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IT LABOR MARKET IN UKRAINE AND THE WORLD: KEY VECTORS OF DEVELOPMENT

The article investigates the processes of transformation and development of the labor market for information technology (IT) professionals in Ukraine and globally from 2015 to 2025, outlining forecast trends up to 2030.

The modern digital economy generates unprecedented demand for highly qualified IT personnel, driven by the massive adoption of generative artificial intelligence (AI), cloud technologies, Big Data, and the automation of business processes.

The purpose of the article is to identify the patterns and specifics of the development of the IT professionals' labor market in Ukraine and globally for the period 2015–2025, define the key factors of supply and demand, analyze wage transformations, and establish forecast benchmarks up to 2030.

The methodological basis of the research relies on general scientific and specialized methods: system-structural, statistical, comparative analysis, and empirical generalization.

As a result of the study, three key stages of market development are identified: pre-pandemic growth, remote transformation during COVID-19, and adaptation to macroeconomic instability (2022–2025). The extraordinary resilience of the global and domestic IT markets to exogenous shocks (the COVID-19 pandemic, war) has been proven, which caused the industry to shift from quantitative growth to qualitative structural optimization.

A profound restructuring of demand and professional polarization is revealed: an exponential increase in the need for Senior-level specialists in AI/ML, Data Engineering, cybersecurity, and cloud computing against the backdrop of the risk of automating the basic tasks of Junior specialists.

The Ukrainian IT sector is successfully adapting by shifting away from traditional outsourcing toward product R&D centers, with Defense Tech emerging as a powerful hiring driver.

It is substantiated that the key challenge for maintaining competitiveness in the context of digitalization is the widespread adoption of continuous learning (upskilling and reskilling).

Recommendations are formulated to mitigate the talent shortage by fostering close synergy among the state, business, and higher education institutions to modernize educational programs.

Keywords: *labor market, IT professionals, supply and demand, artificial intelligence, wage premium, skills gap, digital transformation, globalization.*

Problem statement. Over the past decade, the labor market for IT professionals has undergone profound structural transformations driven by rapid technological innovation, globalization, and a series of external macroeconomic shocks. Information technologies have become an integral component and a catalyst for the development of virtually all spheres of economic activity, ranging from medicine and agriculture to mechanical and aerospace engineering. The global digitalization of the economy drives consistently high demand for qualified professionals with advanced competencies in programming, data analysis,

cybersecurity, and the implementation of artificial intelligence (AI) systems. Simultaneously, the IT labor market is characterized by high dynamism, sensitivity to geopolitical changes, and rapid skill obsolescence, underscoring the urgent need for continuous monitoring and scientific analysis.

Literature review. The development of the IT sector and its labor market remains a focal point for many domestic and foreign scholars. A significant contribution to researching the specifics of the Ukrainian IT market's functioning, its export potential, and statistical patterns was made by such scholars as O. Zhuravlov [1], O. Karyi, L. Halkiv, and A. Tsapulych [2], who analyzed the drivers of the technological sector's activation. The trends in the economic development of the digital services market and benchmarks for Ukraine in the context of globalization are thoroughly covered in the works of I. Shtuler and V. Prestaia [3]. Special attention should be given to modern studies of the domestic technological sector's functioning under the conditions of macroeconomic shocks and war, reflected in the scientific research of T. Melnyk and O. Zavhorodnia [4]. The transformation of professional and qualification requirements in the labor market under the influence of the massive integration of generative AI systems and automation is explored in the fundamental works of leading foreign economists, particularly D. Acemoglu and P. Restrepo [5]. At the same time, the impact of cutting-edge AI technologies on the growth of IT firms, product innovations, and the demand for highly specialized professionals is thoroughly investigated in the works of J. Hodson, A. He, T. Babina, and A. Fedyk [6]. In turn, recent studies by S. Aum and Y. Shin [7] present a comprehensive macroeconomic analysis of the consequences of implementing cloud computing, Big Data, and AI for the structure of vacancies and employment polarization. A significant role in the systematic monitoring of market conditions is also played by analytical reports from leading consulting institutions (Gartner, World Economic Forum (WEF)) and domestic specialized platforms (DOU, Djinni).

