

M.S. Tulegenova<sup>1</sup> , R. Gieze<sup>2</sup>  D.S. Abjalov<sup>1\*</sup> 

<sup>1</sup> Al-Farabi Kazakh National University, Almaty, Kazakhstan

<sup>2</sup> Institute of Applied Sciences, Zittau-Görlitz, Germany

\*e-mail: [dabdzhalov@mail.ru](mailto:dabdzhalov@mail.ru)

## PRIORITY OF THE GENERATIVE ROLE OF HUMAN CAPITAL UNDER THE NEW TECHNOLOGICAL PARADIGM

### Abstract

**Purpose.** This study aims to substantiate the priority of the generative role of human capital in the contemporary economy, where technological change is driven by digitalization, automation, and artificial intelligence, and mediated by the quality of knowledge, skills, and institutional conditions.

**Design/methodology/approach.** The research employs a mixed methodological approach combining theoretical and conceptual analysis of human capital evolution with comparative and index-based analysis of international data. The empirical base includes the World Bank Human Capital Index, OECD data on productivity and innovation, and selected micro-level studies on innovation mechanisms.

**Findings.** The results indicate that countries with similar levels of technological development demonstrate significantly different innovation outcomes depending on the quality of human capital and its institutional integration. Two models are identified: an adaptive model focused on the reproduction of imported technologies, and a generative model based on the creation of new technological and organizational solutions. Kazakhstan is positioned between these models, with fragmented realization of human capital due to institutional gaps between education, the labor market, and the innovation system.

**Originality.** The study contributes to the literature by redefining human capital as a system-forming factor in the new technological paradigm, emphasizing its generative function in fostering innovation, structural transformation, and sustainable economic growth.

**Keywords:** human capital, new technological paradigm, digital economy, innovative development, generative function.

### Introduction

The emergence of a new technological order, driven by the proliferation of digital platforms, automated production systems, and artificial intelligence, is accompanied by a change in the fundamental mechanisms of economic growth. Technological innovations are no longer merely a tool for improving the efficiency of individual industries but are increasingly acting as a factor in the structural transformation of the economy, reshaping the nature of employment, the requirements for competencies, and the ways value is added. Under these conditions, there is a growing need to reconsider traditional notions of the key sources of competitiveness, as technological endowment alone does not ensure sustainable economic outcomes. Contemporary practice demonstrates that comparable technological solutions lead to different development trajectories depending on the quality of human capital and the institutional conditions for its

realization. Economies with a developed potential of knowledge, skills, and innovation activity are capable not only of adapting to technological changes but also of generating their own technological and organizational solutions. Conversely, in conditions of a fragmented innovation environment and limited interconnectedness between education, the labor market, and the production sector, technological modernization often acquires the character of formal adoption, failing to translate into sustained innovation dynamics.

The relevance of this study is determined by the fact that, under the conditions of the new technological order, human capital acquires a qualitatively new function. Its significance extends beyond the traditional understanding of it as a factor of productivity or a resource for adaptation to change. Its generative potential-i.e., its ability to act as a source of innovation, structural transformations, and the formation of long-term economic growth trajectories-is becoming

increasingly significant. At the same time, ambiguity persists in the academic literature regarding the priority of this role: a significant body of research is confined to assessing the contribution of human capital to growth in an aggregated form, leaving the mechanisms of its participation in the creation of new technological and institutional solutions insufficiently explored. This issue acquires particular significance for emerging-market economies, including Kazakhstan, which are characterized by structural constraints on innovative development combined with the need for technological modernization and integration into global value chains. Under such conditions, human capital becomes not merely a supplementary element, but a potentially decisive factor in the transition from adaptive development to an innovation-oriented growth model.

The purpose of this article is to substantiate the priority of the generative role of human capital under the conditions of the new technological order and to identify the mechanisms through which human capital transforms technological potential into innovative and structural changes in the economy. To achieve this goal, the study provides a conceptual understanding of the evolution of human capital theory, analyzes international empirical data, and juxtaposes the national context of Kazakhstan with broader global trends of digital and innovation transformation.

