# THE IMPACT OF ARTIFICIAL INTELLIGENCE ON THE EUROPEAN LABOUR MARKET - POLARISATION, CHALLENGES AND OPPORTUNITIES

# VPLYV UMELEJ INTELIGENCIE NA EURÓPSKY TRH PRÁCE – POLARIZÁCIA, VÝZVY A PRÍLEŽITOSTI

***Balázs Fábián***[1]

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**ABSTRACT**

*The rapid development and diffusion of artificial intelligence (AI) is having a major impact on the European labour market, transforming employment structures, skills, and ways of working. This technological revolution is both a challenge and an opportunity for workers, companies, and policy makers. This research is about to focus on the sectors, the depth, and the ethical use of AI, and will explore the labour law issues of new forms of employment generated by AI (e.g. platform work).Overall, the integration of AI into the labour market presents both opportunities and risks that require initiative-taking policy responses, ongoing research, and collaboration between governments, businesses, and social partners. By addressing the legal, social, and ethical implications of AI-driven work, Europe can harness the benefits of technological advancement while safeguarding workers' rights and promoting a more inclusive labour market.*

**ABSTRAKT**

*Rýchly rozvoj a šírenie umelej inteligencie (AI) má veľký vplyv na európsky trh práce, mení štruktúru zamestnanosti, zručnosti a spôsoby práce. Táto technologická revolúcia je výzvou a zároveň príležitosťou pre pracovníkov, spoločnosti a tvorcov politík. Tento výskum sa zameria na odvetvia, hĺbku a etické využívanie umelej inteligencie a bude skúmať pracovnoprávne otázky nových foriem zamestnávania vytvorených umelou inteligenciou (napr. práca na platforme). Celkovo integrácia AI do trhu práce predstavuje príležitosti aj riziká, ktoré si vyžadujú iniciatívne politické reakcie, pokračujúci výskum a spoluprácu medzi vládami, podnikmi a sociálnymi partnermi. Riešením právnych, sociálnych a etických dôsledkov práce založenej na AI môže Európa využiť výhody technologického pokroku a zároveň chrániť práva pracovníkov a podporovať inkluzívnejší trh práce.*

## I. INTRODUCTION

The advent of Artificial Intelligence (AI) has precipitated a paradigm shift in various domains, with the European labour market being one of the most profoundly impacted. This technological advancement is profoundly impacting not only the nature of employment, but also our fundamental conception of work, careers, and the future of labour.

Contemplate a workplace where humans and machines collaborate seamlessly, leveraging each other's strengths, or conceptualise a labour market where routine tasks are automated, thereby liberating human creativity and innovation. To facilitate this transition, it is imperative

[1] Dr., University of Győr, Faculty of Law, Győr, Hungary
Univerzita v Győri, Právnická fakulta, Győr, Maďarsko.

to address the challenges that lie ahead. Moreover, it is crucial to explore strategies through which employers, employees, and legislators can effectively prepare for this transition. The advent of AI gives rise to numerous intriguing inquiries: for instance, how are traditional jobs being transformed? Which professions will be created, and which will be rendered obsolete? Furthermore, it is crucial to consider the necessary skill sets for future success. Of pertinence is the question of ensuring that this technological revolution benefits all members of society.

This subject is of interest not only to technology enthusiasts but to all members of society, including workers, entrepreneurs, educators, and decision-makers. A comprehensive understanding of the interplay between AI and the labour market is imperative for effectively navigating the challenges of the future. This paper aims to provide a comprehensive overview of this rapidly evolving field, and to inspire further reflection on the future of work.

The starting point of this research is the observation that AI's integration into the workplace represents more than a mere technological upgrade; it is a profound socio-economic transformation. Recent advancements in AI have given rise to critical questions regarding the evolution of employment structures and skill requirements, necessitating a systematic investigation into these changes within the European context.

The current research reveals a complex picture. Numerous studies have examined the dual impact of AI: while its automation capabilities can displace routine tasks and contribute to labour market polarisation, there is also strong evidence that AI spurs the creation of new job opportunities and drives innovation. Despite the growing body of literature addressing these issues, there are still significant gaps in our understanding, particularly regarding the interplay between technological advancements, regulatory frameworks, and demographic shifts. This paper seeks to address these gaps by integrating insights from economic theory, legal analysis, and social science research.

The primary objective of this research is to analyse the transformative effects of AI on the European labour market. To this end, the study employs an interdisciplinary methodology, encompassing a critical review of extant literature, an analysis of empirical data, and case study evaluations of sectoral impacts. The central hypothesis guiding this investigation is that, although AI accelerates the polarisation of job roles – thereby boosting both high-skilled and low-skilled positions at the expense of medium-skilled ones – it simultaneously offers significant opportunities for economic growth and workforce development, provided that effective policy interventions and re-skilling initiatives are implemented.

The present study systematically explores these dimensions, with the aim of contributing valuable insights into the policy and practical implications of AI-driven transformations in the European labour market.

## II. ON THE IMPACT OF AI ON THE LABOUR MARKET IN GENERAL

When examining the impact of MI on the labour market, it is important to stress that it is not simply about job losses or job creation, but about changes overall in work. According to a study from 2023, 32.8% of activities are likely to be fully affected by the emergence of ChatGPT and similar generative AI services, 36.5% partially affected, while 30.7% are likely to remain unaffected.[2] This figure illustrates the expected overall impact of MI on the labour market.

[2] ZARIFHONARVAR, A.: Economics of ChatGPT: A Labor Market View on the Occupational Impact of Artificial Intelligence. *ZBW - Leibniz Information Centre for Economics*. 2023. p. 2. https://doi.org/10.2139/ssrn.4350925.

