Journal of Theoretical and Applied Information Technology
15th September 2025. Vol.103. No.17
© Little Lion Scientific
ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

IMPACT OF DIGITAL TRANSFORMATION OF THE HUMAN CAPITAL MANAGEMENT SYSTEM ON STATE REGULATION OF THE NATIONAL ECONOMY DEVELOPMENT

KOSTIANTYN SHAPOSHNYKOV[1], ANASTASIIA DUKA[2], GRYGORIY STARCHENKO[3], IHOR CHORNODID[4], DENYS KRYLOV[5], OLENA SELEZNOVA[6]

[1]Department of Research and Certification of Scientific Personnel,
State Scientific Institution "Institute of Education Content Modernization", Kyiv, Ukraine
[2] Department of Management, Higer Educational Institution "University of Future Transformation", Chernihiv, Ukraine
[3] Department of Enterprise Economics and Management, Academy of Labour, Social Relations and Tourism, Kyiv, Ukraine
[4]Department of Enterprise Economics and Management, Academy of Labour, Social Relations and Tourism, Kyiv, Ukraine
[5]Department of Finance, Banking, Insurance and the Stock Market, Zaporizhzhia National University, Zaporizhzhia, Ukraine
[6]Department of Finance, Banking, Insurance and Marketing, Institute of Economics and Law of Classic Private University, Zaporizhzhia, Ukraine

E-mail: [1]k.s.shaposhnykov@gmail.com; [2]apd@online.ua; [3]g.v.starchenko@gmail.com; [4]chornodid@ukr.net; [5]krylov.denys2021@gmail.com; [6]olenaseleznova84@gmail.com

ABSTRACT

The study reveals the role of human capital as a key factor of sustainable economic growth and a tool for state regulation of the national economy in the context of digital transformation. The purpose of the study is to determine the role of human capital in state regulation of the national economy development in Ukraine in the context of digital transformation and to substantiate directions for improving state regulation to increase the management efficiency of this capital. The research used methods of comparative analysis, statistical generalization, structural and logical analysis, graphic modeling, and the inductive-deductive approach. The source of empirical data was indicators of the State Statistics Service of Ukraine and Eurostat for 2019-2023, which made it possible to trace changes in functioning of the human capital system before the start of a full-scale war and under its influence. It is shown that indicators of the educational level, demographic situation, employment, and digital competencies of the population are decisive for formation of the competitive economy. Despite high level of the higher education coverage in Ukraine (28% in 2023), other socio-economic indicators, in particular low GDP per capita, high unemployment and negative natural growth, indicate low efficiency of the human potential realization. Emphasis is placed on demographic challenges, in particular population decline and aging, which threatens stable reproduction of human capital. Comparative analysis with EU countries shows deep gap in economic productivity, which requires systematic modernization of approaches to human capital management. The digital economy is transforming the labor market, increasing the demand for new competencies, while simultaneously displacing traditional forms of employment. Both positive (innovation, new forms of employment, access to the global market) and negative (increasing inequality, displacement of labor) effects of digitalization are identified. The need for digital modernization of the human capital management system based on analytics, forecasting and information technologies is proven. Strategic role of the state in the human capital development is outlined: from investing in education to forming the inclusive digital policy. Priority areas of state regulation are proposed, aimed at increasing digital competencies, adapting the education system, supporting innovative business, regulating new forms of employment and ensuring digital equality.

Keywords: *Human Capital; Digital Transformation; Government Regulation; Employment; Digital Economy; Human Capital Management; Education; Digital Competencies; Investment In Human Capital.*

Journal of Theoretical and Applied Information Technology
15th September 2025. Vol.103. No.17
© Little Lion Scientific
ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

1. INTRODUCTION

In today's global digitalization environment, human capital is emerging as a key factor in ensuring economic competitiveness and sustainable development of countries. Information and digital technologies are significantly changing the nature of labor, structure of the employment market, requirements for employee competencies, and human capital management models. These changes necessitate rethinking of approaches to formation, use, and reproduction of human capital, especially in countries with high levels of social and economic risks, such as Ukraine.

Digital transformation of the human capital management system has not only internal organizational significance, but also serves as an important tool of state regulation, as it affects employment, education level of the population, innovative capacity and economic productivity. Effective state regulation in this area allows both to reduce negative effects caused by automation and robotization, and to maximize positive potential of the digital economy for the national welfare growth.

Given relevance of these challenges, the study is devoted to analyzing relationship between the human capital development, digital transformations, and state regulation of the national economy, with the emphasis on the need to form new regulatory strategies and institutional solutions.

2. LITERATURE REVIEW

Digital transformation has become a key factor in global changes in the economy and the human capital management [1], [2], [3].

Schwab [4] introduces the concept of the fourth industrial revolution, in which digital technologies (AI, IoT, Big Data) are changing the structure of the economy, production and work and are based on widespread implementation of digital technologies, the artificial intelligence, the Internet of Things and Big Data. These changes create both new opportunities for increasing productivity and challenges related to adaptation of the workforce and human resource management systems.

Cooke et al. [5], Boxall and Purcell [6], Fahim [7] emphasize that digitalization significantly changes requirements for workers' skills, which poses the task for states to modernize education systems and create conditions for continuous learning and retraining. Similarly, Farndale and [8], Popelo and al. [9], Tulchynska and [10], Novomlynets and al. [11] point to the need to develop digital skills as the foundation for human capital that will allow economies to respond effectively to changes taking place.

The issue of the human capital management digital transformation is also considered in the works [12], [13], [14], which show that digital technologies can lead to the gap between the productivity growth and employment, requiring flexible regulatory approaches from states. The use of new technologies in the personnel management opens up prospects for increasing efficiency, but at the same time requires appropriate political decisions to protect workers and stimulate innovation [15], [16], [17].

Researchers [18], [19], [20] propose conceptual approaches to formation of the digital state policy that takes into account interests of business, citizens and the state, in particular in terms of regulating digital markets and infrastructure. The important role in this process is played by the analysis of digital barriers, which is explored in the works [21], [22], [23], which developed the index of digital trade restrictions, which helps to assess the extent to which state regulations facilitate or inhibit the digital economy development. The Ukrainian context is reflected in the Strategy for Digital Transformation of Ukraine until 2030, which emphasizes importance of developing human capital through introduction of digital technologies into the education system and public administration [24], [25]. However, there is the need for additional empirical research to adapt international models to the specifics of the national economy. At the same time, despite significant amount of research [26] [27], [28], [29], the issue of adapting global approaches to national characteristics and regional contexts remains open.

Taking into account the results of the studies presented in the works of Schwab [4], Cooke et al. [5], Boxall and Purcell [6], Farndale et al. [8], Popelo et al. [9], Tulchynska et al. [10], as well as the analysis of state strategies for digital transformation [24], [25], it is worth focusing on a comprehensive study of the transformation of the human capital management system under the influence of digital factors. In particular, this study investigates the correlation between the level of higher education and the possession of digital skills of the population in Ukraine and the EU countries based on comparative statistical analysis, which allows us to quantitatively determine the interdependence between educational potential and the ability of the population to adapt to the digital economy; to identify the specifics of the impact of digital transformations on employment, labor productivity, and the structure of the labor market, in particular during the war and post-crisis period in Ukraine, using approaches to analyzing human capital dynamics proposed in modern foreign

and domestic scientific literature [7], [9], [10], [12]–[14]; to analyze digital factors that shape the modern model of human resources management, including automation, remote employment, development of digital competencies, globalization of the labor market, symbiosis of humans and artificial intelligence; to systematize the challenges and threats associated with digital inequality, as well as propose directions for overcoming it through public policy, taking into account recommendations on digital policy in European sources [18]–[23] and the national Digital Transformation Strategy [24], [25]; develop scientifically based proposals to improve state regulation of human capital development in the digital economy, in particular through the formation of a national digital competences program, modernization of education, stimulation of the creation of high-tech jobs, and improvement of labor legislation.