### Literature review

The formation of a new technological order in the modern economy is regarded by researchers as a process accompanied not only by the acceleration of technological change but also by a profound restructuring of growth mechanisms and competitiveness factors. Analytical reports from the Organisation for Economic Co-operation and Development emphasize that the proliferation of digital platforms, automated production systems, and artificial intelligence is transforming the sectoral structure, the nature of employment, and the ways value is created, which necessitates a revision of traditional development models (OECD, 2020; OECD, 2021). These changes demonstrate the limitations of approaches in which technological progress is interpreted primarily through the accumulation of physical capital and the expansion of material infrastructure. The theoretical foundations of human capital research were laid in the seminal works of G. Becker, who regarded knowledge and skills as a special form of capital capable of enhancing productivity and income growth (Becker, 1993). In economic theory, human capital is defined

as a set of knowledge, skills, qualifications, and intellectual abilities that individuals acquire throughout their lives and which serve as the foundation for enhancing their productivity and income. According to the classical view of G. Becker, human capital represents a form of capital in which investments are made through education, training, and the accumulation of experience. These investments, as Becker argues, yield long-term economic benefits for both individuals and the economy as a whole. In the context of the new technological order, the concept of human capital acquires a broader meaning. It encompasses not only an individual's ability to perform labor tasks but also their potential in the sphere of innovation, adaptation to technological transformations, and contribution to the development of new organizational and production models. This gives human capital a key significance for the modern economy. A similar line of reasoning was developed by J. Mincer, who substantiated the dependence of earnings on the level of education and accumulated experience (Mincer, 1974). At the same time, early models of human capital focused primarily on the individual returns on investment in education, while its systemic role in generating technological and institutional changes remained secondary. In the Russian and post-Soviet scientific tradition, a significant contribution to the development of human capital theory was made by S. Dyatlov, who considered human capital as a structural element of economic growth and modernization (Dyatlov, 1994). Contemporary authors, such as Gritsaenko, emphasize the need for a methodological expansion of the concept of human capital beyond labor and income effects, drawing attention to its connection with innovation processes and institutional dynamics (Gritsaenko, 2022). A. Bulina, K. Mozgovaya, and M. Pakhnin, analyzing classical growth models, also note that new approaches increasingly interpret human capital as an endogenous source of technological development rather than as a supplementary resource (Bulina et al., 2020). Empirical studies conducted in the context of the digital economy confirm the qualitative complication of human capital functions. Thus, T. Liu et al., analyzing the innovative activity of corporate inventors, show that it is the characteristics of human capital that determine firms' ability to generate new technological solutions even with comparable access to material and digital resources (Liu et al., 2023). At the macro level, similar patterns are identified in the work of A. Grigorescu and colleagues, who find a robust relationship between the quality of human capital and the innovation dynamics of Central and Eastern Eu-

European countries (Grigorescu et al., 2021). B. Shao and H. Wang, in a more recent study, emphasize that the accumulation of human capital becomes a crucial factor in the structural advancement of the economy under conditions of digital transformation (Shao & Wang, 2025).

The question of why identical technological solutions lead to different economic outcomes is actively discussed in contemporary literature. The OECD, in its materials, points out that the effectiveness of digitalization and innovation significantly depends on the institutional environment and the economy's capacity for learning and adaptation (OECD, 2021). K. Forichon, examining human capital in a multidimensional analysis of fragility, also emphasizes that technological effects are mediated by the quality of human resources and the conditions for their realization (Forichon, 2020). Thus, technologies do not act as an autonomous source of growth, but as a factor whose economic effectiveness is determined by the generative function of human capital. This issue acquires particular significance for emerging-market economies, where limited investment resources and dependence on traditional industries amplify the role of human capital as a key factor of structural modernization. Zh. Baigireyeva and S. Niyazbekova, analyzing the economy of Kazakhstan, show that human capital is the dominant factor of growth in the long term (Baigireyeva & Niyazbekova, 2020). G. Dinzhanova and M. Bayetova confirm that in the industrial sector of Kazakhstan, the quality of human capital is directly linked to innovative potential and the possibilities of technological renewal (Dinzhanova & Bayetova, 2022). A. Serikkyzy, S. Baktymbet and A. Baktymbet also note the importance of human capital for the sustainable economic development of the country, emphasizing the need for its institutional strengthening (Serikkyzy et al., 2024). These findings are consistent with data from the World Bank, which records the structural constraints on the realization of human capital in transition economies (World Bank, 2020). Despite a significant increase in the number of studies devoted to human capital in the digital economy, a substantial part of the work concentrates either on an aggregated assessment of its contribution to growth or on the analysis of individual components of digital skills, employment, and educational indicators. For instance, M. Eskindarov and his co-authors examine the role of human capital in the digital economy through institutional and regional differences; however, the question of its priority generative function remains insufficiently disclosed (Eskindarov et al., 2022). Similarly, A. Veshkurova and colleagues

