

**DIGITAL TRANSFORMATION OF HIGHER EDUCATION
ON THE EXAMPLE OF UNIVERSITIES
IN THE KHARKIV REGION**

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INTRODUCTION

The generalization of humanity's problems, as well as the way to solve them, was realized in the Sustainable Development Goals, 17 of which were adopted in 2015 based on the analysis and revision of the Millennium Goals and whose achievement is planned for 2030. These goals are the basis for strategic development documents of the European Union and, separately, of European countries.

The decree of the President of Ukraine¹ approved ensuring the compliance with the goals of sustainable development until 2030, which were announced by the resolution of the General Assembly of the United Nations Organization of 2015 years and the results of their adaptation taking into account the specifics of Ukraine's development, set out in the National Report "Sustainable Development Goals: Ukraine 2017".

Progress in achieving the SDGs by Ukraine is highlighted on the official website of the State Statistics Service together with VoxUkraine with the support of the UN Development Program in Ukraine on the basis of the Voluntary National Review of the Sustainable Development Goals according to the methodology of the United Nations Economic and Social Commission for Asia and the Pacific².

Progress has been made in terms of indicators since 2015 indicating the institutions responsible for calculating and providing data to the State Statistics Service.

First of all, it should be noted that all the problems of humanity are summarized in 17 goals of sustainable development, which are focused on the social, economic and environmental spheres. Accordingly, the environmental sphere includes goals 6, 13, 14 and 15, which are focused on the sustainable management of water resources, the fight against climate change and its consequences, the sustainable use of oceans, seas and marine resources, the protection and restoration of terrestrial ecosystems and the promotion of their rational use. In order to ensure the achievement of these goals in Ukraine, the Decree of the President of Ukraine On the Goals of Sustainable Development

¹ Advantage Ukraine. URL: <https://advantageukraine.com/> (date of application: 09.01.2024).

² UNESCAP. URL: <https://data.unescap.org> (date of application: 09.01.2024).

of Ukraine for the period until 2030 was issued and the Project of the Sustainable Development Strategy of Ukraine was developed. Accordingly, all strategies and plans must take into account the SDGs. Since each goal contains a number of indicators, their achievement will ensure a gradual green transition of all spheres of activity in Ukraine. Also, in this aspect, there is an orientation of the country's economy to change the energy structure and energy consumption – switching to alternative energy sources.

The transformation on the way to climate neutrality will cost Ukraine 15% of the total GDP by 2050 – this share is much higher than in developed countries (according to the McKinsey report).

Thus, digital transformation will cover such elements of development as economic growth, social inclusion, and environmental sustainability. The positive impact on the ecology of digital transformation is obvious: reduction of paper consumption, optimization of equipment operation, etc.

The degree of achievement of these goals is monitored through the achievement of a set of indicators:

The environmental component is planned to be achieved through the development and implementation of digital startups related to renewable energy, responsible consumption, preservation of marine and terrestrial ecosystems, etc.

This paper explores the concept of digital transformation and its significance in turbulent circumstances, taking into account war challenges with a specific focus on the education of the Universities of Kharkiv region in the context of Ukraine's aspirations for EU integration and economic recovery. The purpose of this paper is to analyze the current challenges faced by Universities regarding digitalization and outline the opportunities and strategies for digital transformation.

Achieving the goal is realized through solving a set of tasks. First of all, it is necessary to study the work of scientists in this field, which allows us to establish the challenges and problems faced by universities during the digitization of the educational process, effective models of digitization and methods of their study and implementation. Secondly, to analyze the current state of digitalization at different levels, the main directions and support programs. Thirdly, to determine the main stakeholders of the digitization processes of universities, identify their problems (pain), risks and reasons for resistance, goals and potential benefits and develop communication and action plan. Fourth, to establish the advantages, challenges and risks that will accompany the process of digitalization of the educational process in the universities of the Kharkiv region. Fifth, develop scenarios for the development of digitization of universities in the Kharkiv region based on key drivers.

1. Current State, Challenges, and Directions in Higher Education Transformation in Ukraine

A significant number of scientific works, both by domestic and foreign scientists, are devoted to the study of the transformation of higher education in the field of digitization. Thus, Kitsing M.³ focused on digital ecosystems and the importance of digitization, taking into account different political economic views, as they cover economic, political and social contexts at different levels of governance. The author also explored alternatives for the future, including in education. In their study, scientists Tapia, J.C.⁴ noted the need to find support mechanisms in the use of business process management as a driver of digital transformation in education, and also provided recommendations to heads of higher education institutions regarding the use of business processes in management. Lukyanenko D. G.⁵ substantiated the model of building a digital university with digitization of the management system, educational and scientific activities, development of human capital, infrastructure and creation of a digital ecosystem. John P. Kotter & Dan S. Cohen⁶ describe the challenges faced when implementing large-scale changes, including those related to digitalization, and offer an eight-step action plan for a bold leap forward in a turbulent world. The implementation of digital technologies in educational activities is a very complex process. Thus, Hayes J.⁷ in his study describes the consequences of ineffective change management, which can be devastating for management. In the research of the authors Dovhodko T. & Korchuk O.⁸ digitalization is considered as a socio-cultural phenomenon that has become a component of the development of all spheres of life in modern society, including education. Thus, Marienko M. &

³ Kitsing M. *The Political Economy of Digital Ecosystems Scenario Planning for Alternative Futures*. 7 B/W. Routledge. 2023. 172 P.153.

