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THE INNOVATION-DRIVEN TRANSFORMATION OF THE GLOBAL LABOR MARKET: VIRTUAL AGGLOMERATION AND STRUCTURAL CHANGES BY 2030

The study analysed that the global labor market is navigating a “double disruption” scenario driven by the acceleration of intelligent automation and the imperatives of the green transition. This study synthesizes data from the “World Economic Forum’s Future of Jobs Report 2025” and recent empirical evidence on “Virtual agglomeration”. The paper identifies that the projected creation of millions of jobs could be accompanied by a shift in the key skills of the workforce, potentially deepening labor stratification. Based on the concept of “Virtual agglomeration”, this study elucidates how digital platforms are reshaping the spatial and structural dynamics of employment, moving beyond physical clusters to digital ecosystems. Paper proves that while AI acts as a “promotional” force for aggregate employment, it simultaneously risks reducing the role of human labor. Paper argues that the minimization of the risks “transforming human labor to the appendix of machine” might be possible on the basis of reskilling those workers from “Precarity” Cohort who’s their routine skills devalued by automation.

Key words: labor market transformation, virtual agglomeration, structural churn, intelligent automation, technological precarity, reskilling revolution, job displacement, artificial intelligence.

Table – 1, Figure – 1, Literature – 11

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ІННОВАЦІЙНО-ОРІЄНТОВАНА ТРАНСФОРМАЦІЯ РИНКУ ПРАЦІ: ВІРТУАЛЬНА АГЛОМЕРАЦІЯ ТА СТРУКТУРНІ ЗРУШЕННЯ ДО 2030 РОКУ

У статті аналізується, що світовий ринок праці переживає сценарій «подвійних потрясінь», зумовлений прискоренням інтелектуальної автоматизації та імперативами зеленого переходу. У цьому дослідженні узагальнено дані зі «Звіту Всесвітнього економічного форуму про майбутнє робочих місць за 2025 рік» та новітні емпіричні дані щодо «віртуальної агломерації». У статті визначено, що прогнозне створення мільйонів робочих місць може супроводжуватися зміною ключових навичок робочої сили, що потенційно поглибить стратифікацію праці. Базуючись на концепції «віртуальної агломерації», це дослідження пояснює, як цифрові платформи змінюють

просторову та структурну динаміку зайнятості, виходячи за межі фізичних кластерів до цифрових екосистем. У статті доведено, що хоча штучний інтелект діє як «просувальна» сила для сукупної зайнятості, він одночасно ризикує зменшити роль людської праці. У статті обгрунтовано, що мінімізація ризиків «перетворення людської праці на додаток до машини» може бути можливою на основі перекваліфікації тих працівників з когорти «прекарності», чиї рутинні навички знецінилися автоматизацією.

Ключові слова: трансформація ринку праці, віртуальна агломерація, структурні зрушення, інтелектуальна автоматизація, технологічна незахищеність, революція перекваліфікації, витіснення робочих місць, штучний інтелект.

Табл. – 1, Рис. – 1, Літ. – 11

Problem Statement. The central problem addressing the global economy in the mid-2020s is the paradox of "high-velocity structural mismatch". On the one hand, the Fourth Industrial Revolution has changed the approach to productivity growth based on using of Generative AI (GenAI) and Big Data analytics for technology-driven change for creation of the inclusive, human-centred future. On the other hand, digitization stipulated the formation of new relationships within labor market creating new types of demand. The Future of Jobs Report 2025 forecasts that 92 million jobs-primarily in clerical, administrative, and routine manual sectors-will be displaced by 2030 [1, p. 22].

Conceição and el. warns that without intervention, technological integration inevitably leads to the evasion of labor, where human agency is subordinated to algorithmic efficiency [2, p. 340]. Furthermore, the mechanism of job creation is shifting; employment growth is no longer solely dependent on physical industrial density but on "Virtual agglomeration" a phenomenon that creates new disparities between digitally integrated and isolated regions. The problem, therefore, is not mass unemployment, but the emergence of a dualistic labor market characterized by high-value "cognitive" roles and low-agency "precarious" roles, with a hollowing middle class [3, p. 2]. That's why it is important to define the specific features of the innovation-driven transformation of the global labor market.