Unresolved issues. Despite the existence of thorough scientific research on individual aspects of the IT industry's development, there remains a lack of a comprehensive analysis regarding the evolution of the IT professionals' labor market over the extended period of 2015–2025, which would combine the assessment of quantitative macro-indicators (employment volumes, vacancy dynamics, market capitalization) with a systemic study of structural shifts. In particular, the cumulative impact of the global COVID-19 pandemic, the full-scale war in Ukraine, and the widespread adoption of generative AI on the transformation of professional and qualification requirements for employees requires a deeper understanding.

The purpose of the article. The primary purpose of the article is to identify the patterns and specifics of the development of the IT specialists' labor market in Ukraine and globally from 2015 to 2025, define the key factors of supply and demand, analyze wage transformations, and establish forecast benchmarks up to 2030.

Research methodology. The fundamental principles of economic theory, labor economics, and the concept of the digital economy form the theoretical and methodological basis of the research. To achieve the set purpose, a complex of general scientific and special methods was applied: the process of system analysis (to study the labor market as a complex dynamic system), statistical and graphical techniques (to analyze the dynamics of the number of IT professionals, vacancies, and wage levels), the method of comparative analysis (to compare the development trends of the national and global markets), and the process of empirical generalization (to formulate conclusions and recommendations based on industry analytics

data). The information base comprised analytical reports from international organizations (WEF, Gartner), data from the State Statistics Service of Ukraine, the National Bank of Ukraine, as well as statistics from specialized Ukrainian and international job search platforms.

Research results. The global information technology market is characterized by significant volumes of capitalization and a high level of spatial concentration. Leading positions by the share of IT professionals in the employment structure are traditionally held by countries such as the USA, India, China, Japan, Germany, and France. At the same time, Ukraine has confidently integrated into the global technological space, ranking among the top in international rankings of software developers. Given the specifics of the industry, it is advisable to treat the IT labor market as an independent object of research, influenced by specific macroeconomic and technological factors.

A retrospective analysis allows identifying three key stages in the development of the modern IT labor market: the pre-pandemic period (up to the end of 2019), the transformation stage under the influence of the COVID-19 pandemic, and the period of macroeconomic turbulence, which for Ukraine is burdened by the consequences of the full-scale invasion (2022–2026 with a transition into the forecasted future).

In the pre-pandemic period (up to the end of 2019), the global IT labor market demonstrated steady, rapid growth. This stage was characterized by the rapid scaling of technology companies, increased corporate budgets for digitalization, and the rapid emergence of innovative startups. These processes generated a high demand for qualified personnel, which was accompanied by a stable increase in wage levels and the formation of a global shortage of experienced specialists (Middle and Senior levels).

According to data from the analytical portal Globe Newswire [8], in 2018, the Asia-Pacific region held the largest share of the global IT market (34%), followed by North America (30%), while Africa accounted for only 2%. The expansion of the technological sector was accompanied by a proportional increase in companies' operating expenses, the main items of which were the payroll fund and the development of office infrastructure. According to Gartner reports [9], global IT spending in 2019 reached 3.74 trillion USD, up 0.6% from 2018. Despite macroeconomic uncertainty (the threat of recession, Brexit, trade wars), technological spending remained stable, and the US market maintained its status as the world's most significant (31% of total volume, or 1.6 trillion USD). According to the CompTIA Cyberstates report [10], the economic contribution of the US technology sector to the country's GDP exceeded that of traditional industries such as retail trade, construction, and transportation.

