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DIGITAL TRANSFORMATION AS A DRIVER OF HUMAN DEVELOPMENT: CHALLENGES AND OPPORTUNITIES FOR UKRAINE

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Abstract. The article examines digital transformation as a key factor in the development of human capital in modern society. The author analyzes the conceptual framework of human capital, its relationship with digital technologies and

innovations, and identifies the main indicators that reflect the level of development of e-government and digital participation of citizens. A comparative analysis of digital transformation and the level of human development in Ukraine and advanced European countries such as Denmark, Finland, and Estonia is carried out. The impact of digital reforms on the Human Development Index (HDI), the E-Government Development Index (EGDI), and the Electronic Participation Index (EPI) is studied.

The purpose of this article is to analyze the relationship between digital transformation and human capital development, to identify key indicators of digital governance and their impact on socio-economic processes. Particular attention is paid to the experience of advanced European countries, in particular Denmark, Finland, and Estonia, as well as to the analysis of the current situation in Ukraine.

Based on correlation and regression analysis, it is determined that EGDI has a strong positive impact on HDI, while EPI does not show a statistically significant relationship. In addition, the role of public spending on digital technologies is noted, the results of which indicate a possible lag effect, when investments in digital infrastructure yield results after several years. The main challenges to the digital transformation of the population are identified, including digital inequality, insufficient digital literacy, cybersecurity, and structural changes in the labor market due to automation.

The research findings confirm that digital transformation is a key factor in raising the level of human capital, creating new opportunities for education, healthcare, and the labor market. However, to maximize the effect, it is necessary to ensure targeted government policies to expand access to digital technologies, increase digital literacy, and invest in the development of the digital economy.

Keywords: Digital transformation, human capital, e-government, digital economy, EGDI, HDI, EPI, regression analysis.

Introduction. In the context of digital transformation, the key role in ensuring the development of society is changing, contributing to the growth of the modern economy, improving the efficiency of public administration and the formation of competitive human capital. The integration of digital technologies into all spheres of life is changing traditional models of education, employment, social interaction, and government, opening up new opportunities for increasing productivity, access to knowledge, and improving the quality of life. At the same time, digital transformation is accompanied by a number of challenges, such as digital inequality, the need for new competencies, the threat of job losses due to automation, cybersecurity issues, and the need to adapt educational systems to rapid technological change.

Ukraine is making significant progress in the development of digital technologies, which is confirmed by its high positions in global e-government rankings. According to the UN, in 2024, Ukraine ranked 30th in the global EGDI (e-government development index) with a score of 0.8841, which confirms the effectiveness of digital reforms and the introduction of innovative solutions in public administration. At the same time, Ukraine was ranked 1st among 193 countries in the Electronic Participation Index (EPI), which is due to the active involvement of citizens in digital processes and the use of electronic tools to interact with the government. However, despite significant achievements, there are still a number of problems related to the impact of digital transformation on human development, namely the effectiveness of digital investments, their impact on education, healthcare, and social equality.

The relevance of the study is to assess the relationship between digital change and human capital development. Scientific research confirms that digitalization contributes to improving the level of education, developing the labor market and improving civil society institutions. For example, a Deloitte study (2024) shows that the use of digital technologies reduces administrative barriers, automates routine tasks, and increases access to educational resources, which affects the formation of competitive human capital. However, the question of measuring the effectiveness of digital changes remains open, especially in countries undergoing active digital modernization, such as Ukraine.

The method of this study is to determine the impact of digital transformation on human capital development by analyzing key indicators of digital governance (EGDI, EPI) and their relationship with the Human Development Index (HDI). It is especially important to compare Ukraine with advanced countries such as Denmark, Finland, and Estonia, which have high European development indicators and have successfully integrated digital solutions into public administration, education, and social protection. To achieve this goal, correlation and regression analysis is used to assess the strength and direction of the relationship between digital indicators and human development. The study also examines the effect of public spending on digital technologies, taking into account the possibility of lag effects (the delayed impact of investments in digitalization on human capital development). The results of the study are expected to identify key factors of the impact of digital reforms on socio-economic development and to formulate recommendations for improving digital policy in Ukraine, taking into account international experience.

