Digitalization and Structural Transformation in Education and Economy: A Neutrosophic Evaluation Approach

Aliya T. Akhmedieva[1,*], Abdurashid M. Kadyrov[2], Bahtiyor H. Mamurov[2], Svetlana Yu. Shatokhina[2], Saziye Yaman[3]

[1]Tashkent State University of Economics, Tashkent, Uzbekistan
[2]Research center under the Tashkent State University of Economics, Tashkent, Uzbekistan
[3]Liberal Arts Department, American University of the Middle East, 54200, Egaila, Kuwait
Emails: a.axmedieva@tsue.uz; a.kadirov@tsue.uz; b.mamurov@tsue.uz; sshatokhina165@gmail.com; saziye.yaman@aum.edu.kw

Abstract

The research analyses the impact of digitalisation levels on structural transformations in regional economies and the education sector, highlighting their reciprocal relationship in generating sustainable and inclusive growth. This study assesses the multi-dimensional mediation of digitalization with economic performance and learning modernization in education. It also analyzes the efficacy and efficiency of digital policies and institutional strategies as data, as well as offers databased policy recommendations for a more balanced and knowledge based regional development. A full mixed-methodological approach is employed consisting of statistical (correlation and regression between regional digitalization and economic variables) and neutrosophic multi-criteria evaluation of the education system dynamics. Crosscutting comparisons between regions and higher education end-users with various degrees of digital maturity are analysed, enabling to understand more in depth how digital infrastructure and the enactment of policies can contribute to structural transformation as both economy and educational institutions move forward. Under the light of the findings, the paper calls for focused digital and educational policies to strengthen regional and institutional capabilities through increased investment in digital infrastructure, the professional capacities of educators and the integration of digital competences into curricula. The study also offers a strategic approach to align educational digitalization with regional innovation systems, so that the benefits of digital transformation truly and in a balanced way support both economic modernisation and the development of human capital. A strategic framework, based on neutrosophy, is contributed for policymakers, university managers and development planners to formulate sustainable digitally enabled-smart ecosystems building up the link between economic growth and education development.

Keywords: Digital Transformation in Education; Neutrosophic Evaluation Approach; Structural Change in Education; Educational Innovation and Policy; Sustainable Development Goals and Digitalization

1. Introduction

The rapid spread and development of information technology worldwide are causing dramatic changes in not only the regional economic policy and state governance but also in the form, management system, operation mechanism etc. of higher education systems. Digitalization has become a general trend that profoundly affects economic upgrading and educational innovation, reshapes the "processes in which knowledge comes into being spreads, and gets used involving people throughout institutions or industries." In modern times, the extent of digital integration determines a nation's ability to build an economy based on knowledge in which education is the engine for innovation, productivity and sustainable growth [1-6].

The rise of digital technologies and their uneven penetration into economic and social life are changing educational institutions, forcing them to adjust curriculums, teaching methods and administrative structures according to the demands of digital economies. In a time when globalization and competitiveness are growing, the nexus of education, digitalization, and regional development has been widely recognized as an important research field. Today, the universities are a key factor in defining skills for the digital era, promoting entrepreneurship and leading to them becoming innovation engines for regional economic resilience [7-14].

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While Industry 4.0 drives the digitalization of a global economy, there is no question that the contemporary digital transformation in education – encompassing smart learning systems, e-learning platforms, databased administration and virtual collaboration areas will match and contribute to this general tendency toward regional economies' digitalization as well. The development of educational technology infrastructure promotes the reinforcement of human capital and inclusive innovation to narrow the fissure between economic modernization and social progress. In this context, education digitalization should not be regarded as an add-on process but instead serves as a driving force for the structural transformation of economies and societies.

Investigating the impact of digital transitions in both economic and educational areas is vital to develop appropriate policy for sustainable development. This book analyses the nexus between digitalization and regional economic growth, education and ICT in the knowledge society, and regional innovation systems (RIS).

The major goals of this study are the development and testing (including digitalization as a factor) of both model components for the structural changes in regional economies and an education institution, modeling of the institutional means by which to ensure that educational institutions could be involved in the economy digitalization, assessment of existing structural data about Russians' ways of life on both global and regional levels, and designating some predictive indicators that allow one to facilitate the breaking out process toward new forms of national information society as well.

For this reason, Uzbekistan provides a worthy case for the analysis of actual tendencies in development digital economy and its effects on regional development as well educational modernization with respect to the globalization.

- **Relevance**

The rapid progress of digitalization on a global scale is causing significant changes in the economic and educational landscape and has led to greater disparities between regions with high levels of technological development and those with lowest. Uzbekistan is promoting digitalization in order to modernize its economy and improve the quality of life by narrowing disparities between regions. However, the precise affect that digitalization has on structural change in regional economies and educational institutions is not well investigated. This lacuna is filled by this study, which raises an important and topical issue regarding the country's sustainable development process and its competitiveness in the global digital era.

