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Article

Human Capital and the Labour Market in Uzbekistan amid the Development of Artificial Intelligence

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Abstract: This article examines the impact of artificial intelligence on the labour market and the role of human capital in adapting to technological change, taking account of conditions in Uzbekistan. The study is based on a review and comparative analysis of academic publications, international studies and national sources. It focuses on changes in work tasks, productivity, employment and skill requirements. The findings show that improved performance in individual operations through AI does not automatically lead to higher earnings or more jobs. Particular importance is attached to employment opportunities for early-career professionals and their acquisition of practical experience. Human capital is considered both a prerequisite for the effective use of AI and a resource that changes under its influence. In Uzbekistan, widespread internet use coexists with limitations in workforce training and firms' adoption of technology. The article argues for combining training in AI use with the development of foundational and professional skills, maintaining mentoring and assessing workers' ability to perform independently.

Keywords: human capital, artificial intelligence, generative AI, labour market, automation, labour productivity, professional skills, Uzbekistan.

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1. Introduction

The development of artificial intelligence (AI) is changing the content of work and the requirements placed on workers. Software already helps create texts, write code and analyse information, affecting tasks that previously required a specialist's direct involvement. This raises questions about the future of employment, earnings and the value of professional knowledge. However, the ability to automate an individual task does not yet imply the disappearance of an occupation. According to the International Labour Organization, changes in the content of work are more likely for many occupations, since some tasks still require human involvement [1]. It is therefore important to distinguish changes already observed from forecasts based on the technology's potential capabilities.

The term 'artificial intelligence' is associated with John McCarthy and the proposal for the Dartmouth research project that he prepared with colleagues in 1955. The authors proceeded from the possibility of reproducing learning and other manifestations of intelligence by machine [2]. Under the current OECD definition, an AI system uses input data to generate predictions, content, recommendations or decisions for explicit or implicit objectives. Such systems vary in their degree of autonomy and ability to adapt after

deployment [3]. This article pays particular attention to generative AI, which creates texts, images and computer code, expanding the scope for automating intellectual work.

Understanding the economic consequences of these changes requires consideration of the concept of human capital. Adam Smith already regarded acquired knowledge and skills as part of fixed capital. The historian of economic thought Margaret Schabas traces the first use of the term itself to Irving Fisher's work of 1897, and the development of modern theory to mid-twentieth-century research, primarily by Theodore Schultz and Gary Becker [4]. In this theory, education and vocational training are viewed as investments that can increase an individual's productivity and income [5]. In this article, human capital is understood as the combination of knowledge, skills, experience and health characteristics that influence a person's capacity for productive activity. It cannot be assessed solely by the possession of a diploma or the number of years spent in education: the quality of training and the worker's actual abilities matter [6].

AI can simultaneously increase the returns to some skills and reduce demand for others. Daron Acemoglu and Pascual Restrepo show that automation displaces labour from some tasks, while the emergence of new tasks creates additional demand for workers [7]. Research by Erik Brynjolfsson and co-authors also found productivity gains from using a generative assistant, particularly among less experienced employees [8]. However, better performance in an individual activity does not yet determine the long-term consequences for employment and earnings. Assessing these consequences requires consideration of which tasks are delegated to AI, which remain with people and how prepared workers are to learn new ways of working.

In Uzbekistan, AI development is enshrined in the Strategy through 2030, approved by Resolution No. PP-358 of the President of the Republic of Uzbekistan of 14 October 2024 [9]. At the same time, technology adoption faces constraints in workforce training. The UNDP report on Uzbekistan's private sector identifies a shortage of specialised skills, insufficient links between education and firms' practical tasks, and regional differences in access to AI training [10]. Foreign estimates must therefore be considered in light of the structure of the national labour market, firms' capabilities and the availability of retraining.

The aim of this article is to use academic literature and available data to identify how AI changes work tasks and human capital requirements, and what opportunities and risks this creates for Uzbekistan. To this end, studies of AI's impact on productivity, employment and earnings are compared, alongside changes in sought-after competencies and the conditions for applying international experience in the national economy.