Literature Review. Early analyses of the Fourth Industrial Revolution emphasized the "substitution effect", warning of a "Great Decoupling" between productivity and wages [4, p. 11]. However, the situation changed significantly. Acemoglu and Restrepo introduced the "task-based approach", suggesting that automation displaces labor in specific tasks while "reinstatement" effects create new, more complex tasks [5, p. 1489]. This task-based model is critical for understanding why total employment has not collapsed despite exponential increases in computing power; as machines take over routine tasks, humans are reallocated to non-routine cognitive tasks that technology complements rather than substitutes [6, p. 5].

Valdir Conceição's "The Impact of Technology in the World of Work" argues that while technology reduces physical burden, it often increases "cognitive load" and stress, transforming the nature of labor. He highlights the environmental and social costs as a "technological waste" and "precarious work" that accompany the drive for efficiency [2, p. 342].

Complementing this, Shen and Zhang in Nature introduce the concept of "Virtual Agglomeration". Under traditional economy jobs cluster in physical cities due to knowledge spillovers (Marshallian externalities). Shen and Zhang demonstrate that in the digital economy, these spillovers occur on platforms, creating "virtual clusters" that allow for labor deepening and division without physical proximity. Their empirical analysis proved that AI mitigates the damaging impact of robot adoption, exerting a net positive "promotional effect" on employment, particularly in sectors capable of remote integration [3, p. 4].

Recent studies by Arntz, Gregory, and Zierahn challenge the high displacement figures of earlier studies (like Frey and Osborne, who predicted 47% of US jobs were at risk [7, p.

254]), arguing that when focusing on tasks rather than occupations, the risk drops significantly to around 9% in OECD countries [8, p. 4]. This distinction implies that jobs will not disappear but will be radically transformed. Furthermore, the "skill-biased technological change" (SBTC) hypothesis suggests that technology increases the returns to education, widening the gap between the skilled and unskilled [9, p. 3]. According to the point of view of Goldin, C., & Katz, L., this reinforces the urgency of the "Reskilling Revolution" proposed by global organizations, as the "race between education and technology" enters a critical phase where the educational system is currently lagging behind the technological frontier [10, p. 14].

Research Aim. The primary aim of this study is to investigate the structural transformation of the global workforce based on conception of Virtual Agglomeration and the warnings of labor precarity. Specifically, this paper seeks to:

- Quantify the net impact of macro-trends on global employment levels
- Analyse the role of Virtual Agglomeration in distributing these new roles
- Assess the qualitative risks to the workforce regarding skills gaps and job quality

By synthesizing these diverse datasets, we aim to define the directions for minimization of the risks for labor market transformation during the post-2025 labor landscape [1, p. 8].

Analysis Results. The analysis of the converging datasets reveals the existence of significant structural changes. The findings are categorized into three dimensions: The Quantitative Outlook (WEF 2025 Data), The Spatial Mechanism (Virtual Agglomeration), and The Qualitative Impact (Precarity and Skills).

Data from the World Economic Forum's Future of Jobs Report 2025 provides the baseline for our quantitative analysis. The report, surveying over 1,000 global employers representing 14 million workers, establishes the intensification of the "Transformation of Work" process.

By 2030, the global labor market expects a structural labor market churn of 22%. This churn is the aggregate of creating new roles and phasing out obsolete ones [1, p. 29].

Employers forecast the gross creation of 170 million new jobs. This is driven by three macro-trends: the green transition (creating roles in renewable energy and sustainable agriculture), the adoption of new technologies (AI, Big Data), and the broadening of digital access. Simultaneously, 92 million jobs will be displaced. The decline is concentrated in roles susceptible to "algorithmic standardization". The net result is a positive addition of 78 million jobs to the global economy [1, p. 31].

Figure 1 below illustrates this structural shift, highlighting the specific occupational clusters driving these numbers. As shown in Figure 1, the growth is heavily skewed towards specialized technical roles, while the decline is precipitous in traditional administrative functions.