analyze human capital as a condition for the digital transformation of companies, focusing on adaptive mechanisms but leaving open the question of its role as a source of innovative production (Veshkurova et al., 2022). The existing literature provides a significant theoretical and empirical foundation for the study of human capital in the context of the new technological order; however, the question of the priority of its generative role remains debatable. This determines the need for further conceptualization of human capital as a system-forming element of economic transformation, which sets not only the speed of technology diffusion but also the depth of structural changes, the sustainability of growth, and the competitiveness of national economies.

### Methodology

The methodological framework of the study is formed considering the need for a joint analysis of the qualitative and quantitative aspects of human capital in the context of the new technological order. This approach is determined by the specifics of the object under study: the generative role of human capital cannot be adequately described solely through aggregated indicators of employment or education, since it is manifested in the dynamics of innovation activity, structural shifts, and institutional transformations. In this regard, the work employs a mixed methodology combining theoretical-conceptual analysis and analytical processing of statistical and index data. The theoretical part of the study is based on the evolution of the human capital concept, starting from the classical propositions laid down in the works of G. Becker and J. Mincer, and ending with modern interpretations in which human capital is considered as an active factor of technological and institutional development (Becker, 1993; Mincer, 1974; Borisova, 2016). At the same time, the analysis is not limited to reproducing well-known models but is aimed at identifying those aspects of the theory that allow interpreting human capital as a source of generating innovations, and not only as a factor of labor productivity growth. Additional attention is paid to modern approaches of economic growth theory, within which knowledge and skills are considered as an endogenous factor of technological progress. To comprehend the context of the new technological order, the concepts of the digital economy and technological revolutions presented in the works of international organizations and academic research were used. The analysis of OECD documents made it possible to identify structural changes in the economy associated with digitaliza-

tion, the spread of platform-based models, and the increasing complexity of production chains, as well as to clarify the mechanisms of interaction between human capital and innovation at the sectoral level. These provisions are supplemented by studies examining the impact of digital transformation on institutional and regional differences in economic development (Kochetkov, 2019).

The empirical part of the study is based on the use of secondary data and analytical indices reflecting the state and dynamics of human capital and innovative development. The World Bank's Human Capital Index is used as a key data source, allowing for a comparison of the potential productivity of future generations of workers, taking into account education and health. Despite the aggregated nature of this indicator, its use is justified by the objectives of the study, since it captures the structural constraints on the realization of human capital in the long term. To clarify the interrelationships between human capital and innovation dynamics, OECD materials reflecting sectoral differences in productivity and innovation activity are used. Analytical data processing was carried out using comparative and index analysis, which made it possible to identify stable patterns between the quality of human capital and indicators of technological and innovative development. Within the framework of comparative analysis, data on economies with different levels of digitalization and institutional development were compared, which made it possible to trace how identical technological conditions lead to different economic outcomes. Particular attention was paid to the interpretation of differences, rather than their formal recording, which made it possible to avoid reducing the analysis to simple correlational dependencies. To deepen the empirical findings, the results of recent studies based on micro- and meso-level data were used. In particular, the conclusions of works analyzing the innovative activity of firms and the role of human capital in the creation of technological innovations were drawn upon, which made it possible to link macroeconomic indices with the mechanisms operating at the level of economic agents. This comparison provided a logical linkage between aggregated indicators and the processes of innovation generation occurring within organizations and industries.

