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POLICY MISMATCH AND THE DIGITAL SKILLS GAP AS FACTORS OF LABOUR MARKET INEQUALITY AMONG OLDER WORKERS

The article aims to substantiate how digital transformation produces unequal labour market outcomes for older workers and why this issue is important for inclusive employment policy. A qualitative research design was applied, combining conceptual synthesis, cause-and-effect analysis, factor grouping and ontology-based modelling of links between digitalisation, policy response, skills, inequality and labour market participation. The results show that exclusion is driven not only by individual digital limitations, but also by policy mismatch: institutional support, training and reskilling measures often lag behind technological change, creating a persistent skills gap. The practical value of the study lies in identifying points for timely policy intervention, lifelong learning programmes and age-inclusive organisational practices. It offers guidance for policymakers, educators and employers.

Keywords: digitalisation; older workers; policy mismatch; skills gap; labour market inequality; ontology modelling; lifelong learning; DIGI-net.

JEL classification: J14; J24; J68.

НЕВІДПОВІДНІСТЬ ПОЛІТИКИ ТА РОЗРИВ У ЦИФРОВИХ НАВИЧКАХ ЯК ЧИННИКИ НЕРІВНОСТІ НА РИНКУ ПРАЦІ СЕРЕД ПРАЦІВНИКІВ СТАРШОГО ВІКУ

У статті досліджено проблему формування нерівності на ринку праці серед працівників старшого віку в умовах прискореної цифрової трансформації. Актуальність теми зумовлена тим, що цифровізація змінює зміст праці, підвищує вимоги до цифрових компетентностей, посилює потребу в постійному навчанні та водночас створює ризики професійного виключення для осіб старших вікових груп. Метою статті є обґрунтування впливу прискореної цифровізації на участь працівників старшого віку в ринку праці через невідповідність політики та розрив у цифрових навичках як чинники посилення нерівності й професійного виключення. Методика дослідження ґрунтується на якісному концептуальному аналізі, систематизації чинників впливу, причинно-наслідковому моделюванні та онтологічному представленні взаємозв'язків між цифровізацією, політикою, навичками,

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нерівністю, зайнятістю та участю в трудовій діяльності. У результаті визначено, що нерівність не може пояснюватися лише індивідуальним браком цифрових компетентностей, оскільки значну роль відіграють інституційні умови доступу до навчання, перекваліфікації, професійного супроводу, психологічної підтримки та адаптації робочих місць. Обґрунтовано, що ключовими механізмами формування нерівності є невідповідність політики потребам цифрової економіки та спричинений нею розрив між вимогами ринку праці й наявними навичками працівників старшого віку. Показано, що несвоєчасні або фрагментарні заходи підтримки можуть посилювати технострес, зменшувати мотивацію до навчання та поглиблювати ризики виключення із зайнятості. Практична цінність отриманих результатів полягає у можливості їх використання під час формування та вдосконалення політики підтримки працівників старшого віку в умовах цифрової трансформації ринку праці. Запропонований підхід дає змогу виявляти не лише сам факт цифрового розриву, а й конкретні механізми його поглиблення, що створює підґрунтя для розроблення більш гнучких програм безперервного навчання, перекваліфікації та підвищення цифрових компетентностей з урахуванням вікових особливостей, професійного досвіду та різного початкового рівня цифрової підготовки працівників. Це дозволяє визначити ключові точки втручання, у яких узгоджені дії державної політики, системи освіти, а також роботодавців здатні не лише зменшити цифровий розрив, а й підтримати професійну мобільність і забезпечити довше активне працевлаштування працівників старшого віку.

Ключові слова: цифровізація, працівники старшого віку, невідповідність політики, розрив у навичках, нерівність на ринку праці, онтологічне моделювання, навчання впродовж життя, DIGI-net.

Problem Statement. The rapid digital transformation of European labour markets has significantly changed the conditions of employment participation, creating new opportunities but also deepening existing inequalities. Although digitalisation contributes to productivity growth and the emergence of new forms of work organisation, its effects are unevenly distributed across different groups of workers. Older workers, particularly those aged 50 and above, are among the most vulnerable groups in this process, as they face increasing demands for digital adaptation, continuous learning and the use of new technologies in the workplace.