⁴ Tapia J.C., Avilés F.P., García J.Z., Cuesta D.A., Flores C.O. Business Process Management in the Digital Transformation of Higher Education Institutions. In: Rocha, A., Ferrás, C., Ibarra, W. (eds) *Information Technology and Systems. ICITS 2023. Lecture Notes in Networks and Systems*. 2023. Vol 691. Springer, Cham. https://doi.org/10.1007/978-3-031-33258-6_51

⁵ Лук'яненко Д. Г., Мозгаллі О. П., Лук'яненко О. Д., Дворник І. В., Орехов М. О. (2021). Цифровий імператив трансформації діяльності університетів. *Financial and Credit Activity Problems of Theory and Practice*. 2021. 4(35), 449–458.

⁶ John P. Kotter, Dan S. Cohen. *The Heart of Change: Real-life Stories of How People Change Their Organizations*. Harvard Business School Press. Boston. 2002. 190 p.

⁷ Hayes J. *The Theory and Practice of Change Management*. Red Globe Press. 2021. 488 p.

⁸ Довгодько Т., Корчук О. Діджиталізація як соціокультурний феномен: філософсько-освітній аспект. *Молодь і ринок*. 2020. № 6/185. С.104-110.

Kovalenko V.⁹ and Tra My Nguyen¹⁰ describe the risks that can be caused by the use of digital technologies, namely artificial intelligence in education: the reduction of the role of the teacher, the reduction of creativity and critical thinking skills of students, the risk of increasing the gap between students with high and low socioeconomic status. Thus, the analyzed studies of scientists indicate that the current state, challenges, directions and scenarios of transformation in educational activity are not fully defined. It is also worth analyzing in this context the changes caused by the introduction of digitization in education.

Based on existing research it is proposed to form a research methodology that will allow to determine the current state, challenges, directions and scenarios of the transformation of higher education in Ukraine in the field of digitization¹¹. Its visualization is presented in fig. 1.

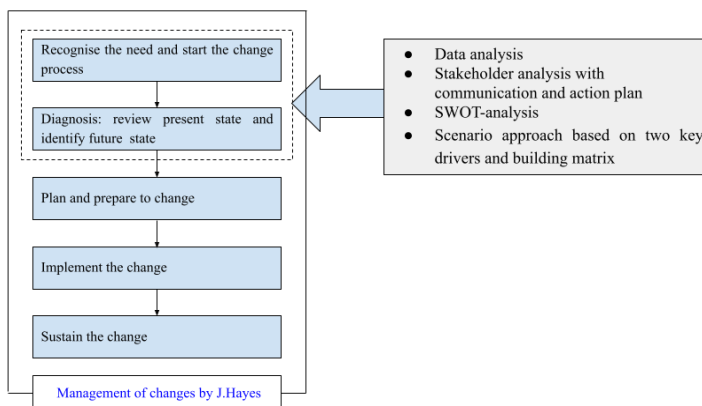


Fig. 1. Research methodology

Source: Developed by authors

⁹ Мар'єнко М., Коваленко В. Штучний інтелект та відкрита наука в освіті. *Фізико-математична освіта*, 2023. 38(1), 48–53.

¹⁰ Tra My Nguyen. Digitization of Education in Vietnam in the Crisis of COVID-19 Pandemic. *Springer Books*, in: *Nguyen Hoang Thuan & Duy Dang-Pham & Hoanh-Su Le & Tuan Q. Phan (ed.), Information Systems Research in Vietnam*, Springer, 2023. 145-158.

¹¹Kyzym, M., Dymchenko, O., Smachylo, V., Rudachenko, O., Dril, N. Cluster Analysis Usage as Prerequisite for Implementing Strategies of Countries *Startup Ecosystems Development*. In: *Arsenyeva, O., Romanova, T., Sukhonos, M., Tsegelnyk, Y. (eds) Smart Technologies in Urban Engineering. STUE 2022. Lecture Notes in Networks and Systems*. 2023. Vol 536. Springer, Cham. Pp. 290-301.

First of all, we will take into consideration the change management approach proposed by J. Hayes¹², which includes the following stages:

- Recognize the need and start the change process;
- Diagnosis: review present state and identify future state;
- Plan and prepare to change;
- Implement the change;
- Sustain the change.

In our opinion, this sequence can conditionally be divided into 3 broader components: stages 1–3 are implemented within the preparatory component for changes; the fourth stage directly involves the implementation of the planned measures, and the last stage, 5, creates conditions for supporting changes. To achieve the goal of this study, we will focus on the 2 first stages, which will allow us to determine the need for changes, the current state, and form a strategic vision.

The identification of the necessary changes and the analysis of the current state in the field of digitalization in general, and, directly, of higher education, is based on a review of the opinions of experts in this field, analytical data of international platforms, and EU regulatory documents.

According to the approaches of M. Kitsing¹³, it is necessary to take into account such components of the digital ecosystem as rules, participants, and resources. This necessitates the identification of key groups of stakeholders of digitalization processes in higher education, their problems, goals and possible actions. For this purpose, the method of stakeholder analysis according to Mendlow is used.

One of the important components of implementing changes in the organization (8 Stage approach to leading change), according to John P. Kotter¹⁴, is the development of a vision and strategy: to clearly define the desired future state and outline a strategic plan for its achievement. This will be facilitated by the use of SWOT-analysis, which is the basis for developing strategies based on the identification of strengths and weaknesses (internal environment) and threats and opportunities (external environment)¹⁵⁻¹⁶. It is advisable to describe the future state on the basis of a scenario approach,

¹² Hayes J. *The Theory and Practice of Change Management*. Red Globe Press. 2021. 488 p.