Thus, digital transformation is a major factor in human capital development that requires in-depth analysis to develop effective digital reform strategies that promote

sustainable development, reduce digital inequality, and ensure a high quality of life for citizens.

The analysis of research and problem definition. Digital transformation is a driving force for human development in Ukraine, creating challenges and opportunities, and is the subject of research by many scholars. The conceptual foundations of human capital are laid down in the works of T.V. Schultz (1961) and G. Becker (1964), who defined it as a set of knowledge, skills, health, and abilities that contribute to employee productivity and economic development. Further studies consider human capital as a critical factor in the innovation economy, which requires continuous updating of knowledge and adaptation to technological change (World Bank, 2020).

Digital transformation has a significant impact on the development of human capital, changing traditional models of education, employment, and social interaction. Deloitte (2024) notes that digital technologies contribute to increased productivity, the creation of new forms of employment, and the expansion of new opportunities for distance education. At the same time, digitalization poses challenges related to unequal access to technology, complicated retraining, and changes in the structure of employment.

A separate area of research is the assessment of the relationship between digital transformation and human capital development. The United Nations Development Program (UNDP, 2023) analyzes the dynamics of the Human Development Index (HDI) and emphasizes the importance of integrating digital technologies into the social sphere. Research by the World Economic Forum (WEF, 2022) confirms that digital reforms can accelerate economic productivity growth and ensure social mobility.

The level of digital transformation is measured by indices such as the Electronic Government Development Index (EGDI) and the Electronic Participation Index (EPI), calculated by the United Nations. According to the United Nations (2024), EGDI is a key indicator of a country's digital development, and EPI assesses the involvement of citizens in digital processes. Analyzing these indicators in the context of Ukraine, the researchers emphasize the high rate of implementation of digital public services, which increases the efficiency of public administration and the level of digital literacy of the population.

International studies also show the positive impact of digital transformation on socioeconomic development. The World Bank (2022) notes that public spending on digital technologies has a long-term effect on human capital, in particular through improved access to education and healthcare. At the same time, studies emphasize the

need to widen digital inequality and expand access to digital tools for all segments of the population.

Special attention in the literature is paid to the experience of advanced European countries, in particular Denmark, Finland, and Estonia, which have achieved high results in the digitalization of government processes and the integration of digital technologies into public life (United Nations, 2024). The experience of these countries demonstrates that effective digital policies can contribute to significant human capital development, improved access to education, and increased social inclusion.

Thus, the scientific literature confirms the close relationship between digital transformation and human capital development. However, further research requires a deeper analysis of the mechanisms of influence of digital reforms on socioeconomic indicators, especially in the context of countries undergoing active digital modernization, such as Ukraine.

Methodology. The study of the impact of digital transformation on human capital development is based on quantitative analysis, including correlation analysis and regression analysis. Open data from international organizations and government agencies were used in the process. The e-Government Development Index (EGDI) and the UN e-Participation Index (EPI) were taken from the United Nations E-Government Knowledgebase, while the Human Development Index (HDI) data were obtained from the United Nations Development Program (UNDP). Public spending on digital technologies was taken from national statistical sources, and macroeconomic indicators (economic growth, education, health) were taken from the World Bank, WHO, and relevant national agencies.

At the first stage of the study, a correlation analysis was conducted between the digital indices (EGDI, EPI) and the Human Development Index (HDI) to determine the strength of the relationship between these variables. For this purpose, the Pearson correlation coefficient is used to estimate the linear relationship between the two data sets. The results of the correlation analysis showed that the EGDI has a very strong positive correlation with the HDI ($r = 0.998$), and the EPI also shows a high level of correlation ($r = 0.994$).

At the next stage, a multiple regression analysis was conducted to assess the impact of digital variables and public spending on digital technologies on human capital development. The model included independent variables of EGDI, EPI, and the logarithm of public spending on digital technologies. The results of the regression analysis confirmed that EGDI has the largest positive impact on HDI, while the

impact of EPI was less significant. Government spending on digital technologies did not show an immediate impact on HDI, which suggests that there is no lag effect.