The purpose of the study is to determine the role of human capital in ensuring state regulation of the national economy development in Ukraine in the context of digital transformation and to substantiate directions of improving state regulation to increase efficiency of management of this capital.

3. METHODOLOGY

Digital transformation has become the key factor in global changes in the economy and the human capital management [1], [2], [3].

Schwab [4] introduces the concept of the fourth industrial revolution, in which digital technologies (AI, IoT, Big Data) are changing the structure of the economy, production and work and are based on widespread implementation of digital technologies, the artificial intelligence, the Internet of Things and Big Data. These changes create both new opportunities for increasing productivity and challenges related to adaptation of the workforce and the human resource management systems.

Cooke et al. [5], Boxall and Purcell [6], Fahim [7] emphasize that digitalization significantly changes requirements for workers' skills, which poses the task for states to modernize education systems and create conditions for continuous learning and retraining. Similarly, Farndale and [8], Popelo and al. [9], Tulchynska and [10], Novomlynets and al. [11] point to the need to develop digital skills as a foundation for human capital that will allow economies to respond effectively to changes taking place.

The issue of human capital management in the context of digital transformation is also considered in the works [12], [13], [14], which show that digital technologies can lead to the gap between the productivity growth and employment, requiring flexible regulatory approaches from states. The use of new technologies in the personnel management opens up prospects for increasing efficiency, but at the same time requires appropriate political decisions to protect workers and stimulate innovation [15], [16], [17].

Researchers [18], [19], [20] propose conceptual approaches to formation of the digital state policy that takes into account interests of business, citizens and the state, in particular in terms of regulating digital markets and infrastructure. An important role in this process is played by the analysis of digital barriers, which is explored in the works [21], [22], [23], which developed the index of digital trade restrictions, which helps to assess the extent to which state regulations facilitate or inhibit the digital economy development. The Ukrainian context is reflected in the Strategy for the Digital Transformation of Ukraine until 2030, which emphasizes relevence of developing human capital through introduction of digital technologies into the education system and public administration [24-30]. However, there is a need for additional empirical research to adapt international models to the specifics of the national economy. At the same time, despite significant amount of research [31] [32], [33], [34], the issue of adapting global approaches to national characteristics and regional contexts remains open.

The purpose of the study is to determine the role of human capital in ensuring state regulation of the national economy development in Ukraine in the context of digital transformation and to substantiate directions of improving state regulation to increase efficiency of management of this capital.

That is, within the framework of the study of human capital as a factor of digital transformation of the economy, a comprehensive interdisciplinary approach was used, combining demographic, economic, educational and technological dimensions. The basis of the research design is a comparative quantitative and qualitative analysis, covering both the international (EU countries) and national (Ukraine) levels. Human capital is assessed using the following indicators: total birth rate (per 1000 people), total death rate (per 1000 people), natural population growth; unemployment rate (%) as an indicator of socio-economic integration; share of the population with higher education (% of the total); share of people with basic and above-basic digital skills (%).

The conceptual model of the study is built on the hypothesis that: the higher the level of education of

the population, the higher the level of its digital competencies, which, in turn, determines the effectiveness of the digital transformation of the economy and requires appropriate state regulation to ensure the sustainable development of human capital.

4. RESULTS

Although formation of the human capital theory as a separate scientific direction is usually associated with the 1960s, its origins can be found in the works of classics of economic thought - such as A. Smith, W. Petty, J.-B. Say, I. Fisher and others. In particular, W. Petty was the first to propose the quantitative assessment of the value of a person as a component of the national wealth [38]. A. Smith in his work "Inquiry into the Nature and Causes of Wealth of Peoples" emphasized that abilities acquired in the process of learning have real value, which is equal to the capital invested in a person [39]. J.-B. Say also believed that knowledge and skills, which are purchased for a certain price and increase productivity, should be considered as a form of capital [40].

Later, these ideas were systematized and deepened within the neoclassical economic paradigm, where human capital began to be interpreted as investment in education, professional training and retraining. Significant contribution to development of this theory was made by T. Schultz [41], G.S. Becker [42; 43], J. Mincer [44], K.R. McConnell, S.L. Bru [45] and other researchers. Subsequently, the structure of human capital also included costs of medical care, information in the labor market, as well as mobility - both professional and geographical.

Thanks to the research of economists of the specified period, it was proved that adding the human capital indicator to traditional factors of production (capital and labor) provides better explanatory power of economic growth models. Thus, a new theoretical direction was formed, dedicated to assessing the human capital impact on economic development, in which education was considered a key factor. Empirical studies proved effectiveness of investing in people, showing that difference in income between individuals may be due not so much to characteristics of employment, but to the effective personal investment strategy in one's own education and development of competencies.

Human capital is a set of knowledge, skills, competencies, experience, health status and personal qualities that affect labor productivity and the person's ability to create economic value. Development of human capital is a key factor in sustainable economic growth, and therefore is a central element in the state regulation system. The targeted formation of high-quality human capital is a strategic resource that determines competitiveness of the national economy in the globalized world.

Human capital is one of the key resources that determine the economic development level and effective state regulation. Investments in education, health care, employment and social mobility contribute to increasing labor productivity and, accordingly, increasing gross domestic product (GDP) per capita. At the same time, the unemployment rate serves as an indicator of how effectively the labor market functions and how the state implements its employment policy (Fig. 1).

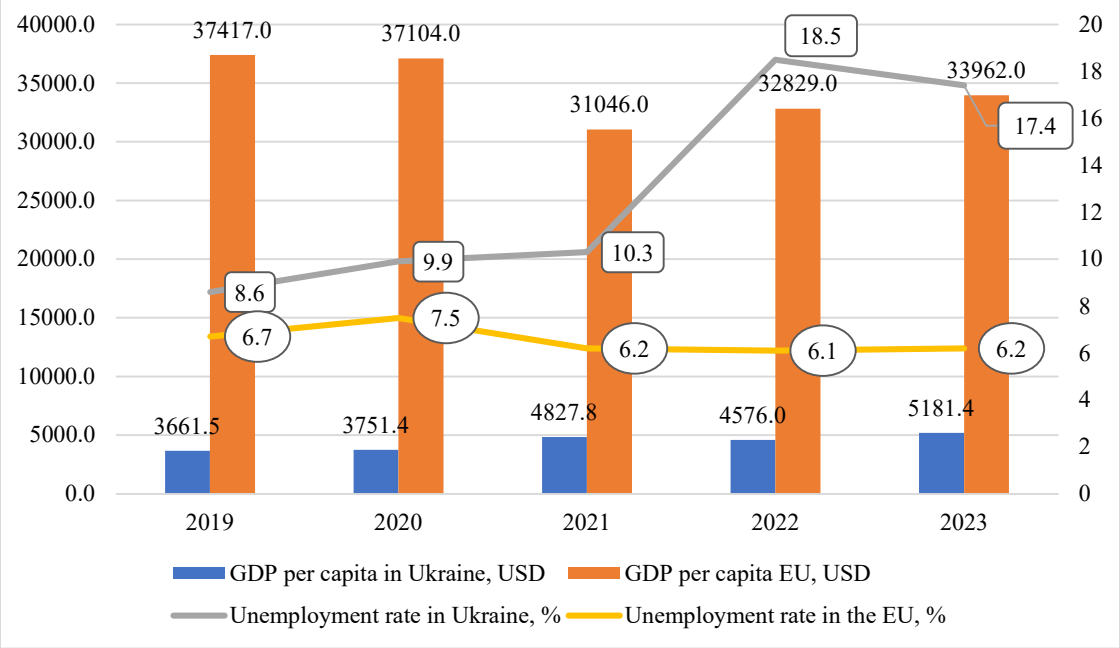

Figure 1: Dependence of the main macroeconomic indicators of Ukraine and the average for the European Union on the state of human capital as a factor of state regulation of the national economy (2019 - 2023)
Source: constructed by the authors based on [37; 46]

In 2019-2023, there is a general trend towards the GDP growth per capita in Ukraine: from $3,661.5 to $5,181.4. The largest increase occurred after 2021, which indicates certain stabilization of the economy after the pandemic. However, in absolute terms, the GDP level per capita in Ukraine significantly lags behind the EU countries - almost 6-9 times, which demonstrates insufficient level of the potential realization of the human capital.

