

The regional dimension additionally links to age as most European countries have rural regions characterized by an exodus of younger workers. This implies that there are many organisations in rural areas where older workers are overrepresented, lacking both an age-diverse workforce and the digital facilities present in larger urban areas.

3E Socio-economic

A number of studies in the literature (Casas-Mas et al., 2020; Deschacht, 2021; ILO, 2022; Martindale & Lehdonvirta, 2023) show that digitalisation has an impact on labour market inequalities. For instance, Autor et al. (2020) highlight that automation and AI have led to job polarisation, where middle-skill jobs decline, favouring high-skill and low-skill employment, thus increasing income inequality. Studies also emphasize the digital divide as a critical factor; individuals lacking internet access or digital literacy are at risk of being excluded from emerging digital economies (OECD, 2019).

The COVID-19 pandemic further accentuated these divisions, with remote work and digital platforms becoming essential, yet unevenly accessible across socio-economic groups (Lupton, 2020). A recent study (Eurofound, 2025) reports that access remains a challenge for vulnerable groups, including low-income households, older adults, and those with limited education. These groups often rely heavily on public services and may face difficulties accessing e-government platforms. Despite progress in digital inclusion, some populations remain at risk of being left behind in the digital transition. Overall, older workers with higher socio-economic status benefit more from online job advertising, online job interviews, online courses and training, etc. (Helsper, 2021). Addressing these disparities is essential for fostering inclusive digital growth and preventing social exclusion. Overall, the literature underscores that while digitalization has the potential to promote inclusive growth, without targeted policies, it may exacerbate existing inequalities in the labour market.



4. Schematic framework

4A Explanation of the schematic framework

This figure synthesises the framework by bringing together the theoretical foundations (Part 2), the key concepts and definitions (Part 3), and the analytical dimensions (Part 4). The figure is organised around three interacting elements.

On the left, the axes of inequality represent structural divisions such as age, gender, migrant background, socioeconomic status, and regional location. These reflect life-course dynamics, intersectional processes, and labour market segmentation that shape opportunities and constraints over time.

At the top, digitalisation processes, including automation, platform work, remote work, and AI, reshape labour market structures and skill requirements. Here, labour market theories and concepts such as the digital divide, employability, and technostress explain why these changes do not affect all groups equally.

On the right, unequal outcomes capture the measurable consequences for older workers, including employability, job quality, well-being, and social inclusion or exclusion. Outcomes are influenced both by digitalisation and by underlying axes of inequality, and may feed back into cumulative patterns of disadvantage.

Placing the older worker at the centre shows that these are not abstract forces but lived realities. The arrows indicate the dynamic and cumulative nature of inequality, showing how structural divisions, digital transformations, and labour market outcomes continuously interact. The framework shows how digitalisation can reinforce or reduce inequality, with a focus on groups facing compounded challenges, for example, older migrants and ageing rural remote workers.

4B Conceptual propositions derived from the framework

Building on the theoretical foundations outlined in Part 2, the framework shows how cumulative disadvantage, uneven labour market structures, and intersectional dynamics shape inequalities over time. These processes suggest that certain subgroups of older workers may face particularly complex risks. For instance, older migrants often experience compounded disadvantage, as interrupted work histories and labour market segmentation intersect with age and migrant status in digitalised employment contexts.

From the key concepts discussed in Part 3, mechanisms such as the digital divide, employability, and technostress point to a “double digital divide” for several groups. This may affect not only older migrants but also older women in low-skill or low-tech occupations, who frequently encounter both limited access to training opportunities and persistent stereotypes about technological competence. Such dynamics reduce employability and increase vulnerability to technostress.

The analytical dimensions in Part 4 further indicate that location matters. Older rural residents engaged in remote work are at particular risk of exclusion, as digitalisation magnifies infrastructural gaps while interacting with socio-economic disadvantage and age-related barriers to skill development. These examples illustrate how multiple and overlapping axes of inequality, whether related to migrant background, gender, occupation, or region, shape who benefits and who is excluded in digitalising labour markets.