2. Materials and Methods

The study is based on an analysis of academic publications on human capital and AI's impact on the labour market, as well as materials from international organisations and public policy documents from Uzbekistan. Contemporary studies are used to assess changes in employment and worker requirements, while classical works clarify the main concepts and theoretical approaches.

The analysis draws on the approach of Daron Acemoglu and Pascual Restrepo, which examines the effects of technology through changes in individual work tasks [11]. Studies are compared according to their findings on productivity, employment, earnings and professional skills. The analysis takes account of the conditions under which the studies were conducted and distinguishes observed effects, assessments of automation potential and forecasts.

The discussion of Uzbekistan uses the Strategy for the Development of Artificial Intelligence Technologies through 2030 and UNDP materials on the conditions for AI adoption in the private sector [12]. These sources inform the discussion of the applicability of international findings to the national economy, particularly in light of workforce training and firms' capabilities. The conclusions draw on a synthesis of existing research; no original quantitative assessment of AI's impact on employment is conducted.

3. Results

3.1 The Impact of AI on Work Tasks, Productivity and Employment

AI's impact on the labour market begins with changes in the tasks performed by a worker. A single occupation may involve processing documents, searching for information, communicating with customers and making decisions. The scope for automating these activities varies: drafting a standard text can be delegated to software, while assessing an unusual situation requires professional judgement. Even widespread AI use within an occupation therefore does not necessarily imply its disappearance. The allocation of working time, the content of duties and the requirements placed on employees change.

Acemoglu and Restrepo's approach identifies several mechanisms behind these changes. Automation allows tasks previously performed by people to be transferred to technical systems, thereby reducing the need for labour in the relevant area. At the same time, higher productivity lowers costs and may create conditions for expanding production and demand for workers. The emergence of new tasks provides an additional source of employment [13]. These processes do not necessarily offset one another: a firm may increase output without expanding its workforce, and new jobs may require different qualifications. The economic consequences therefore depend on which tasks are automated and what opportunities arise for workers alongside this process.

The scale of potential change is reflected in the ILO's 2025 study. The authors estimate that around one-quarter of global employment is in occupations whose tasks are exposed to generative AI to varying degrees. The highest exposure category accounts for 3.3% of employment. The impact is most pronounced in administrative and clerical occupations; opportunities for AI use in specialised work involving digital information are also expanding [14]. These indicators describe the technical potential for changes in tasks. They do not mean that the corresponding share of workers will be dismissed: actual adoption depends on technology costs, the reliability of results and work organisation. Figure 1 presents the distribution of employment across exposure levels in selected country groups.

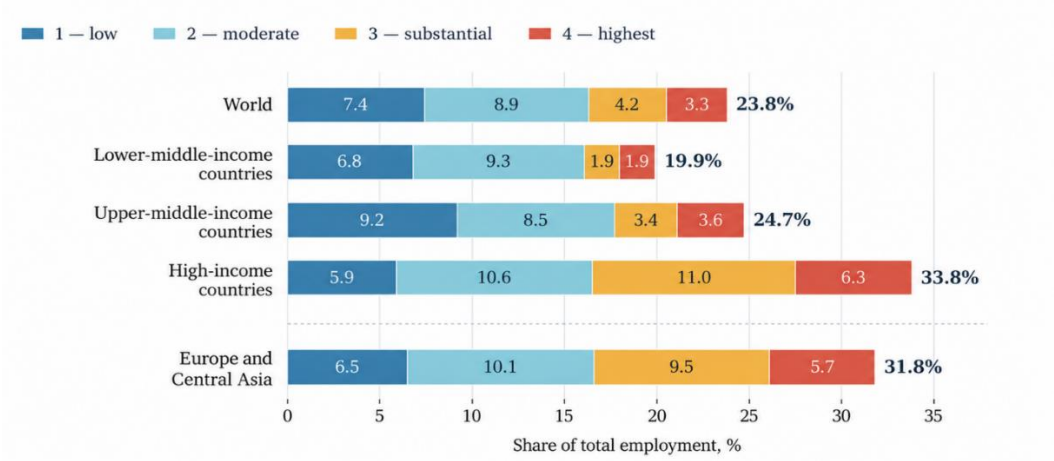


Figure 1. Employment exposure to generative AI by country group and region, % of total employment