In order to study the delayed effect of public spending, we analyzed time lags in which public spending on digital technologies was shifted by 2-3 years. The results showed that public spending made two years ago has a weak positive impact on HDI. This may be due to the fact that digital reforms and investments in technology produce results only in the medium term, after which they affect the levels of other factors.

Thus, the study results confirm that digital transformation is a driver of human capital development. Investments in digital technologies, e-governance, education, and healthcare can significantly increase the HDI. At the same time, risks such as the economic crisis and digital inequality that may slow down this process should be taken into account. For further research, it is advisable to use time series analysis or machine learning methods to more accurately predict the development of human capital in the context of digital transformation.

Main Part. Human capital is a key economic resource that ensures the productivity and competitiveness of a country. Its classical definition was proposed by T. Schultz and G. Becker, who interpreted human capital as a set of knowledge, skills, health, and abilities that develop a person's ability to be productive and affect his or her economic well-being (Schultz, 1961; Becker, 1964). The main components of human capital are the level of education, health, professional experience and competence that are formed in the course of a person's life.

Human capital development is a complex process that encompasses the educational system, healthcare, social and economic factors. Countries with a high level of human capital experience sustainable economic growth, which is confirmed by numerous studies by the World Bank and the UN (World Bank, 2020). At the same time, human capital development requires significant investment in education, retraining, professional development, and access to innovative technologies.

Recent decades have seen a significant impact of digital transformations on human capital development. Digitalization is changing traditional models of education, employment, and social interaction, creating new opportunities and challenges for the development of human competencies. A Deloitte study (2024) shows that digital technologies contribute to increased productivity, increased access to knowledge, automation of routine tasks, and the development of new models of work organization. In addition, distance education and online courses allow people from different social groups to obtain quality knowledge that helps to equalize opportunities.

However, digital transformation also poses a number of challenges related to digital inequality, the need for new skills, and the risk of job loss due to automation. A study by the World Economic Forum (2022) notes that about 40% of jobs over the past 20 years may have changed due to digitalization, which requires the adaptation of educational systems to new realities.

Several indicators are used to measure the level of human capital development. The most well-known is the Human Development Index (HDI), which is calculated by the United Nations Development Program and takes into account three key components: life expectancy, education (average and expected years of schooling), and gross national income per capita (UNDP, 2023).

Another indicator is Human Capital Index (HCI), developed by the World Bank. It shows how a country ensures economic growth and social development through the growth of the potential of its population (World Bank, 2022). The index takes into account such indicators as infant mortality, literacy rate, access to education and health.

Digital transformation affects human capital indicators through the development of digital literacy, the spread of online education, and the use of artificial intelligence to personalize the learning process. The UN's E-Government Development Index (EGDI) demonstrates the level of a country's digital capacity and its ability to provide citizens with access to electronic services (United Nations, 2024). In 2024, Ukraine was ranked 30th in the global EGDI ranking with a score of 0.8841, which indicates the positive impact of digital reforms on public administration and citizen engagement with the government (United Nations E-Government Knowledgebase, 2024).

Another indicator is the Electronic Participation Index (EPI), which measures the level of citizen engagement in decision-making through a digital platform. A high score on this index has a negative impact on government openness and the effectiveness of digital technologies in public administration.

In general, digital transformation is one of the key drivers of human capital development, as it provides access to knowledge, labor efficiency, social inclusion, and opens up new opportunities for economic growth. However, its implementation requires a coherent government policy, investment in digital infrastructure, and overcoming digital inequality. Future research should focus on assessing the long-term impact of digitalization on the quality of life, labor change, and market efficiency of educational systems.

The experience of Denmark, Finland, and Estonia in human capital development and digital transformation is a vivid example of the effective implementation of

digital technologies in public administration, education, and the economy. These countries demonstrate high scores in the e-Government Development Index (EGDI) and the Human Development Index (HDI), which leads to the successful integration of digital solutions into all spheres of public life. The analysis of their strategies allows us to apply key success factors and opportunities for imitation in Ukraine.