AI will not lead to a *leisure era* as Keynes predicted earlier.[3] Instead, it is transforming the labour market by creating new jobs and replacing old ones.[4] This process can both create fears of unemployment but also encourage workers to learn new skills.[5]

However, we must also recognise that the impact of AI is not equally distributed across different occupations and income levels. A 2019 study shows that, on average, occupations affected by MI experience small positive wage increases, while employment levels do not change significantly. However, in higher income occupations there is a strong positive relationship between the impact of MI and both employment and wages.[6] This suggests that AI has the potential to increase labour market polarisation.

## III. LABOUR MARKET POLARISATION

Labour market polarisation is a phenomenon that has been increasingly seen in advanced economies – also in the European Union – in recent decades, especially since the 1980s. This process is manifested in two main aspects: the transformation of the employment structure and the increase in wage differentials.

Thus, soon, the structure of the labour market will take an *hourglass* shape, with an increasing number of high-skilled, well-paid jobs and an increasing share of low-skilled, low-paid jobs, and a parallel decline or disappearance of medium-skilled and medium-paid jobs.[7]

Another important feature of polarisation is the widening of income inequality, with high skilled workers seeing their wages rise significantly, while low skilled workers' wages stagnate or increase only slightly, and the middle class sees their incomes fall relatively.[8]

This phenomenon is driven by a number of factors: on the one hand, technological changes, such as automation and digitalisation, which are mainly replacing routine tasks requiring medium skills.[9] On the other hand, some of the medium-skilled jobs can be outsourced to lower-wage countries.[10] Finally, changes in labour market institutions, weakening trade unions and changes in minimum wage policies may also contribute to polarisation.[11]

Skills development and education are key to meeting these challenges. The European Union's strategy for the period 2021 to 2027 gives priority to supporting cybersecurity innovation, which is linked to AI.[12] This shows that the EU has recognised the importance of AI and its potential impact on the labour market.

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3 KEYNES, J. M.: The general theory of employment, interest and money. *Közgazdasági és Jogi Könyvkiadó*, Budapest, 1965. p. 21.

4 ZHANG, X.: Research on the impact of artificial intelligence on the labor market. *Advances in Economics and Management Research*, 2023. 8, pp. 252-257. https://doi.org/10.56028/aemr.8.1.252.2023.

5 BAKOŠOVÁ, L.: Climate action through artificial intelligence: International legal perspective, *STUDIA IURIDICA Cassoviensia*, Vol. 10.2022, No.2. pp. 8-9. https://doi.org/10.33542/sic2022-2-01.

6 FELTEN, E. W. - RAJ, M. - SEAMANS, R.: The Occupational Impact of Artificial Intelligence: Labor, Skills, and Polarization (available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3368605).

7 BONCZ B. – SZABÓ ZS. R.: The labour market impact of artificial intelligence: how to prepare? (A mesterséges intelligencia munkaerő-piaci hatásai: hogyan készüljünk fel?) *Vezetéstudomány*, issue 2022/2, p. 71. https://doi.org/10.14267/veztud.2022.02.06.

8 KESZI R.: Artificial intelligence, labour market, disability (Mesterséges intelligencia, munkaerőpiac, fogyatékosság.) Seventh Disability Conference, Budapest, 26 November 2019 (available at: https://keszi.krolify.hu/wp-content/uploads/2019/11/KesziRoland_MestersegesIntelligenciaMunkaeropiacFogyatekossag.pdf).

9 ILLÉSSY M. – HUSZÁR Á.: Technological development and labour market: how does automation affect jobs in Hungary? (Technológiai fejlődés és munkaerőpiac: hogyan hat az automatizáció a munkahelyekre Magyarországon?) *Statisztikai Szemle*, issue 100/2, p. 143. https://doi.org/10.20311/stat2022.2.hu0137.

10 Drivers of employment polarisation and wage growth at the top end of the wage scale in recent years in Europe: European Labour Force Monitor, 2014 Summary (available at: https://www.eurofound.europa.eu/system/files/2021-05/EF14191HU.pdf).

11 Labour market polarisation and job quality in the crisis: European Labour Force Monitor 2013 Executive Summary (available at: https://www.eurofound.europa.eu/system/files/2021-05/EF13041HU.pdf).

12 ZARIFHONARVAR, A. op. cit. p. 8. https://doi.org/10.2139/ssrn.4350925.

The impact of MI on the European labour market is therefore complex and multifaceted. Artificial Intelligence (AI) and its impact on the European labour market is a highly topical and much researched subject. I have found several relevant publications that examine this issue from different angles.

## IV. EUROPEAN PERSPECTIVES ON ARTIFICIAL INTELLIGENCE

A recent comprehensive survey from 2024 examined support for basic universal income, which is linked to the issue of technology unemployment caused by AI. The study found twenty-three relevant articles, twelve of which analysed data from the European Social Survey 2016. This research highlights that changes in the labour market caused by AI require innovative solutions, and basic income appears as one of these potential solutions.[13]

Previously, Kitti MEZEI[14] and Lucia BAKOŠOVÁ[15] also examined the legal context of artificial intelligence in the European Union. Their research highlights that the development of AI must ensure that it is human-centred and ethical, transparent, and respectful of fundamental rights. MEZEI's study analyses in detail the EU's draft regulation on artificial intelligence, which could directly affect the use of AI in the labour market.[16]