The problem is not limited to the lack of individual digital skills or lower levels of technology adoption among older workers. A narrow focus on personal deficits does not fully explain why this group remains at higher risk of labour market exclusion. The ability of older workers to adapt to digital change is strongly influenced by institutional conditions, including access to training, reskilling programmes, workplace support and age-inclusive employment policies. When these mechanisms arrive too late or are poorly designed, digitalisation may reinforce rather than reduce labour market inequality.

This creates a need to examine the systemic mechanisms through which digital transformation affects older workers' employment opportunities. In this context, particular attention should be paid to the mismatch between the pace of technological change and the responsiveness of public and organisational policies. Such policy mismatch contributes to the widening of the digital skills gap, which in turn reduces the adaptive capacity of older workers and limits their participation in the labour market. Therefore, the key research problem lies in explaining how the interaction between digitalisation, policy mismatch and the digital skills gap produces labour market inequality among older workers.

Literature review. The literature on digitalisation and older workers spans several disciplinary domains, including labour economics, gerontology, organisational behaviour, public policy and digital inequality studies. Synthesising these contributions reveals a tension between ap-

proaches that emphasise individual-level adaptation and those that examine institutional, organisational and structural conditions. This distinction is important because the labour market position of older workers in the digital economy cannot be explained only by personal digital skills or motivation, it is also shaped by access to training, workplace support, policy design and broader socio-economic inequalities.

From an economic perspective, digital technologies are commonly associated with skill-biased technological change. They increase the relative demand for highly skilled and digitally proficient labour while reducing demand for routine, repetitive and manually intensive tasks (Autor, 2015). For older workers, who may be concentrated in occupations more exposed to automation and who often had fewer opportunities to acquire digital competencies during formal education, this shift creates structural vulnerability (Rašticová et al., 2023). Interpreting this vulnerability as an inherent limitation of age would be misleading, it emerges from the interaction between changing labour demand, accumulated occupational trajectories and unequal opportunities for lifelong learning.

The digital divide literature provides an important theoretical lens for understanding this process. Digital inequality is not limited to physical access to technologies, it also includes differences in motivation, skills, quality of use and the ability to convert digital engagement into meaningful social and economic outcomes (van Dijk, 2017, van Dijk, 2020). In the case of older workers, this means that formal access to digital tools at the workplace does not automatically lead to effective participation in digital work. Without adequate training, organisational support and user-oriented design, digitalisation may deepen rather than reduce employment inequality.

Research on technostress (the psychological and physiological stress associated with technology use) has documented the disproportionate burden experienced by older employees. Nedeljko, Gu and Bostan (2023) identify a dual impact of digital tools: while they can enhance productivity, they may simultaneously increase cognitive load, particularly among workers without adequate training or insti-

tutional support. This finding is consistent with broader research connecting work-related technology use to health outcomes, wellbeing and reduced labour market participation (Spijker et al., 2025). Therefore, technostress therefore extends beyond individual psychological reactions and becomes an organisational and policy-relevant issue.

The policy dimension has received growing attention. Ní Léime et al. (2024), in a policy document for DIGI-net, document systematic gaps in Irish policy provisions for older workers navigating digital transitions: training programmes are frequently inaccessible: schedules do not fit working hours, participation involves costs, and the digital format itself becomes a barrier. Similar structural patterns are identified in comparative European analyses (Genkova et al., 2025, Xhumari et al., 2024). Recent European policy initiatives on skills, upskilling and reskilling further confirm that digital competencies are now central to employability and social inclusion (Cedefop, 2020, European Commission, 2025). However, the effectiveness of these initiatives depends on whether they are sufficiently accessible to workers who are already at risk of exclusion, including older workers, low-skilled workers, rural workers and those in less protected forms of employment.

Ageism is another mechanism that compounds digital and labour market inequalities. Institutionalised and interpersonal age-based discrimination may limit older workers' access to training, career development and technologically intensive tasks, even when they are willing and able to learn (Versal et al., 2025). The global literature on ageism shows that age-based stereotypes affect opportunities, participation and wellbeing, making ageism a structural factor rather than a merely interpersonal problem (WHO, 2021). In the labour market, this means that digital exclusion may be reinforced by assumptions that older workers adapt more slowly and are less capable of mastering new technologies.