Source: compiled by the authors using ILO data

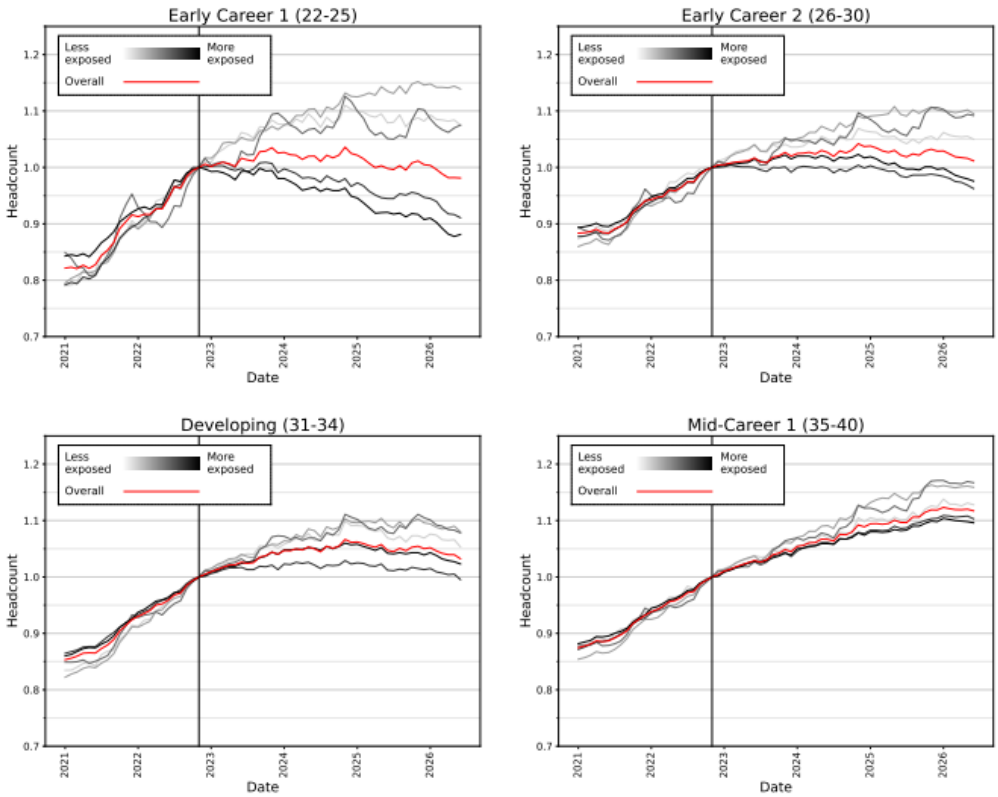
The total share of exposed employment is around 34% in high-income countries, around 25% in upper-middle-income countries and around 20% in lower-middle-income countries. Differences are particularly pronounced at the two highest exposure levels. For Europe and Central Asia, the total reaches approximately 32% [15]. This distribution reflects differences in the occupational structure of employment: the prevalence of work involving texts, documents and other digital information broadens the range of tasks to which generative AI can be applied. High exposure entails both opportunities for productivity gains and the risk of replacing individual work functions. These data provide

a comparative reference for analysing Uzbekistan, but the regional estimate cannot be applied to the national labour market without taking its structure into account.

Worker-level studies already document measurable benefits from AI use. Brynjolfsson, Li and Raymond examined the phased introduction of a generative assistant using data on 5,172 customer support employees. The number of issues resolved per hour increased by an average of 15%, with a stronger effect among less experienced and less skilled workers [16]. An experiment by Shakked Noy and Whitney Zhang involved 453 university-educated professionals performing professional writing tasks. Access to ChatGPT reduced average completion time by 40% and increased assessed output quality by 18% [17]. These studies show that AI can improve the performance of particular tasks, but do not measure changes in demand for the corresponding occupations across the economy.