The regional aspect of the study is represented by an analysis of works devoted to the economy of Kazakhstan, as well as by the interpretation of national statistical and analytical data. The use of findings from domestic research made it possible to take into account the specifics of an emerging-

market economy, in which human capital plays a compensatory and simultaneously system-forming role under conditions of limited access to advanced technologies. This approach ensured the comparability of international and national findings and reduced the risk of mechanically transferring foreign models to a different institutional context. The interpretation of the obtained results was carried out on the basis of logical-economic generalization and structural-functional analysis. These methods made it possible to consider human capital not as an isolated factor, but as an element of a broader system of interaction between technologies, institutions, and economic agents. As a result, the methodological framework of the study provided an opportunity to identify cause-and-effect relationships between the quality of human capital and the nature of technological development, as well as to substantiate its priority generative role in the context of the new technological order.

### Results and discussion

The obtained results make it possible to record persistent differences in the nature of economic effects arising from a comparable level of technological development but a different quality of human capital. A comparison of international and national data indicates that, in the context of the new technological order, it is human capital that acts as a key factor determining the ability of an economy to transform technological potential into real innovative and structural shifts. At the same time, the identified dependencies are not linear but mediated in nature, which requires their interpretation through a set of institutional and sectoral characteristics.

An analysis of the World Bank's Human Capital Index in combination with indicators of innovative development and digitalization demonstrates that countries with similar levels of technological endowment differ significantly in terms of productivity growth rates and innovation activity. This discrepancy is not explained by the level of investment in equipment or digital infrastructure and points to the presence of a qualitative factor associated with the accumulation and realization of human capital. In particular, higher values of the Human Capital Index correlate with a greater intensity of adoption of complex technologies and a higher share of innovative products in the output structure, whereas in economies with limited quality of human capital, technological borrowing is often not accompanied by a comparable economic effect.

For a visual illustration of the identified differences, a comparison of aggregated indicators for a number of countries and Kazakhstan was used (see

Table 1). The presented data do not claim to provide an exhaustive econometric interpretation, but they allow for the identification of stable empirical patterns.

**Table 1**  
*Human capital and innovation performance (averaged data)*

Economy	HCI (Human Capital Index)	Global Innovation Index (баллы)	GII Rank
Kazakhstan	0.63	26.3	81
Exemplary developed country (e.g., Germany)	0.78	~60–65	~10
EU average	0.70–0.75	~40–50	~25–35

\*Note- Compiled by the authors based on World Bank (2020)

Interpretation of the data in the table allows us to identify a fundamentally important result: the level of human capital by itself does not guarantee an automatic increase in innovation activity; however, when its quality is insufficient, the economic effect of technological development turns out to be significantly limited. In this sense, human capital acts as a kind of ‘amplifier’ of technological changes, without which digitalization and automation do not lead to the expected structural shifts.

Additional analysis of sectoral data presented in OECD materials shows that productivity differences between industries within the same economy are also largely determined by the quality of human capital, and not only by the level of technological endowment. Industries characterized by a high share of skilled labor and a developed system of in-house training demonstrate more sustained growth rates even with a comparable level of capital-to-labor ratio. This suggests a shift in the center of economic gravity from the accumulation of material resources to the processes of knowledge generation and processing.

At the micro level, the identified patterns are confirmed by the results of studies analyzing the innovative activity of firms and individual economic agents. Empirical data on corporate inventors indicate that it is the characteristics of human capital—the level of education, the cognitive complexity of tasks, and experience in innovation projects—that determine the likelihood of creating technological innovations. At the same time, access to digital tools and technological platforms acts more as a necessary condition, while the decisive factor becomes the ability of human capital to use them productively.

To generalize the identified relationships, an analytical matrix was formed that reflects differences in the mechanisms of technological potential implementation depending on the quality of human capital.