Denmark is a world leader in digital transformation and social well-being, as evidenced by its consistently high positions in digital governance rankings. In 2022, the country was ranked first in the global EGDI ranking with a score of 0.9717, which indicates a high level of integration of digital technologies into public administration (United Nations, 2024). One of the main features of Denmark's digital transformation is the national strategy "Digital Denmark" aimed at automating public services and increasing the digital literacy of the population. Almost all public services have been transferred to an online format, which ensures speed and transparency of interaction between citizens and government agencies. Denmark actively uses digital passports NemID and MitID, which provide citizens with a single access to all administrative services through a centralized platform. In addition, the country demonstrates a high level of human capital development, with one of the highest HDI scores in the world at 0.940 (UNDP, 2023). A high level of social protection, an advanced education system, and effective healthcare create favorable conditions for increasing the productivity of the population. The main success factors of Denmark's digital transformation are the full integration of digital technologies into public administration, a high level of digital literacy, significant investments in education and social protection, and the active use of artificial intelligence to improve public services. Finland has traditionally been a leader in human capital development and digital transformation. In 2022, the country was ranked second in the global EGDI ranking with a score of 0.9533 (United Nations, 2024). It is also among the top ten in terms of HDI - 0.938 (UNDP, 2023). Finland has focused on innovation, education, and digital development, which has become the basis of its strategic success. The country's educational system is focused on developing critical thinking, creativity, and adaptability. The large-scale use of digital technologies in educational institutions is aimed at promoting the development of digital skills among young people, which ensures high competitiveness of graduates in the labor market. In addition, the country is a leader in terms of digital citizen participation (EPI), which indicates the active use of a digital platform for interaction with the government. The Suomi.fi portal provides centralized access to all public services, including healthcare, tax returns, and administrative procedures. In addition, Finland invests heavily in the development of artificial intelligence and its integration into public

administration. For example, the AI Finland program implements algorithms for automating decisions in healthcare and social security. The main factors of Finland's success include a high level of investment in science and education, developed digital infrastructure, active use of digital platforms in public administration, and innovative approaches to the implementation of artificial intelligence.

Estonia is the most digitized country in Eastern Europe, which has made it one of the most successful countries in the field of e-government. In 2022, it was ranked eighth in the global EGDI ranking with a score of 0.9393 (United Nations, 2024). The basis of the country's digital transformation is the e-Estonia program, which provides for the full digitalization of public services. Every citizen has a digital ID that allows them to receive medical services, make tax payments, and even vote online. The government is actively using blockchain technologies to ensure transparency and security of data processing. Estonia has also introduced a unique e-Residency program that allows entrepreneurs from anywhere in the world to do business in the European Union without a physical presence, which significantly contributes to attracting international investment and developing the startup economy. The country's educational system is also focused on digital technologies: educational institutions actively choose e-Kool and Teele platforms that ensure the integration of the digital learning process and the development of digital literacy among students. The main success factors of Estonia's digital transformation are full digitalization of public administration, the use of blockchain technologies for data protection, a high level of digital literacy of the population, and the creation of a favorable environment for international business development.

The experience of Denmark, Finland, and Estonia demonstrates that successful human capital development and digital transformation is possible by investing in technological infrastructure, education, social protection, and transparency of public administration. Denmark has succeeded due to the deep integration of digital technologies into public services and a high level of public trust in the digital platform. Finland has focused on innovative education, investment in the digital economy, and expanding artificial intelligence capabilities. Estonia has built a digital governance ecosystem using blockchain technologies and the e-Residency program to support business development. Ukraine, which demonstrates dynamic progress in the development of e-governance and digital initiatives, can use the experience of these countries to further develop human capital. The introduction of innovative educational methods, expansion of digital infrastructure, and reduction of digital inequality are key factors in successful digital transformation. Here is a comparison

of the development of digital transformation and human capital in Ukraine with the leading European countries - Denmark, Finland, and Estonia (Figure 1).

Figure 1 shows that Ukraine has a high level of e-participation (EPI), which even exceeds the indicators of advanced countries. Denmark, Finland, and Estonia have more developed EGDI (e-government) and significantly higher public spending on digital technologies. Education and healthcare levels in advanced countries are also higher, which correlates with their overall human capital development.

Thus, digital transformation is a key factor in modern economic and social development, which has a significant impact on the formation of human capital. In Ukraine, this process is particularly important in the context of integration into the European Union, recovery from the crisis, and adaptation to the challenges of the global digital environment.