In parallel with global trends, the Ukrainian IT market experienced active expansion. A favorable business climate spurred the launch of new products and the expansion of outsourcing companies, leading to the consolidation of the IT industry in leading positions in wage levels in Ukraine. As of 2018, nearly 160,000 professionals were employed in the domestic IT industry, an increase of 26% from 2017 [11]. Overall, during 2017–2018, the industry demonstrated an unprecedented growth of 60%. The positive dynamics continued in 2019: the market volume expanded by another 20%, resulting in the creation of 32 thousand new jobs [12] (Figure 1).

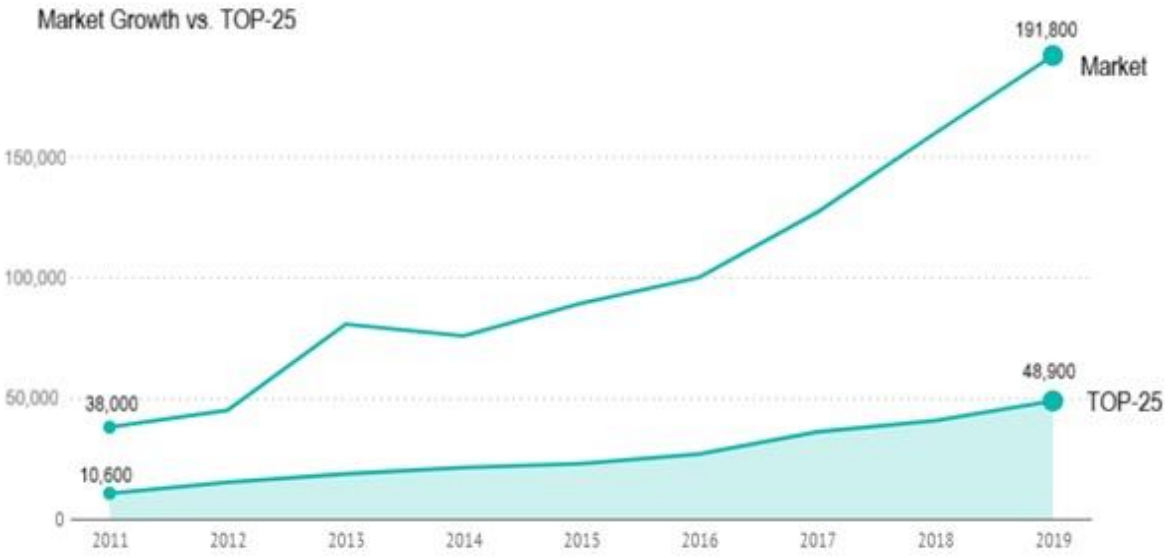

Figure 1. Dynamics of the number of professionals in the IT labor market in Ukraine (2011–2019), thousand people

Source: compiled by the authors based on [12]

As shown in Figure 1, the number of professionals increased exponentially from 2011 onward, indicating a phase of exponential growth in the IT labor market in Ukraine. A slight slowdown in the expansion rate in 2014 was caused by geopolitical force majeure factors (the annexation of the Autonomous Republic of Crimea and the outbreak of hostilities in Eastern Ukraine). However, the industry quickly adapted to the new conditions and resumed its upward trend.

In the first quarter of 2020, the global labor market experienced an unprecedented shock due to the COVID-19 pandemic and the imposition of strict quarantine restrictions. According to estimates by the International Labour Organization (ILO), the economic crisis threatened to increase global unemployment by nearly 25 million people. Recessionary processes also temporarily affected the technological sector: specifically, in the UK, the number of vacancies in the IT industry in April 2020 decreased by 56.5% compared to the previous month and by 59.4% year-on-year [13, 14].

However, for the IT sphere in particular, the pandemic crisis became a powerful catalyst for accelerated digital transformation. The massive transition to remote work significantly altered the architecture of the labor market, eliminating geographical barriers to hiring and stimulating demand for cloud solutions, online collaboration tools, and cybersecurity systems.