- **Research Objective**

The focal point of the research is to investigate how digitalization changes the structure of regional economy and education in Uzbekistan. To accomplish this, the study performs the following:

Formulate an overall approach to measure digitalisation induced structural changes in economic and educational terms.

Analyse institutional frameworks enabling digitalization and evaluate the current situation of structural changes in regional economies and higher education institutions.

Recommend the introduction of an information-analytical platform for monitoring structural and digital transformations.

Suggest predictive indices for the digital economy and educational progress, which will be responsible for advancing structural modernization and long-term competitiveness.

- **Theoretical Basis**

Structural changes in the regional economy denote the alteration of the internal framework and relationships among diverse industries and economic sectors, with the objective of improving efficiency, sustainability, and responsiveness to external fluctuations. The modifications encompass the reallocation of resources among sectors, the shift towards digitalization, and the enhancement of public administration systems, legislation, and infrastructure.

The interplay between digitization and regional economic structure embodies a multifaceted combination of technological, economic, and social elements. Schumpeterian economics underscores the significance of innovation and entrepreneurship in propelling economic growth and structural transformations. Theoretical themes pertaining to the evolution of post-industrial society have been examined in the writings of D. Bell [7], A. Toffler [28], and J. Galbraith [12]. Theories on the attainment of progress by structural modifications in the economy were formulated in the studies of A. Lewis [19] and G. Ranis. Concurrently, researchers including D. Kucera [25], D. Restuccia [10], D. Rodrik, C. Sepulveda, L. Roncolato [25], M. Duarte [10], M. McMillan, and Z. Ghosh examined matters pertaining to enhancing the efficacy of structural alterations within the framework of the creative economy. Digitalization is regarded as a significant catalyst for innovation, facilitating the development of novel business models and industries.

The new economic geography emphasizes the geographical allocation of economic activities. The research conducted by economists from the CIS nations focused on the examination of regional and sectoral dimensions of structural economic changes. Taimasov (2017) [29] emphasizes that the rising degree of digitization profoundly impacts the industrial framework of regional economies, resulting in the establishment of new economic clusters and the evolution

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of established sectors. Moshkov (2023) [23] contends that digitalization improves labour productivity and innovation capacity, hence expediting structural transformations in regional economies by promoting high-tech companies and diminishing dependence on resource-based sectors. Furthermore, Dyuvina (2023) illustrates that the implementation of digital technologies is directly linked to alterations in regional competitiveness, with places possessing advanced digital infrastructure exhibiting greater economic diversity and development rates. Trofimova (2017) [29] contends that the degree of digitalization influences workforce composition, leading to job polarization and necessitating reskilling initiatives to facilitate structural transition in regional labour markets. Bessonov (2023) [8] demonstrates that digital platforms and intelligent technologies are pivotal in transforming supply chains and economic exchanges, thereby altering the fundamental framework of regional economies. Ivanov (2023) concludes that variations in digital adoption among regions lead to unequal economic development, with digitally proficient areas experiencing more rapid modernization and industrial restructuring than their less advanced counterparts.

Uzbek economists, such as G.R. Baltabaeva, K.H. Abdurakhmanov, O.M. Abdullaev, O. Umarov, R.Kh. Ayupov, S.S. Gulyamov, [5] [15] and other prominent figures, have undertaken research on the application of information technology in Uzbekistan's economy, focusing on critical issues of digital economy implementation and evaluating its effects on the socio-economic landscape. The challenges of structural changes during economic transformation have been thoroughly analyzed in the scholarly works of Kadyrov, Ruzmetov, Alimov, Nazarov, Akhmedov, Mamurov, and others. Kadyrov et al. (2021) [17] assert that the advancement of the digital economy in Uzbekistan is vital for structural reforms, as it promotes economic modernization and bolsters national competitiveness. Mamurov (2021) [22] demonstrates that digitalization bolsters regional economic competitiveness by facilitating innovative company models and enhancing access to global markets. Furthermore, Alimov (2010) [4] delineates structural variables that enhance Uzbekistan’s economic competitiveness, while underscoring the necessity for industrial diversification and technological progress. Nazarov (2011) [24] analyzes the methodological dimensions of regional competitiveness, illustrating that investment in infrastructure and innovation are essential factors in structural economic growth. Akhmedov (2011) [3] delineates a plan for sustainable regional development, emphasizing the necessity of incorporating modernization strategies to guarantee enduring economic stability and structural transformation.

Digitalization significantly impacts regional economic structures by modifying transportation costs, agglomeration economies, and the geographical distribution of industries. It can also facilitate the advancement of human capital and technology innovation, resulting in structural transformation. This idea emphasizes the significance of digital platforms in establishing new markets and business models. The proliferation of platform-based enterprises can profoundly influence regional economic frameworks by catalyzing the growth of digital sectors. Digital technologies frequently demonstrate significant network effects, resulting in the swift expansion and supremacy of specific digital platforms, thereby influencing regional economic environments.