Digital adaptation studies, including work on the 50-75 age cohort in Cyprus, document significant variation in digital competencies shaped by socio-economic status, educational attainment and geographic location (Dimitriou et al., 2026). Rural-urban disparities, differences in infrastructure, informality of employment and limited access to workplace-based training are identified as contextual factors that further constrain access to digital learning opportunities. Tofan et al. (2026) extend this analysis to social dimensions, demonstrating that digital technologies reshape the social support networks of older workers in ways that can both facilitate and undermine wellbeing.

Adult learning research also confirms that participation in training is unevenly distributed across socio-demographic groups (OECD, 2025a, 2025b). Older workers, lower-qualified employees and workers in less secure employment often face stronger barriers to learning, including time constraints, cost, limited employer support and low confidence in digital environments. This is particularly relevant because the digital skills gap is not a static condition, it is continuously reproduced when workers do not have regular opportunities to update their competencies. Therefore, lifelong learning, in this sense, is an institutional condition of digital inclusion and cannot be reduced to individ-

ual responsibility.

Most research in this area remains descriptive. The causal pathways through which accelerated digitalisation, mediated by policy and organisational responses, translates into employment outcomes are rarely made explicit. As a result, the mechanisms through which policy mismatch and digital skills gaps reinforce inequality and labour market exclusion among older workers remain insufficiently understood.

The article aims to substantiate the causal mechanisms through which accelerated digitalisation affects the labour market participation of older workers, with particular emphasis on policy mismatch and the digital skills gap as key factors reinforcing inequality and employment exclusion.

Research Methods. To achieve the research aim, the study employed a combination of general scientific and specialised methods within a qualitative, concept-driven research design. A synthesis-oriented approach was used to integrate findings from the selected sources and to identify recurring relationships and explanatory mechanisms rather than treating individual studies as isolated contributions. The comparative-analytical method enabled the examination of similarities and differences in how digitalisation, policy responses, skills, inequality, and labour market participation are addressed across the analysed materials. The systems approach was applied to examine digital exclusion among older workers as a multilevel process shaped by the interaction of technological transformation, institutional and organisational responses, and individual labour market outcomes. Structural-functional analysis was used to determine the role of specific factors within the overall causal system and to distinguish their functional effects on the development of labour market inequality. The identified factors were then reclassified into technological, individual, socio-economic and institutional dimensions according to their function within the system rather than their surface description in the source literature. The methods of generalisation and abstraction were applied to move from fragmented evidence to an integrated conceptual explanation of the mechanisms underlying employment exclusion. Cross-source synthesis supported the identification of policy mismatch and the digital skills gap as the central mechanisms linking accelerated digitalisation with growing inequality and declining labour market participation among older workers. To formalise the identified causal relationships, ontology-based modelling was carried out using Protégé. The key concepts were represented as ontology classes, while the relationships between them were formalised through object properties reflecting causal and modifying effects. The resulting ontology captures the core causal sequence connecting digitalisation, policy mismatch, the skills gap, inequality, and labour market participation. Technostress, health constraints and ageism were added to the model as modifying factors that can either deepen or ease the effects along the primary causal chain.

Research Results. The conceptual model explains labour market inequality among older workers as a dynamic outcome of interactions between technological, individual, socio-economic and institutional factors under conditions of accelerated digitalisation. Unlike descriptive frame-

works that enumerate isolated variables, the model provides a mechanism-based explanation of how inequality is produced through interconnected processes.

At the centre of the model lies a causal chain linking digital transformation to labour market outcomes. Digitalisation increases the demand for new and more advanced skills, generating pressure for continuous adaptation. The capacity of older workers to respond to this pressure is unevenly distributed and depends on multiple interacting conditions.

An important dimension of this process is the temporal and structural misalignment between technological change and institutional responses. This misalignment constitutes

the policy mismatch mechanism: the insufficient synchronisation between the pace of digital transformation and the way policy measures are timed, designed and made accessible to those who need them most, particularly in training, reskilling and institutional support for at-risk workers.