The relationship between such improvements and earnings is less clear-cut. Anders Humlum and Emilie Vestergaard linked surveys of workers in 11 occupations in Denmark to administrative data on income and working time. In the March 2026 version of their study, the authors found no statistically significant average effect of AI chatbot use on earnings or recorded working hours through the end of 2024. The precision of the estimates allowed average effects greater than 2% to be ruled out within the sample and model studied. Meanwhile, the content of work was changing: tasks emerged involving checking AI outputs and integrating AI into workflows [18]. In this case, the absence of a noticeable change in income coexisted with a reorganisation of workers' duties.

The position of early-career professionals deserves particular attention. A working paper by Brynjolfsson, Bharat Chandar and Ruyu Chen, updated in August 2026, uses ADP data on US employment through June 2026. Employment among workers aged 22–25 in occupations with high AI exposure was 19% below the counterfactual level that would have prevailed had it followed the same trajectory as that of less exposed peers. The difference was primarily associated with weaker hiring. The authors explicitly state that the finding is descriptive: differences in education, prior trends and sample characteristics may influence it [19]. The figure cannot be interpreted as the share of young workers who lost their jobs because of AI. Differences between age groups are presented in Figure 2.



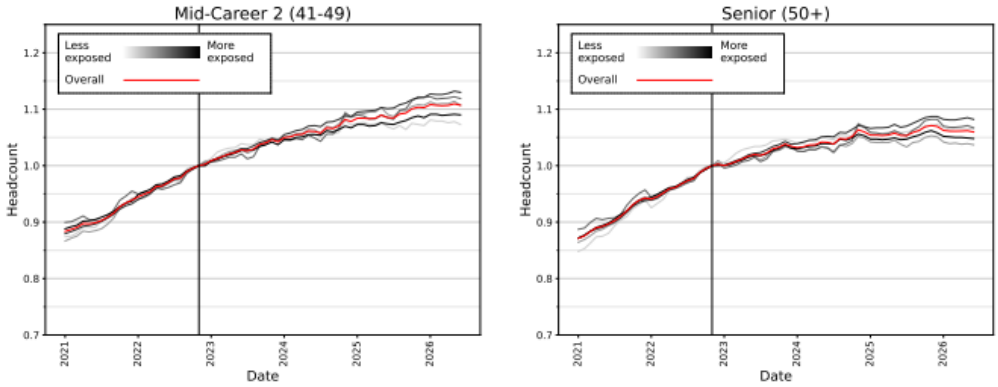


Figure 2. US employment trends by age group and occupational exposure to AI

Source: Brynjolfsson, Chandar and Chen ADP data.

Note. Worker counts are normalised to November 2022, set equal to 1. Darker lines represent occupational groups with greater AI exposure; the red line shows the overall trend within the age group.

The figure shows the most pronounced divergence among workers aged 22–25: after late 2022, employment in the most exposed occupations declines, while employment in less exposed occupations grows. Among workers aged 35–40, growth is observed across different exposure levels. This difference shows that aggregate employment trends can conceal a deterioration in the position of particular groups. However, age serves here only as a rough indicator of career stage and does not replace a direct assessment of experience and qualifications [20].

Productivity growth, limited changes in earnings and weaker hiring can coexist because they reflect different aspects of technology adoption. One possible explanation is that reducing the time spent on standard operations allows a firm to perform more work with its existing workforce. Under these conditions, the need for new employees may decline before it becomes necessary to reduce existing employment. At the same time, tasks emerge involving checking AI outputs, handling complex cases and organising its use. This raises the question of which knowledge and skills help workers use AI and how the opportunities to acquire them are changing.

3.2 Human Capital: Changing Skill Requirements and Conditions for Accumulation

AI-driven changes in work tasks affect both the use of existing knowledge and the acquisition of new knowledge. However, higher productivity with a digital tool does not always imply an increase in the worker's own human capital. A professional may prepare a document or perform a calculation faster without better understanding the content of the work completed. Assessing these changes requires distinguishing the quality of an AI-assisted result from a person's ability to solve tasks independently, verify conclusions and apply knowledge in new situations.