2. Literature Review

Nevertheless, no specific research have been undertaken to investigate the effects of digitalization procedures. (Table 1).

Table 1: Research by the authors in assessing the impact of the level of digitalization on structural changes in the regional economy

№	Research streams	Authors
1	“Scientific and methodological aspects of structural changes”	D. Bell, E. Toffler, J. Gelbreyt, A. Lyuis, G. Ranis, J. Fey
2	Theories of “achieving progress through structural changes in the economy”	L. Ronkolato, D. Kuchera, Z. Goshin, M. Duarte, D. Restuchcha
3	“Regional and sectoral aspects of structural changes in the economy”	V. A. Bessonov, N. V. Trofimov, A. R. Taimasov, A. V. Moshkov, N. V. Dyuvin
4	“Use of information technologies in the economy of Uzbekistan and assessment of the impact on the socio-economic situation”	S.S. Gulyamov, K.H. Abdurakhmonov, R.H. Ayupov, G.R. Baltabayeva
5	“Issues of structural changes in the process of economic transformation”	A. Kadyrov, B. Ruzmetov, T. Akhmedov, Sh. Nazarov and others.
6	“Digital economy” as “the absence of physical weight of products, replaced by the volume of information”	N. Negroponte, 1995

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7	"Digital economy as a complex of activities based on digital technologies"	I. Boyko et al., 2017
8	"Digital economy is the problem of finding a model of human relations corresponding to the technologies of the fourth century"	V. Bondarenko, 2017
9	"Digital economy is a system of institutional categories (concepts) in the economy, based on advanced scientific achievements and advanced technologies"	T. Hasanov, G. Hasanov, 2017
10	"Digital economy is a constant change in management methods and technologies in order to improve the efficiency of socio-economic processes, social, cultural, economic and technological relations between the state, business, communities and citizens operating in the global information space"	Golovenchik, 2019
11	"Digital (electronic) economy is a development based on online technologies and aimed at satisfying the needs for vital goods"	R. Ayupov, G. Baltaboeva, 2019
12	"Modern trends in the development of the global economy are associated with the increasing role of information technology and knowledge in the economic life of society, characterized by intensive structural shifts towards the high-tech information sector"	A. Kadyrov, A. Akhmedieva, F. Bazarov, B. Mamurov, 2021
13	"Telecommunication technologies are methods and processes of information transmission and ways of their implementation"	E. Bezverkhaya, 2023

Source: Compiled by the authors

Nonetheless, concurrently, no specific studies have been undertaken to examine the influence of digitalization processes on structural transformations within the regional economy. This research is regarded as one of the critical concerns facing contemporary Uzbekistan.

3. Method and Data

To address the research objectives, data on digitalization levels and indicators of structural change were collected for all regions of Uzbekistan. Correlation and regression analyses were used to determine the relationships between digitalization and structural shifts, identifying the most significant factors. Additionally, a comparative analysis of regions with differing levels of digital development was conducted to highlight regional characteristics and disparities. This multi-method approach provides a robust basis for evaluating the impact of digitalization on structural changes in regional economies.

This study employed the following methods: Systematization of data about the extent of digitalization and indicators of structural changes; correlation and regression studies were performed to ascertain the degree of interrelation between digitalization levels and structural changes, with the objective of identifying the most significant factors. A comparative interregional examination of Uzbekistan's regions, characterized by differing levels of digitalization, was conducted to reveal regional attributes.

The Presidential Decree of Uzbekistan about the Execution of the Investment Program for 2021–2023 is designed to enhance digital infrastructure and broaden the innovation sector, thereby promoting structural changes in the regional economy both presently and in forthcoming years. The examination of global experiences facilitates the identification of the most efficacious strategies impacting the advancement of the digital economy.

Global evidence indicates that the competitiveness of a national economy is generally associated with the advancement of information technologies. The World Economic Forum indicates a strong correlation between a nation's economic competitiveness index and its information and communication technology development index. Information technology are presently among the most rapidly expanding sectors globally. A survey of the scientific literature about methodological approaches to evaluating regional economic systems indicates that the most successful assessment relies on comprehensive indicators. Nonetheless, an approach that sufficiently integrates the "digital" aspect of regions

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and economic sectors remains absent. Consequently, an exhaustive examination of approaches for evaluating the extent of digital economy development must encompass the following areas (Fig. 1). In conclusion, recommendations were formulated to elevate digitization and maximize structural transformations within the regional economy.