The GDP per capita in the EU ranges between $31,000 and $37,400, with slight decrease in 2021 (effect of the COVID-19 pandemic). Maintaining consistently high GDP level in the EU indicates efficient use of human capital and strong institutional support.

The unemployment rate in Ukraine shows rapid increase from 8.6% in 2019 to 18.5% in 2022 – apparently due to the war. Partial decrease in the unemployment rate in 2023 (17.4%) indicates the beginning of the economy's adaptation to new conditions. Such dynamics emphasize the insufficient effectiveness of the state employment policy, as well as the vulnerability of the labor potential.

The unemployment rate in the EU varies between 6.1–6.7%, which demonstrates stable social protection system and high efficiency degree of state regulation of the labor market.

The presented data confirm that developed human capital and effective state regulation are interrelated factors of economic growth. In Ukraine, despite positive dynamics of the GDP per capita, high unemployment rate indicates inefficient use of human capital, which reduces the economy potential. To reduce the gap with EU countries, it is necessary to deepen investments in education, digitalization, the adaptive employment system and healthcare as priority areas of the policy in the human capital development.

Human capital as a key resource for economic growth is formed under the influence of the complex of demographic factors, in particular, indicators of fertility, mortality and natural population growth. In the conditions of the demographic crisis characteristic of Ukraine, state regulation should be aimed at stabilizing and developing human potential. Analyzing the dynamics of relevant coefficients in comparison with countries of the European Union, it is possible to assess effectiveness of policies in socio-economic development and identify critical threats to sustainable reproduction of labor resources (Fig. 2).

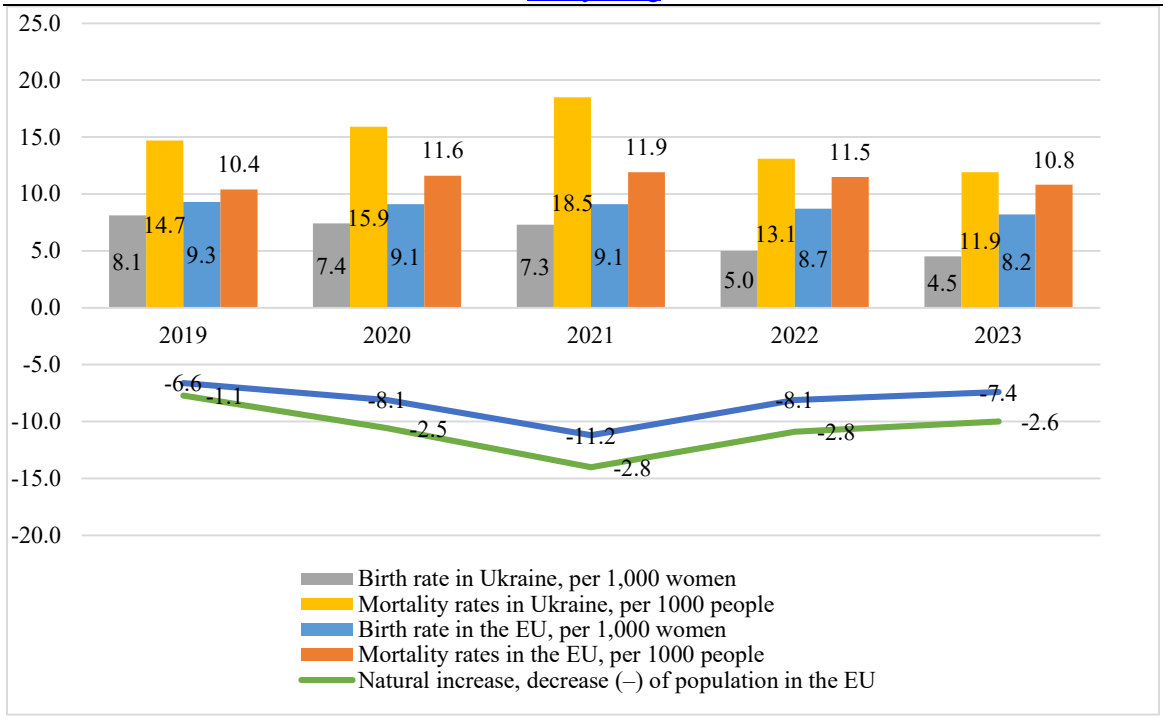

Figure 2: Demographic factors of the human capital formation in the state regulation system of the economy: comparative analysis of Ukraine and the EU (2019 - 2023)
Source: constructed by the authors based on [37; 46]

Ukraine is experiencing steady decline in birth rates: from 8.1% in 2019 to 4.5% in 2023. This indicates deepening demographic crisis, exacerbated by the impact of war, migration, and declining social optimism.

In EU countries, the fertility rate fluctuates between 8.2–9.3%, with a slight downward trend, but remains more stable compared to Ukraine.

In Ukraine, the mortality rate remains very high, especially in 2021 - 18.5%, which is associated with the COVID-19, low levels of healthcare, and social instability.

In the EU, mortality is lower, although it also shows growth: from 10.4% in 2019 to 10.8% in 2023.

The most acute situation in Ukraine: during 2019-2023, there is negative dynamics of the natural population growth, with the peak reduction in 2021 (–11.2%).

The EU also has negative natural growth (from –1.1% to –2.8%), but compared to Ukraine, it is less threatening and is more compensated by migration.

The presented demographic indicators indicate critical reduction in the demographic base of the Ukraine's human capital, which requires active intervention from state regulation. These should be comprehensive policies to support fertility, health care, reintegration of migrants, as well as measures aimed at preserving and developing human potential as the basis for the economic recovery.

Human capital is the driver of innovative development, economic sustainability and competitiveness of the country. One of its key components is the education level of the population, in particular the share of people with higher education. In today's global competition, it is the state that plays a decisive role in shaping the educational environment that ensures high-quality development of human capital. Research on the higher education level in different European countries allows us to determine how effectively state policy in education is being implemented and how these processes affect economic development (Fig. 3).