¹³ Kitsing M. *The Political Economy of Digital Ecosystems Scenario Planning for Alternative Futures*. 7 B/W. Routledge. 2023. 172 P.153.

¹⁴ John P. Kotter, Dan S. Cohen. *The Heart of Change: Real-life Stories of How People Change Their Organizations*. Harvard Business School Press. Boston. 2002. 190 p.

¹⁵ Raximov S. D Pirimqulov R. O. Problems of applying modern digitization processes in algorithm in modern education. *O'zbekistonda fanlararo innovatsiyalar vailmiy tadqiqotlar jurnali*, 2023. 2(18), 509–511.

¹⁶ Димченко О., Смачило В., Гнатченко С., Тараруєв Ю., Рудаченко О. Теоретичні засади провадження біржової торгівлі в аспекті діджиталізації. *Комунальне господарство міст*, 2023. 2(176), С. 53–58.

which involves the determination of key indicators and the construction of a matrix taking them into account.

By aligning the university's digital initiatives with the broader vision of building Ukraine 2.0, this paper aims to contribute to the academic discourse surrounding digital transformation in higher education¹⁷.

Given the rapid development of digital technologies, in 2020 Ukraine has developed a National Digital Transformation Strategy that identifies key areas and tasks for the development of the digital economy and digitalization in various fields, including education¹⁸⁻¹⁹. The process of developing e-government is also ongoing, simplifying procedures and improving access to services for citizens and businesses. In addition, Ukraine has a strong IT sector and an active startup ecosystem that promotes the development of the digital industry and innovation.

Ukrainian digitalization legislation is focused on creating a favorable environment for the development of digital technologies and services, taking into account the Law "On Electronic Trust Services" and the Law "On Electronic Document Flow".

According to the project of Digital Adjenda of Ukraine²⁰, digitalization of education occupied an important place. Thus, the ability to work with "digital" technologies is gradually becoming permanent and necessary for most specializations, that is, end-to-end or cross-platform. Ukraine should move forward with a modern national training program for general and professional digital competencies and skills as key components of the digital economy. "Digital" literacy (or "digital" competence) is recognized by the EU as one of the 8 key competencies for a full life and work. Ukraine has joined the implementation of sustainable development goals, including high-quality education, which is impossible without digitalization²¹.

Similar to IQ or EQ, which are used to measure the level of general and emotional intelligence, skills in relation to "digital" technologies are DQ

¹⁷ Building Ukraine 2.0. URL: <https://www.economist.com/leaders/2023/06/22/building-ukraine-20> (date of application: 09.01.2024).

¹⁸ Стратегія цифрової трансформації соціальної сфери. URL: <https://zakon.rada.gov.ua/laws/show/1353-2020-%D1%80#n10> (date of application: 09.01.2024).

¹⁹ Україна 2030Е – країна з розвинутою цифровою економікою. URL: <https://strategy.uifuture.org/kraina-z-rozvinutoyu-cifrovoyu-ekonomikoju.html#6-2-2> (date of application: 09.01.2024).

²⁰ Цифрова адженда України. URL: <https://www.me.gov.ua/News/Detail?lang=uk-UA&id=bd512af7-5e94-430a-9842-452d843a5c1a&title=UMinekonomrozvitkuPrezentuvaliProekttsifrovoiAdzhendiUkraini2020-?kbcvxbmfkbtgdmix> (date of application: 09.01.2024).

²¹ Про Цілі сталого розвитку України на період до 2030 року. URL: <https://zakon.rada.gov.ua/laws/show/722/2019#Text> (date of application: 09.01.2024).

(Digital Quotient), that is, "digital" intelligence. DQ contains 3 levels: – "Digital Citizenship", "Digital" creativity, "Digital entrepreneurship".

The key solution is a combined strategy for the digitalization of education, in which there are long-term measures and scale inherent in the state education system, and short-term rapid measures that are more relevant for implementation in the segment of commercial education. After all, the commercial segment is much more flexible, more reactive in terms of transfer and implementation of innovative teaching methods in Ukraine.

Currently, Ukraine is experiencing a significant level of digitalization across various sectors. The country has made substantial progress in embracing digital technologies and implementing digital solutions in areas such as e-governance, e-commerce, fintech, and education, taking into account the pandemic and war influence.

There has been an increasing adoption of digital platforms and services, including online banking, e-commerce platforms, and mobile applications. For instance, the establishment of the Diya digital platform has streamlined public services, making them more accessible to citizens. Economically, Ukraine faces challenges such as a fragmented market, limited access to capital, and brain drain. These factors impact the pace of digitalization in the country. However, there are notable examples of organizations harnessing technology to drive positive change. For instance, the private sector has witnessed the emergence of successful e-commerce platforms like Rozetka and Prom.ua, which have revolutionized online shopping in Ukraine and created economic opportunities. Nonprofit organizations are also leveraging technology to address societal challenges. For instance, the Kyiv Smart City project aims to improve the quality of life for residents through the integration of smart technologies.

Additionally, the Ukrainian government has been actively promoting the digital transformation agenda, with initiatives focused on improving digital infrastructure, fostering innovation, and enhancing digital skills among the population. While challenges remain, such as addressing the digital divide and ensuring cybersecurity, the level of digitalization in Ukraine is steadily advancing, contributing to increased efficiency, accessibility, and connectivity in the digital landscape.