A study from 2023 presents the EU project AIM@VET (Artificial Intelligence Modules for Vocational Education and Training), which focuses on the development of vocational training modules focused on AI.[17] The aim of the project is to adapt vocational training to the needs of the labour market, with a special focus on MI. This research will highlight the importance of teaching and learning in vocational education and training (VET), which is key to preparing the European workforce for the labour market transformed by VET.[18]

The EU AI Act (Regulation (EU) 2024/1689) represents a landmark legislative framework for mitigating risks associated with AI systems, particularly in high-stakes domains such as employment.[19] Under Annex III, AI systems used for recruitment, performance evaluation, and termination of employment contracts are classified as high-risk, necessitating strict compliance with transparency, data governance, and human oversight requirements. For example, AI tools that screen job applications or monitor employee productivity must undergo conformity assessments, maintain detailed logs, and provide clear information to affected workers.[20] This regulatory approach directly addresses concerns about algorithmic bias and opacity in hiring practices, which disproportionately impact marginalized groups.[21]

The Act's risk-based hierarchy creates a dual obligation for employers: (1) to ensure technical compliance with documentation and auditing standards, and (2) to uphold

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13 SZABÓ-SZENTGRÓTI G.-WALTER V.-VÉGVÁRI B.: Support for universal basic income: A crossdisciplinary literature review. *Journal of Infrastructure, Policy and Development*, pp. 11-12, https://doi.org/10.24294/jipd.v8i10.7486.

14 MEZEI K.: Current issues in the regulation of artificial intelligence in the European Union. (A mesterséges intelligencia jogi szabályozásának aktuális kérdései az Európai Unióban) *In Medias Res*, 2023. issue 1, pp. 53-70. https://doi.org/10.59851/imr.12.1.4.

15 BAKOŠOVÁ, L.: Climate action through artificial intelligence: International legal perspective, *STUDIA IURIDICA Cassoviensia*, Vol. 10.2022, No.2. p. 18. https://doi.org/10.33542/sic2022-2-01.

16 MEZEI op. cit. p. 54. https://doi.org/10.59851/imr.12.1.4.

17 EMERŠIČ, Ž. – HRASTNIK, G. – MEH, N. – PEER, P.: Adapting VET Education to Labor Market Needs with Focus on Artificial Intelligence and Computer Vision, ROSUS 2023 - Računalniška obdelava slik in njena uporaba v Sloveniji 2023: Zbornik 17. strokovne konference, https://doi.org/10.18690/um.feri.4.2023.8.

18 EMERŠIČ, Ž.– HRASTNIK, G. – MEH, Nataša Peer – PEER, P. op. cit.

19 Regulation (EU) 2024/1689 of the European Parliament and of the Council of 13 June 2024 laying down harmonised rules on artificial intelligence and amending Regulations (EC) No 300/2008, (EU) No 167/2013, (EU) No 168/2013, (EU) 2018/858, (EU) 2018/1139 and (EU) 2019/2144 and Directives 2014/90/EU, (EU) 2016/797 and (EU) 2020/1828 (Artificial Intelligence Act) Annex III/4.

20 SOUSA E. - SILVA, N.: The Artificial Intelligence Act: Critical Overview (July 30, 2024) https: //doi.org/10.2139/ssrn.4937150.

21 POE, R. L.: Why Fair Automated Hiring Systems Breach EU Non-discrimination Law. Machine Learning and Principles and Practice of Knowledge Discovery in Databases, 465–476. https://doi.org/10.1007/978-3-031-74630-7_34.

fundamental rights under the Charter of Fundamental Rights of the EU, including non-discrimination and dignity.[22] A critical gap in current implementations, however, lies in the lack of enforceable mechanisms for workers to challenge automated decisions. While Article 14 mandates transparency for high-risk systems, it does not explicitly grant employees the right to contest algorithmic outcomes without judicial intervention.[23] This contrasts with Spain's recent reform, which empowers Workers' Councils to audit and negotiate the parameters of AI tools used in employment decisions.[24]

## V. LABOUR MARKET TRANSFORMATION INSTEAD OF THE LEISURE ERA

With the extremely rapid advances in science and technology in recent years, society is rapidly entering a new era of scientific and technological revolution and industrial transformation, led by artificial intelligence. In order to capture this new scientific and technological revolution and industrial transformation, governments around the world have issued a number of relevant policies to develop high-tech industries and to guide research and innovation.[25] Accordingly, AI is a key technology driving the new scientific and technological revolution and industrial transformation, and is at the forefront of global scientific and technological competition. The world is full of development opportunities and challenges due to the changing geopolitical landscape. The continuous advances in artificial intelligence are deconstructing and rebuilding every aspect of the world. But what impact will this have on the labour market?

KEYNES[26] envisaged the leisure age as a future state in which economic development and technological progress would result in people having significantly more leisure time. Keynes distinguished between absolute and relative needs. Modern consumer culture, especially through social media and advertising, amplifies relative needs, which encourages constant consumption and comparison. This makes it more difficult to achieve real satisfaction.

While technological advances and automation have indeed led to more leisure time, this has not led to greater happiness or satisfaction.[27] With increasing mental health problems, loneliness and general dissatisfaction in modern societies, we can now say that the Keynesian leisure era has not been brought about by such a major digital transformation.

Rather than the leisure age, AI is transforming the labour market by creating new jobs and replacing old ones.[28] Currently available research emphasises the importance of skills development[29], education[30] and the role of government policies[31] addressing the potential employment shock caused by AI. Overall, these publications provide a comprehensive picture

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22 HOGAN, L. - LASEK-MARKEY, M.: Towards a Human Rights-Based Approach to Ethical AI Governance in Europe. *Philosophies*, 9(6), 181. https://doi.org/10.3390/philosophies9060181.