The Ukrainian IT market demonstrated strong institutional resilience and adaptability to new conditions. Despite the temporary contraction of the market and the reduction in the total number of vacancies in the first half of 2020 (Figure 2), caused by a drop in purchasing power and the postponement of investment projects by clients, the industry quickly reconfigured its operational activities. The sectors of electronic commerce (e-commerce), game development (GameDev), online education (EdTech), and logistics automation experienced rapid growth during this period, partially offsetting the decline in system integration and hardware sales.

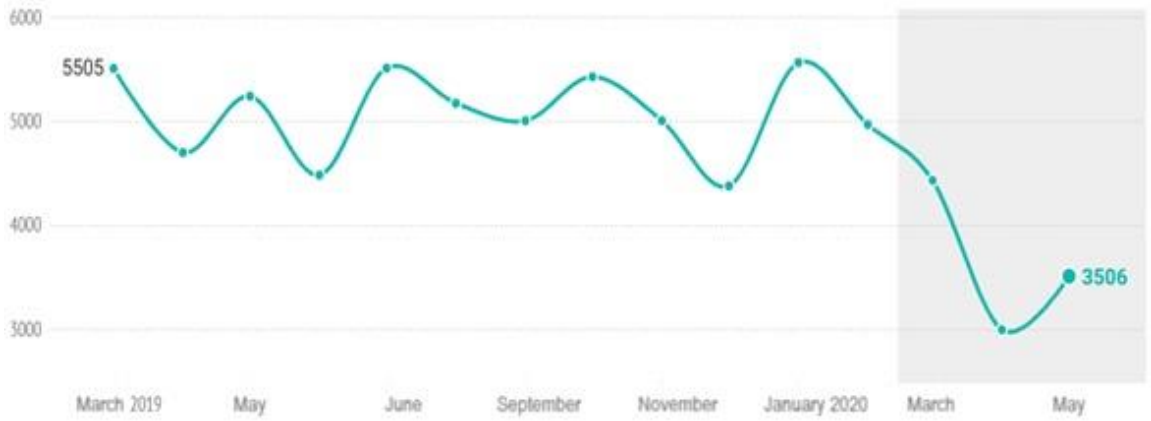

Figure 2. Dynamics of the total number of vacancies on the jobs.dou.ua portal (March 2019 – May 2020), thousand units

Source: compiled by the authors based on [15].

The effect of pent-up demand accumulated in 2020, combined with the global realization of the efficiency of remote teams, led to a significant overheating of the IT professionals' labor market in 2021. This period was characterized by frenzied demand for tech talent and the formation of a pronounced "candidate's market." Employers were forced to compete for talent by offering unprecedented increases in compensation packages.

In Ukraine, the number of posted vacancies on specialized platforms in 2021 grew by 2.5 times compared to the previous year. Specifically, the Djinni portal recorded 315,000 vacancies, up from 130,000 in 2020 [16]. The average developer wage increased by 20–40% [17]. Following the results of 2021, according to data from the "IT Ukraine" Association, the domestic IT industry demonstrated 36% growth, reaching export revenue of 6.8 billion USD, while the number of specialists increased from 244 thousand to 285 thousand.

Similar trends were observed in the US market. According to the Bureau of Labor Statistics (BLS), by the end of 2021, the number of open vacancies in the information sector had doubled (to 217 thousand compared to 109 thousand at the end of 2020) [18]. Despite attempts by large tech corporations to return employees to offices in a hybrid format, the demand for fully remote positions (especially in the fields of DevOps, Data Science, and IT security) continued to grow, reaching a peak of 35–38% of the total number of high-paying offers [19].

The strong momentum of early 2022 in the domestic market was abruptly interrupted by a shock – the full-scale military invasion by the Russian Federation. This caused profound structural deformations: during 2022, the demand for IT specialists in Ukraine dropped by 30–35% compared to 2021. Under conditions of high security risks, companies transitioned to a strategy of optimizing operating expenses, relocating personnel, and preserving critical infrastructure. Wage growth dynamics stalled: after a slight 5% increase in February 2022, a rollback to late 2021 levels occurred by summer, accompanied by the cancellation of several corporate bonuses and non-financial motivation programs.