Thus, as part of the United 24 reconstruction plan for Ukraine by 2025, the government proposes to attract UAH 69.2 billion on digitalization. Forbes chose the most expensive initiatives proposed in the plan²².

The estimated cost of its implementation is \$750 billion by 2032.

²² План «Диджиталізація». URL: <https://forbes.ua/innovations/plan-didzhitalizatsiya-na-vidnovlennya-ta-tsfiroviy-rozvitok-do-2025-roku-khochut-zaluchiti-i-vitratiti-692-mlrd-gm-kudi-pidut-groshi-05072022-7000> (date of application: 09.01.2024).

The plan is based on 15 main "national programs".

The plan is divided into nine directions and three time stages:

wartime tasks for 2022;

recovery in 2023–2025;

modernization in 2026–2032.

By 2025, the authors have budgeted UAH 69.2 billion for digitalization.

Financing is mainly offered by attracting foreign investment and budget funds.

The ratio of project costs of the digital reconstruction of Ukraine 2022–2025 is shown in the Fig. 2.

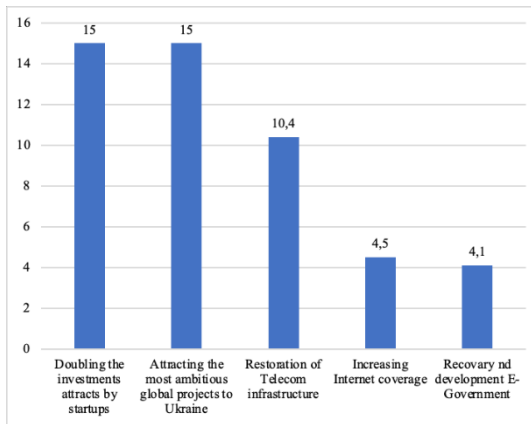


Fig. 2. The most expensive projects of the digital reconstruction of Ukraine 2022–2025, billion UAH

Source: *Plan for the reconstruction of Ukraine United 24*²³

The main directions, according to Ukraine United 24, are:

Development of the digital economy

UAH 34.7 billion. This area accounts for half of all money allocated for digitalization projects. The main task is to increase the share of IT services in the country's GDP from 2.7% in 2021 to 10% in 2025. This is planned to be done through investments in startups, educational programs, attracting foreign companies and professionals to the country. So "Diia.City" (a unique legal and tax space for IT companies in Ukraine)²⁴, where you can do business openly and conveniently – as in Estonia, Singapore, etc. should increase to

²³ План «Диджиталізація». URL: <https://forbes.ua/innovations/plan-didzhitalizatsiya-na-vidnovlennya-ta-tsifrovyy-rozvitok-do-2025-roku-khochut-zaluchiti-i-vitratiti-692-mlrd-gm-kudi-pidut-groshi-05072022-7000> (date of application: 09.01.2024).

²⁴ Дія.City. URL: <https://city.diia.gov.ua/> (date of application: 09.01.2024).

2,000 residents (currently 450) in three years, and the number of startups registered in Ukraine – up to 4,000. In 2022, the IT industry showed growth of \$ 400 million compared to the previous period. Because of the war, the dynamics are lost. An increase of 40–45% was expected, only 6% occurred. Despite difficult circumstances, the industry continues to work. And, in fact, it remained the only export industry in Ukraine that fully operated during the full-scale war. It even grew by almost 6% and brought \$7.4 billion to the state budget²⁵.

Digital infrastructure:

UAH 17.8 billion. The main goal is to restore the destroyed infrastructure of telecom providers and improve Internet penetration. Thus, by 2025, 95% of the population should have access to mobile Internet at a speed of at least 2 Mbps.

In addition, Development of administrative services network, State information resources in cloud technologies and Development of public electronic registers. All this cannot be done without creating an efficient digital ecosystem²⁶, including digital transformation of the educational system.

Another initiative aimed at rebuilding Ukraine and attracting investments, including digitalization projects, is the Advantages Ukraine platform²⁷. This platform was initiated by the President of Ukraine at the end of 2022. for the presentation of investment potential to international investors in the main priority directions: defense-industrial complex; metallurgy and metal processing; energy; agro-industrial complex; woodworking and furniture making; innovative technologies; logistics and infrastructure; pharmaceuticals; natural resources; industrial production. As of August 2023 the Advantage Ukraine platform works with more than 130 projects worth \$67 billion. Since its inception, almost 1,500 companies looking for investment and opportunities for trade cooperation have turned to it ²⁸.

One of the priority areas is innovative technologies, which include 2,000+ players in the startup market and have \$11 billion in investment potential, because Ukraine ranks 4th in the world in terms of the volume of financial transactions using mobile devices. By the number of cryptocurrency

²⁵ Найбільша кількість нових стартапів сьогодні в галузі military-tech. URL: <https://interfax.com.ua/news/interview/893766-amp.html> (date of application: 09.01.2024).

²⁶ Kitsing M. The Political Economy of Digital Ecosystems Scenario Planning for Alternative Futures.7 B/W. *Routledge*. 2023. 172 P.153.

²⁷ Advantage Ukraine. URL: <https://advantageukraine.com/> (date of application: 09.01.2024).

²⁸ Advantage Ukraine. URL: <https://advantageukraine.com/> (date of application: 09.01.2024).

users, Ukraine ranks 4th in the world with legalized mining and cryptocurrency ecosystem²⁹.