23 LI, S. - SCHÜTTE, B.: The Proposed EU Artificial Intelli- gence Liability Directive. *Technology and Regulation*, 2024, 143–151. https://doi.org/10.71265/82fwbw94.

24 DURAN, S. G.: Opening the Black-Box in Private-Law Employment Relationships: A Critical Review of the Newly Implemented Spanish Workers' Council's Right to Access Algorithms. *Global Privacy Law Review*, 4(Issue 1), 17–30. https://doi.org/10.54648/gplr2023003.

25 ZHANG op. cit. p. 252. https://doi.org/10.56028/aemr.8.1.252.2023.

26 John Maynard KEYNES was one of the most important and influential economists of the 20th century. KEYNES was one of the greatest figures in theoretical economics, whose work had an extraordinary impact on economic thought and policy in the 20th century. Among his most important works is The General Theory of Employment, Interest and Money, published in 1936, which is the founding work of macroeconomics.

27 ZHANG op. cit. p. 253. https://doi.org/10.56028/aemr.8.1.252.2023.

28 LIU, J.: From the Perspective of the Labor Market, The Opportunities and Challenges Brought by the New Generation of Artificial Intelligence Technologies such as ChatGPT are Analyzed. *Scientific Journal of Technology*, issue 2023/5, p. 7. https://doi.org/10.54691/sjt.v5i5.4997.

29 ZHANG op. cit. p. 253. https://doi.org/10.56028/aemr.8.1.252.2023.

30 LIU op. cit. pp. 8-9. https://doi.org/10.54691/sjt.v5i5.4997.

31 ZHOU, Q.: Research progress on the impact of artificial intelligence on the labor market. *Advances in Economics and Management Research*, issue 2023/8. p. 242. https://doi.org/10.56028/aemr.8.1.241.2023.

of the impact of AI on the European labour market, highlighting the legal, educational, and economic challenges and opportunities.

Although it is too early to talk about the impact of AI on labour market differences between European countries, the available data suggest some important correlations.

**1. Education systems and social inequalities**

One key factor in the differences between European countries is the diversity of education systems. Differentiation in secondary education has a significant impact on the association between social origin and social status in adulthood.[32] This suggests that in a labour market transformed by AI, the flexibility and adaptability of countries' education systems may be key to adapting to technological change.

Differences between European countries are significantly influenced by institutional and labour market characteristics. Active labour market policies, the generosity of unemployment benefits and the coverage of collective bargaining explain a large part of the differences between countries in labour market insecurity and welfare.[33] With the rise of AI, these factors may become even more important, as they may affect countries' ability to address AI-related challenges.

**2. Language and cultural factors**

Language distance and language skills have a significant impact on the labour market integration of migrant workers, especially women.[34] Research shows that a good knowledge of the language of the destination country is a key factor for successful integration. Better language skills increase the chances of participation in the labour market and of finding a job, as well as having a positive impact on expected wages. However, lack of language skills can make it more difficult to find a job even if you have the right qualifications.[35] The linguistic distance, i.e. the difference between the migrant's mother tongue and the language of the destination country, has a negative impact on labour market integration. This effect is particularly strong for women, for whom a greater language distance reduces labour market participation, employment and hours worked. For men, the effect of linguistic distance is less pronounced, but also has a negative impact on hours worked.[36] Developing language skills not only improves your immediate job prospects but also has a positive impact in many other areas. Better language skills reduce feelings of discrimination in the workplace, increase self-esteem and self-efficacy, and are also associated with better general health. All these factors indirectly contribute to more successful labour market integration.[37]

It is important to note that, in addition to language skills, other factors also affect the labour market situation of migrants. For example, educational attainment, vocational qualifications, the economic situation in the host country and the circumstances of migration (e.g. economic

[32] SCHINDLER, S., BAR-HAIM, Y., BARONE, C., BIRKELUND, J. F., BOLIVER, V., CAPSADA-MUNSECH, Q., EROLA, J., FACCHINI, M., FENIGER, Y., HEISKALA, L., HERBAUT, E., ICHOU, M., KARLSON, K. B., KLEINERT, C., REIMER, D., TRAINI, C., TRIVENTI, M., & VALLET, L-A: Educational tracking and social inequalities in long-term labour market outcomes: Six countries in comparison. *International Journal of Comparative Sociology*, 65(1), pp. 39-62. https://doi.org/10.1177/00207152231151390.

[33] INANC, H. - KALLEBERG, A. L.: Institutions, Labor Market Insecurity, and Well-Being in Europe. *Social Sciences,* 2022, 11(6), 245 p. 3. https://doi.org/10.3390/socsci11060245.

[34] BAR-HAIM E, BIRGIER D.P.: Language distance and labor market integration of migrants: Gendered perspective. *PLoS ONE*, 19(4), pp. 3-4.

[35] GÖDRI I.: Gender differences in the labour market situation of foreign nationals in Hungary (Nemek közötti eltérések a külföldi állampolgárok munkaerő-piaci helyzetében Magyarországon.) *In*: NAGY I.– PONGRÁCZ T.-né – TÓTH I. Gy. (ed.): Role changes. Report about men and women (Szerepváltozások. Jelentés a férfiak és a nők helyzetéről) 2011. TÁRKI, Nemzeti Erőforrás Minisztérium, Budapest, p. 90.

[36] GÖDRI op. cit. p. 91.