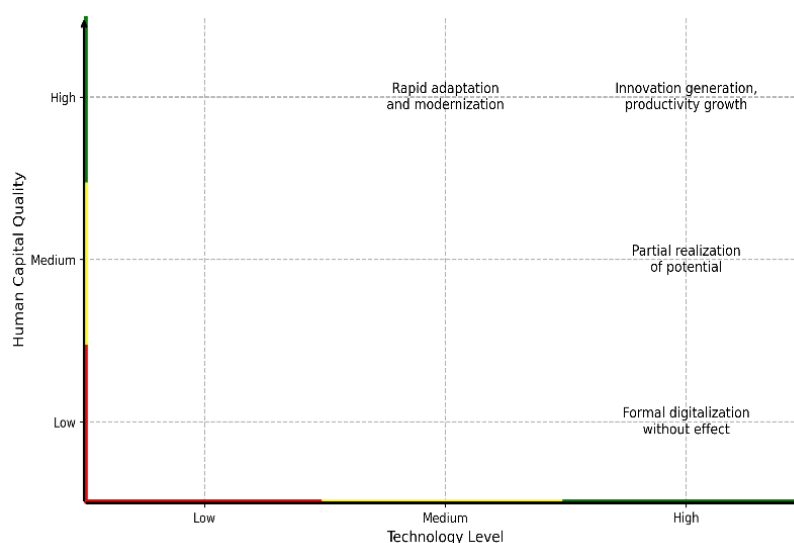
The analysis of the situation in the economy of Kazakhstan deserves special attention, where a combination of a moderate level of human capital and relatively high technological openness is revealed. A comparison of national data with international indicators shows that the existing potential of human capital is realized fragmentarily and is not fully transformed into sustainable innovation effects. This is manifested in the limited diffusion of technologies beyond individual sectors and in the weak interconnectedness between education, the labor market, and the innovation system. The obtained results allow us to draw an interim conclusion that, in the context of the new technological order, human capital ceases to be an auxiliary factor serving technological development and acquires an independent generative function. It is through human capital that differences in the economic performance of digitalization and innovation are formed, which is confirmed by both international and national data.

An in-depth analysis of national data allows for a more detailed examination of the specifics of human capital realization in the economy of Kazakhstan in the context of the new technological order. A comparison of indicators of human capital, innovation activity, and digital development reveals an asymmetry between potential opportunities and actual economic outcomes. With relatively stable values of the Human Capital Index and a fairly high level of digital technology penetration, the innovation returns in a

number of industries remain limited, which indicates a gap between the accumulation of human capital and the mechanisms of its productive use. Data from international indices and national studies demonstrate that human capital in Kazakhstan is more oriented towards reproducing existing production practices rather than generating new technological and organizational solutions. This is manifested in a relatively

low share of employment in knowledge-intensive and creative sectors, weak interconnectedness between the education system and the innovation infrastructure, as well as in the limited diffusion of knowledge between sectors of the economy. As a result, technological borrowing and digital initiatives are often fragmentary in nature and do not create a sustainable economies of scale effect.

**Figure 1**  
*Logical matrix of technological potential realization*



*\*Note- Compiled by the authors based on Liu, T. (2023)*

A comparative analysis with a group of Central and Eastern European countries allows us to clarify the identified patterns. With a similar level of human capital, these economies demonstrate higher innovation performance, which is explained by greater insti-

tutional coherence and a more developed knowledge transfer system. This indicates that the generative role of human capital is not realized automatically, but is embedded in the institutional and organizational structure of the economy.

**Table 2**  
*Comparison of human capital realization (Kazakhstan and CEE countries)*

Indicator	Kazakhstan	CEE countries (average)
Human Capital Index	moderate	moderate–high
Share of employment in knowledge-intensive sectors	low–moderate	moderate
Innovation activity of firms	limited	sustained
Link between education and innovation	fragmentary	institutionalized
Economic effect of digitalization	uneven	Cumulative

*\*Note- Compiled by the authors based on OECD (2021)*

The presented data allow us to conclude that, under comparable initial conditions, it is the nature of the institutional embeddedness of human capital that determines its ability to perform a generative function. In economies where stable channels for transforming knowledge into innovation have been formed, human capital becomes a source of structural shifts, whereas in the absence of such channels, it primarily serves existing technological contours. Additional analysis of the sectoral structure confirms this pattern. In industries oriented toward raw material exports and primary processing, the role of human capital is limited to maintaining

technological processes and managing operational efficiency. At the same time, in sectors related to ICT, engineering services, and scientific research, even with a relatively smaller scale of investment, higher innovation returns are observed. This also indicates differences in the mechanisms of human capital capitalization, which are not reducible to the level of formal education or the number of employees.