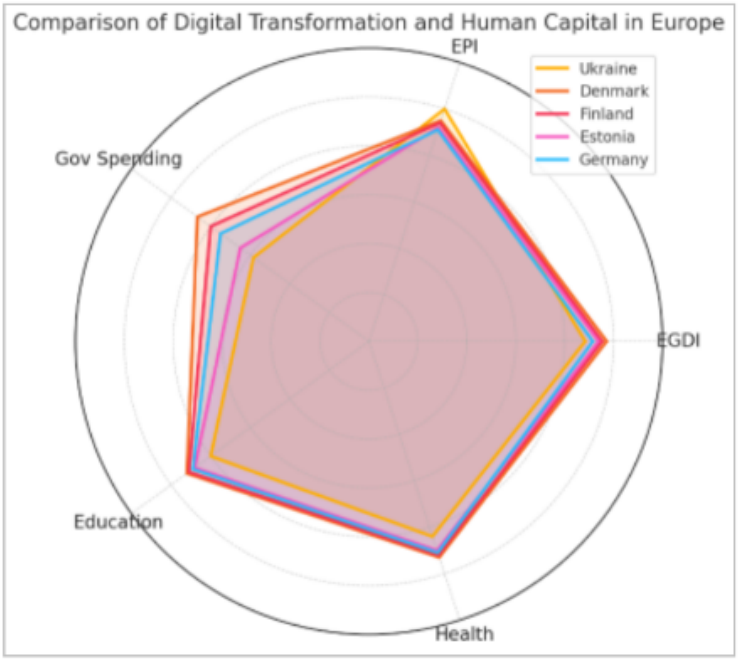

Figure 1. Comparison of digital transformation and human capital in Europe

The introduction of digital technologies helps to improve access to education, healthcare, public services, create new jobs, and increase productivity. At the same time, digitalization raises a number of challenges related to unequal access to technology, cybersecurity, and ensuring the reform of the education system.

To confirm the above information, we will conduct a correlation and regression analysis of the impact of digital transformation on human capital development.

An analysis of official UN development data on e-government in Ukraine allows us to assess the relationship between digital transformation indicators and the level of human development (Table 1). In 2024, Ukraine received an e-Government

Development Index (EGDI) score of 0.8841, which ranked it 30th among 193 countries (United Nations, 2024). At the same time, the country achieved the highest possible value of the Electronic Participation Index (EPI) - 1.000, which ranked it 1st among 193 countries (United Nations, 2024). such high indicators indicate the effectiveness of digital technologies implementation and active participation of citizens in digital processes.

Table 1: Indicators of e-government development in Ukraine

Year	EGDI	EPI	HDI
2016	0,71	0,68	0,743
2018	0,75	0,74	0,75
2020	0,79	0,82	0,759
2022	0,84	0,94	0,767
2024	0,88	1.0	0,773

At the same time, the level of human capital in Ukraine is assessed by the Human Development Index (HDI), which, according to the United Nations Development Program, was 0.773 in 2021, which places Ukraine in the group of countries with a high level of human development (UNDP, 2021). To determine the impact of digital transformation on human capital development, a correlation analysis was conducted, which showed a very strong positive relationship between EGDI, EPI, and HDI. Thus, the correlation coefficient between EGDI and HDI is 0.996, and between EPI and HDI - 0.994, which confirms the significant impact of digital technologies on the country's socio-economic development (Figure 2).