AI can facilitate access to professional experience. In the study by Brynjolfsson, Li and Raymond, the stronger productivity gains among novice employees are linked to the digital assistant making the working practices of more successful colleagues accessible [21]. This mechanism can shorten the time needed to learn particular duties and narrow performance gaps between workers. However, convergence in current performance does not yet prove convergence in qualifications: an employee may perform successfully with assistance while remaining dependent on it. AI's significance for human capital is therefore determined not only by the speed of task completion, but also by whether its use helps people understand the reasons behind decisions and gain independent experience.

The need for new skills also extends beyond training AI developers. Andrew Green's study, published by the OECD in 2024, notes that most workers whose tasks are exposed to the technology will not need specialised machine learning knowledge. Management skills and knowledge of business processes are widely sought in the relevant occupations. At the same time, firm-level analysis identifies signs of declining demand for

some of these skills as AI exposure increases [22]. This prevents the identification of a universal set of competencies whose value will invariably rise. Training content must be aligned with specific tasks: what workers should perform independently, what they can delegate to a system and how they should verify the result.

The importance of such verification is demonstrated in an experiment by Fabrizio Dell'Acqua and co-authors involving 758 Boston Consulting Group consultants. On tasks within the capabilities of the model used, access to GPT-4 improved speed and quality. However, on a particular complex task beyond its capabilities, participants using AI were less likely to reach the correct answer. The authors describe this as a jagged technological frontier: tasks that appear similar in difficulty can differ substantially in the reliability of an automated solution [23]. The finding concerns a specific model and experimental setting, but shows why professional judgement remains important even among highly qualified users.

The studies reviewed suggest several interconnected requirements for workforce training. Domain knowledge is needed to understand a task and detect substantive errors. Digital literacy enables people to select tools and work with data, while the ability to evaluate information supports checking the grounds for a proposed solution. Communication and work organisation skills are needed to align objectives, explain conclusions and allocate responsibility. Within this combination, the ability to formulate AI prompts is useful but insufficient on its own: a precisely worded prompt does not guarantee a reliable answer. This is an analytical synthesis of the studies reviewed, rather than a common list of skills established by them for all occupations.

AI's impact on learning is particularly important. Hamsa Bastani and co-authors conducted an experiment involving nearly a thousand school students studying mathematics. Using a GPT-4-based assistant improved performance on practice tasks. However, once access to the standard version of the assistant was removed, this group's results were 17% below those of students who had not used AI. In another version, the tool was configured to provide pedagogical hints, and the negative effect was largely eliminated [24]. The study does not justify applying this figure to vocational education or adult learning. It demonstrates a more specific risk: successful AI-assisted task completion may coexist with inadequate mastery of the method of solution.

A similar tension may arise in the workplace when entry-level professional tasks are automated. Preparing standard documents, checking data and performing simple calculations both support a firm's ongoing operations and provide practice for newcomers. If these duties are delegated to AI, it is necessary to consider how a new employee will gain the experience needed for more complex work. The previously discussed weakening of hiring among young professionals in certain occupations makes this question particularly significant [25]. However, reduced opportunities for workplace learning should be regarded as a possible mechanism requiring further investigation, rather than an already proven general consequence of AI adoption.

The technology's impact on inequality also depends on the conditions of its use. Assistance for less experienced workers can narrow differences in the performance of particular tasks, but access to tools, training and professional support remains unequal. A reduction in productivity gaps within one experiment therefore cannot automatically be interpreted as a reduction in inequality in earnings or employment opportunities. For analysing Uzbekistan, formal educational indicators matter alongside the conditions in which knowledge is used and updated: training quality, the availability of learning opportunities for working people and firms' ability to organise the adoption of new technologies.