To generalize the obtained results, a conceptual smart object was formed that reflects the mechanisms of human capital's transition from a resource function to a generative function.

**Figure 2**

*Mechanism of the generative role of human capital*



*\*Note- Compiled by the authors based on OECD (2021)*

This diagram illustrates the sequence of transformation of individual knowledge and skills into macroeconomic effects. At the same time, a gap at any stage of the chain leads to a decrease in overall effectiveness, which is observed in economies with insufficient institutional support for innovation.

Of particular interest are the results related to the temporal aspect of human capital realization. An analysis of the dynamics of indicators indicates the presence of a lag effect between investments in human capital and their economic returns. In the context of the new technological order, this lag is reduced but does not disappear completely, which requires consideration of time constraints when interpreting results and formulating economic policy. Countries that have managed to institutionally support the processes of continuous learning and skills updating demonstrate a faster transition from human capital accumulation to its generative realization. Taken together, the obtained results allow us to refine the understanding of the role of human capital in the modern economy. It acts not merely as a factor enhancing technological development, but as a central element determining the nature and depth of economic transformations. In the context of the new technological order, it is through human cap-

ital that the transition from formal digitalization to sustained innovation dynamics is carried out, as evidenced by both international comparisons and the analysis of the national context.

Further analysis allows us to move from quantitative comparisons to identifying qualitative differences in the ways human capital is realized in the context of the new technological order. The obtained data indicate that the generative role of human capital manifests itself heterogeneously and can take various forms depending on the structure of the economy, the nature of the institutional environment, and the degree of integration into global technological chains. This allows us to consider human capital not as a homogeneous quantity, but as a multilevel factor operating in different modes.

The analysis reveals a fundamental difference between adaptive and generative models of human capital realization. In the first case, the knowledge and skills of workers are primarily directed toward the adoption and maintenance of already existing technological solutions, ensuring their stable functioning and cost minimization. This model is characteristic of economies oriented toward technological borrowing and the reproduction of established production structures. In the second case, human capital acts as a source of creating new technological, organizational,

and managerial solutions, forming a cumulative effect of innovative development. It is this model that becomes determining in the context of the new technological order.

To systematize the identified differences, a typology of economies was formed based on the nature of human capital realization, reflecting the qualitative features of its generative function.

**Table 3**  
*Types of economies based on the model of human capital realization*

Type of economy	The dominate function of HC	The nature of technological development	Long-term effect
<b>Adaptive</b>	Supportive	Borrowing and local optimization	Limited growth
<b>Transitional</b>	Mixed	Partial generation of innovations	Unstable dynamics
<b>Generative</b>	Innovative	Creation of new solutions	Sustained growth

\*Note: developed by the authors

A comparison of this typology with empirical data shows that Kazakhstan currently occupies an intermediate position between the adaptive and transitional models. Despite the presence of isolated pockets of generative activity, primarily in sectors related to digital services and engineering development, the adaptive logic of human capital utilization dominates at the economy-wide scale. This limits the possibility of forming sustained innovation chains and reduces the multiplicative effect from the introduction of new technologies. A qualitative analysis of sectoral and institutional differences allows us to clarify the mechanisms hindering the transition to the generative model. These include the fragmentary nature of the innovation infrastructure, insufficient integration of educational and scientific organizations with the real sector of the economy, as well as limited opportunities for the accumulation and redistribution of knowledge within the economic system. As a result, human capital, even

possessing the necessary cognitive characteristics, is not always incorporated into the processes of creating new economic value. The identified effect of institutional asymmetry deserves special attention, whereby the same characteristics of human capital demonstrate different economic returns depending on the environment of their application. In economies with a developed system of innovation and entrepreneurship support, human capital transitions more quickly into a generative mode, whereas under conditions of institutional constraints, it is realized primarily within the framework of adaptive strategies. This confirms the conclusion that the generative role of human capital is formed at the intersection of individual characteristics and systemic conditions.

To integrate the obtained results, an overarching analytical construct was formed that reflects the transition of human capital from a resource function to a system-forming function.