[37] GÖDRI op. cit. p. 88.

migrant, family reunification or refugee status). Ethnic and cultural distance also plays a role, as it can increase the chances of ethnic discrimination.[38]

Overall, developing language skills and bridging cultural gaps is key to the successful integration of migrant workers into the labour market. Host countries should develop programmes and policies that support migrants' language learning and cultural integration, thus helping their economic and social integration. With the spread of AI technologies, this factor may take on a new dimension, as AI-based language tools can reduce language barriers but also require new skills.

**3. Impact of demographic changes**

The demographic transition in the countries of Central and Eastern Europe, including declining birth rates, ageing, and migration, is putting considerable pressure on labour markets and pension systems. Ageing populations and falling birth rates are all contributing to a steady decline in the working age population. The rise of AI could further complicate this situation by changing the demand for labour and the skills needed.[39]

Projected trends suggest that the proportion of the working age population could fall significantly, leading to a decline of up to 25-38% by 2060 compared to the current situation.[40]

These demographic changes not only have an impact on the labour market but also threaten the sustainability of pension systems. Pension systems operate on a pay-as-you-go basis, with contributions from active workers funding pensioners.[41] A declining working-age population and a growing pensioner population could create imbalances, which may require public budget support.[42] The emergence of artificial intelligence further complicates the situation. The spread of AI is creating new challenges and opportunities in the labour market: automation and the use of AI are particularly relevant for low-skilled, routine tasks that can potentially be replaced by machines. However, this means not only job losses but also the emergence of new positions requiring higher skills. The changing demand for labour makes it essential to continuously train and retrain workers. The increase in demand for new AI-generated jobs, such as data analysts or AI experts, means that traditional training systems will also need to be adapted to meet new technological requirements. The future labour market will require skills such as digital literacy, creative problem solving and adaptability.

Overall, the demographic transition in Central and Eastern European countries and the rise of AI are combining to pose serious challenges for labour markets and pension systems. To develop proper responses, it is necessary to strengthen social dialogue and develop policies that consider the changing demographic and economic context.

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38 GÖDRI op. cit. p. 89.

39 BALTES, N.j.-JIMON, S. A.: Study regarding the effects of demographic transition on labor market and public pension system in Central and Eastern Europe. *Studies in Business and Economics*, no. 15(1)/2020. p. 160. https://doi.org/10.2478/sbe-2020-0013.

40 KREISZNÉ H. E.: Labour market effects of demographic change in Hungary (A demográfiai változások munkaerőpiaci hatásai Magyarországon) *Confessio*, issue 2016/4. p. 19.

41 KOLOH G.: The problem of demographic transition. Possibilities of interpreting a global process. (A demográfiai átmenet problematikája. Egy globális folyamat értelmezésének lehetőségei.) *Korall*. Issue 22/85. p. 28. https://doi.org/10.52656/korall.2021.03.002.

42 RAB H.: The circumstances of the 1997-98 pension reform and its impact on the development of the pension system. (Az 1997-98-as nyugdíjreform körülményei és hatása a nyugdíjrendszer fejlődésére.) *Miskolci Jogi Szemle*. 2010/2. issue, p. 52.

## 4. Environmental policies and employment

According to a 2020 study, environmental regulations have a heterogeneous impact on different occupations, increasing the demand for jobs with green potential.[43] The AI is expected to have a similar impact on the labour market, valuing some occupations and marginalising others.

The rise of environmental regulation and AI will significantly reshape the labour market, creating new opportunities and marginalising some professions. This process particularly affects jobs with green potential, for which there is a growing demand.

Tightening environmental regulations and the growing demand for sustainability are leading to the emergence of new professions. For example, the role of urban gardeners is becoming more valued as cities increasingly strive to create greener environments. Precision agriculture is seeing the use of AI-controlled drones, robots, and sensor systems, requiring new types of skills from agricultural professionals. In the environmental field, AI models analyse ecological data, predict the effects of climate change[44], and support sustainable resource management. This increases the demand for professionals who can develop and run these systems and interpret the results.[45]

The rise of green technologies is also creating new opportunities for engineers and technicians. The development and operation of renewable energy, energy efficient systems and green technologies require a skilled workforce. The use of AI in these areas will further increase efficiency and create new jobs.[46] The combined impact of environmental regulation and AI on the labour market is a complex and dynamic process. While some traditional jobs are being sidelined, new, innovative, and sustainability-focused positions are emerging.

This change requires continuous training and retraining of the workforce to meet new challenges and opportunities.

## 5. Regulatory environment

Finally, it should be stressed that changes in the regulatory environment also have an impact on the labour market. For example, the EU AI Regulation sets new requirements for the development and deployment of AI systems.[47]

In 2020, the Commission of the European Union published a White Paper on Artificial Intelligence (AI), which set out a single EU regulatory framework for the development and deployment of AI technologies.[48] The document stresses that the broad societal impact of AI makes it essential to harmonise technological progress with fundamental human values, including respect for human dignity and privacy. It stresses that the reliability of AI systems can

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43 NIGGLI, M. - RUTZER, CH.: Environmental Policy and Heterogeneous Labor Market Effects: Evidence from Europe, p. 3. https://doi.org/10.2139/ssrn.3973664.

44 BAKOŠOVÁ, L.: Climate action through artificial intelligence: International legal perspective, *STUDIA IURIDICA Cassoviensia*, Vol. 10.2022, No.2. p. 14. https://doi.org/10.33542/sic2022-2-01.