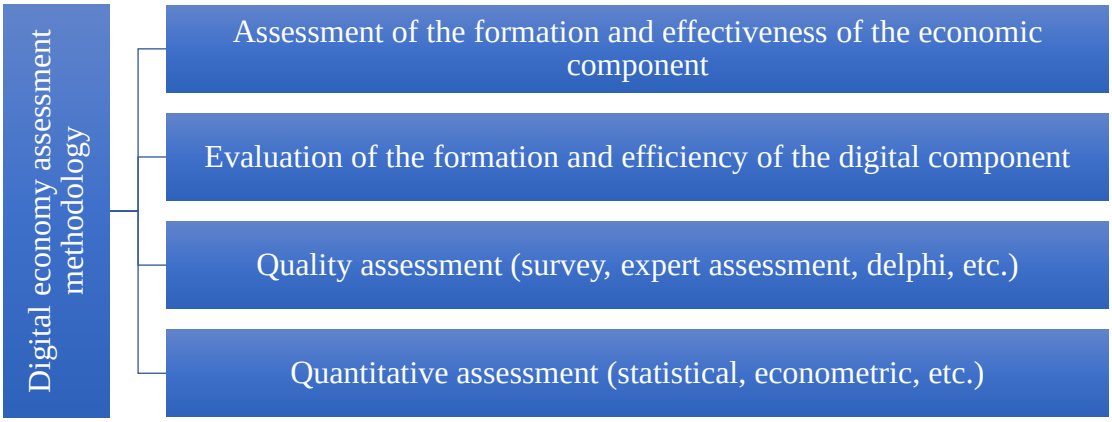

Figure 1. A logical model of a comprehensive methodology for assessing the digital economy

Source: Compiled by the authors based on Kadyrov et al. (2021)

Evaluation of each component of the complex methodology is based on the calculation of index indicators according to the following formulas:

if there is a direct relationship between the variables, then the following formula is used (1):

$$I_{yi} = \frac{Y_1}{Y_0} \quad (1)$$

here,
I_{yi} – i- index of the Y indicator in the region or network;
Y_0 – i- the value of the indicator Y in the region or network in the base period;
Y_1 – i- the current value of the indicator Y in the region or network

The calculation of the aggregate index of the digital economy for each of the components is defined as the arithmetic mean of the private indices according to the following formula (2):

$$I_{ji} = \frac{\sum_{i=1}^{n} I_{yi}}{n} \quad (2)$$

here,
I_{ji} – cumulative index for each component;
n – I_{yi} total number of values;
I_{yi} – i- index of the Y indicator in the region or network

The total index for each of the components allows you to quantify them.

To calculate the overall digital economy development index, the following formula should be used (3):

$$I_{RI} = \frac{\sum_{j=1}^{4} I_{ji}}{4} \quad (3)$$

here,
I_{DE} – general index of digital economy development;
I_{ji} – cumulative index for each component.

The indices standardize many indicators, facilitating comparison across diverse geographies or timeframes. This is essential for monitoring progress or pinpointing areas requiring enhancement. These formulas facilitate the synthesis of complex data into a singular, comprehensible statistic by the calculation of aggregate indices. This assists policymakers, analysts, and stakeholders in assessing the overall vitality and advancement of the digital economy. These indices quantify growth, facilitating the consistent measuring of progress, which is essential for establishing

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objectives, monitoring changes, and making informed decisions.

In addition, the methodology offers a set of indicators for calculating the cumulative index of each component (Table 2).

Table 2: A system of indicators for evaluating the digital economy

Index Symbol	The name of the indicator	Unit of measure
Economic component		
regions		
ER1*	GRP per capita	mln. soum
ER2	the share of economic sectors in the GRP	%
ER3	fixed capital investment, per capita	mln. soum
ER4	the number of people employed in the economy	a thousand people
economic sectors		
ES1**	share of industries in GDP	%
ES2	the number of people employed in networks	a thousand people
ES3	fixed capital investment by sector	mln. soum
ES4	gross value added of industries	%
Digital component		
regions		
DR1***	number of e-commerce entities	unity
DR2	coverage level with the internet network	%
DR3	e-commerce turnover	mln. soum
DR4	Share of information technology and communication network in GRP	%
economic sectors		
DS1****	The volume of goods and services in the ICT sector	mln. soum
DS2	Share of people employed in the ICT sector in the total employed population	%
DS3	The share of services provided through a single interactive public services portal	%
DS4	Share of employees working in the ICT sector	%

ER* economic component of regions,
ES** economic component of economic sectors,
DR*** digital component of regions,
DS**** digital component of economic sectors.

Source: Developed by the authors based on G20 DETF (2018)

The chosen indicators are founded on a systematic framework that incorporates both economic and digital elements at regional and sectoral tiers. These indicators thoroughly evaluate the advancement of the digital economy by encompassing essential economic performance measures in conjunction with digital transformation indicators. The technique adheres to the G20 DETF – Measurement of the Digital Economy framework, guaranteeing conformity with global best practices. This approach offers a comprehensive assessment of the impact of digitalization on economic growth, sectoral productivity, and regional development by integrating traditional economic metrics with digital economy data. Ultimately, it provides a solid basis for policy development and strategic decision-making.