Journal of Theoretical and Applied Information Technology
15th September 2025. Vol.103. No.17
© Little Lion Scientific
ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

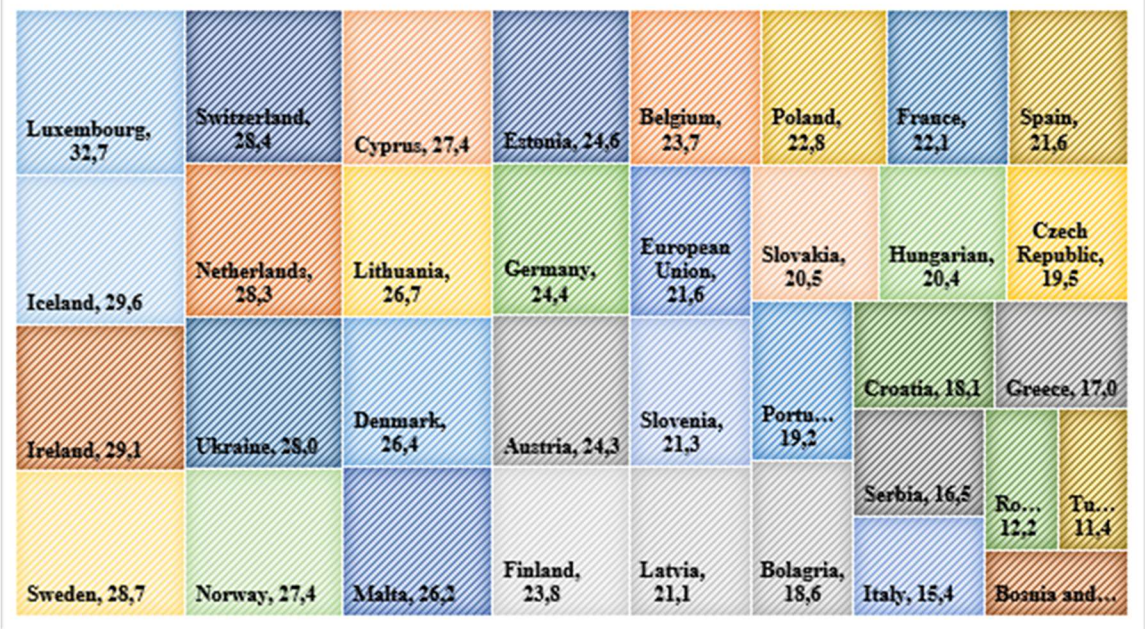

Figure 3: Higher education level as an indicator of the human capital development in state regulation of the economy: comparative analysis of Ukraine and European countries in 2023, % of the total population
Source: constructed by the authors based on [37; 40]

In 2023, the share of the population with higher education in the European Union was on average 21.6%, but the education level varies significantly between countries. For analytical comparisons, it is advisable to group countries by the level of this indicator.

The leaders in terms of higher education (over 28%) are: Luxembourg (32.7%), Iceland (29.6%), Ireland (29.1%), Sweden (28.7%), Switzerland (28.4%), the Netherlands (28.3%), Norway (27.4%), Cyprus (27.4%), Lithuania (26.7%), Denmark (26.4%). These countries are characterized by high level of investment in human capital, flexible education systems and favorable state policies for realization of educational potential in the labor market.

Countries with average level of higher education graduates in the total population (22-27%) are Malta (26.2%), Finland (23.8%), Belgium (23.7%), Germany (24.4%), Estonia (24.6%), France (22.1%), Poland (22.8%), Slovenia (21.3%), Latvia (21.1%). Ukraine (28.0%) is also included in this group, ahead of the EU average (21.6%). Despite challenges of wartime, Ukraine retains high educational potential, which indicates the stability of the education system and the historically formed culture of obtaining higher education. At the same time, real use of this capital depends on the state's ability to create conditions for the knowledege implementation within the national economy, in particular through the labor market reform, investment in science and innovation, and the return of talented youth. The role of the state in ensuring access to quality higher education through state regulatory mechanisms becomes especially critical during periods of instability, such as a full-scale war in Ukraine after 2022.

Countries with lower levels (15-22%): Spain (21.6%), Czech Republic (19.5%), Portugal (19.2%), Bulgaria (18.6%), Croatia (18.1%), Greece (17.0%), Serbia (16.5%), Italy (15.4%). These countries have a lower share of the population covered by higher education, which is the result of both structural features of the economy (orientation towards traditional sectors with lower qualification requirements) and limited access to education due to financial or social barriers.

Countries with very low levels (less than 15%): Romania (12.2%), Turkey (11.4%), Bosnia and Herzegovina (11.1%). These countries require a priority review of state education policies to ensure their accessibility, quality and adaptability to the needs of the modern labor market.

Ukraine demonstrates one of the highest levels of the share of the population with higher education among European countries, which creates significant advantages in formation of the post-crisis economy. However, the real threat of loss of human capital through migration, especially during war, requires active intervention by the state. The priority areas of

state regulation should be as follows: integration of youth into the domestic labor market; stimulation of educational mobility within the country; creation of conditions for the return of specialists from abroad; development of the institutional autonomy and digitalization of education.

In 2023, despite extraordinary external challenges, Ukraine has maintained a high level of educational potential. This is one of the main assets of the state in the context of post-war reconstruction and modernization of the economy. Preservation and development of human capital is a strategic task of state regulation of the national economy, which must be implemented through the systematic educational, scientific, innovative and demographic policy.

In the digital economy, highly qualified personnel possess technological knowledge that contributes to scientific and technological progress. Czarniewski S. [47] emphasizes that development of telecommunications and information technologies requires their developers and users to have appropriate level of qualification. Therefore, the ability to quickly adapt to changing conditions is critically important, in which the tendency to continuous learning (lifelong education) becomes a competitive advantage for an employee. In addition, the quality of human capital in the globalization context includes such characteristics as knowledge of foreign languages, mobility, high level of education, ability to work with computer programs, independence, creativity, new competencies and skills.

Relevence of human capital in economic and social transformation is obvious, but the role of formal institutions in these changes, related to the the human capital management at the global, national, regional and local levels, is becoming increasingly important. Within the digital economy framework, the main tasks of these institutions are not only the training of qualified specialists with necessary skills and competencies, but also formation and development of human capital within the framework of effective state management of the national economy [47].

As noted in the study [47], effective management of human capital in the digital economy is impossible without changes in the conditions and tools for its development. Important aspects of this process are the development of the IT sector, the creation of innovative technologies, organization of international cooperation for their development, as well as institutional changes, in particular creation of appropriate legislative framework that would correspond to rapidly changing conditions and new technological solutions for business processes. However, to effectively determine directions of the digital economy development and to improve the quality of human capital, it is necessary to understand which factors of digitalization affect human capital.

In 2023, the level of digital competences is an important indicator for assessing the human capital development in countries of the European Union and other European countries. In the digitalization of the economy, the ability to work with information and technology becomes critically important for development of not only individuals, but also national economies as a whole. State regulation in this context aims to support the increase in the digital literacy level through educational programs, investments in the IT sector and adaptation of legislation to new technological requirements (Fig. 4).

Journal of Theoretical and Applied Information Technology
15th September 2025. Vol.103. No.17
© Little Lion Scientific
ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