45 DIÓSI SZ.: Artificial intelligence, synthetic reality. Global challenges related to AI and GenMI systems and European regulatory strategies. (Mesterséges intelligencia, szintetikus valóság. Az MI és GenMI rendszerekkel kapcsolatos globális kihívások és európai szabályozási stratégiák.) *Doctoral (PhD) thesis*, 2024, Doctoral School of Public and Law, University of Pécs (available at: https://ajk.pte.hu/sites/ajk.pte.hu/files/file/doktori-iskola/diosi-szabolcs/diosi-szabolcs-muhelyvita-ertekezes.pdf) p. 5.

46 VIRÁG B. – HORVÁTH M.: Economic Policy of Eurasia: Sustainable and Innovative Economic Policy Strategies in Eurasia. (Eurázsia gazdaságpolitikája: Fenntartható és innovatív gazdaságpolitikai stratégiák Eurázsiában.) *Hungarian National Bank*, Budapest, 2024. p. 206.

47 Regulation (EU) 2024/1689 of the European Parliament and of the Council of 13 June 2024 laying down harmonised rules on artificial intelligence and amending Regulations (EC) No 300/2008, (EU) No 167/2013, (EU) No 168/2013, (EU) 2018/858, (EU) 2018/1139 and (EU) 2019/2144 and Directives 2014/90/EU, (EU) 2016/797 and (EU) 2020/1828 (Artificial Intelligence Act).

48 White Paper on Artificial Intelligence: A European approach to excellence and trust, Brussels, 19.2.2020 COM(2020) 65 final.

only be set up if developments are linked to the ethical standards that define European societies. In this context, the concept of human-centred AI is a technological paradigm that not only creates opportunities for innovation but also guarantees respect for European values.[49]

Excellence and trust are at the heart of the EU's White Paper and play a crucial role in the field of AI. In my view, a development can be considered excellent when performance, efficiency, innovation, and ethics are in harmony.

The excellence of AI is a measure of its performance and effectiveness.[50] This includes the accuracy, speed, and reliability of the algorithms in the target area. Achieving excellence requires continuous improvement and innovation in AI. Develop new techniques, algorithms, and approaches to improve effectiveness and functionality. Finally, for AI to achieve excellence, it is important to consider ethical and societal considerations in its development and deployment, including data protection, fairness, and equal opportunities.

Humans are naturally wary of novelty and the unknown, so it is no coincidence that trust is a key issue in AI. Trust fosters the adoption of AI, because when people are convinced that it is safe, reliable and truly supports their daily activities, they are more open to it. But transparency and clear explanations are essential. Transparency in the decisions and operation of the AI strengthens user trust, as it is important that the system can clearly explain its decisions and the logic of its operation. Finally, the responsible use of AI by both developers and users, respecting the relevant legislation and ethical guidelines, is key to trust.[51] Excellence and trust are therefore interlinked, they *go hand in hand,* and one is essential to the other. Developers and users need to place a strong emphasis on both areas for AI to successfully and sustainably serve societal goods.

The Commission is therefore promoting a regulatory and investment-oriented strategy with the dual aim of promoting the uptake of AI and addressing the risks associated with certain applications of the new technology. The White Paper, referred to above, aims to set out policy options on how to achieve these objectives. It does not address the development and use of AI for military purposes. The Commission invites Member States, other European institutions and all stakeholders, including industry, social partners, civil society organisations, researchers, the public and interested parties, to respond to the options presented in order to develop future Commission proposals.[52]

The legal adoption process of the European Union's Artificial Intelligence (AI) Regulation (AI Act) was a two-step process: first voted by the European Parliament on 13 March 2024 and approved by the European Council on 21 May 2024. During this process, the Parliament adopted the legislation with 523 votes in favour, forty-six against and forty-nine abstentions, while the Council unanimously supported the final text. The law was preceded by an agreement between the Council and the Parliament on 9 December during the *trialogue* negotiations. The final text was adopted by the Council on 21 May 2024, thus completing the legislative process. The Regulation was published in the Official Journal of the European Union on 12 July 2024 and entered into force on 1 August 2024. However, the application (implementation) of the

[49] MEZEI op. cit. p. 54. https://doi.org/10.59851/imr.12.1.4.

[50] EKLER, P. – PÁSZTOR, D.: Areas of application and security issues of applied artificial intelligence – Artificial intelligence in practice. (Alkalmazott mesterséges intelligencia felhasználási területei és biztonságos kérdései – Mesterséges intelligencia a gyakorlatban.) *Scientia et Securitas*, 1(1), pp. 36-37. https://doi.org/10.1556/112.2020.00006.

[51] RIDEG G.: Artificial intelligence and public administration: Thoughts on the risk-based approach to artificial intelligence regulation in practice, challenges and opportunities. (A mesterséges intelligencia és a közigazgatás: Gondolatok a mesterséges intelligencia szabályozás kockázatalapú megközelítéséről a gyakorlatban, kihívások és lehetőségek.) *Közigazgatási Tudomány*, issue 2023/3, p. 161. https://doi.org/10.54200/kt.v3i2.65.