**Figure 3**  
*Qualitative modes of human capital functioning*



\*Note: developed by the author

This construct allows us to capture the key finding of the study: in the context of the new technological order, the priority of human capital is deter-

mined not so much by its quantitative characteristics as by its ability to be involved in the processes of generating new economic solutions. It is precisely

this ability that becomes the criterion for distinguishing between economies that demonstrate sustained innovation dynamics and economies limited by the framework of adaptive development. The totality of the obtained results forms a holistic understanding of human capital as a central element of the new technological order. It ceases to perform an exclusively auxiliary function and acquires the status of a system-forming factor that determines the nature, depth, and sustainability of economic transformations. This creates a methodological foundation for the subsequent discussion of the obtained conclusions in the context of modern economic theory and the practice of economic policy.

The results of the analysis make it possible to significantly deepen existing understandings and, to a certain extent, adjust the dominant views on the role of human capital in the context of the new technological order that have developed in modern economic theory. In a significant body of research, human capital is still considered a factor derivative of technological progress, performing mainly an adaptive function—ensuring the assimilation and effective use of already existing technologies. This approach traces back to classical models in which technological progress is treated as exogenous and human capital as a means of increasing individual and aggregate labor productivity (Becker, 1993; Mincer, 1974). Within this framework, knowledge and skills are interpreted primarily as investments that increase incomes and efficiency, but not as an independent source of forming new technological trajectories. At the same time, the results of this study show that in the context of the new technological order, such an interpretation proves insufficient. The identified empirical dependencies indicate a more complex nature of the interaction between human capital and technological changes, in which human capital not only reacts to the introduction of new technologies but also actively shapes their direction, intensity, and economic effectiveness. This aligns the obtained results with modern endogenous theories of growth and innovation, in which knowledge, skills, and learning abilities are considered as internal sources of technological progress (Bulina et al., 2020; Grigorescu et al., 2021). Of particular importance in this context are studies emphasizing the institutional conditionality of the role of human capital. Thus, OECD work shows that digitalization and the introduction of advanced technologies do not automatically lead to productivity growth and innovation activity without appropriate learning mechanisms, knowledge transfer, and organizational changes (OECD, 2020; OECD,

2021). Similar conclusions are found in studies by K. Forichon (2020), where it is emphasized that human capital demonstrates its economic effectiveness only in an institutional environment capable of supporting its reproduction and use in complex economic processes. This confirms the thesis that human capital should be viewed not as an isolated resource, but as an element of a broader system of interaction between technologies, institutions, and economic agents. The obtained results allow for a different interpretation of the problem of technological borrowing, which is traditionally considered a universal tool for accelerated development for emerging-market economies. A number of studies emphasize that technology imports can ensure short-term growth and modernization of production processes (Baigireyeva & Niyazbekova, 2020). However, the empirical evidence obtained in this study is consistent with the conclusions of more critical approaches, pointing to the existence of the so-called ‘catch-up development trap.’ Within this trap, the economy proves capable of reproducing and exploiting borrowed technologies, but does not form sustainable mechanisms for generating its own innovations (Shao & Wang, 2025). It is in this context that the identified distinction between adaptive and generative models of human capital realization acquires fundamental importance. Although this distinction is rarely formulated directly in the economic literature, it is implicitly present in studies analyzing the heterogeneity of innovation processes and the role of knowledge in shaping the competitive advantages of firms and countries. Thus, T. Liu et al. (2023), investigating the innovative activity of corporate inventors, show that the presence of similar technological resources does not guarantee identical innovation outcomes if human capital lacks the ability to create and combine new knowledge. Similar conclusions are drawn by A. Grigorescu and colleagues (2021), emphasizing that differences in the innovation dynamics of Central and Eastern European countries are determined not so much by the level of digitalization, but by the quality of human capital and the mechanisms of its institutional embeddedness. Interpreting the results through an institutional lens allows us to assert that the generative role of human capital is formed not at the level of individual characteristics such as education or work experience, but in the space of interaction between the education system, the labor market, innovation infrastructure, and economic policy. This conclusion aligns with the propositions of institutional economics, according to which innovations are the result of collective, organizationally and institutionally mediated processes (Dyatlov, 1994;