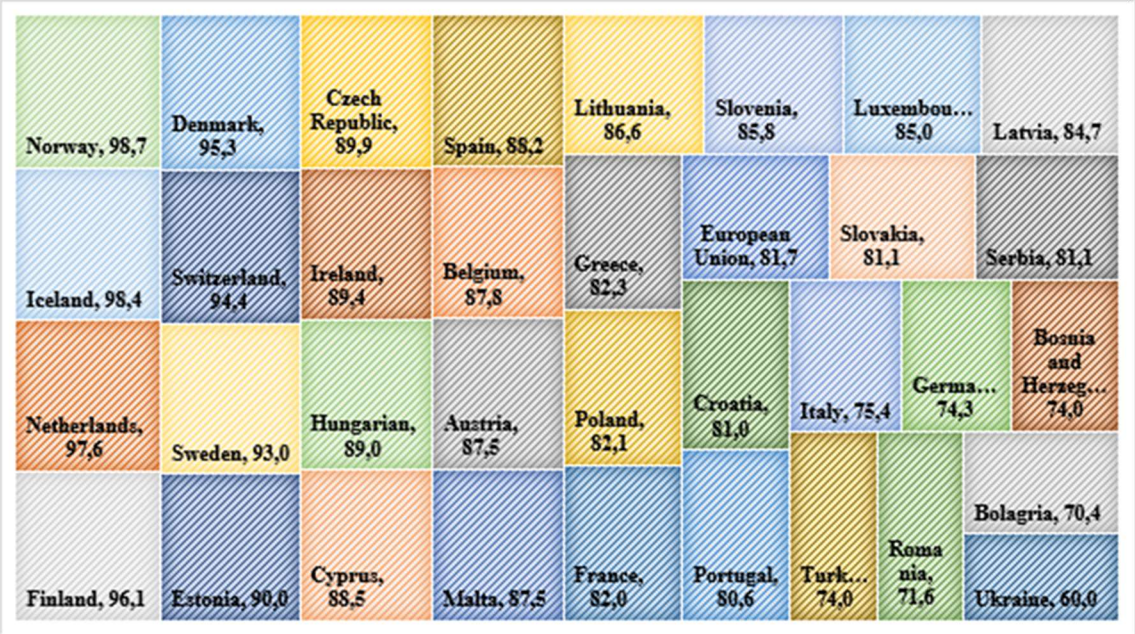

Figure 4: Level of digital competence of the population of Ukraine and the EU in 2023, % of the total population

Source: constructed by the authors based on [36; 37]

High level of digital literacy of the population is characteristic of the following countries: Iceland (98.4%), Norway (98.7%) and Sweden (93.0%). These countries have the highest indicators, which indicates high effectiveness of their state policy. They actively invest in technological education and have the developed infrastructure to support digitalization at all levels of the economy.

High level of digital literacy in the EU is characteristic of some countries, in particular the Netherlands (97.6%), Denmark (95.3%) and Austria (87.5%), which also demonstrate high levels of digital literacy. These countries regularly update educational programs, support technological innovation and provide specialized programs for adults, which allows citizens to constantly improve their skills in the face of rapid technological change.

Average level of digital literacy of the population is typical for the following countries: Ireland (89.4%), Greece (82.3%), France (82.0%), Serbia (81.1%), Italy (75.4%), which have noticeable level of digital literacy of the population, but they face certain difficulties in adapting educational programs to digital requirements. Here, state regulation still needs to be optimized, in particular by creating incentives to support digital literacy of the population.

Low level of digital literacy of the population and the need for development are characteristic of the following countries: Ukraine (60.0%), Bulgaria (70.4%), Romania (71.6%). This indicates the need for significant changes in the public policy, in particular in educational initiatives, public funding of digital programs and national strategy to increase the level of digital skills among the population.

Low level of digital literacy of the population in Ukraine can be explained by several factors that interact and are complex in nature:

1. Low accessibility and quality of education. In Ukraine, despite some improvements in recent years, the education system still faces challenges in ensuring high quality educational programs, particularly in the information technology and digital literacy. Educational institutions often do not have sufficient resources to implement modern technologies in the educational process, which affects development of digital skills in schools and higher education institutions.

2. Uneven access to the Internet and technology. In Ukraine, there is significant difference in the level of access to the Internet and modern technologies between urban and rural regions. In rural areas, access to modern technologies is limited, which hinders acquisition of necessary digital literacy skills.

3. Economic problems and instability. In conditions of economic instability and difficult socio-economic situation, most resources, including budget funds, are directed to more urgent problems than the digital literacy development. Lack of

adequate investment in digital education and educational programs, as well as in supporting state and public initiatives in this area, reduces the overall level of digital literacy.

4. Low motivation for continuous learning. Ukraine lacks culture of continuous learning (lifelong learning). Traditionally, most citizens have focused on acquiring basic knowledge and skills in schools and universities, and only a small portion of the population invests in further developing their digital skills after completing formal education.

5. Although Ukraine has taken some initiatives to develop the digital economy and e-government, in practice, implementation of these programs often faces bureaucratic obstacles, lack of funding, and insufficient coordination between government agencies. This results in many strategies failing to achieve their goals or their implementation being delayed.

6. The war and its aftermath are having negative impact on Ukraine's economy and social infrastructure. Many people, particularly in conflict zones, have limited access to education and new technologies due to physical and economic hardship. This creates additional barriers to development of digital skills among the population.

These factors, together with other features of the Ukrainian economy and social structure, create a situation in which digital transformation remains at low level compared to more developed European countries.

The level of digital literacy has a direct impact on the human capital development in countries. Effectiveness of state regulation of the economy determines how quickly a country can adapt to requirements of the digital age. Countries grouped with high, medium and low literacy levels demonstrate different approaches to the human capital development, which requires the state to constantly improve its policy towards investment in education and technology.

The impact of digital transformation of the human capital management system on state regulation of the national economy development is a complex phenomenon. The analytical overview of relationship in European countries and Ukraine is shown in Fig. 5.

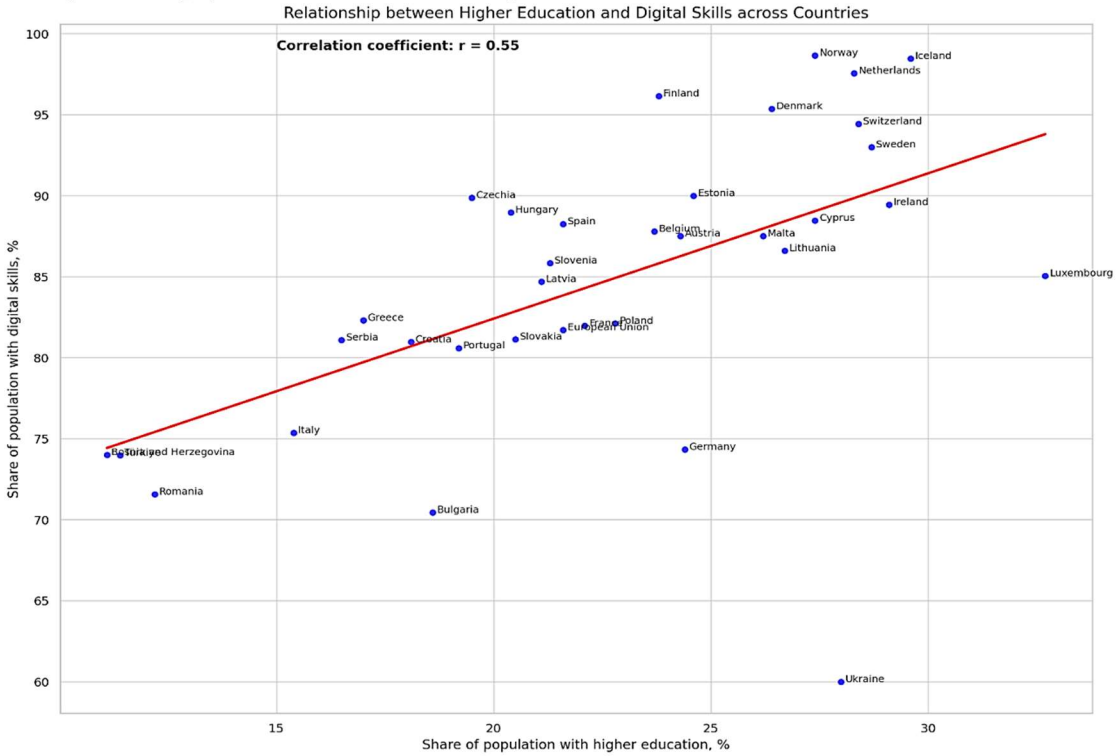

Figure 5: Relationship between the higher education level and digital competences of the population in European countries

Source: Authors' development

Correlation between the share of the population with higher education and the share of the population with digital skills is around 0.55, a moderate positive correlation. This means that the increase in the share of the population with higher education is generally accompanied by the increase in the share of people with digital skills, but does not guarantee it.