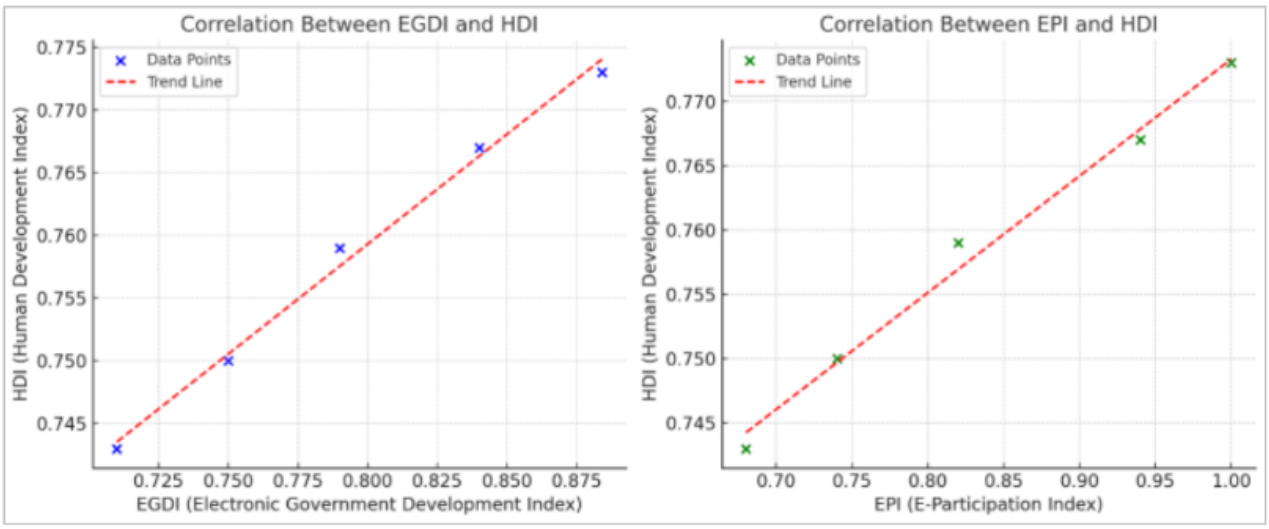

Figure 2. Correlation between EGDI and HDI and EPI and HDI

The graphs illustrate the relationship between digital transformation and human capital development:

1. Correlation between EGDI and HDI - shows that the growth of the e-Government Development Index (EGDI) is closely related to the increase in the Human Development Index (HDI).

2. The correlation between EPI and HDI demonstrates that active e-participation of citizens (EPI) has a positive impact on human capital development.

In both graphs, the red dotted line shows a trend relationship, confirmed by a high correlation. This means that there is a stable, natural relationship between the two variables (in this case, digital transformation and human capital development).

Thus, the results show that improving the EGDI and EPI indicators contributes to the human development of Ukraine. A high level of digital transformation ensures the efficiency of public administration, the availability of online services, the reduction of administrative barriers, and the transparency of government processes. In addition, e-participation of citizens ensures the level of social engagement and contributes to more effective policy-making focused on the needs of society. However, despite the positive correlation between digital indicators and the level of human capital development, it should be noted that the full potential of digital transformation can only be realized if additional factors are taken into account, such as the level of education, access to digital infrastructure, development of digital literacy among the population, and overcoming digital inequality.

It is important to note that the correlation analysis does not seek a causal relationship, but only indicates an existing trend in the relationship between digital transformation and human capital development. A more detailed statistical analysis using a larger data set over a longer period is needed to better understand this impact. Such a study would allow us to assess the long-term effects of digital reforms and identify optimal strategies to increase the effectiveness of digital initiatives in the context of improving human capital, and will be conducted based on regression analysis. A detailed regression analysis of the impact of digital transformation on human capital development allows us to assess the extent to which the EGDI (e-government development) and EPI (e-participation) indices affect the HDI (human capital). The linear regression model built on the basis of available statistical data demonstrates a high level of explanability, which indicates the importance of digital transformation for the country's socio-economic development (Table 2).

Table 2. Extended sample of indicators, including public spending on digital technologies

Year	EGDI	EPI	Gov_Spending
2010	0,6	0,55	0,5
2012	0,65	0,6	0,7
2014	0,68	0,63	0,8
2016	0,71	0,68	1.0
2018	0,75	0,74	1.5
2020	0.79	0.82	2.0
2022	0.84	0.94	2.8
2024	0.88	1.0	3.5

An extended analysis of the impact of digital transformation on human capital development, based on data from 2010 to 2024, included an additional parameter - public spending on digital technologies, which allowed us to perform a non-linear regression analysis using the logarithmic form of this variable as a predictor. The results obtained indicate the high accuracy of the model, which is confirmed by the value of the coefficient of determination R-squared = 0.998, which indicates that the model explains 99.8% of the variation in the HDI. This is evidence of the close relationship between digital transformation and human capital development, which confirms the key role of digital reforms in improving the country's socio-economic performance.