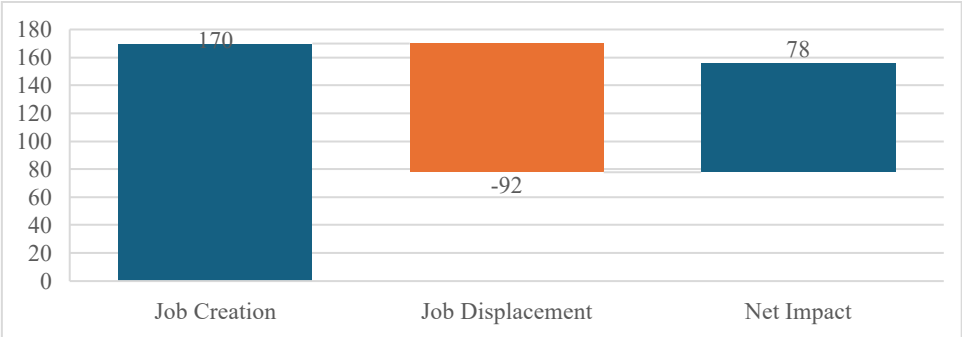

Figure 1 - Projected Global Labor Market Churn (2025-2030)

Source: Synthesized from World Economic Forum, The Future of Jobs Report 2025 [1]

The data in Figure 1 reveals a critical insight: the jobs being created are not direct substitutes for the jobs being lost. A displaced "Data Entry Clerk" cannot immediately pivot to become a "Fintech Engineer". This "mismatch" is the core of the friction. The report highlights that 39% of workers' skills will be disrupted in the next five years. The fastest-growing skills are AI and Big Data Literacy, Creative Thinking, and Resilience/Agility. The decline of manual dexterity and memory-based skills is accelerating, rendering the "human repository of facts" obsolete [1, p. 48].

To understand how these 170 million jobs are created and distributed, we apply the framework of "Virtual Agglomeration" proposed by Shen and Zhang. Traditional industrial economics relies on physical agglomeration-factories clustering in Detroit or tech firms in Silicon Valley-to reduce transaction costs and share labor pools [3, p. 3]. In the 2025 context, Virtual Agglomeration refers to the concentration of economic activity on digital platforms (cloud computing, remote work ecosystems, digital marketplaces). This phenomenon fundamentally alters the elasticity of labor demand.

Shen and Zhang's econometric modeling demonstrates that as industries adopt AI and robotization, they initially displace labor (substitution). However, the efficiency gains lead to "capital deepening" and cost reductions, which expand market size. In a virtual agglomeration, these gains are amplified because the market is not spatially constrained [3, p. 6]. A firm in Bangalore can instantaneously access a specialized AI engineer in Bucharest.

Furthermore, the analysis shows that virtual agglomeration "mitigates the damaging impact of robot adoption". By breaking down the physical barriers to entry, it allows for a finer "division of labor". Tasks that were previously bundled into a single job (e.g., an administrative assistant doing scheduling, data entry, and travel booking) are unbundled. The data entry is automated, but the scheduling and complex coordination are outsourced to specialized virtual service providers, often creating more total employment hours but in a fragmented structure [3, p. 8].

Table 1 visualizes this mechanism, comparing the traditional industrial impact of automation with the new virtual agglomeration model. Table 1 demonstrates that while traditional agglomeration relied on local labor supply, virtual agglomeration leverages global talent pools, fundamentally shifting the "Job Effect" from substitution to complementarity.

The WEF 2025 report corroborates this mechanism by citing "Broadening Digital Access" as the second most impactful trend (78.4% of companies) [1, p. 12]. The ability to work within a "Virtual agglomeration" is what allows the net positive figure of 78 million to be realized. Without digital platforms, the displaced workers in declining regions would simply remain unemployed; with virtual agglomeration, they technically have access to global demand-provided they possess the requisite digital skills.

Table 1 - The Mechanism of Virtual Agglomeration on Employment

Feature	Traditional Industrial Agglomeration	Virtual Agglomeration (AI Era)	Impact on Employment
Space	Physical proximity (Industrial Parks)	Digital Platforms (Cloud/Remote)	Decoupling of residence and work
Labor Market	Localized / Regional	Global / Hyper-connected	Access to larger talent pools

Feature	Traditional Industrial Agglomeration	Virtual Agglomeration (AI Era)	Impact on Employment
Skill Match	Limited by local supply	Precision matching via algorithms	Reduced structural unemployment
Job Effect	Substitution Dominant: Machines replace local workers.	Complementarity Dominant: AI augments remote specialists.	Net Positive (Promotional Effect)

Source: Derived from Shen, Y. & Zhang, X. [3] and WEF Data [1]

The transition to a high-tech, virtually agglomerated workforce is not without severe risks to the quality of work. Conceição argues that as technology advances, the worker is increasingly transformed into an "appendix of machines" [2, p. 341]. In the 2025 context, this manifests in the "human-in-the-loop" economy. While 170 million jobs are created, many (such as data labeling for AI or gig-economy delivery) involve interacting with algorithms that dictate the pace, scope, and remuneration of work [2, p. 343].