At first glance, there is positive correlation between higher education levels and digital skills. That is, countries with a higher percentage of the population with higher education tend to have higher digital skills. For example:

Iceland (29.6% higher education → 98.44% digital skills); Netherlands (28.3% → 97.55%); Norway (27.4% → 98.65%). This indicates that higher education is often accompanied by acquisition of digital skills through the increased use of digital technologies in learning and work.

However, relationship is not completely linear. There are cases where high levels of digital skills are observed with average or even low levels of higher education: Czech Republic (19.5% education → 89.86% digital skills); Hungary (20.4% → 88.96%); Belgium (23.7% → 87.79%). This indicates strong role of extracurricular digital education, state digitalization programs, or technical culture in society.

In Ukraine, the share of the population with higher education is 28%, but only 60% have digital skills. This is an anomaly compared to EU countries. With a similar level of higher education (for example, Luxembourg – 32.7%), the level of digital skills in the EU exceeds 85-95%. In Ukraine, the gap between education and digital skills is the largest among all countries. The reasons for this gap are as follows: the quality of higher education does not always provide for acquisition of digital skills; insufficient digitalization of the educational process; limited access to infrastructure (Internet, modern devices); less integration of digital technologies into everyday life and work.

Although Greece, Romania, and Bulgaria have low levels of higher education, their level of digital skills is not the lowest – informal learning and digital policy. The Czech Republic, Estonia, and Hungary are countries with high levels of digital skills and average levels of higher education. They demonstrate good digital literacy among their populations with average levels of higher education. This indicates effective digital policies and educational programs in schools and on the labor market.

Thus, higher education has positive impact on digital competence, but it is not the only or sufficient factor. Digital transformation policies, access to technology, institutional quality of education and the digital infrastructure level are no less important. Ukraine should rethink approaches to digital skills in higher education, improve infrastructure and access to digital services, especially for the adult population.

The digital economy opens up wide opportunities for increasing labor productivity, optimizing resources and flexibility of employment, but at the same time it also creates a number of challenges, namely: risk of job losses, growth of digital inequality, need for continuous professional development. Therefore, it is worth investigating the impact of digital economy factors on employment and human resource management, given their dual (positive and negative) effect. Understanding these changes is necessary for formation of effective personnel policy, ensuring competitiveness of employees and development of the inclusive labor market in the conditions of digital transformation (Fig. 6).

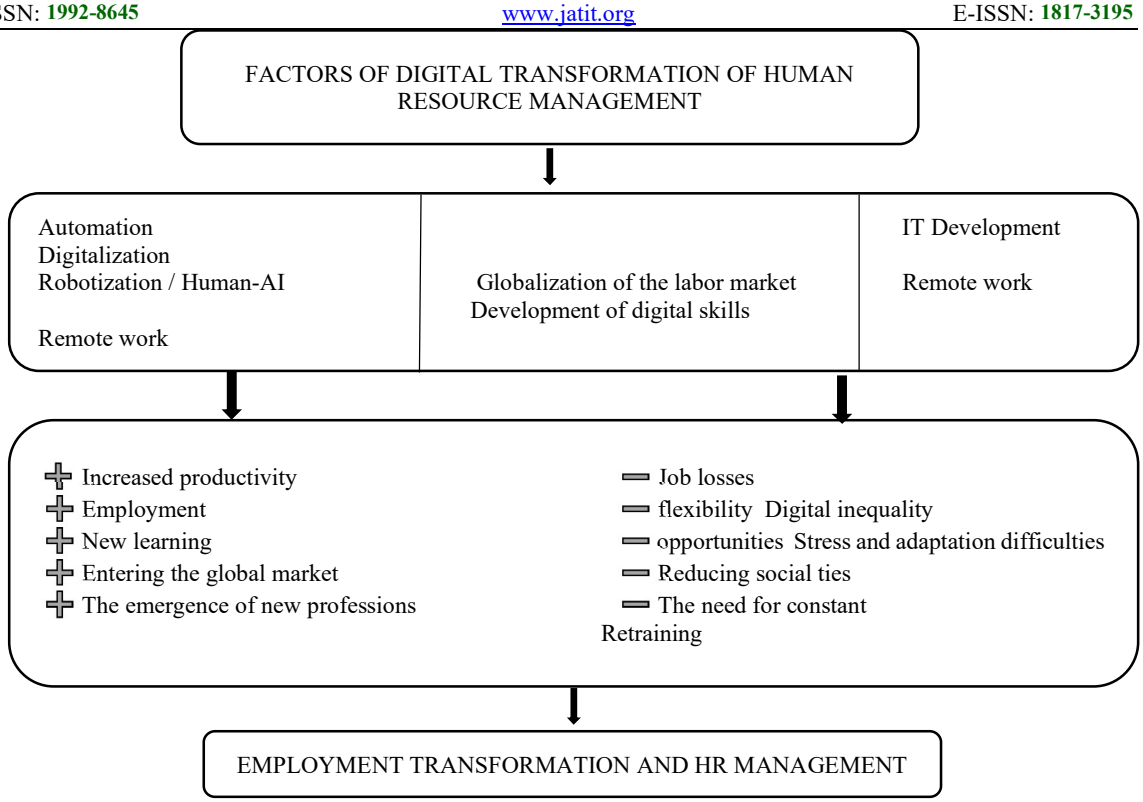

Figure 6: The impact of digital economy factors on transformation of the human capital management system

Source: developed by the authors

Digital economy factors (including automation, digitalization, robotization, IT development, remote employment, globalization of the labor market and formation of digital competencies) significantly affect transformation of employment and human resource management. Their impact is twofold: on the one hand, they contribute to creation of new professions, increasing labor flexibility, productivity and efficiency of personnel management; on the other hand, they provoke the loss of traditional jobs, the growth of digital inequality, social isolation of workers and the need for constant adaptation to technological changes. In such conditions, rethinking the role of a person in the economy, increasing importance of digital education, adaptability of HR policies and formation of new models of interaction between the employee and the employer become key.

5. DISCUSSION

Today, in the context of the digital technologies development, new principles of the functioning of national economies are being formed, where human capital is a key factor of competitiveness. Digital transformation, covering all spheres of public life, radically changes approaches to labor resource management, requiring states to develop new regulatory mechanisms capable of ensuring adaptability, flexibility and efficiency of economic policy.

We cannot disagree with Cooke's statements. and al. [5], Malik and Sanders [12] and Knice and al. [49], who prove that modernization of the human capital management system is of particular importance, which in the digitalization context should be based on integration of information and communication technologies, development of digital skills and provision of continuous professional training. At the same time, effective state regulation requires not only technical re-equipment, but also a review of management strategies, institutional models and the regulatory environment. Water carrier Kholiavko and al. [1], Djakona and al. [19] and Imran and al. [50] identify key technologies for digital transformation through key technologies for digital transformation. Digitalization is changing the nature of work and requires a rethinking of human capital. They highlight the need to modernize the human resource management system. They identify

digital skills as a central factor in human capital development.

Thus, the analysis of the scientific literature shows that digital transformation is a multidimensional process that not only changes the methods of human capital management, but also sets the state the task of developing new regulatory mechanisms to ensure sustainable economic development.

6. CONCLUSIONS

Human capital is a key determinant of economic growth. The level of education, demographic characteristics, employment and competences of the population directly affect the country's ability to develop economically. The study shows that although Ukraine has a high percentage of the population with higher education (28% as of 2023), other indicators (low GDP per capita, high unemployment, negative natural growth) demonstrate weak realization of human potential.