As a consequence of policy mismatch, a skills gap emerges: the discrepancy between the skills demanded by evolving labour markets and those available among older workers. Rather than reflecting individual deficiency, this gap results from under-resourced and temporally lagged institutional responses. The two mechanisms (policy mismatch and skills gap) form the central explanatory structure of the model, as illustrated in Fig. 1.

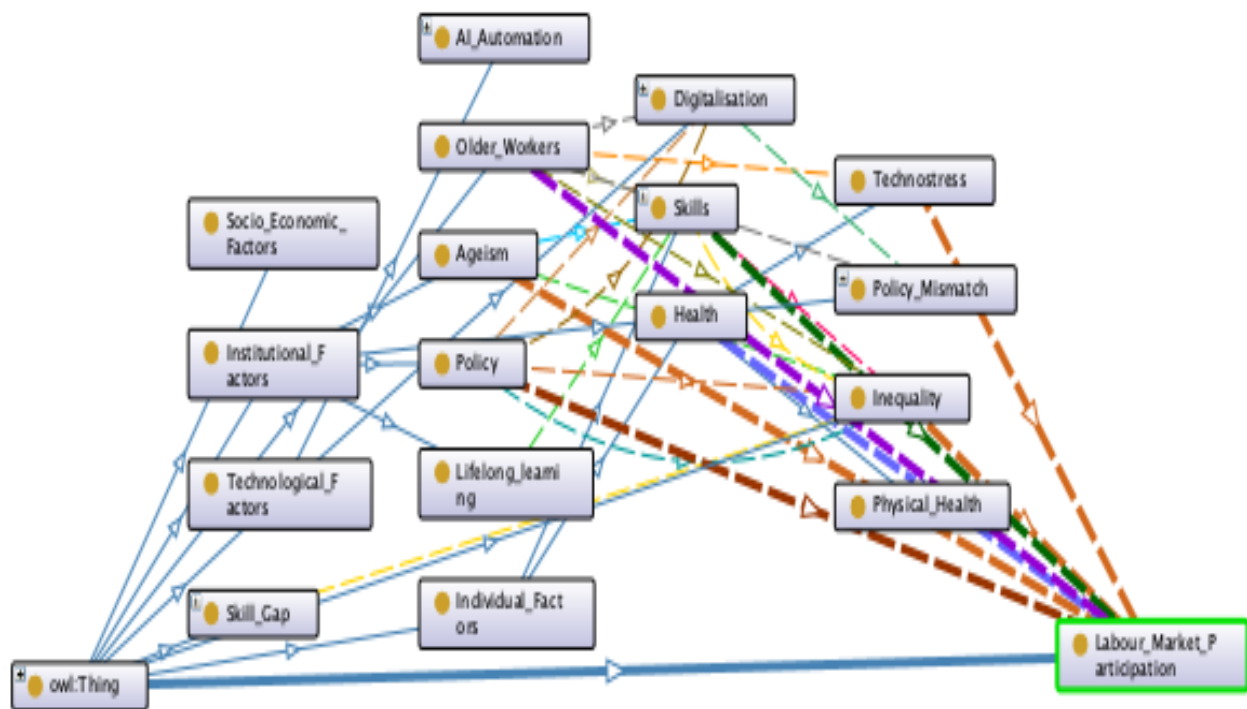


Fig. 1. Conceptual ontology model of digitalisation and labour market inequality, visualised in Protégé

Source: authors' elaboration using Protégé

When policy responses fail to keep pace with digitalisation, workers lose access to timely and adequate training. The skills gap then widens, and older workers find it harder to adapt and to meet changing job requirements. Inequality follows: their participation in the labour market declines, and the risk of being pushed out of employment grows.

Importantly, inequality operates across several levels (macro, meso and micro) and is best understood as the product of cumulative, interacting mechanisms rather than as a single-factor outcome. The model's causal structure is presented in simplified form in Fig. 2.