Additionally, areas and economic sectors are categorized based on the advancement of the digital economy. The index value ranges from 0 to 1. The index results categorize regions and economic sectors into three groups: "High conditions," "Medium conditions," and "Low conditions." (Table 3).

Table 3: Groups according to the value of the general index of the development of the digital economy

Names of groups	Index value	Content
High condition	0,67 - 1,0	Favorable conditions for the formation and high efficiency of economic and digital components

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Medium conditions	0,34 - 0,66	Favorable conditions for the formation of economical and digital components with average efficiency of operation
Low condition	0 - 0,33	Favorable conditions for the formation of economic and digital components with low efficiency of operation

Source: Mamurov, B. (2023). Improving the Structure of the Regional Economy Under Conditions of Digitalization. Abstract of the dissertation of Doctor of Philosophy in Economics. https://www.interaktiv.oak.uz/avtoreferat/3aO8746fO1.file (Access date: 12.12.2023)

The general index of digital economy development is calculated as of 2022 for the regions of Uzbekistan (Fig. 2).

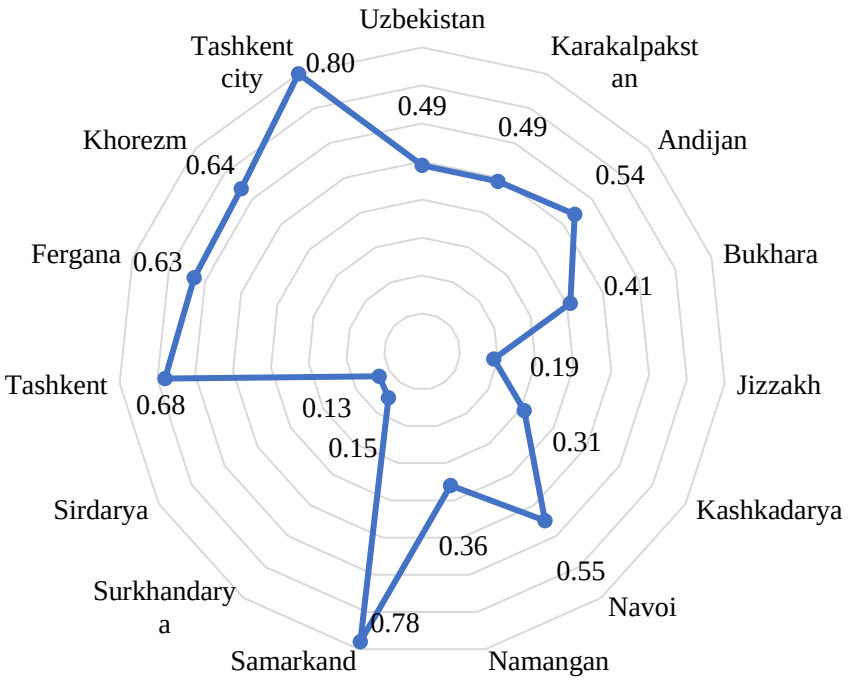

Figure 2. Index of the overall development of the digital economy in the regions

Source: Calculated by the authors based on data from the Statistics Agency of Uzbekistan. (2022). Socio-economic situation of the Republic of Uzbekistan for January-December 2022. Retrieved from https://stat.uz/files/403/choraklik-natijalar-yanvar-dekabr-2022en/2769/January-December-2022.pdf (Access date: 15.01.2024)

The findings indicate that the Samarkand, Tashkent regions, and the city of Tashkent exhibit high conditions, while the Republic of Karakalpakstan, Andijan, Bukhara, Navoi, Namangan, Ferghana, and Khorezm regions display average conditions. Conversely, the Jizzakh, Kashkadarya, Surkhandarya, and Syrdarya regions are characterized by low conditions.

To eradicate disordered structural changes and facilitate market and administrative transformations, it is essential to achieve consensus and harmonious collaboration among all sectors of the regional economy in the context of developing strategic and programmatic documents. The extent of stakeholder influence on the transformation of the regional economy towards digitalization differs considerably.

The advancement of the digital economy across regions and sectors aims to provide an efficient interdepartmental coordination framework for evaluating the growth of sectoral and regional digital initiatives in the future. A uniform rating system is implemented to evaluate the development status of the digital economy and e-government across various economic sectors, social domains, and regions. The assessment technique facilitates a comprehensive examination of the status of digital transformation. This table presents an analysis of the gross regional product and employment figures in the ICT sector for the years 2018 and 2022 across several regions of Uzbekistan (Table 4).