In the second half of 2022, the global IT market faced a wave of mass layoffs, driven by fears of a macroeconomic recession and excessive hiring in previous periods. According to the analytical resource Layoffs.fyi, over 1,000 technology companies laid off approximately 152,000 employees [20]. Transnational corporations such as Meta, Amazon, and Twitter experienced the largest reductions [21]. The peak of staff optimization occurred in November 2022, when nearly 53 thousand tech workers were laid off, marking the highest monthly figure since 2000 [22].

During the 2023–2025 period, the global IT labor market transitioned to a phase of stabilization and profound structural transformation. The key driver of these changes was the massive commercial implementation of generative AI (GAI) and machine learning (ML) tools. According to Gartner forecasts, global IT spending was expected to grow by 7.9% in 2025, reaching 5.43 trillion USD, further confirming the industry's resilience [23]. A pronounced polarization emerged in the labor market: the exponential growth in demand for highly specialized, senior-level professionals in AI, cybersecurity, and cloud infrastructure was accompanied by intensified competition for entry-level (Junior) positions due to the automation of basic programming tasks [24, 25, 26]. Economic and statistical modeling of the European labor market, conducted on a dataset from 29 countries [27], confirms the existence of a substantial "AI wage premium". The study shows that developers who implement machine learning algorithms directly receive a statistically significant premium of 4% to 8% compared to other IT professionals and up to 24% compared to workers with a similar level of education in different fields. Such differentiation in remuneration is primarily explained by higher qualification requirements for the positions and a general shortage of relevant competencies in the market. International studies by Stack Overflow and LinkedIn report a sharp increase in demand for specialists with skills in working with large language models (LLMs) and AI [28, 29].

Empirical confirmation of these structural shifts at the global level, particularly using India, one of the world's largest IT hubs, as an example, can be found in recent scientific articles. Quantitative analysis shows that the massive integration of AI has a dual impact on the labor market: it displaces several traditional routine positions yet simultaneously stimulates the emergence of new roles that require advanced cognitive and digital skills. In this context, the implementation of large-scale reskilling programs supported by a proactive state policy becomes critically necessary, enabling the minimization of the negative consequences of automation and the maximization of the industry's innovative potential [30].

The Ukrainian IT market in 2025, despite macroeconomic instability and the consequences of martial law, demonstrated a steady recovery and adaptability. The total number of vacancies in the market increased by 30% compared to previous periods, reaching 78.1 thousand (Figure 3).

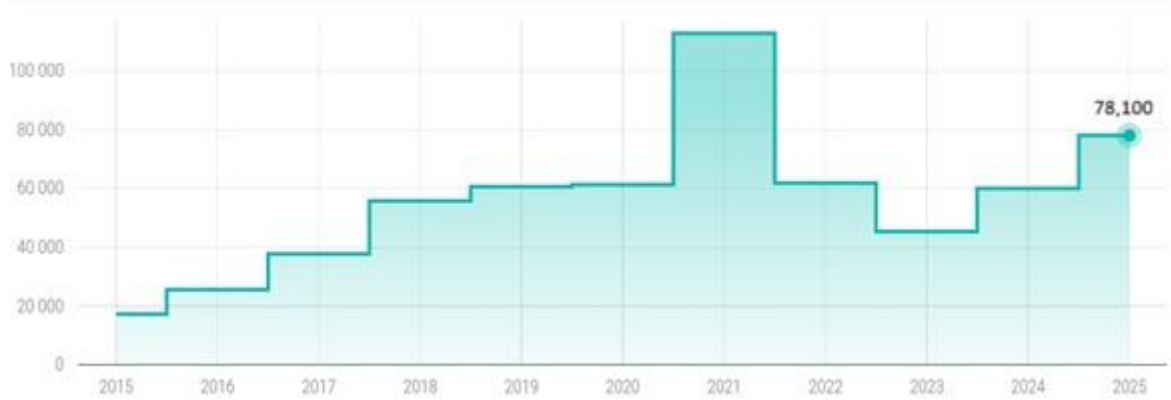

Figure 3. Dynamics of the total number of vacancies on the jobs.dou.ua portal for 2015–2025, thousand units

Source: compiled by the authors based on [31].