[52] White Paper on Artificial Intelligence: A European approach to excellence and trust, Brussels, 19.2.2020 COM(2020) 65 final.

provisions of the Regulation will be phased in gradually, with full compliance obligations for high-risk AI policyholders, for example, only coming into force on 2 August 2027.[53]

The regulation was finally adopted as a regulation that classifies AI applications into three risk categories. It bans applications and systems that pose an unacceptable risk[54] and for high-risk[55] use cases it imposes a strict regulatory regime, including record-keeping, detailed user information, monitoring, intervention, and recall. Finally, the third category of low-risk or no-risk applications.[56]

The GDPR's Article 22 establishes a right against fully automated decisions that significantly affect individuals, including hiring, promotion, or dismissal.[57] In CJEU Case C-634/21, the Court ruled that credit scoring systems classifying individuals based on algorithmic profiling constitute automated decision-making under Article 22, requiring explicit consent or contractual necessity.[58] Applying this precedent to employment contexts, AI-driven tools that rank candidates or evaluate performance without human intervention may violate GDPR unless employers demonstrate strict necessity or obtain worker consent.[59]

However, the GDPR's individual-centric framework struggles to address systemic biases embedded in training data. For instance, AI models trained on historical hiring data may perpetuate gender or racial disparities, even if compliant with technical GDPR standards.[60] A collective governance model, such as Spain's algorithmic co-governance, offers a solution by mandating worker representatives' involvement in auditing and refining AI systems.[61] This approach aligns with the EU AI Act's emphasis on human oversight but goes further by institutionalizing worker participation in algorithmic design.[62]

In another case of the Court of Justice of the European Union, Case C-157/15, the interpretation of employer responsibility (occupational stress claims) could extend to failures in AI system maintenance, creating a hybrid liability regime where both technical providers and employers share accountability.[63]

## VI. ILLUSTRATE SOME SECTORAL IMPACTS WITH EXAMPLES

Finally, in this research I would like to mention some examples of areas where AI has a significant impact on the labour market. Although this impact varies from sector to sector, I will briefly provide an overview of how AI is affecting different sectors in the labour market, illustrated by a few examples. AI is expected to transform the labour market, creating new jobs, and making others redundant. The World Economic Forum estimates that by 2025, AI and

53 Regulation (EU) 2024/1689 of the European Parliament and of the Council of 13 June 2024 laying down harmonised rules on artificial intelligence and amending Regulations (EC) No 300/2008, (EU) No 167/2013, (EU) No 168/2013, (EU) 2018/858, (EU) 2018/1139 and (EU) 2019/2144 and Directives 2014/90/EU, (EU) 2016/797 and (EU) 2020/1828 (Artificial Intelligence Act) Article 113.

54 Artificial Intelligence Act, Article 5.

55 Artificial Intelligence Act, Chapter III.

56 Artificial Intelligence Act, Chapter V.

57 Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation).

58 HORSTMANN, J.: CJEU: The Rating of a Natural Person's Creditworthiness by a Credit Rating Agency Constitutes Profiling and Can Be an Automated Decision under Article 22 GDPR. *European Data Protection Law Review*, 10(1), 117–123.

59 DURAN op. cit p. 25. https://doi.org/10.54648/gplr2023003.

60 POE op. cit. 469. https://doi.org/10.1007/978-3-031-74630-7_34 .

61 DURAN op. cit p. 26. https://doi.org/10.54648/gplr2023003.

62 HOGAN, L. - LASEK-MARKEY, M. op. cit. p. 181. https://doi.org/10.3390/philosophies9060181.

63 DE GRAAF, T. - VELDT, G.: The AI Act and Its Impact on Product Safety, Contracts and Liability. *European Review of Private Law,* 30(Issue 5), 803–834. https://doi.org/10.54648/erpl2022038.

automation could eliminate eighty-five million jobs while creating ninety-seven million new jobs.[64]

Artificial intelligence is fundamentally transforming the way manufacturing and industry works, from optimising production processes to rethinking workforce organisation. The technology's impact is most clear in four primary areas: predictive maintenance and equipment management; quality assurance and defect detection; supply chain optimisation; and human-machine interaction.

Artificial intelligence can predict machine failures by analysing sensor data, reducing the frequency of unplanned downtime. For example, in the automotive industry, processing robot performance data can reduce lost production time by 30-50%. Digital twins help simulate equipment behaviour so that maintenance can be scheduled outside peak production times. The General Electric example shows that AI-based solutions can increase equipment lifetime by 20%.[65] Computer vision-based AI systems can find manufacturing defects in real time, exceeding the accuracy of traditional visual inspection. BMW, for example, has achieved a 99.9% defect detection rate for in-production part inspection on its AIQX platform. Similar solutions can be applied in the electronics industry, where soldering defects can be found 40% faster.

AI algorithms can predict demand fluctuations, optimise inventory management, and simulate different scenarios. Walmart in the US achieved a 15% reduction in inventory levels with AI-based demand forecasting.[66] Swedish manufacturer Hexpol reduces parts shortages by 30% by combining IIoT sensors and RFID tracking.[67] Finally, the example of the Dutch Airbus shows that autonomous design systems can generate 10 000 design variants in 1 hour.[68]

Artificial Intelligence (AI) has brought a major transformation to healthcare, where technology has become a strategic partner, not just a tool, in everything from diagnostics to therapies. In the diagnostic field, for example, breakthroughs in the analysis of imaging technologies have revolutionised patient care. In breast cancer screening, FDA-approved AI systems such as those developed by Google Health can find tumours on mammograms with 99% accuracy, while reducing scan times by a factor of thirty compared to traditional methods. At the same time, wearable devices such as smartwatches can detect early heart rhythm disturbances with 97% confidence based on continuously collected ECG data.[69] These innovations are not limited to physiology: for rare diseases, machine-learning algorithms link symptoms from different databases, reducing diagnosis time from years to months.[70]

## VII. CONCLUSION

The revolutionary impact of artificial intelligence on the European labour market is no longer a futuristic vision, but an everyday reality. Technology is not just automating routine tasks, it is

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64 LOSONCI D. – TAKÁCS O. - VÁROSINÉ D. K.: In the wake of the effects of Industry 4.0 – an analysis of the Hungarian automotive industry. (Az ipar 4.0 hatásainak nyomában – a magyarországi járműipar elemzése.) *Közgazdasági Szemle,* Vol. LXVI, February 2019, pp. 185-218. https://doi.org/10.18414/ksz.2019.2.185.