In order to capture the systemic complexity of labour market inequality in the context of digital transformation, the model distinguishes four interrelated groups of determinants: technological, individual, socio-economic and institutional. Technological determinants set the overall pressure. The speed of digitalisation, the spread of AI and au-

tomation and the growing role of ICT in work processes raise the demand for advanced and constantly updated skills, and they act mainly at the macro level. Individual determinants work at the opposite pole, at the level of the worker: digital competencies, health, technostress and psychological barriers together shape how readily an older employee adapts to new occupational requirements. Socio-economic conditions sit between these levels. Educational attainment, uneven digital infrastructure across regions, informal employment and labour market segmentation all influence who gains access to training and reskilling in the first place. Institutional determinants, from policy design and lifelong learning systems to HR practices and ageism, form the regulatory and organisational environment that can soften the risks of exclusion or, on the contrary, deepen them.

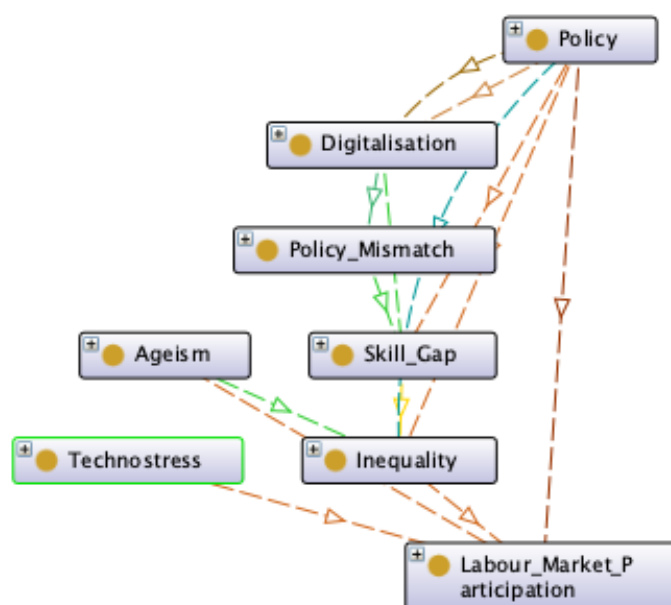


Fig. 2. Simplified causal model of the relationship between digitalisation, policy mismatch, skills gap, inequality and labour market participation, visualised in Protégé

Source: authors' elaboration using Protégé

These four groups do not act in isolation. Table 1 sets out the extended structure in detail, with the variables, the direction of their influence and the level at which each operates.

Table 1

Extended factor structure of labour market inequality in the context of digitalisation

Factor	Level	Concept	Variable	Functional Effect in the Model	Interpretation for the Model
1	2	3	4	5	6
Technological	Macro	Digitalisation	Speed of change	The acceleration of digitalisation increases demand for new and advanced skills.	Creates pressure for adaptation
		AI, Automation	Job replacement	The expansion of automation increases the risk of job displacement.	Intensifies structural inequality
	Micro	ICT Use	Work intensity	More intensive use of ICT increases work complexity and may contribute to stress.	Contributes to technostress
		Digital Tools	Productivity	Digital tools can improve work efficiency when adequate skills and support are available.	Represents a potential positive effect
Individual	Micro	Digital Skills	Competence level	Insufficient digital skills increase the risk of employment exclusion, while skill development reduces the skills gap.	Reduces the skills gap when developed
		Health	Work ability	Deteriorating health may limit the ability of older workers to remain active in employment.	Limits labour market participation
		Physical Health	Ergonomic impact	Poor ergonomic and working conditions reduce functional capacity.	Reinforces the risk of exclusion
		Technostress	Psychological stress	Higher levels of technostress reduce adaptation capacity and labour market participation.	Acts as a negative adaptation factor
		Psychological Barriers	Learning ability	Anxiety, low confidence and fear of new technologies weaken learning capacity.	Slows digital adaptation
		Motivation	Engagement	Stronger motivation supports learning, engagement and competence development.	Supports skill development
Socio-economic	Macro	Education	Human capital	Higher educational attainment increases the likelihood of digital competence development.	Improves adaptation capacity
		Rural / Urban Gap	Infrastructure	Territorial disparities in infrastructure limit access to digital technologies and training.	Restricts participation opportunities
		Migration	Labour structure	Migration processes reshape labour supply and may increase reliance on older workers.	Increases pressure on older workers
		Socio-economic Status	Resource access	Lower socio-economic status limits access to resources, training and employment opportunities.	Affects skills acquisition
	Meso	Informal Economy	Training access	Informal employment reduces access to institutional training and reskilling mechanisms.	Produces structural exclusion