Eskindarov et al., 2022). In this sense, human capital acts not merely as a bearer of knowledge, but as an active element of the system ensuring its transformation into economic outcomes. With regard to the economy of Kazakhstan, the obtained results allow for a critical reconsideration of existing technological modernization strategies, focused primarily on the development of digital infrastructure and the introduction of ready-made technological solutions. A number of studies indicate the presence of significant human capital potential in Kazakhstan (Baigireyeva & Niyazbekova, 2020; Serikkyzy et al., 2024). However, empirical data show that this potential is realized primarily in an adaptive mode. This is manifested in the weak interconnectedness between education, science, and the real sector, limited diffusion of knowledge between industries, and insufficient institutionalization of innovation activity (Dinzhanova & Bayetova, 2022). In the context of global competition for human resources and high mobility of skilled labor, such a situation creates additional risks. The absence of conditions for the generative realization of human capital can lead to talent outflows and the entrenchment of an adaptive development model, which reduces the long-term potential for economic growth. This is consistent with the findings of the World Bank (2020), pointing to structural constraints on the realization of human capital in emerging-market economies. Taken together, the discussion of the obtained results allows us to assert that the priority of human capital in the context of the new technological order is not declarative but structural in nature. It is manifested in the ability of human capital to set the direction of technological changes, shape innovation ecosystems, and ensure the sustainability of economic development. The theoretical contribution of the study lies in expanding the analytical framework of human capital theory by emphasizing its generative function. Considering human capital as an active mechanism for shaping technological trajectories allows us to link micro-level processes of learning, innovation activity, and organizational changes with macroeconomic outcomes—structural modernization and sustainable growth. At the same time, the research results complement discussions on industrial and technological policy, in which the limitations of universal solutions are increasingly emphasized. The analysis shows that measures aimed solely at stimulating technology adoption prove insufficient without creating institutional conditions for the generation and capitalization of knowledge. This confirms the need for context-dependent development strategies that take into account the structure of the economy

and the specifics of the institutional environment. In this context, the priority of human capital acts as a key condition for the effectiveness of technological policy and the long-term competitiveness of national economies, especially under the conditions of the new technological order.

## Conclusion

The study shows that in the new technological paradigm, human capital becomes not only a resource allowing the economy to adapt to digital changes, but also a key source of innovations and structural transformations. Technologies and digital infrastructure by themselves do not guarantee sustainable growth: their impact largely depends on the knowledge, competencies of the economy, and the institutional conditions for the creation and diffusion of new solutions. A comparison of Kazakhstan with Central and Eastern European countries confirms that differences in innovation indicators are determined not only by the level of technological complexity, but also by the degree of establishment of stable links between education, the labor market, academia, and business. In the case of Kazakhstan, human capital is still used adaptively, which limits the possibility of transforming digitalization into a cumulative, long-term innovative effect.

Thus, the priority of human capital in the modern economy is primarily associated with its generative function – the ability to form new trajectories of technological and organizational development. The transition from adaptive use of human capital to its full-fledged innovative application becomes one of the main conditions for sustainable competitiveness and modernization of the national economy.

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The authors declare that there are no acknowledgements and no conflicts of interest related to this study.

## Author Contributions

*Conceptualization, T.M.; Methodology, T.M. and A.D.; Software, A.D.; Validation, T.M. and A.D.; Formal Analysis, G.R.; Investigation, T.M.; Resources, A.D.; Data Curation, A.D. and G.R.; Writing – Original Draft Preparation, T.M. and A.D.; Writing – Review & Editing, G.R.; Visualization, T.M. and A.D.; Supervision, T.M. and G.R.; Project Administration, T.M. and G.R.*

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**Information about authors:**

*Tulegenova Madina – d.e.s., professor, Al-Farabi Kazakh National University (Almaty, Kazakhstan, e-mail: Ms.tulegenova17@gmail.com).*

*Giese Roland – d.e.s., professor, Institute of Applied Sciences (Zittau-Görlitz, Germany, e-mail: R.Giese@hszg.de).*

*Abdzhalov Danil (corresponding author) – master's student, Al-Farabi Kazakh National University (Almaty, Kazakhstan, e-mail: dabdzhalov@mail.ru).*

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