Table 4: Gross regional product and the number of people employed in the ICT sector by regions of Uzbekistan

Regions	**2018**	**2022**	**Change (+), (-)**

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	GRP, billion soum	Number of employees, person	GRP, billion soum	GRP, billion soum	Number of employees, person	GRP, billion soum
Karakalpakstan	15 009,4	1 031	29 925,4	1 309	+14 916,0	+278
Andijan	26 503,0	1 397	54 464,0	1 611	+27 961,0	+214
Bukhara	21 158,3	1 506	45 797,3	1 908	+24 639,0	+402
Jizzakh	12 074,7	731	27 140,8	1 133	+15 066,1	+402
Kashkadarya	27 962,2	927	49 520,8	1 256	+21 558,6	+329
Navoi	22 132,2	1 219	66 685,4	1 346	+44 553,2	+127
Namangan	18 046,0	1 234	41 098,2	1 625	+23 052,2	+391
Samarkand	31 233,5	1 503	62 440,3	2090	+31 206,8	+587
Surkhandarya	17 802,0	855	34 858,5	1 125	+17 056,5	+270
Sirdarya	8066,3	211	18 136,8	664	+10 070,5	+453
Tashkent	38 774,3	1 865	93 433,1	2 896	+54 658,8	+1 031
Fergana	26 611,5	2 341	55 972,1	2 388	+29 360,6	+47
Khorezm	15 242,5	1 039	31 963,1	1 277	+16 720,6	+238
Tashkent city	54 694,3	24 389	147 414,6	36 506	+92 720,3	+12 117

Source: Formed by the author based on data from the Statistics Agency of Uzbekistan. (2022). Socio-economic situation of the Republic of Uzbekistan for January-December 2022. Retrieved from https://stat.uz/files/403/choraklik-natijalar-yanvar-dekabr-2022en/2769/January-December-2022.pdf (Access date: 15.01.2024)

In 2022, Tashkent occupied the foremost position, contributing 16.6% to the GDP. The Tashkent and Navoi regions accounted for 10.5% and 7.5%, respectively. The Syrdarya (2.0%) and Jizzakh (3.1%) regions contributed the least to the republic's GDP formation.

Regarding the employment figures in the ICT sector for 2018 and 2022, the following regions of the republic ranked highest: The most significant rise in employment within the ICT sector in 2022 vs to 2018 occurred in Tashkent city (+12,117) and Tashkent region (+1,031).

The advancement of the Internet and the use of contemporary information systems and software for management and manufacturing processes are pivotal in establishing a digital economy and networks within regions. The illustration below presents an overview of the communication and information services sector in Uzbekistan from 2018 to 2022 (Figure 3).

From 2018 to 2022, the number of Internet users rose from 22.8 million to 32.0 million, representing an increase of 140.4%. The traffic speed rose from 1200.0 Gbit/s to 1800.0 Gbit/s, but the cost of an Internet connection fell from $30.3 to $3.0.
In global competitiveness, the assured victors are those equipped with sophisticated information systems. The experiences of advanced nations relevant to Uzbekistan are particularly significant, along with effective strategies for building a successful information economy, including the commercialization of the ICT industry.

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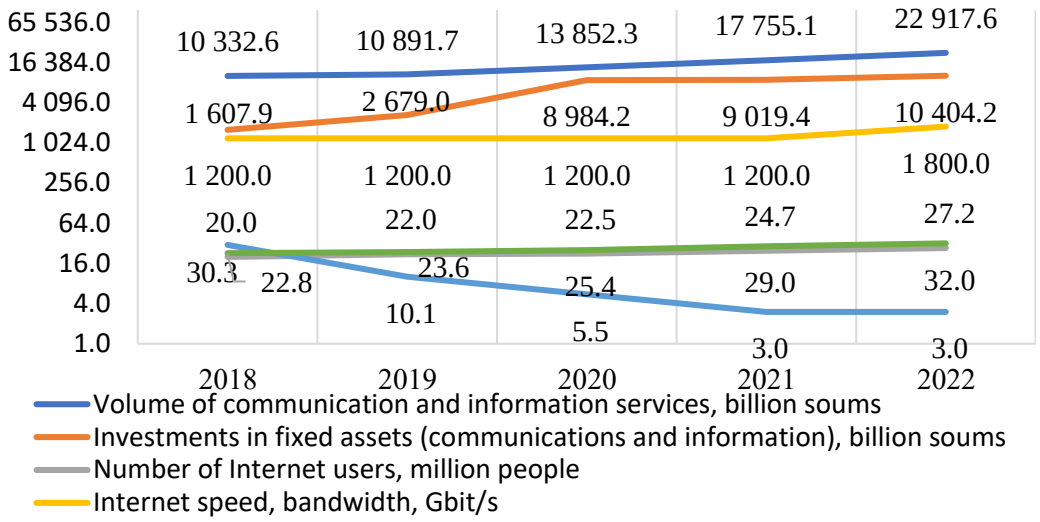

Figure 3. *The main indicators of communication and information services in Uzbekistan*

Source: Formed by the author based on data from the Statistics Agency of Uzbekistan. (2022). Socio-economic situation of the Republic of Uzbekistan for January-December 2022. Retrieved from https://stat.uz/files/403/choraklik-natijalar-yanvar-dekabr-2022en/2769/January-December-2022.pdf (Access date: 15.01.2024)

An investigation of the information and communication sector was conducted, and an econometric model utilizing multidimensional time series was built. The analytical data are derived from information provided on the website of the Agency of the Republic of Uzbekistan on Statistics (www.stat.uz).