Finally, the framework exposes a broader research gap: while older workers as a general category have been studied, subgroups facing layered disadvantages remain largely overlooked. Propositions emerging from this framework therefore call for research and policy to focus more closely on these populations, in order to understand how digitalisation can reinforce or mitigate inequality in later working life.

To examine these propositions, the next section outlines methodological approaches—qualitative, quantitative, and experimental—that can capture how digitalisation shapes inequality in later working life.

5. Methodological approach

The concepts in this framework can be studied with three complementary approaches: qualitative methods (5A), quantitative analyses (5B), and experimental or intervention studies (5C).

5A Qualitative

Qualitative methods are essential for capturing older workers' perceptions of digital life and employability. They reveal not only *how much* digitalisation matters but also *how* and *why* inequalities emerge. A basic qualitative design is well suited, emphasising meanings and lived experiences (Creswell, 2007, 2009; Merriam & Tisdell, 2016). Sampling would target employees aged 50+, with maximum variation in gender, education, disability, and country (Patton, 1998). Semi-structured interviews, tested in a pilot, allow for in-depth exploration. Transcripts are coded in two stages and analysed thematically to identify central mechanisms of digital exclusion (Özdemir, 2010; Yıldırım & Şimşek, 2015). Such evidence provides nuanced insight for policy design.

5B Quantitative work

Quantitative analyses are crucial for testing relationships and identifying general patterns across countries. Traditional life-course studies often control for social categories, which risks erasing the very intersectional effects under investigation. Instead, approaches such as interaction terms or MAIHDA (Multilevel Analysis of Individual Heterogeneity and Discriminatory Accuracy) are recommended to capture additive and multiplicative disadvantages (Holman & Walker, 2021).

Data sources include national microdata, such as household surveys (e.g., SLOSH in Sweden), as well as cross-national datasets like the Labour Force Survey (LFS), SHARE, and EUROMOD. These can be used in two ways: (1) microdata, which are individual-level records (e.g., answers from each respondent), and (2) aggregate indicators, which are summary measures such as averages or percentages reported at the group or country level (e.g., the employment rate of workers aged 55–64 in a given country). Using both kinds of data makes it possible to compare across countries and to analyse how inequalities develop over time.

Such analyses benefit from interdisciplinary collaboration, combining insights from sociology, economics, social policy, and gerontology to reveal how structural, institutional, and demographic factors interact in shaping digital inequalities.

5C Experimental or intervention studies

Experimental and quasi-experimental approaches make it possible to test directly how interventions affect older adults' digital skills and well-being. Research shows that even short programmes can make a measurable difference. For instance, a one-hour media literacy module significantly improved older participants' ability to recognise misinformation (Moore & Hancock, 2022). In rural South Korea, a smartphone training programme enhanced not only device use but also happiness, cognitive function, and self-efficacy (Lee, Lim, & Nam, 2022).

These studies highlight two key mechanisms: skill acquisition achieved through hands-on and structured training, and psychosocial benefits such as greater confidence and well-being. Applying such approaches in workplace settings, through simulation, peer-learning, intergenerational learning, or tailored training modules, could test impacts on employability, technostress, and workforce inclusion.

Together, these methodological approaches provide a comprehensive toolkit for examining how digitalisation reshapes inequality in later working life.

6. Implications and applications

This section outlines the practical applications of the framework across policymaking, civil society, organisations, and digital tool development, highlighting pathways toward more inclusive digital transitions.