As analytical reports [31, 32] indicate, there has been a significant shift in the demand structure of the domestic market. The share of purely technical roles has decreased slightly (to 66%), while demand for specialists in marketing, data analytics, and product management has

grown. A defining trend for 2025 was the growth in the Defense Tech (defense technologies) sector, where the number of specialized vacancies increased sevenfold. The domestic market is gradually transforming from a classical outsourcing model to product-based and R&D-oriented formats of cooperation. Median salaries remain highly competitive: for qualified technical specialists, compensation reaches 6,000 USD, while there is a tendency toward a reduction in the share of specialists working exclusively under the Individual Entrepreneur model [31].

Forecast estimates for the development of the global and domestic IT markets for the 2026–2030 period indicate a further deepening of technological transformations. According to the WEF report, by 2030, the international labor market will undergo large-scale restructuring: the creation of 170 million new jobs in digital industries is expected, along with the reduction of 92 million traditional positions, resulting in net employment growth of 78 million [33, 34]. In 2026, an exacerbation of the IT talent shortage is forecasted in the European market, which could reach 10 million specialists by 2030 [35]. Analysts from Robert Half and Gartner confirm the growing demand for professionals capable of practically implementing AI solutions and ensuring the resilience of cloud infrastructure [36, 37].

The profound structural transformation of the labor market amid global digitalization requires new approaches to classifying and identifying workforce needs. As recent studies indicate [38], traditional international occupational classification systems (in particular, ISCO-08) often lack the necessary level of detail to adapt rapidly to the dynamics of the technological sector. The application of modern hierarchical taxonomies, built on data-mining methods applied to job vacancy datasets, enables not only highly accurate categorization of IT roles but also effective forecasting of demand for specific skills. The development of such analytical frameworks provides a reliable foundation for aligning academic programs with the strategic needs of the global IT market.

In Ukraine, a further increase in the number of technology sector employees (up to approximately 400 thousand people) and the strengthening of the AI/ML, Defense Tech, FinTech, and Green Tech segments are expected in 2026 [39, 40]. A significant stimulus to the expansion of the domestic labor market will be the Government's digital transformation plan for 2025–2026, which envisages the widespread adoption of electronic wallets (EUDI Wallet), 5G technologies, and the expansion of the state digital services ecosystem [41]. Relevant data from early 2026 confirm the stabilization of hiring processes in the top 50 largest IT companies in Ukraine and the maintenance of high demand for engineering personnel at middle and senior levels [42]. At the same time, the key challenges to ensuring the sustainable development of the industry will remain the need for continuous staff upskilling [43], overcoming the structural skills gap, adapting academic education to industry needs, and mitigating the consequences of human capital outflow. As recent comprehensive studies by European scientists confirm [44], the problem of qualification mismatch in the context of a rapid technological transition is acquiring a systemic macroeconomic nature. Even amid local waves of staff optimization (layoffs) in technology companies, the global shortage of highly specialized professionals is only deepening. This requires implementing systemic solutions, among which a leading role is played by modernizing academic education, developing a dual education system, and implementing large-scale retraining programs (upskilling and reskilling).

Conclusions. The conducted research on the IT professionals' labor market in Ukraine and globally for the period of 2015–2025 indicates that over the last decade, the global and domestic IT markets have demonstrated extraordinary resilience to exogenous shocks. The COVID-19

pandemic catalyzed unprecedented digitalization and the institutionalization of remote work. At the same time, the period of macroeconomic instability in 2022–2023 burdened Ukraine with the consequences of the full-scale invasion, leading the industry to transition from quantitative growth to qualitative structural optimization.