Current demographic crisis deepens the risks to the human capital reproduction. The natural decline in the population in both Ukraine and the EU indicates an aging population, the decrease in the labor force, and the need for new approaches to labor resource management.

Ukraine has a significantly lower level of economic productivity compared to EU countries. In 2023, GDP per capita in Ukraine was $5,181.4, while the EU average was $33,962. This gap reduces competitiveness of the Ukrainian human capital in the global context.

Digital transformation is changing the structure of employment and skill requirements. Factors of the digital economy – automation, robotization, IT development, remote work and globalization of the labor market – have both positive and negative consequences. On the one hand, they create new opportunities, on the other hand, they displace low-skilled labor and increase social inequality.

The human capital management system in Ukraine needs digital modernization. In today's conditions, traditional mechanisms are no longer able to effectively respond to the dynamics of the digital economy. Flexible, analytically supported management using data, IT tools, and forecasting models is needed.

The role of state regulation in the human capital development in the digitalization context is growing. The state must play not only a supervisory but also a proactive role - through investing in education, supporting digital competencies, and encouraging employers to modernize and be socially responsible.

Improving state regulation to enhance digital transformation of the human capital management system and strengthen its role in economic development should be carried out in the following areas:

1. Formation of the national program for development of digital competencies for the population, with the emphasis on continuous training, retraining and adaptation to the labor market in the digital economy.
2. Transforming education through the integration of digital skills, critical thinking, information management, and IT literacy at all levels – from schools to vocational and higher education.
3. State incentives for creation of high-tech jobs, encouraging businesses to invest in digital innovations, and developing the IT sector, startups, and technology parks.
4. Regulation of the labor market in the context of digital transformation through improving labor legislation, taking into account new forms of employment (freelance, gig economy, remote work), ensuring social protection for new categories of workers.
5. Ensuring equal access to digital infrastructure in rural areas, among socially vulnerable groups of the population, and the elderly.
6. Monitoring digital inequality and effectiveness of investments in human capital.

The results of this study have practical, analytical and strategic value for public policy, the education system, the labor market and the management of digital transformation, and also emphasize the strategic importance of investments in human capital in the digital era; serve as the basis for creating a national program for the development of digital competencies; show the need to integrate education, ICT and labor market regulation into a single policy context.

Further research may be aimed at analyzing implementation of programs to develop digital competencies of the population, studying their impact on employment, productivity, and adaptation to the digital labor market.

REFERENCES:

[1] Kholiavko, N., Dubyna, M., Zhavoronok, A., Safonov, Yu., Krylov, D., Tochylina, Yu. (2022). The ICT sector in economic development of the countries of Eastern Europe: a comparative analysis. *WSEAS Transactions on Business and Economics*, 19, 169-185. https://doi.org/10.37394/23207.2022.19.18

[2] Trébucq, S., Belghit, A.G. (2021). Talent

Management or Human Capital? An Analysis of Corporate Communication Strategies with Integrated Reports. *Accounting, Finance, Sustainability, Governance & Fraud: Theory and Application*. Springer, Singapore. https://doi.org/10.1007/978-981-33-6808-8_9

[3] Zybareva, O., Kravchuk, I., Pushak, Y., Verbivska, L., Makeieva, O. (2021). Economic and Legal Aspects of the Network Readiness of the Enterprises in Ukraine in the Context of Business Improving. *Estudios de economía aplicada*, 39(5). https://doi.org/10.25115/eea.v39i5.4972

[4] Schwab, K. (2016). *The Fourth Industrial Revolution*. Crown Business. URL: https://www.weforum.org/about/the-fourth-industrial-revolution-by-klaus-schwab

[5] Cooke, F.L., Xiao, M., and Chen, Y. (2021). Still in search of strategic human resource management? A review and suggestions for future research with China as an example. *Human Resource Management,* 60, 89–118. https://doi.org/10.1002/hrm.22029

[6] Boxall, P., and Purcell, J. (2016). *Strategy and Human Resources Management (4th ed.)*. Cham: Palgrave Macmillan. https://doi.org/10.1007/978-1-137-40765-8

[7] Fahim, M.G.A. (2018). Strategic human resource management and retention of government employees. *Review of Economics and Political Science,* 3, 20–23. https://doi.org/10.1108/REPS-07-2018-002

[8] Farndale, E., Mc Donnell, A., Scholarios, D., and Wilkinson, A. (2020). A look to the past, present, and future of the journal and HRM scholarship. *Human Resource Management.* 30, 1–12. https://doi.org/10.1111/1748-8583.12275

[9] Popelo, O., Tulchynska, S., Kharchenko, Y., Dergaliuk, B., Khanin, S., Tkachenko, T. (2021). Systemic Approach to Assessing Sustainable Development of the Regions. *Journal of Environmental Management and Tourism*, XII, 3(51), 742-753. https://doi.org/10.14505/jemt.v12.3(51).1 3

[10] Tulchynska, S., Lagodiienko, N., Popelo, O., Radin, A. M., Moskalenko, A. (2021). Methodical Approach to Forecasting the Intensification of Innovative Development of Regions Using the Mathcad Program. *International Journal of Circuits, Systems and Signal Processing*, 15, 1591-1601. https://doi.org/10.46300/9106.2021.15.171.

[11] Novomlynets, O., Marhasova, V., Tkalenko, N., Kholiavko, N., Popelo, O. (2023). Northern outpost: Chernihiv Polytechnic National University in the conditions of the russia-Ukrainian war. *Problems and Perspectives in Management*, 21 (Special Issue), 1-9. http://dx.doi.org/10.21511/kpm.06(1).2022.01

[12] Malik, A., and Sanders, K. (2021). Managing human resources during a global crisis: a multilevel perspective. *British Journal of Management,* 10, 1–19. https://doi.org/10.1111/1467-8551.12484

[13] Potgieter, I.L., Ferreira, N. (2022). Introductory chapter: conceptualising human resource management in the context of the new normal. *Human Resource Management*, 1–6. https://doi.org/10.1007/978-3-031-09803-1_1

[14] Mendy, J. (2022). Internationalising HRM framework for SMEs: Transcending high-performance organisation theory's economic utilitarianism towards humanism. *The International Dimension of Entrepreneurial Decision-Making. Contributions to Management Science*, 132–167. https://doi.org/10.1007/978-3-030-85950-3_8

[15] Zubak, A., Dasborough, M., Hughes, K., Jiang, Z., Kirkpatrick, S., Martinsons, M. G., Tucker, D. and Zwikael, O. (2021). Interface of strategy and change: understanding the "enabling" processes and knowledge. *Management Decision,* 59, 481–505. https://doi.org/10.1108/MD-03-2021-083

[16] Boxall, P., and Purcell, J. (2016). *Strategy and Human Resources Management (4th ed.)*. Cham: Palgrave Macmillan. https://doi.org/10.1007/978-1-137-40765-8

[17] Zhavoronok, A., Kholiavko, N., Popelo, O., Dubyna, M., Verbivska, L., Fedyshyn, M. (2024). Higher education for sustainable development in the digital era: Mapping the bibliometric analysis. *Problems and Perspectives in Management*, 22(4), 202-216. https://doi.org/10.21511/ppm.22(4).2024.16

[18] Armstrong, M., and Brown, D. (2019). *Strategic Human Resource Management: Back to the Future. Literature Review (Report No. 517)*. Brighton: Employment Research Institute.