In general, according to ³⁰ there are 22,606 startups in the field of EdTech (startups in education) (as of August 2023). In October 2022 Delarom.co released a report dedicated to Edtech startups: Activity in private and public markets. It defines the following key characteristics:

In 2022, venture capital invested \$7.6 billion in Edtech startups. Global venture capital activity fell by 37% in the first half of 2022 compared to the same period in 2021. Among the dominant regions, Europe is showing the strongest signs of resilience, attracting US\$1.4 billion in H1 2022, the highest half-year figure.

There is a huge untapped potential in education. The education market is approximately \$6.5K, of which only <4% is digitized. This sector is significantly underfunded compared to other sectors of similar size.

In October 2022 there were 70 Edtech unicorns worldwide. The creation of unicorns slowed down compared to the record figures of 2021, but already in 9 months of 2022, nine new startups received the status of "unicorns". As of August 2023 there were 81 Edtech unicorn startups in the Delarom.co database.

Ukraine is part of the European community and is constantly studying and adapting the legislative integrative documents. The main legislative acts regulating digitalization at the European Union level include the General Data Protection Regulation (GDPR); the Directive on Electronic Commerce; the Directive on Electronic Identification and Trust Services (eIDAS Directive); the Cybersecurity Regulation (NIS Directive), which aims to ensure a high level of cybersecurity in sectors that play a strategic role for social and economic activity. These legislative acts form the basis for regulating digitalization in Europe, contribute to the protection of citizens' rights and data, promote the development of e-commerce and ensure security in the digital environment.

In obedience to EU research in terms of the Digital Economy and Society Index (DESI)³¹, Estonia ranks 9 th of 27 EU Member States in the 2022 (Fig. 3). Estonia performs well and scores above the European Union (EU) average in all indicators, except connectivity where it ranks 26th. The country presented the new Estonian Digital Agenda 2030 with three priorities: (i) developing further digital public services; (ii) focusing on cybersecurity

²⁹ Advantage Ukraine. URL: <https://advantageukraine.com/> (date of application: 09.01.2024).

³⁰ Discover the world's most promising companies URL: <https://edtech.dealroom.co/intro> (date of application: 09.01.2024).

³¹ Advantage Ukraine. URL: <https://advantageukraine.com/> (date of application: 09.01.2024).

and (iii) improving connectivity across the country. Estonia is a front-runner in some DESI indicators, in particular digitalisation of public services, but other areas need attention. Timely implementation of measures, specifically those for 5G deployment and increased business digitalisation should bridge the gap between Estonia’s current situation and the Digital Decade ambitions.

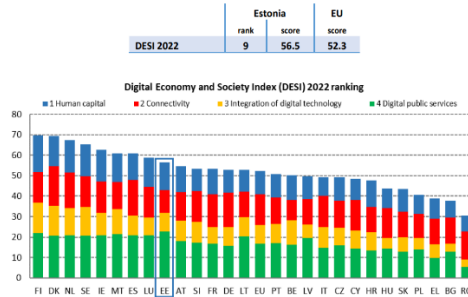


Fig. 3. Digital Economy and Society Index 2022 ranking

Source: *Digital Economy and Society Index (DESI), 2022*³²

Ukraine can draw valuable lessons from Estonia's experience of digitalization, adapt them to its own context and build a digital ecosystem. Here are a few ways Ukraine can utilize Estonia's expertise:

e-Governance and Digital Services, Ukraine can learn from Estonia's success in developing comprehensive e-governance platforms and digital services. By investing in user-friendly online portals and applications, Ukraine can streamline administrative processes, enhance transparency, and improve access to public services. This can reduce bureaucracy, minimize corruption, and increase citizen satisfaction;

implementing a secure digital identification system similar to Estonia's e-ID can have numerous benefits for Ukraine. It would facilitate secure online transactions, simplify administrative procedures, and enhance cybersecurity. It can also enable convenient access to government services and foster trust between citizens, businesses, and the government;

e-residency and digital entrepreneurship, Ukraine can explore the concept of e-residency, as Estonia has successfully done. By offering e-residency to entrepreneurs and investors worldwide, Ukraine can attract foreign investment, encourage digital entrepreneurship, and create an environment

³² Цифрова адженда України. URL: <https://www.me.gov.ua/News/Detail?lang=uk-UA&id=bd512af7-5e94-430a-9842-452d843a5c1a&title=UMinekonomrozvitkuPrezentuvaliProektsifrovoiAdzhendiUkraini2020-?kbcvxbmfkbidgmix> (date of application: 09.01.2024).

conducive to innovation and economic growth. This can help diversify the economy and promote international collaboration;

Ukraine can invest in digital literacy programs and educational initiatives to equip its citizens with the necessary skills for the digital era. By prioritizing technology education and training, Ukraine can prepare its workforce for the digital job market, foster innovation, and bridge the digital divide, ensuring that no one is left behind etc.

It's important to note that while Estonia's experience can provide valuable insights, it's crucial for Ukraine to adapt these lessons to its unique context and challenges. Ukraine should consider its specific cultural, political, and infrastructural factors while implementing digitalization strategies, taking into account the positive experience that Ukraine already has in the field of digitalization. By leveraging Estonia's digitalization experience and tailoring it to its own needs³³, Ukraine has the potential to drive significant progress, improve governance, stimulate economic growth, and enhance the overall quality of life for its citizens in the digital age, developing the digital ecosystem.

Professor Kitsing M.³⁴ developed the elements of a digital ecosystem that can be categorized into three main groups – participants, resources, and rules. He attributed to the Participants:

Users. Individuals or organizations that interact with the digital ecosystem, contributing to its development and utilizing its resources.