6A Implications for Policymaking

Policy frameworks play a central role in ensuring that digitalisation reduces rather than reinforces existing inequalities. National digital skills strategies should be designed to reflect age and gender sensitivity, offering modular training, micro-credentials, and flexible learning opportunities that accommodate the needs of older workers (OECD, 2023). At the same time, bridging the urban–rural divide requires targeted investment in digital infrastructure and training provision for rural and peri-urban regions, where older adults are particularly at risk of compounded disadvantage due to their geographical location, socio-economic status, and age (European Commission, 2020). Anti-ageist labour market policies are also vital, including the strong enforcement of legislation against age discrimination and technological competence, as well as incentives for employers to implement age-diverse recruitment, retention, and training practices (Walker & Maltby, 2012). Furthermore, integrated health and employment policies are necessary to ensure sustainable participation of older adults in digitalised workplaces. This entails support through assistive technologies, flexible working arrangements, and initiatives that reduce technostress while promoting healthy work–life balance (Kroon et al., 2018). To ensure that these policies address real needs, cross-sectoral advisory councils, comprising policymakers, employers, and representatives of older workers, can help ensure that evidence and lived experience inform policy development jointly.

6B Implications for civil society

Civil society organisations are key actors in shaping public discourse and supporting digital inclusion. Persistent stereotypes of older workers as resistant to technology undermine both policy adoption and labour market inclusion (Kroon et al., 2018). Counteracting these narratives requires active collaboration with journalists, influencers, and broadcasters to promote positive representations of older workers' contributions to digital economies. Equally important are community-based digital literacy initiatives delivered in partnership with NGOs, libraries, and local organisations. Such programmes provide low-cost, hands-on learning opportunities accessible to older adults, particularly in rural areas where formal training provision is limited (European Commission, 2020). Public campaigns highlighting the value of lifelong learning can further support equitable digital transitions by underlining both the economic and social benefits of continued participation of older workers in digital societies (OECD, 2023).

6C Implications for organisations

Employers and organisations play a decisive role in mediating how digitalisation affects opportunities and risks for older workers. Age-inclusive human resource practices are crucial to counter stereotypes that portray older employees as less adaptable or technologically skilled. Inclusive recruitment, promotion, and retention strategies can reduce workplace stress, improve retention, and foster stronger organisational identification (Farr-Wharton et al., 2023; Waligóra, 2024). Providing continuous and accessible training is equally important. Modular and flexible learning approaches, particularly those that build on peer support and acknowledge tacit expertise, have been shown to increase engagement and reduce digital exclusion (Eurofound, 2024). Work design also matters; flexible arrangements and the gradual introduction of new technologies can help mitigate technostress and enable employees to balance their professional and personal responsibilities (Nedeljko et al., 2023). Finally, involving older employees directly in decisions about digital transitions ensures that workplace tools and practices are adapted to diverse needs, thereby contributing to more equitable and sustainable outcomes (OECD, 2025).

6D Implications for developers of digital tools

The design of digital tools strongly influences whether older workers are supported or excluded in digital transitions. Age-friendly design principles emphasise accessible interfaces, with clear layouts, legible text, and intuitive navigation that accommodate sensory and cognitive changes associated with ageing. Recent guidelines emphasise the effectiveness of simplified mobile interfaces, as demonstrated through rigorous usability studies with older adults (Jiang, 2024; Gómez-Hernández et al., 2023). Beyond design, participatory methods are essential. Including older workers in the design process ensures that tools respond to actual needs and usage patterns, with co-design approaches revealing insights that extend beyond assumptions of user behaviour (Backåberg, 2025). Developers also have a responsibility to reduce technostress by prioritising stability, transparency, and user guidance, avoiding unnecessary complexity and disruptive updates (Nedeljko et al., 2023). Additionally, inclusive digital learning platforms can empower older workers by integrating training with online communities. Evidence shows that such platforms enhance digital skills, reduce social isolation, and strengthen confidence, underscoring their potential to support lifelong employability (Sen, 2022).

7. Limitations and future research

Our analyses indicate a significant gap in the literature on ageing and digitalization: the neglect of older rural workers as a distinct group. While older people or rural communities may be addressed separately, these perspectives are rarely combined. There is a lack of approaches that account for overlapping disadvantages such as age, gender, socio-economic status, and geographical location. Older rural women in particular face cultural and economic barriers to entering the labour market. Many measures proposed or implemented have an urban bias, marginalising rural needs. Rural development policies tend to focus mainly on younger generations and agriculture, rarely offering in-depth diagnoses and recommendations for other sectors of the rural economy.