[19] Djakona, A., Kholiavko, N., Dubyna, M., Zhavoronok, A., & Fedyshyn, M. (2021). Educational dominant of the information economy development: a case of Latvia for Ukraine. *Economic Annals-XXI*, 192(7-8(2)), 108-124. https://doi.org/10.21003/ea.V192-09

[20] Popelo, O., Shaposhnykov, K., Popelo, O., Hrubliak, O., Malysh, V., Lysenko, Z. (2023). The influence of digitalization on the

innovative strategy of the industrial enterprises development in the context of ensuring economic security. *International Journal of Safety and Security Engineering*, 13(1), 39-49. https://doi.org/10.18280/ijsse.130105

[21] Filyppova, S., Zhavoronok, A., Tochylina, Yu., Ozarko, K., Neykov, S., Krylov, D. (2025). The Impact of Artificial Intelligence on the Development of the Digital Business Ecosystem. *Journal of Theoretical and Applied Information Technology*, 103(9), 3945-3958. https://www.jatit.org/volumes/Vol103No9/29Vol103No9.pdf

[22] Zhavoronok, A. Popelo, O., Shchur, R., Ostrovska, N., Kordzaia, N. (2022). The role of digital technologies in the transformation of regional models of households' financial behavior in the conditions of the national innovative economy development. *Ingénierie des Systèmes d'Information*, 27(4) 613-620. https://doi.org/10.18280/isi.270411

[23] Adisa, T. A., Mordi, K., and Gbadamosi, G. (2022). Introduction: Context matters in human resource management. *Human resource management in the Global South*. Cham: Palgrave Macmillan. p. 3–14. https://doi.org/10.1007/978-3-030-98309-3_1

[24] Kosach, I., Duka, A., Starchenko, G., Myhaylovska, O., Zhavoronok, A. (2020). Socioeconomic viability of public management in the context of European integration processes. *Administratie si Management Public*, 35, 139-152. https://doi.org/10.24818/amp/2020.35-09

[25] Viknianska, A., Kholiavko, N., Zhavoronok, A., Kozlovskyi, S., & Herasymiuk, K. (2020). Countries disposition in the global scientific and educational area: Management and clustering. *International Journal of Management*, 11(5), 400-415.

[26] Macovei, A.-G., Popelo, O., Zhavoronok, A., Dankiewicz, R., Cosmulese, C.G., Popova, L. (2024). Pre- and post-effect of COVID-19 on the insurance industry: A study based on Romanian companies. *Insurance Markets and Companies*, *15*(2), 74-84. https://doi.org/10.21511/ins.15(2).2024.07

[27] Tkachuk, I., Kobelia, M., Popelo, O., Zhavoronok, A., & Vinnychuk, O. (2023). Modelling financial influence of political and oligarchic interests of governed-sponsored enterprises on the creation and implementation of the financial policy in the state. Journal of *Hygienic Engineering and Design*, 42, 271-279.

[28] Popelo, O., Kychko, I., Shaposhnykova, I., Shaposhnykov, K., Tochylina, Y., Stoika, V. (2023). The Role of Digital Technologies in Balancing the Labor Market in the Conditions of the Post-War Recovery of the Ukraine's Economy. *Review of Economics and Finance*, 21, 1991-2002. https://doi.org/10.55365/1923.x2023.21.214

[29] Hrubliak, O., Shaposhnykov, K., Zhavoronok, A., Ostrovska, N., Krylov, D., Popelo, O. (2024). Digital Currency of the Central Banks: Trends of the Euro Area and Prospects of the Use Within the Implementation of the European Green Deal. *Journal of Theoretical and Applied Information Technology*, 102(7), 2954-2967. URL: https://www.jatit.org/volumes/Vol102No7/17Vol102No7.pdf

[30] Nikiforov, P., Abramova, A., Zhavoronok, A., Bak, N., Yaremchuk, V., Kulynych, Y. (2024). Strengthening green taxation within the framework of fulfilling the green deal conditions in the context of formation of the environmental security system of EU countries. *International Journal of Sustainable Development and Planning*, 19(3), 1099-1109. https://doi.org/10.18280/ijsdp.190328

[31] Revko, A., Butko, M., Derhaliuk, M. Popelo, O., Tulchynska, S., (2022). Methodological Approaches to the Evaluation of Innovation in Polish and Ukrainian Regions, Taking into Account Digitalization. *Comparative Economic Research. Central and Eastern Europe*, 25(1), 55-74. https://doi.org/10.18778/1508-2008.25.04.

[32] Hamburg, I. (2019). *Implementation of a Digital Workplace Strategy for Behavior Change and Skill Development*. https://www.intechopen.com/chapters/66027

[33] Gallardo-Gallardo, E., Tunnissen, M., and Scullion, H. (2020). Talent management: context matters. *Human Resource Management,* 31, 457–473. https://doi.org/10.1080/09585192.2019.1642645

[34] Kistiunik, O., Raichava, L., Mykhalchenko, O. Popelo, O., Tulchynska, S., Krasovska, G., (2023). The impact of the national economy digitalization on the efficiency of the logistics activities management of the enterprise in the conditions of intensifying international competition. *Journal of Theoretical and Applied Information Technology*, 101(1), 123-134.

http://www.jatit.org/volumes/Vol101No1/11Vol101No1.pdf

[35] Harney, B., and Collings, DG (2021). Navigating the changing landscapes of HRM. *Human Resource Management,* 31, 100824. https://doi.org/10.1016/j.hrmr.2021.100824

[36] Research on digital literacy in Ukraine. https://osvita.diia.gov.ua/uploads/1/8800-ua_cifrova_gramotnist_naselenna_ukraini_2023.pdf.

[37] Official Eurostat website. https://ec.europa.eu/eurostat/web/main/data/database.

[38] Petty, W. (1690). Political Arithmetick: Or, a Discourse Concerning the Extent and Value of Lands, People, Buildings... London: Printed for Robert Clavel and Hen. Mortlock.

[39] Smith, A. (1776). An Inquiry into the Nature and Causes of the Wealth of Nations. London: Strahan and Cadell.

[40] Say, J.-B. (1803). Traité d'économie politique (Treatise on Political Economy). Paris: Crapelet.

[41] Schultz, T.W. (1961). Investment in human capital. *The American Economic Review.* 1961, *51*, 1–17.

[42] Becker, G.S. (2009). Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education; University of Chicago Press: Chicago, IL, USA; ISBN 0226041220.

[43] Becker, G.S. (2012). The economic way of looking at life. *Rev. Univ. EAFIT*, *29*, 7–21.

[44] Mincer, J. (1958). Investment in human capital and personal income distribution. *Journal of Political Economy*, *66*, 281–302. https://www.jstor.org/stable/1827422

[45] McConnell, C.R., Brue, S.L., Flynn, S. (1969). *Econom ics: Principles, Problems, and Policies,* 19th ed. (Vol. 2). McGraw-Hill Education. New York, NY, USA.

[46] State Statistics Service of Ukraine. https://www.ukrstat.gov.ua/.

[47] Czarniewski, S. (2014). Quality Parameters of Human Capital in the Digital Economy. *International Journal of Academic Research in Accounting Finance and Management Sciences, 4*(3), 262–270.

[48] Krysovaty, A.I., Desyatnyuk, O.M., Ptashchenko, O.V. (2024). *Digital economy: textbook.* ZUNU.

[49] Knice, E., Boselie, P., Gould-Williams, J., and Vandenabeele, W. (2018). *Strategic Human Resource Management and Public Sector Performance: Context Matters*. https://www.tandfonline.com/doi/full/10.1080/09585192.2017.1407088

[50] Imran, F., Shahzad, K., Butt, A., and Kantola, J. (2020). Leadership competencies for digital transformation: evidence from multiple cases. *Advances in Human Factors, Business Management and Leadership,* 1209, 81–87. https://doi.org/10.1007/978-3-030-50791-6_11