3.3 Human Capital and the Readiness of Uzbekistan's Labour Market for the Spread of AI

Opportunities for AI use in Uzbekistan depend on the combination of workers' professional training, the nature of their employment and access to technology. Foundational skills remain a significant constraint in the educational component of human

capital. According to PISA 2022, 19% of participating students in Uzbekistan reached Level 2 or above in mathematics and 14% in reading, compared with OECD averages of 69% and 74%, respectively. These results concern 15-year-old students and do not characterise the qualifications of all workers. However, the difficulties identified matter for subsequent professional learning: understanding texts, working with numbers and assessing the validity of conclusions are necessary both for independent problem-solving and for checking AI answers.

Opportunities to update skills also vary with employment conditions. The study by UNDP and the Center for Economic Research and Reforms notes the prevalence of informal employment in agriculture, construction, trade and services, as well as the vulnerability of young people, women and rural residents. For AI analysis, this means that the experience of technology adoption in large organisations reviewed above covers only some of the possible settings for its use. A firm's employee may receive access to corporate tools, guidance and help from colleagues. For a self-employed person, learning to use the technology may depend more on their own knowledge, time and resources. The same technical possibility therefore does not yet create equal conditions for professional adaptation.

Internet access already reaches a substantial share of the population. According to a sample household survey, 94.2% of Uzbekistan's residents used the internet in January–August 2025. This creates conditions for the spread of digital assistants, but does not show how well people can use them at work. The UNDP report on the private sector, published in 2026, identifies a shortage of trained specialists, limitations in computing infrastructure and a lack of high-quality Uzbek-language data among the obstacles to AI adoption. Comparing these sources points to a gap between widespread internet use and the conditions for professional AI use. The scale of this gap cannot yet be expressed by a single figure: the indicators cited do not measure the share of workers who regularly use AI to perform work tasks.

Given these initial conditions, one opportunity offered by AI is easier access to knowledge and professional support. The previously reviewed findings on digital assistants suggest that such tools may help employees of Uzbek firms prepare documents, handle customer enquiries and learn unfamiliar operations. For small organisations, this may broaden the range of tasks that the existing team can perform. However, the usefulness of such assistance depends on the content of the work. For example, preparing a draft document saves time only if the employee can check whether it corresponds to the actual situation. Here, human capital determines not only how quickly software is learned, but also whether its answer can be turned into a usable work result.

Changes in employment will depend on how firms use the time saved. When sales and services expand, AI may help increase the volume of work and create new duties. With unchanged demand, automating the same operations may reduce the need for additional employees. For Uzbekistan, this distinction is particularly important when assessing the prospects for digital services: tools that help local providers prepare texts, translate or write code are also available to their customers and competitors. Growth in technical capabilities therefore does not guarantee more jobs. Workers able to combine AI use with domain knowledge, an understanding of customer needs and quality control may attain more secure positions. This is a possible direction of change based on international research, rather than an established forecast for the national labour market.

A separate tension arises in the training of early-career professionals. AI can help a newcomer perform duties faster, but automating simple operations may reduce both the need to hire them and the amount of practice available to them. Foreign observations of young workers' employment provide grounds for considering this risk, although they do not prove that it has materialised in Uzbekistan. In the local context, it also deserves attention because participants in the UNDP study note the need for additional training for young professionals after they start work. If a firm delegates to AI tasks through which an employee previously learned, experience must be acquired through other forms of

participation: analysing errors, checking results and progressively learning to handle more complex cases.

Differences in human capital may also affect the distribution of AI benefits. A worker with solid professional training can use digital assistance to broaden their duties. With insufficient knowledge, the same tool may facilitate standard activities while maintaining dependence on guidance. If access to training is also unequal, the initial advantage of better-prepared workers and firms may increase. At the same time, studies show that carefully designed support can improve the performance of less experienced users. Both directions are therefore possible for Uzbekistan: narrowing certain productivity gaps and widening differences in professional opportunities. Their relative importance will depend on training content and work organisation.

This dependence links AI adoption to the renewal of human capital. Expanding access to digital assistants can facilitate learning if a person studies explanations, checks solutions and continues to perform some tasks independently. Receiving a ready-made answer without understanding the method of solution produces a different outcome: the current task is completed, but the ability to handle the next one has not necessarily improved. Assessing AI use in Uzbekistan therefore requires two related questions: how much the technology improves work today, and what knowledge remains with the worker after using it.