The results of the regression analysis led to the conclusion that EGDI (β = 0.2520, p = 0.014) has a statistically significant positive impact on HDI. This means that a 0.1 unit increase in EGDI leads to an increase in HDI by about 0.025, which indicates a significant contribution of e-government to human development. On the other hand, the impact of EPI (β = -0.0386, p = 0.105) was negative, although insignificant in terms of statistical significance. This may indicate that digital citizen participation does not always directly translate into human capital development and may depend on additional socioeconomic factors.

Special attention was paid to analyzing the impact of public spending on digital technologies. The use of the logarithmic form of this variable in the regression model showed a very weak relationship with the human development indicator (β = 0.0005, p = 0.959). This suggests that the direct impact of digitalization expenditures on HDI is negligible or indirect. One possible explanation for this result is the lag effect, which means that the results of investments in digital infrastructure may not be immediately apparent, but after several years. It is important to note that the lasting impact of such expenditures may be more pronounced in the future, especially if

digital transformation is accompanied by an increase in digital literacy and the labor market adapting to new technological changes.

The key findings of this study confirm that EGDI has a strong and statistically significant positive impact on HDI, which contributes to the development of e-government to improve human capital. At the same time, the EPI showed a weak impact, which may indicate that digital citizen participation without integration with other social institutions does not always lead to improved human development. Public spending on digital technologies in logarithmic form has not yet had a significant effect, which can be explained by the impact of such investments after some time.

Conclusions. Based on the analysis of digital transformation and its impact on human capital, several important conclusions can be drawn about Ukraine's current state in this process and its prospects in comparison with advanced European countries. The analysis shows that Ukraine is making significant progress in the development of e-governance, digital citizen participation, and digitalization of public services, as evidenced by high EGDI (0.8841) and EPI (1,000) scores. However, Ukraine remains behind countries such as Denmark, Finland, and Estonia, which are consistently among the world leaders in digital transformation and human capital development.

A comparative analysis of the digital transformation of Ukraine and the leading European countries (Denmark, Finland, and Estonia) has revealed the key success factors of these countries that can be used to further develop the digital society in Ukraine. Denmark is the world leader in digital governance, as evidenced by its EGDI (0.9717). The key drivers of the country's digitalization are the full integration of electronic services, high digital literacy of citizens, and the active use of artificial intelligence to optimize public services. Finland, which has an EGDI of 0.9533, has emphasized innovative education and digital skills to train highly skilled personnel for the digital economy. In turn, Estonia (EGDI - 0.9393) has become a model country in the field of digital governance, having developed the e-Estonia platform, which allows citizens to receive almost all public services online. The use of blockchain technologies, digital identification, and automated administrative processes has created a unique ecosystem that helps attract international investment and develop the startup economy.

Despite high rates of digital transformation, Ukraine lags behind advanced countries in key areas such as public spending on digital technologies, education, and healthcare. For example, Denmark and Finland invest significantly more in the development of the digital economy, which helps improve infrastructure and ensure

equal access to digital services for all citizens. At the same time, the leading countries have a much higher level of digital literacy, which allows them to more effectively use the possibilities of digital governance and technology.

The study confirmed that digital transformation is one of the key drivers of human capital development, which allows for higher levels of education, healthcare, public administration, and economic productivity. However, to ensure sustainable digital development, a number of challenges need to be addressed, including digital inequality, insufficient cybersecurity, lack of qualified IT professionals, and the risks of job automation.

Given the experience of advanced European countries, Ukraine should focus on the following priority areas:

1. Expanding access to digital technologies and the Internet, especially in rural and remote regions.
2. Investing in digital education and professional development to reduce the gap between market demands and the level of skills.
3. Strengthening cybersecurity and data protection to reduce threats from digital risks.
4. Stimulating innovations in artificial intelligence and automation to maintain the competitiveness of the economy.
5. Adapting employment policy to the digital economy by retraining workers and creating new opportunities for the gig economy.