Table 1 (continued)

1	2	3	4	5	6
Institutional	Macro	Policy	Support mechanisms	Effective policy support strengthens inclusion and improves access to adaptation measures.	Reduces inequality
		Policy Mismatch	Timing adequacy	Delayed or inadequate policy responses widen the gap between labour market requirements and available skills.	Serves as a core mechanism
	Meso	Lifelong Learning	Training systems	Accessible lifelong learning systems improve the adaptive capacity of older workers.	Reduces the skills gap
		HR Practices	Inclusion	Inclusive human resource practices strengthen participation, retention and workplace adaptation.	Supports employment retention
		Ageism	Discrimination	Age-based discrimination increases inequality and restricts access to opportunities.	Limits labour market opportunities
Mechanism	System	Skill Gap	Skills mismatch	A mismatch between labour market demand and available skills produces inequality.	Functions as a central mechanism
Outcome	Macro	Inequality	Employment gap	Greater employment inequality reduces opportunities for labour market participation.	Represents the core outcome
		Labour Market Participation	Inclusion level	Reduced participation results in a higher risk of labour market exclusion.	Represents the final system result

Source: authors' elaboration.

Around this core chain the model places a set of modifying influences. Some of them make inequality worse. Technostress and poor health lower the capacity to adapt, and ageism narrows the range of opportunities open to older workers in the first place. Others work the other way. Where policy intervenes effectively, where organisations build inclusive practices and where lifelong learning is genuinely accessible, the skills gap narrows and the path back into employment widens. The model thus provides a basis for identifying targeted intervention points, above all the design and timing of policy responses, where systemic change can interrupt the causal chain leading to inequality.

Conclusions. The study allows for a reconsideration of the relationship between digitalisation, ageing and labour market inequality. Its main implication is that the exclusion of older workers from digitalised labour markets should not be interpreted primarily as a consequence of individual inability or reluctance to acquire new skills. Such an interpretation is too narrow, as it shifts responsibility to workers themselves and underestimates the role of institutions: how quickly they respond, how their policies are designed and how much support employers actually provide. The findings suggest that the problem lies not only in the existence of digital skills gaps, but also in the conditions under which these gaps emerge and are subsequently addressed by institutions.

The temporal dimension of labour market policy deserves separate attention. Digital transformation develops continuously and unevenly across sectors, while policy responses are often delayed and, in many cases, still designed for technological conditions that no longer exist. This creates a structural risk that even well-intentioned training and reskilling programmes may become insufficient if they are not regularly updated and aligned with actual workplace demands. Therefore, policies aimed at older workers should be adaptive rather than episodic, combining flexible learning pathways with stronger links between public pol-

icy, employers and lifelong learning institutions.

Inequality among older workers is not homogeneous. Its forms and intensity vary with the territorial, socio-economic, organisational and institutional context in which workers find themselves. Workers in rural areas, informal employment or age-discriminatory organisational environments may face barriers that cannot be removed by digital training alone. Universal policy measures are therefore rarely sufficient on their own. They need to be paired with context-sensitive instruments that address not only infrastructure and access, but also motivation, health and the climate of inclusion at the workplace.

From a methodological perspective, the ontology-based approach offers a promising way to structure complex relationships between technological change, policy responses and labour market outcomes. Beyond visualising factors, its value lies in creating a basis for cumulative and comparative research. At the same time, the proposed model should be regarded as a conceptual framework requiring further empirical validation. Future research should test these mechanisms against primary data. Comparative work across national policy contexts would show how far the model travels, and a further task is to develop measurable indicators of policy mismatch. This would make it possible to move from conceptual explanation to evidence-based monitoring and practical policy design for a more inclusive digital labour market.

Declaration on the Use of Artificial Intelligence Tools. During the preparation of this article, the authors used the artificial intelligence tool ChatGPT (GPT-5.5 Thinking model, OpenAI). The tool was used solely as an auxiliary aid for the linguistic and stylistic refinement of the manuscript, including the generation and editing of the abstract and the formatting of the reference list in accordance with *APA Style* (7th edition). The authors assume full responsibility for the scientific quality, accuracy, and integrity of the content of this article.

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