The shift away from formal, physical employment to virtual, platform-based roles often strips workers of traditional protections (unions, benefits, long-term contracts). The "flexibility" cited by WEF as a positive skill is interpreted by critical theorists as "instability" [1, p. 50]. Additionally, Conceição highlights the environmental "cost-technological waste". The WEF report cites the "Green Transition" as a job creator (e.g., Farmworkers, Renewable Engineers). However, the massive computational power required to sustain "Virtual Agglomeration" (data centers, AI training) creates a tension between the digital jobs and the ecological goals they purport to support [2, p. 339].

Merging these three perspectives, the analysis identifies the Skills Gap as the single determinant of whether a worker ends up in the "Net Creation" (Promotional) cohort or the "Net Displacement» (Precarity) cohort. The WEF notes that 63% of employers see skills gaps as the main barrier [1, p. 55]. The "Promotional" Cohort utilizes Virtual Agglomeration to leverage high-skill cognitive tasks (Creative Thinking, AI management) across a global market. The "Precarity" Cohort finds their routine skills devalued by automation and, if they fail to reskill, are pushed into the low-end of the virtual agglomeration (precarious micro-tasks) or displaced entirely. The 39% skills churn implies that nearly half of the workforce's current value proposition will evaporate by 2030 [1, p. 58].

This polarization is consistent with findings on labor market hollowing, where middle-skill jobs are eroded [8, p. 12]. The virtual agglomeration effect risks exacerbating if access to the digital infrastructure (both physical internet access and cognitive digital literacy) is not equitably distributed. As highlighted by Acemoglu and Restrepo, if the rate of automation outpaces the rate of reinstatement (creation of new tasks), the labor share of income will permanently decline [5, p. 1492]. The WEF data suggests we are currently in a "positive reinstatement" phase (170 million jobs created vs 92 million jobs lost), but this is a non-stable balance dependent on the rapid scaling of the new tasks.

As the Future of Jobs Report 2025 forecasts, the economy will add a net 78 million jobs, refuting the dystopia of total automation [1, p. 60]. However, this growth is contingent on the mechanism of Virtual Agglomeration, which allows digital technologies to deepen capital and expand labor markets beyond physical borders [3, p. 9]. Yet, this expansion comes

with a caveat: the risk of precarity. As Conceição warns, without a human-centric approach, this technological integration risks reducing workers to mere extensions of the digital apparatus [2, p. 344].

The significance of the adaptability growths sharply. The “half-life” of professional skills has shrunk to less than five years. Consequently, the traditional “learn-then-work” model is obsolete. The successful realization of the 2025-2030 growth potential requires a “Reskilling Revolution” that is as aggressive as the technological revolution itself. As Goldin C. and Katz L. noted, governments and corporations must move beyond passive “open” online courses to active, funded, and protected transition pathways [10, p. 22]. According to point of view of Manyika J., Lund S. and others, if successful, the era of Intelligent Automation can yield a “promotional effect” for human dignity and prosperity; if left to market forces alone, it will likely yield a polarized landscape of digital elites and a precarious digital proletariat [11, p. 18].

Conclusion. In general, Virtual Agglomeration leads to the concentration of economic activity on digital platforms (cloud computing, remote work, digital marketplaces) and fundamentally alters the elasticity of labor demand. Virtual Agglomeration propose possibilities for so called “Promotional” Cohort to carry high-skill cognitive tasks (Creative Thinking, AI management) across a global market. As for “Precarity” Cohort, their routine skills devalued by automation and, if they fail to reskill, are pushed into the low-end of the virtual agglomeration or displaced entirely. Virtual agglomeration needs equitably distribution of access to the digital infrastructure (physical internet access as well as cognitive digital literacy). Minimization of the risks “reducing the role of human labor” might be possible on the basis of reskilling those workers from "Precarity” Cohort who’s their routine skills devalued by automation.

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