Thus, if Ukraine continues to implement digital reforms based on the best European practices, it has every opportunity to become a leader in the digital economy in Eastern Europe. The analysis has confirmed that digital transformation not only contributes to the improvement of public administration, but it is also becoming a fundamental factor in the growth of human capital, which is a key element of the country's sustainable development.

Discussion. Ukraine is making significant progress in the development of digital technologies, as evidenced by its high rankings in the E-Government Development Index (EGDI) and the E-Participation Index (EPI) (United Nations, 2024). The introduction of digital solutions increases opportunities for improving the quality of life and human capital development. First, digitalization helps to expand access to quality education through the use of online education, MOOC platforms, and digital resources such as Coursera, Prometheus, and Diia.Education, which improves the skills of the population. In addition, the development of STEM education and digital skills training from an early age increases the competitiveness of Ukrainian specialists in the global labor market. Secondly, digital transformation contributes to

the modernization of healthcare systems, including the introduction of electronic healthcare (eHealth), which improves access to healthcare services, reduces bureaucratic barriers, and increases the efficiency of diagnosis and treatment. The use of artificial intelligence for disease prediction and personalized medicine contributes to improving public health. Thirdly, digitalization increases the efficiency of public administration, which is manifested in the expanded functionality of the Diia portal, which is a successful example of the digitalization of public services and significantly facilitates the interaction of citizens with the state. Automation of administrative processes helps to reduce corruption and increase government transparency. Fourth, digital transformation affects the development of the digital economy and labor market, creating favorable conditions for the IT sector and startups, which contributes to the creation of highly skilled jobs. The introduction of remote work and the gig economy is expanding employment opportunities for Ukrainians on a global scale. Fifth, digital technologies contribute to inclusiveness and digital equality, enabling people with disabilities to receive education, work, and interact with society. Expanding access to the Internet in rural areas will help reduce the social divide.

At the same time, despite significant progress, Ukraine faces a number of challenges that could slow down digital transformation and its impact on human capital development. One of the main problems is digital inequality, which is manifested in limited access to fast Internet, especially in remote regions, as well as differences in the level of digital literacy between age and social groups. In addition, one of the most pressing challenges is cybersecurity and data protection. The growth of cyber threats and cyber attacks on critical infrastructure requires strengthening the state cyber defense policy. Insufficient protection of personal data may cause distrust of public digital services. Another important challenge is the resilience of digital infrastructure during war and crisis. War and geopolitical instability pose risks to the continuous functioning of digital platforms and communications, while physical destruction of IT infrastructure and lack of funding can slow down the development of digital services. Another threat to development is the shortage of IT specialists and the outflow of skilled personnel abroad, which could negatively affect the country's long-term digitalization. In addition, the educational system needs to adapt to rapid technological changes and introduce new digital literacy and cybersecurity programs. The challenges of digital transformation also relate to automation and the disappearance of traditional jobs, as automation of production and digitalization of business processes may lead to job losses in traditional industries, requiring massive retraining of workers to work in new digital sectors.

In order for digital transformation to become a real driver of human capital development, a number of strategic steps need to be taken. First, access to digital technologies needs to be expanded, including improving Internet infrastructure in rural and remote regions and developing digital inclusion programs for socially vulnerable groups. Secondly, it is necessary to increase the level of digital literacy by introducing mandatory digital skills courses in school and university education, as well as launching state programs to retrain the population in the digital economy. Third, it is necessary to strengthen cybersecurity by developing a national cybersecurity strategy and improving digital security legislation, as well as to increase the level of protection of public digital services and personal data. Fourth, it is necessary to stimulate innovation and support startups by providing tax incentives for technology companies developing digital products and expand international cooperation in the field of digital technologies. Fifth, it is important to adapt labor to the digital economy through a program to support retraining and professional development, as well as investing in the development of the gig economy and remote work.

Thus, digital transformation is a powerful tool for the development of human capital in Ukraine, creating new opportunities for education, economy, public administration, and social interaction. At the same time, challenges related to digital inequality, cybersecurity, and labor adaptation require active intervention in digitalization processes. By investing in digital infrastructure, education, and innovation, Ukraine has a chance to become a leader in the digital economy in the region.

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