Clearly, existing research and data on the subject are fragmented, isolated, and fail to reflect the lived experiences of older rural workers, many of whom participate in informal or semi-formal economies. Digital inequalities in the labour market affecting this group are intersectional and multidimensional, arising from overlapping factors such as poor internet infrastructure in rural areas, an ageing population, low digital skills, and limited employment opportunities. The most common focus is internet access, while a reflection on skills training, job creation, and the combined impact of age and location is also highly needed. A more holistic approach is needed to capture the full extent of digital exclusion experienced by older rural workers.

The high variability of labour regulations across countries presents a significant challenge to comparative analysis and the effective transfer of best practices in the field of employment and labour governance. National labour laws are deeply embedded in specific socio-economic, political, and cultural contexts, leading to considerable divergences in areas such as employment contracts, collective bargaining rights, minimum wage standards, working hours, and occupational health and safety regulations. This regulatory fragmentation complicates efforts to conduct systematic cross-national comparisons (Khan-Freund, 1974), as seemingly similar practices may be underpinned by distinct legal and institutional frameworks that render direct analogies misleading or inapplicable.

Moreover, the diversity in labour regimes can hinder the transnational transferability of policies and practices deemed successful in one context. For example, a labour market intervention that proves effective in a country with a highly centralized industrial relations system may yield different outcomes in a country where labour relations are more fragmented or decentralized. This lack of regulatory harmonization impedes international organizations, policymakers, and scholars from drawing generalized conclusions or recommending universal strategies for labour reform. As a result, while global initiatives often advocate for the diffusion of "best practices," the adaptability of such practices is constrained by the structural and normative heterogeneity of labour law regimes. Thus, comparative labour law analysis must navigate this complexity by adopting context-sensitive approaches that account for the interplay between national legal systems and broader socio-economic environments.

Financial and digital literacy pose a significant and multifaceted challenge for older workers seeking to remain active and economically secure in contemporary labour markets. As employment structures shift toward digital platforms, remote work environments, and technology-based financial services, older adults often experience a compounded disadvantage due to limited proficiency in both digital technologies and financial tools (Lusardi & Mitchell, 2014; Gonzales et al., 2020). This dual literacy gap exacerbates age-related vulnerabilities, restricting access to employment opportunities and undermining the capacity for informed financial decision-making at a critical stage in the life course.

Older workers, in particular, may have had minimal exposure to online banking systems, digital financial management platforms, and technology-enabled retirement planning resources. This gap not only reduces their ability to adapt to new forms of work—such as platform-based and gig economy models—but also impedes their financial resilience in the face of fluctuating incomes and the absence of traditional employer-provided financial support. As workplace processes become increasingly digitised, the ability to navigate irregular payment systems, manage benefits independently, and engage with complex digital interfaces becomes essential.

Addressing these challenges necessitates the design and implementation of targeted, age-sensitive educational interventions that integrate both financial and digital competencies. Such

initiatives should be attuned to the cognitive, social, and emotional learning preferences of older adults, emphasising practical application, user-friendly design, and confidence-building strategies. Empowering older workers with these integrated literacies is essential not only for fostering individual economic well-being but also for ensuring their active participation in a rapidly evolving, technology-dependent labour market.

We call for research approaches that are intersectional and location-aware, while perceiving older rural workers not only as recipients of support but as key contributors to resilient, age-diverse labour markets. We also argue for recalibration digitalisation policies and strategies to jointly address age, geography, and workforce participation. Achieving this requires an integrated, context-specific approach backed by more detailed and qualitative data, alongside recognising older rural workers as a distinct category in both research and policy. Research on digitalisation and older workers should be sensitive to the unique realities of different workplaces and living environments. At present, older rural workers face “double marginalisation and invisibility” stemming from both age and rural location, which their lived experiences largely absent from existing studies, which are often limited to basic comparisons between age groups without deeper socio-demographic or workplace analysis.