65 FINIO, M. – DOWNIE, A.: How is AI being used in manufacturing? (available: https://www.ibm.com/think/topics/ai-in-manufacturing).

66 BHARADWAJ, CH.: How AI in Manufacturing is Revolutionizing the Industry: Key Use Cases and Examples. (available: https://appinventiv.com/blog/ai-in-manufacturing).

67 GREENFIELD, D.: Top Manufacturing Tech Applications in 2025, Six experts from across the industrial automation sector weigh in with their expectations about the technologies manufacturers will use most effectively this year. (available: https://www.automationworld.com/factory/digital-transformation/article/55253334/ai-robots-supply-chain-and-energy-tech-will-drive-manufacturing-in-2025).

68 DILMEGANI, C.: Manufacturing AI: Top 15 tools & 13 use cases & case studies. (available: https: //research.aimultiple.com/manufacturing-ai/).

69 SU, L. (ed.): A Review of the Role of Artificial Intelligence in Healthcare. *J Pers Med*. 2023. June 5;13(6):95.

70 DAVE, M. – PATEL, N.: Artificial intelligence in healthcare and education. *British Dental Journal* 234, pp. 761–764. https://doi.org/10.1038/s41415-023-5845-2.

fundamentally transforming the philosophy of work, presenting new challenges and opportunities for workers and decision-makers alike. The most significant trend in this transformation is the polarisation of the labour market, embodied in an 'hourglass model': the proportion of high- and low-skilled jobs is increasing, while the proportion of medium-skilled jobs is decreasing.

Demographic changes are worsening the situation in Central and Eastern Europe. The working age population is expected to fall by 25-38% by 2060, which could mean the collapse of pay-as-you-go pension systems. In this context, AI plays a dual role: on the one hand, it accelerates the displacement of low-skilled jobs, and on the other hand, it creates new opportunities in the fields of predictive analytics, automated production, or digital health.

The European Union took steps to create a regulatory environment in 2024 when it adopted the Regulation on Artificial Intelligence. The EU's regulatory response is key to balancing technological progress with human values. Although the Regulation will enter into force gradually, for example full compliance obligations for high-risk systems will only become mandatory from August 2027, this regulatory framework does not only impose technical requirements but also serves to protect the European social model of human dignity, solidarity, and social justice.

In my view, a transformation of training systems is becoming urgent. The European Commission's AIM@VET programme, for example, is developing AI-based vocational training modules to prepare the workforce for the new challenges. Digital literacy, creative problem-solving and adaptability are among the priority skills of the future. While AI tools (e.g. real-time translation tools) can help to reduce language barriers, they also pose new challenges for the integration of migrant workers. Workers who cannot or have difficulty in buying these skills will have little chance of succeeding in a changing labour market.

In summary, artificial intelligence is not a technical tool, but a paradigm shifts in society. Rethinking work is not about the disappearance of jobs, but about their profound transformation. AI will be a partner, freeing people from being slaves to routine, but social cooperation is essential.

My *de lege ferenda proposal* is as follows. The EU AI Act’s current framework prioritizes technical compliance but lacks mechanisms for institutionalizing worker participation in AI system design and deployment. To address this, national labour laws should be amended to grant trade unions explicit rights to audit algorithmic decision-making systems used in recruitment, performance evaluation, and task allocation, including access to training data and model parameters. They should also ensure the right to negotiate algorithmic transparency clauses in collective agreements, requiring employers to disclose how AI systems influence working conditions, wage structures, and disciplinary actions. Finally, they should also guarantee the right to veto the implementation of high-risk AI systems that fail independent bias audits or conflict with sectoral ethical guidelines.

This approach aligns with Spain’s 2023 reforms, where Workers’ Councils may demand technical documentation of AI tools affecting employment terms. However, the EU should standardize these rights through a Directive on Algorithmic Co-Governance, mandating Member States to integrate trade union oversight into their AI compliance frameworks.

Europe is now facing a choice. The choice is now between technological progress guided by people-centred values or being overshadowed by polarisation and a demographic divide. The labour market of the future requires institutions capable of flexibility, a culture of lifelong learning and ethical innovation. Transforming education, strengthening social dialogue, and constantly updating regulations are not a luxury but a vital condition for sustainability. Europe's response to this challenge will decide whether the continent stays a global value model in the 21st century or loses its competitiveness.

**KEY WORDS**
Artificial intelligence, European Union, labour market, transformation, machine learning, ethical AI, job displacement, upskilling, AI Act, new skills, skill gap, emergence of new jobs, regulation, labour market polarisation

**KĽÚČOVÉ SLOVÁ**
umelá inteligencia, Európska únia, trh práce, transformácia, strojové učenie, etická umelá inteligencia, strata pracovných miest, zvyšovanie kvalifikácie, zákon o umelej inteligencii, nové zručnosti, rozdiely v zručnostiach, vznik nových pracovných miest, regulácia, polarizácia trhu práce

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**CONTACT DETAILS OF THE AUTHOR**

**Dr. Balázs Fábián**
ORCID: 0009-0004-0051-3890
PhD student
University of Győr, Faculty of Law,
Department of Labour and Social Law
Egyetem tér 1., H-9026, Győr, Hungary
Phone number: +36308501511
E-mail: fabian.balazs@ga.sze.hu