Producers. Entities that create and provide digital products, services, or technologies within the ecosystem.

Integrators. Entities that facilitate the integration of various components and services within the ecosystem, ensuring interoperability and seamless interactions.

Facilitators. Entities that support and enable the functioning of the ecosystem by providing infrastructure, platforms, or specialized services.

Regulators. Organizations or entities responsible for setting and enforcing the rules and regulations governing the digital ecosystem.

As Resources has been proposed (Data, Digital platforms, Applications, Infrastructure, Knowledge). And Rules that all ecosystem participants should follow (Standards, Governance, Legal and regulatory framework, Trust and security mechanisms, Business models and incentives).

These elements, along with their functions and instruments, provide the foundation for the development, collaboration, and sustainability of a digital ecosystem, enabling participants to leverage resources, innovate, and create value within the digital landscape.

Regarding the digitalization of such a necessary element of the digital ecosystem as education, educational institutions can act as users and

³³ Малахов А., Хмельна О. Діджиталізація закладу освіти як ефективна модель управління якістю надання освітніх послуг. *Грааль науки*, 2021. (10), 396-409.

³⁴ Kitsing M. *The Political Economy of Digital Ecosystems Scenario Planning for Alternative Futures*. 7 B/W. *Routledge*. 2023. 172 P.153.

integrators, as well as perform some functions of other participants, using knowledge, skills, technologies, and competencies for developing long life learning processes.

On the basis of the stakeholders matrix of, the main interested parties of digitalization of the educational process were analyzed.

Digitalization of education is possible in the digital technology growth direction, the development of e-learning and distance education, which allows more accessible learning and expands geographical opportunities for students, given the need to leave the country as a result of the war. Universities implement digital tools, such as virtual reality, online platforms, adaptive learning, etc., to enable more interactive and effective learning (fig. 4).

Thus, taking into account the statistics of the Universities, we can observe that only about 26% of students now live in Kharkiv, 15% – Kharkiv region, 33% – other regions of Ukraine, 23% – abroad. As for teachers, only 50% live in Kharkiv (Fig. 3). In this case, only 60% of students can engage in synchronous mode, the rest agree only to asynchronous learning.

Turbulent circumstances in Ukraine's higher educational system encompass a complex convergence of challenges stemming from both the ongoing war and the impact of the Covid-19 pandemic. This involves a state of flux marked by disrupted academic activities, educational institutions destroyed due to the war, strained institutional resources, displacement of students and faculty due to war issues, health safety concerns, shifting modes of instruction, and potential limitations on international collaborations. These combined factors create an environment of uncertainty, hindering the normal functioning and development of the higher education system in Ukraine.

So, first pandemia, then the war put forward its limitations and challenges, which became the impetus for the rapid development of digital technologies and creating a sense of urgency³⁵.



Fig. 4. Location of staff and students of universities of the Kharkiv region, average indicators by region, %, march 2023

Source: Developed by authors

³⁵ John P. Kotter, Dan S. Cohen. The Heart of Change: Real-life Stories of How People Change Their Organizations. *Harvard Business School Press*. Boston. 2002. 190 p.

Table 1

Stakeholder matrix

Stakeholder	Problems (pain), risks and reasons for resistance	Goals and potential benefits	Communication and action plan
Teachers (lecturers)	Resistance to innovations. Fear of speaking in front of the camera and be active at the social media. Lack of motivation of life long learning (getting additional, even free, courses). Lack of digital skills. A bit Inertial university environment. Teachers have a lot of bureaucracy work. Lack of understanding the importance of spreading the professional information through the social media and other digital sources.	To increase rediness to innovations. To work with the fear of speaking in front of the camera and be active at the social. Efficient motivation system for lifelong learning principals. Appropriate level of digital skills. More flexible academic environment. Less level of bureaucracy.	To develop system of trainings. Training “Change management”. Training “Digital tools in online education”. Psychological Trainings. Ethic Trainings.
University managment	Lack of the creative teachers willing to develop their digital skills. Resistance to innovations. Lack of appropriate equipment.	To Develop the effecient system of motivation for teachers to improve their hard and soft skills. To increasy level of readiness to inivations. To develop a plan for getting appropriate equipment.	To develop a motivation system to encourage teachers to increase their hard and soft skills. Training “Change management”.
Students	Lack of the appropriate information in the social media. Lack of possibilities.	To get the appropriate information through the social media ond other digital resources. To receive modern knowledge using the new technologies.	To ask these teachers to spread the information on their pages (for example, FB).

Source: Developed by authors

John Kotter's process for leading organizational³⁶ change provides a structured approach that can be valuable in navigating challenging times such as war. When considering the applicability of these steps to the Kharkiv region's Universities, it's important to take into account the specific context of the university in a war region. One of the important components of implementing changes in the organization, according to Kotter, is the development of a vision and strategy: clearly define the desired future state and set out a strategic plan to achieve it.

2. Scenarios for Higher Education Transformation in the Kharkiv Region (Ukraine), Focused on Digitalization Amidst Turbulent Times

So, understanding the need for digital transformation, the exploration of the drivers and factors that necessitate digitalization in the higher education sector, taking into account Ukraine's aspirations for EU integration and economic recovery developed in the paper, according to the insights provided by Kitsing's³⁷ lectures on the importance of digital transformation for economic growth and innovation³⁸. Additionally, the EU's digital agenda and its implications for the higher education sector in Ukraine, including the need for flexible learning environments, evolving student expectations, and data-driven decision-making has been considered.