This study justifies the use of "volume of communication and information services" as a dependent variable since it directly indicates the level of development and changes within the communication and information technology sector. In this context, alterations in variables such as fixed capital investment, the quantity of Internet users, and mobile subscribers influence this industry. The amount of communication and information services serves as a crucial measure of the digital economy and technological infrastructure inside the region. An augmentation in the amount of these services signifies an enhancement in the accessibility and calibre of communication.

4. Results

The advancement of the digital economy in Uzbekistan is a pivotal factor affecting fundamental transformations in the regional economy and the trajectory of economic growth. The implementation of contemporary digital technologies is essential for the modernization of industrial sectors, influencing the labour market, and improving competitiveness. This study generated the regional digital economy development index to evaluate its influence on economic growth and structural shifts. The investigation sought to elucidate the interconnection between economic and digital variables and ascertain the principal drivers of regional development.

The investigation indicated that Tashkent city, Tashkent, and Samarkand regions exhibit a high degree of digital economy development, attributable to their sophisticated infrastructure and investment appeal. The study also revealed that digital transformation initiatives in the Jizzakh, Kashkadarya, Surkhandarya, and Syrdarya regions are advancing at a diminished rate. In light of these findings, the article offers policy recommendations to enhance regional digitization policies aimed at promoting equitable economic development.

In recent years, digital technologies have experienced several alterations and have significantly influenced society. They have transformed our lifestyle, methods of work, communication, and interaction. Currently, digital technologies serve as the catalyst for social transformation and economic advancement on a worldwide scale. Their impact on the development of the digital economy is clearly illustrated in Figure 5.

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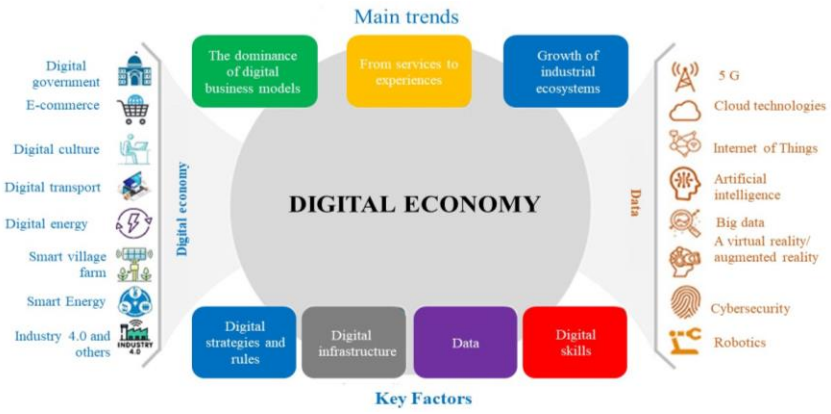

Figure 5. The structural structure of the digital economy

Source: Mamurov, B. (2023). Improving the Structure of the Regional Economy Under Conditions of Digitalization. Abstract of the dissertation of Doctor of Philosophy in Economics. https://www.interaktiv.oak.uz/avtoreferat/3aO8746fO1.file (Access date: 12.12.2023)

Digital transformation broadly entails a reevaluation of strategy, models, operations, products, marketing methodologies, and management objectives via the integration of digital technologies. It facilitates the expeditious advancement of commerce, enterprises, and the economy at large, while also enhancing the efficacy of non-profit organizations, such as colleges and other educational entities.

The velocity of digital transformation is critical, serving as the determining factor. The swift progression of technology and the resulting socio-economic and infrastructural changes associated with human life facilitate a notable acceleration in development, indicating a transition to a new epoch. Digital transformation occurs when firms and organizations modify their operating strategies to provide enhanced benefits to their stakeholders.

From our viewpoint, the digital transformation of the regional economy must include a range of elements, integrating several stages (Fig. 6). Each stage of the digital transformation journey tackles different aspects of businesses and organizations, including operations, basic computer literacy, training, expertise, and technology.