4. Discussion

Comparing studies shows that assessments of AI's consequences depend substantially on the outcome measured. Time saved in completing a task, changes in earnings and employment opportunities reflect different aspects of technological change. Productivity gains in experiments therefore do not refute concerns about employment, while a deterioration in the position of particular groups does not prove that large-scale worker displacement is inevitable. Between the technical possibility of automation and its consequences for individuals lie firms' decisions: whether to expand operations, redistribute duties, train employees and how to use the resulting savings. This allows the future of the labour market to be viewed as the outcome of interaction between technology and the organisation of its use.

Human capital plays a dual role in this process. Accumulated knowledge helps people select tasks for AI and evaluate its answers, but using the technology itself changes the conditions for acquiring that knowledge. A tension emerges: firms need employees capable of checking automated solutions, while transferring entry-level operations to a system may limit the practice needed to develop that capability. Studies of learning and professional activity provide grounds for considering this risk, although they do not yet permit an assessment of its long-term scale. The effectiveness of adoption should therefore be evaluated both through current work quality and through whether employees retain the ability to understand tasks independently.

For Uzbekistan, this implies a need to combine training in AI use with stronger foundational and professional preparation. The identified difficulties in skill acquisition and constraints on firms' adoption show why merely expanding access to digital tools is insufficient. Practical training can be built around real work tasks: an employee formulates a problem, uses AI, checks the input data and explains the decision made. In education, it is useful to combine digitally supported tasks with independent work that enables acquired knowledge to be assessed. For employers, indicators of such training may include fewer errors, the ability to solve new tasks and less need for constant assistance.

Particular attention is needed for new workers and people with limited access to company training. When routine operations are automated, internships and mentoring become important ways of maintaining entry into an occupation. Young employees need opportunities to help check results, examine complex cases with an experienced colleague and gradually make decisions independently. For employees of small firms and the self-employed, accessible programmes offered by professional and educational organisations

can provide similar support. These measures address the risk of uneven adaptation identified by comparing international findings with conditions in Uzbekistan. Their effectiveness should be assessed through subsequent use of skills and employment opportunities.

The conclusions of our review are limited by differences between the occupations, countries and forms of AI use studied. Many studies assess individual tasks or relatively short periods, and observed relationships do not always establish the technology's causal impact. For Uzbekistan, the sources reviewed describe the conditions for adoption better than its consequences for workers. Further research could track changes in duties, hiring, earnings and independent skills before and after AI adoption in firms. Of particular interest is whether time savings are accompanied by business expansion and employees' professional development, or primarily reduce the need for their labour.

5. Conclusion

The studies reviewed show that AI's impact on the labour market is manifested primarily through changes in individual tasks, the content of work and qualification requirements. Productivity gains from its use have already been confirmed in several professional settings, but do not guarantee higher earnings or expanded employment. Benefits may coexist with a reduced need for new employees and diminished opportunities to enter an occupation. The available data identify these risks, but provide no grounds for treating the large-scale disappearance of occupations as an inevitable result of AI development.

Human capital determines workers' ability to use the opportunities offered by the technology and, at the same time, changes under its influence. AI facilitates access to knowledge and professional support, but completing a task with its assistance is not always accompanied by the acquisition of independent skills. Both the result achieved and the preservation of a person's ability to understand the task, check the solution and learn through practice therefore matter. Professional knowledge, digital skills and the organisation of learning jointly determine whether AI use will support a worker's development.

For Uzbekistan, widespread internet access creates conditions for the spread of AI, while differences in training and employment conditions may limit the benefits obtained. Strengthening foundational and professional skills, providing accessible training for the working population and maintaining opportunities for young professionals to gain experience are priorities. The quantitative consequences for the national labour market require further study. The practical objective of AI adoption should be higher productivity accompanied by the development of competencies and expanded opportunities for productive employment.

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