Analyzing the current state of digitalization, comprehensive analysis of the Universities digital infrastructure, systems, and processes has been used.

We examine the strengths, weaknesses, and gaps in the existing digital landscape, incorporating the technological readiness, digital skills among faculty, staff, and students, as well as the integration and interoperability of digital systems.

Developing the SWOT-analysis of the university's digital activities, we get the following (Table 2).

This SWOT-analysis can be used to develop strategies to achieve the goal of creating a modern digital infrastructure and improving the quality of education and research.

Building upon the SWOT-analysis the paper focuses on defining a clear vision for digitalization at the Universities, aligned with the institution's goals and values.

³⁶ John P. Kotter, Dan S. Cohen. *The Heart of Change: Real-life Stories of How People Change Their Organizations*. Harvard Business School Press. Boston. 2002. 190 p.

³⁷ Kitsing M. *The Political Economy of Digital Ecosystems Scenario Planning for Alternative Futures*.7 B/W. Routledge. 2023. 172 P. 153.

³⁸ Tra My Nguyen. Digitization of Education in Vietnam in the Crisis of COVID-19 Pandemic. *Springer Books, in: Nguyen Hoang Thuan & Duy Dang-Pham & Hoanh-Su Le & Tuan Q. Phan (ed.), Information Systems Research in Vietnam*, Springer. 2023. 145-158.

Table 2

SWOT-analysis of the university's digital activities

Strengths	Weaknesses
<p>Active use of digital technologies in all areas of the university.</p> <p>Development of institutional repository and system of electronic journals and conferences.</p> <p>Gradual introduction of electronic document management (paperless) and business intelligence system to improve university management.</p> <p>Increasing the visibility of the University in the global information space through the development of educational electronic resources and international rankings.</p>	<p>The need for further development of digital competencies of participants in the educational process.</p> <p>Challenges related to the full integration of distance and e-learning into educational programs.</p> <p>Limited international recognition and visibility of the University in the global information space.</p> <p>Probable differences in digital skills and resources among different groups in the university community.</p> <p>Dependence on external platforms and services for educational activities.</p>
Opportunities	Threats
<p>Development of digital competence of teachers and students.</p> <p>Improving the content of e-learning courses and platform.</p> <p>Expanding the use of webinars, video conferencing, and other online tools to create an open educational space.</p> <p>Use Office 365 and Google Suite for Education to improve your education.</p> <p>Involvement of teachers in scientometric databases Scopus, Web of Science, etc.</p> <p>Using virtual and remote access labs for distance learning of technical students.</p> <p>Development of educational and scientific laboratories for artificial intelligence and machine learning.</p> <p>Reduction of paper consumption and optimization of equipment operation</p>	<p>Destruction, instability, vulnerability caused by war. There may be resistance from faculty and staff to digital transformation.</p> <p>Ensuring the security and confidentiality of digital systems and data.</p> <p>Reliance on external infrastructure and services that may affect control and ownership of data.</p> <p>Maintaining the relevance and renewal of digital resources in the context of rapid technological development.</p> <p>Competition with other universities and educational institutions that are also investing in digitalization.</p>

Source: Developed by authors

The vision of the University can be formulated as – the creation of a modern integral information and telecommunication infrastructure that unites all the digital resources of the University, provides conditions for continuous improvement of the quality of education and research and makes it competitive through the use of modern digital technologies.

Besides, after considering SWOT-analysis results and actual trends, two key drivers were developed, that can significantly impact the future of digitalization at the university:

technological advancement. Rapid advancements in technology, such as artificial intelligence, data analytics, and cloud computing, can revolutionize the digitalization process at the university. These advancements can enhance efficiency, accessibility, and collaboration, ultimately improving the overall educational experience.

stakeholder engagement. Active engagement and collaboration with stakeholders, including students, faculty, staff, business and the local community, can be a crucial driver for successful digitalization. Involving stakeholders in the decision-making process, co-creation of digital solutions, and fostering a culture of innovation can lead to greater acceptance and adoption of digital technologies.

So, based on the key drivers, the possible scenarios were developed (Fig. 5).

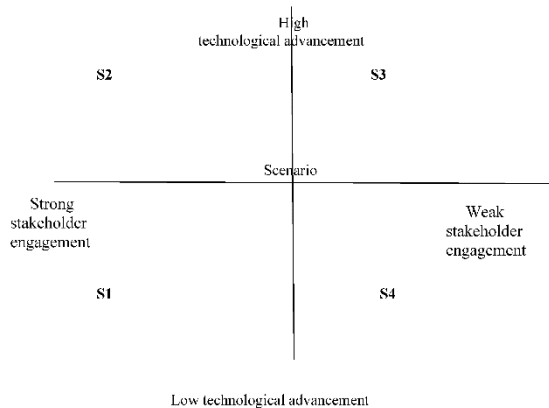


Fig. 5. Scenarios for the development of universities digitization in the Kharkiv region, based on key drivers

Source: Developed by authors

Regarding sustainability, these key drivers can have a positive impact. By leveraging technological advancements, the university can implement sustainable practices such as virtual classrooms, online resources, and digital administration systems, reducing paper consumption and minimizing environmental impact. Additionally, stakeholder engagement can foster a sense of responsibility towards sustainability goals, leading to collective efforts for a greener and more sustainable university.

Alternative options for key drivers could include funding availability for digitalization initiatives, regulatory support for educational technology integration and the digital literacy and skills of the university community. Each option could have different implications for sustainability and the overall digital transformation process.