The current stage of the labor market's development is characterized by a profound restructuring of demand for competencies driven by the widespread adoption of generative AI systems and automation. A pronounced professional polarization is observed: the exponential growth in demand for Senior-level specialists in AI/ML, Data Engineering, cybersecurity, and cloud computing occurs amid intensified competition among entry-level (Junior) specialists, whose basic tasks are most at risk of automation.

The domestic IT sector, despite unprecedented security and logistical challenges, maintains its status as a critically important donor to the national economy and the export of services. The market is successfully adapting by reformatting business models: there is a gradual shift away from traditional outsourcing toward product R&D centers and higher-value companies. A distinct and powerful driver of hiring in Ukraine in 2025–2026 is Defense Tech and the initiatives of the state digital plan. Under these conditions, the concept of continuous learning (upskilling and reskilling) becomes the main challenge for maintaining the competitiveness of both individual IT professionals and the industry. To mitigate the global and local talent shortage, close collaboration among the state, businesses, and higher education institutions, it is necessary to modernize educational programs and rapidly integrate innovative technologies into the educational process.

Prospects for future research. Given the high dynamism of the technological sector, a promising direction for further scientific research is the quantitative modeling of the impact of generative AI on labor productivity across specific IT professions. In addition, studying the effectiveness of state programs aimed at stimulating the development of the Defense Tech sphere, as well as developing mechanisms for the reintegration of domestic IT professionals into the Ukrainian economic space in the post-war period, remains highly relevant.

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РИНОК ІТ-ПРАЦІ В УКРАЇНІ ТА СВІТІ: КЛЮЧОВІ ВЕКТОРИ РОЗВИТКУ

У статті досліджено процеси трансформації та розвитку ринку праці фахівців у сфері інформаційних технологій (ІТ) як в Україні, так і на глобальному рівні впродовж 2015–2025 років з окресленням прогнозних тенденцій до 2030 року.

Сучасна цифрова економіка формує безпрецедентний попит на висококваліфіковані ІТ-кадри, що зумовлено масовим впровадженням генеративного штучного інтелекту (ШІ), хмарних технологій, великих даних (Big Data) та автоматизації бізнес-процесів.

Метою статті є виявлення закономірностей та специфіки розвитку ринку праці ІТ-спеціалістів в Україні та світі за період 2015–2025 рр. із визначенням ключових чинників попиту й пропозиції, аналізом трансформації заробітних плат та побудовою прогнозних орієнтирів до 2030 року.

Методологічною основою дослідження слугують загальнонаукові та спеціальні методи: системно-структурний, статистичний, порівняльний аналіз та метод емпіричного узагальнення. У результаті дослідження визначено три ключові етапи розвитку ринку: допандемічне зростання, дистанційна трансформація в умовах COVID-19 та етап адаптації до макроекономічної нестабільності (2022–2025 рр.).

Доведено надзвичайну стійкість глобального та вітчизняного ІТ-ринків до екзогенних шоків (пандемія COVID-19, війна), що зумовило перехід галузі від кількісного зростання до якісної структурної оптимізації.

Виявлено глибоку реструктуризацію попиту та професійну поляризацію: експоненційне зростання потреби у Senior-фахівцях з AI/ML, Data Engineering, кібербезпеки та хмарних обчислень на тлі ризику автоматизації базових завдань Junior-спеціалістів.

З'ясовано, що український ІТ-сектор успішно адаптується шляхом відходу від традиційного аутсорсингу на користь продуктових R&D-центрів, а потужним драйвером найму стає напрям Defense Tech.

Обґрунтовано, що ключовим викликом для збереження конкурентоспроможності в умовах цифровізації є масштабне впровадження концепції безперервного навчання (upskilling та reskilling).

Сформульовано рекомендації щодо пом'якшення кадрового дефіциту шляхом тісної синергії держави, бізнесу та закладів вищої освіти задля модернізації навчальних програм.

Ключові слова: *ринок праці, ІТ-фахівці, попит і пропозиція, штучний інтелект, зарплатна премія, дефіцит навичок, цифрова трансформація, глобалізація.*