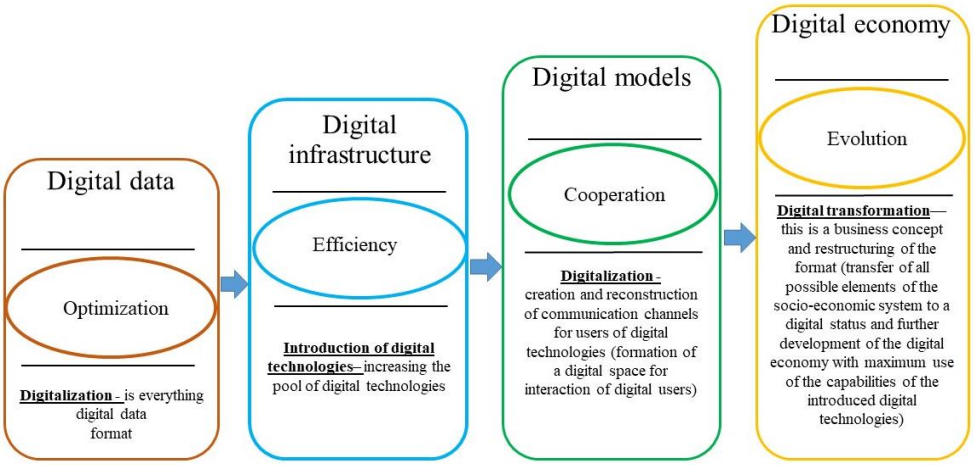

Figure 6. The content of the digital transformation process in the regional economy

Source: Mamurov, B. (2023). Strategy and prospects for the development of the digital economy in regions. Nashrlar, 1(1), 326–329. https://doi.org/10.60078/2023-vol1-iss1-pp326-329 (Access date: 19.12.2023)

The standards and expectations of our consumers are perpetually increasing. The digital economy immediately affects the activities of market actors, including governments, networks, and corporations, with information technologies and innovative business models. It affects the magnitude of the consumer base and revenue, frequently leading to an increase in both income and expenses. The extensive accessibility of the Internet has contributed to the rise of digital services.

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5. Discussion

Consequently, it has become feasible to formulate and execute a program of pragmatic measures for cities and regions exhibiting "unsatisfactory" socio-economic development indicators; the initiative to enhance the deployment of an information and analytical platform designed to automate the processes of collecting, storing, analyzing, and transmitting extensive data (Big Data) as part of digitalization, predicated on the integration of information that influences effective structural transformations in the regional economy. The idea to implement a grading system for evaluating the development status of the digital economy, grounded in the existing digital transformation of sectors and regions, has been articulated for the formulation of future sectoral and regional digital development initiatives. The implementation of this proposal has reduced the time required for the collection and processing of extensive data (Big Data) regarding socio-economic processes in the regions, as well as the monitoring and forecasting of various regional indicators, by 15 percent. This advancement enables the formulation of evaluative and effective management decisions, eliminates the need for traditional data processing methods, and diminishes the likelihood of errors and the impact of human factors in the preparation of data processing and analytical materials. The practical significance of the study's results lies in the applicability of its proposals and conclusions within the conceptual framework for enhancing economic structure, assessing the influence of the digital economy on structural transformations, and refining indicators and methodologies for evaluating the efficacy of structural changes and econometric models.

6. Conclusion

This study concludes that accelerating digitalization is essential for driving structural change in regional economies. A comprehensive framework for assessing digital development has been proposed, showing that digital technologies create more equal opportunities for businesses. However, challenges such as data timeliness and fragmentation remain. We evaluated indices from key indicators and examined sectoral correlations, identifying potential pathways for structural adjustments through balanced sectoral growth.

The investigation of the effects of digitalization on structural transformations within the regional economy has yielded some significant conclusions and recommendations. The research delineated the fundamental elements of the economy pertinent to digital transformation and formulated an extensive methodology for evaluating digital advancement. These findings can provide a foundation for the formulation of sectoral and regional digital development initiatives in the future.

The utilization of ICT in the economy fosters equitable chances for product promotion for both large and small firms. The advantages include the objectivity and comparability of sub-indices that delineate the primary directions of development. Nonetheless, certain disadvantages encompass the lack of timeliness and the disarray of information. The study evaluated indices derived from essential indicators, and correlation coefficients were examined to investigate the interrelations among economic sectors. This method recognized potential for enacting structural modifications via the proportional advancement of industries.

The results underscore multiple prospective avenues for subsequent investigation. This involves assessing the long-term consequences of digitalization on structural transformations within the regional economy, emphasizing the lasting implications of digital technologies across multiple industries. Furthermore, it is essential to analyze the impact of digital technology adoption on regional labour markets in Uzbekistan. Public and private investments in digital infrastructure are anticipated to significantly influence structural transformations. Creating more accurate and comprehensive metrics for evaluating digitalization levels across various regions would improve analysis and strategic planning.

Overall, these findings can inform evidence-based policy recommendations. They can help government authorities craft digital transformation strategies to speed up digitalization in lagging regions and improve competitiveness. The study provides insights for businesses on effective technologies for their operations. Implementing these insights in underdeveloped areas should promote more equitable development and improve quality of life. Furthermore, the results could guide educational initiatives in digital skills, which are crucial for meeting the growing needs of the digital economy.

This research contributes to both theoretical understanding and practical implementation of digitalization's effects on regional economic structures. It bridges theory and practice in public administration, business, and social development, promoting sustainable regional development and enhanced socio-economic welfare.

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