Combining the selected key drivers, various scenarios may emerge:

S1: The joint desire for development among stakeholders in the absence of progressive digital support will lead to social tension in teams, will provoke the outflow of stakeholders (students and teachers) to other educational institutions. This will lead to low competitiveness of the university in the market of educational services and further decline. The positive impact on the ecology of digital transformation occurs through the transition to electronic document circulation, which will ensure a reduction in paper consumption.

S2: With strong technological advancements and robust stakeholder engagement, the university could become a hub of innovation and digital excellence, leading to improved sustainability outcomes. Compliance with EU norms and standards is present in the educational process.

S3: If technological advancements outpace stakeholder engagement efforts, sustainability goals may not be adequately prioritized, potentially resulting in negative environmental and social impacts. The existing technological solutions will not be used in the activities of the university or will be used not fully or incorrectly, which reduces the level of digitization and achievement of SDGs. Also, in this option, there is a high resistance to changes on the part of stakeholders.

S4: Under the conditions of low technological progress and involvement of stakeholders, the outflow of stakeholders is possible, the inability to compete with other higher education institutions, the obsolescence of educational programs, lack of development, non-compliance with the Central Bank, non-compliance with EU norms and standards.

So, the chosen key drivers of technological advancements and stakeholder engagement are essential for the future digitalization of the Universities. By aligning these drivers with sustainability goals, the university can contribute to achieving greater sustainability, promoting environmental responsibility, and fostering a digitally empowered learning environment.

The next steps might be providing a roadmap for implementing digital transformation initiatives at the university; creating a culture of innovation and digital adoption; implementing digital solutions and systems; ensuring sustainability and scalability of digital transformation.

Then, it is crucial to emphasize the importance of fostering a culture that embraces innovation and digital adoption at the University on the basis of

insights from Kitsing's ³⁹ lectures on the significance of creating such a culture.

Strategies for promoting digital literacy, providing training and support to faculty, staff, and students, fostering cross-functional collaboration, and incentivizing innovative practices are explored.

Identifying specific digital solutions and technologies that can enhance various aspects of the University's operations is the focus of this step. These solutions will include e-learning platforms, collaborative tools, virtual laboratories, and cloud technologies. The implementation process, potential challenges, and suggested solutions are discussed, taking into account the need for mobile accessibility, data security, and scalability.

Sustainability and scalability are vital considerations for successful digital transformation. This step addresses the long-term maintenance, updates, and scalability of digital initiatives at the University. We discuss the need for ongoing investment, potential partnerships, collaborations, and funding opportunities, aligning with the vision of Building Ukraine 2.0 and digital strategy of the university.

The presents the methodology of scientific research, formed mechanisms, developed a SWOT-analysis of the university's digital activities and the main scenarios for the introduction of digitization in the educational activities of Ukraine. However, key drivers, their qualitative and quantitative characteristics, which were selected by the authors for the development of scenarios, remain debatable in the study. Also, the financial component of the implementation of such measures, both on the part of the management of educational institutions and the Ministry of Education and Science of Ukraine, needs further research.

CONCLUSIONS

In conclusion, this paper has explored the concept of digital transformation and its importance in modern organizations, particularly in the higher education sector. It has been established that digitalization is a promising direction of development in the world and in Ukraine, which is confirmed by investments in this area; and startups in the field of education have significant economic potential, which is currently underutilized. Examples of the positive impact on the environment due to digitalization of the educational sphere are given. Based on the composition of the digital ecosystem proposed by M. Keetsing, its elements at the level of the digital ecosystem of the university were investigated. The main stakeholders of university digitization processes (teachers (lecturers); university management; students) were identified, their problems (pain), risks and reasons for resistance, goals and potential benefits and developed communication and action plan were identified.

³⁹ Kitsing M. The Political Economy of Digital Ecosystems Scenario Planning for Alternative Futures.7 B/W. Routledge.2023. 172 P. 153.

The advantages, challenges and risks that will accompany the process of digitalization of the educational process in the universities of the Kharkiv region have been established, based on a SWOT-analysis.

Besides, after considering SWOT-analysis results and actual trends, two key drivers were developed, that can significantly impact the future of digitalization at the university: technological advancement; stakeholder engagement. So, based on the key drivers, 4 possible scenarios were developed.

By analyzing the challenges and opportunities faced by the University in the context of Ukraine's EU aspirations and recovery paths, the vision on the basis of SWOT-analysis has been outlined and proved the necessity of the next steps of digital transformation, such as the roadmap etc. By aligning the university's digital initiatives with the vision of Building Ukraine 2.0, University can enhance operational efficiency, improve learning outcomes, and contribute to Ukraine's digital future.

SUMMARY

The current state of the level of digitalization of Ukraine, its adaptation to European legislation, analyzes what lessons Ukraine can learn by studying the evolution of the digitalization process in Europe, using the example of Estonia. The research methodology was formed, which made it possible to determine the current state, challenges, directions and scenarios of the transformation of higher education in Ukraine in the field of digitalization. The importance of education in this process is outlined and a SWOT-analysis of the development of a digitalization strategy is presented using the example of Kharkiv region Universities. After considering SWOT-analysis results and actual trends, key drivers and various scenarios were developed that can significantly impact the future of digitalization at the university. Key drivers include technological advancement and stakeholder engagement. Further steps on digital transformation of the university were outlined. The practical significance of the research lies in the development of scenarios for the development of digitization of universities on the example of the Kharkiv region.

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