8. Conclusion

This conceptual framework highlights how digitalisation interacts with structural and social inequalities that shape later working life. Within the life-course perspective, cumulative advantage/disadvantage theory shows how early educational and social opportunities influence trajectories in work, health, and aging, often resulting in inequalities later in life. Workforce adaptation models, particularly skills-based approaches, provide practical strategies to mitigate work disadvantages by fostering lifelong learning, reskilling, and recognising older workers’ tacit knowledge.

The analysis of digital inequalities among older workers indicates that it may be necessary to consider dimensions beyond age, such as ethnicity, gender, migration status, region, and socio-economic position. While older workers as a group may benefit less from workplace digitalisation than younger workers, those situated at the intersection of vulnerabilities can be even more limited in their opportunities. Being an older migrant, an older woman, or living in rural areas with fewer resources restricts access to training, infrastructure, and employment opportunities. In such cases, digitalisation may risk reinforcing or deepening social inequalities. However, more research on determinants is needed.

Appendix A - Glossary of key terms

Adaptability - digital literacy underpins the capacity to adjust to rapidly changing digital environments, which is essential for sustaining employability and resilience.

Age - the measurable length of time an individual has lived, often expressed in years, but also understood through biological, psychological, and social dimensions.

Ageism – Stereotypes, prejudice, and discrimination directed toward individuals based on their age, often targeting older adults but also affecting younger people. Ageism can negatively impact health, employment, and social participation, reinforcing inequalities across the life course.

Digital divide - the gap between individuals or groups who have access to and skills in using digital technologies and those who do not, resulting in unequal opportunities and outcomes.

Digital literacy - the ability to effectively access, evaluate, and use digital tools, incorporating technical, cognitive, and socio-emotional skills.

Digitalisation - embedding of digital technology into societal processes, reshaping access to resources and opportunity. Digital capital encompasses individuals' digital skills and access to technology, enabling them to convert digital engagement into social and economic gains.

Employability - refers to an individual's ability to gain, maintain, and succeed in employment, based on a combination of skills, knowledge, personal attributes, and adaptability that are valued by employers.

Inequality - the core concept of this framework. As shown in the framework (section 4) inequality comprises axes of inequality and unequal outcomes. Axes of inequality are the root causes: some groups respond differently to societal changes like digitalisation than others or are even able to influence the shape of digitalisation in their work environment.

Intergenerational learning - educational exchanges between younger and older generations supports bridging digital divides, programs that improve digital literacy among older participants.

Job security refers to the extent to which employees perceive their employment as stable, predictable, and free from the risk of involuntary job loss, allowing them to plan for their future and feel confident in their work role.

Older adults - the individuals typically considered to be in the later stages of life (defined as 50+ for the purpose of this framework), characterised by age-related physiological, cognitive, and social changes that may influence their health, independence, work and participation in society

Job quality - broader dimensions, including job security, fair compensation, meaningful tasks, autonomy, supportive work environments, and opportunities for development, which together influence employee well-being, performance, and satisfaction (Green, 2021).

Social capital - the resources embedded within social networks, relationships, and norms of trust and mutuality that individuals and groups can access and mobilise.

Technostress is a harmful stress response arising from ICT use, including overload, invasion, complexity, insecurity, and uncertainty with documented impacts on health and productivity.

Workforce inclusion – the equitable participation in digital economies, ensuring individuals from diverse backgrounds can access training, technology, and opportunities.

Workforce inclusion is the practice of ensuring all individuals, regardless of background or characteristics, can access, participate in, and contribute meaningfully to the workplace (Shore, Cleveland, & Sanchez, 2018; Qureshi, Pan, & Zheng, 2020).

Appendix B – References

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