Bobro Natalia. Chapter II. Modeling the risks of digital transformation in the system of strategic management of higher education institution ecosystems. Artificial Intelligence in Education. Part 1 : Monograph / [Collective of authors]; edited by Iatsyshyn A. – Kyiv : IDE NAES Ukraine, 2025. P. 24-36. ISBN 978-617-8330-53-8

CHAPTER II. MODELING THE RISKS OF DIGITAL TRANSFORMATION IN THE SYSTEM OF STRATEGIC MANAGEMENT OF HIGHER EDUCATION INSTITUTION ECOSYSTEMS

DOI: 10.33407/lib.NAES.id/747951

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Abstract. The article considers the urgent problem of digital transformation of higher education institution ecosystems, which is caused by the need to adapt educational institutions to the challenges of the digital age and the needs of social development. The importance of the research is due to the growing role of digital solutions in ensuring the sustainable functioning and competitiveness of universities. The aim of the research is to identify, classify, and model the main risks that accompany the digital transformation of university ecosystems in the context of strategic management. The paper substantiates the need to develop a comprehensive approach to analyzing the risks arising both in the internal and external environment of higher education institutions. The research applies structural-functional and systematic approaches to the analysis of the university's digital ecosystem. The classification of digital solutions implemented in HEI activity has been carried out, and the risks of digital transformation are systematized by the characteristics of their environment. The analytical comparison of the obtained results with the experience of leading foreign universities (Switzerland and the United States) has been carried out, which allowed us to substantiate the universality of the identified risks. Practical recommendations for risk management in the context of strategic digitalization have been developed. The research hypothesis is that unsystematic digital transformation can generate risks that can destabilize key functions of the university ecosystem. The novelty of the research is to combine the theoretical model of risk management with practical tools for assessing digital threats. The research used the methods of comparative analysis, content

analysis of scientific sources, generalization, structural modeling, logical interpretation, and expert approach to the formulation of critical risks. The typology of digital transformation risks is built, seven main groups of risks are identified, and examples of their manifestation in the educational environment are systematized. It is established that the highest threat is posed by material and technical, personnel, information, organizational and management risks. The foreign experience in identifying digital risks is summarized and the potential consequences of ignoring them are assessed. The structured table of digital risks and practical recommendations for their minimization is proposed. The theoretical significance of the research is to develop the concept of HEI digital ecosystems as an object of strategic risk management. The practical significance lies in the possibility of applying the results to develop digital transformation strategies and improve management decisions in higher education. The originality of the research is manifested in a comprehensive approach to modeling the risks of digital transformation in university ecosystems. The main conclusions are aimed at integrating digital tools with the strategic management system to achieve sustainable educational development. Prospects for further research include expanding the empirical base, conducting in-depth case analyses, and studying the effectiveness of the implemented risk management mechanisms.

Keywords: digitalization, university digitalization, risk of digital transformation, strategic management systems, university ecosystems.

Introduction. In modern conditions of transformational changes, digitalization has become crucial for ensuring the competitiveness and sustainable development of the higher education system. The integration of digital technologies into the strategic management of higher education institutions has led to the formation of new models of interaction within university structures and with external partners, which creates the basis for the development of university ecosystems. At the same time, the active implementation of digital solutions is accompanied by an increase in the complexity of management processes, the emergence of new threats and uncertainties, which makes it necessary to systematically analyze the risks of digital transformation.

The problems of digital transformation have already become a subject of discussion in academic and professional environments, but the issue of assessing and modeling the risks associated with this process is still insufficiently developed. In the context of the digital transition, universities face various challenges that cover the material and technical, human resources, regulatory, informational, and socio-psychological planes. These risks can not only slow down the implementation of digital strategies but also reduce the quality of education and management efficiency and create obstacles to the realization of the innovative potential of higher education. That is why there is a need for a comprehensive approach to risk modeling that allows for identifying critical factors of influence and offering effective management solutions.

The relevance of the research is due to the need to ensure the balanced development of digital ecosystems of higher education institutions, taking into account potential risks and limitations. In this context, the ability of universities not only to integrate digital tools into their activities but also to manage the risks that arise in the process of such transformation effectively is of particular importance. It is a strategic approach to digital transformation risk management that allows for increasing the resilience of university systems, strengthening their adaptability, and ensuring the long-term effectiveness of digital changes.

The novelty of the proposed research lies in the integration of the concept of digital ecosystems with risk management approaches, which allows for the formation of a methodological basis for identifying, classifying, and minimizing threats that may hinder digital transformations in higher education. The article is aimed at filling the gaps in the scientific discourse related to the lack of practical mechanisms for risk forecasting and ensuring the sustainability of digital changes in HEIs.

Literature review. Much of the current research is devoted to the digital transformation of higher education, including the implementation of digital technologies, the development of digital infrastructure, and the transformation of pedagogical practices. Among the most significant works are the research of A. Gogollari, S. Mitchell and S.

Guttormsen [1], M. Laufer et al. [2], T. Gkrimpizi, V. Peristeras and I. Magnisalis [3], representing the international scientific community. Domestic authors who have made a significant contribution to the study of education digitalization include O. Skliarenko [4], Ya. Kolodinska [5], O. Khomenko [6], and others. These papers consider various aspects of digital changes in the university environment: from ICT integration and transformation of teaching practices to organizational readiness of higher education institutions and barriers to innovation. Some researches emphasize the role of leadership, digital competence of personnel, and strategic management in ensuring the effectiveness of digital transformation.

At the same time, most existing publications focus mainly on the technical and organizational dimensions of digitalization or a general list of difficulties arising in the process of change without offering clearly structured risk models. While some researches detail the work of digital platforms or the development of educational tools, they often lack a comprehensive view of the risks that are systemic and interconnected. The impact of digital risks on strategic management, organizational sustainability, and the quality of educational services remains insufficiently studied. There is a need to form an integrated methodology that would allow not only for identifying the main threats but also for implementing practical tools for their assessment and minimization within the framework of university ecosystem management. Therefore, there is a gap in the existing scientific literature that relates specifically to the modeling of digital transformation risks in the system of strategic management of higher education institutions – this research is aimed at filling this gap.

Data analysis and results. First of all, it is necessary to define the essence of the university ecosystem. The ecosystem of a higher education institution is a flexible, adaptive, and self-organizing system based on a set of socio-economic relations and network interactions. These interactions are formed and developed between the internal elements of the university environment and external actors from different sectors of social activity and are mutually beneficial [7, p.1223].

The model of the university ecosystem can be considered as a symbiosis of the internal environment, which includes the main resources of the higher education institution (human, material, financial, and informational) and the relationships between the structural elements, and the external environment, represented by actors such as: public authorities, business structures, industrial enterprises, research institutions, and other educational organizations. The university actively forms and strengthens partnerships with them for its sustainable development.

Digital transformation covers both the internal contour of the university ecosystem and its external component. The integration of digital technologies for various functional purposes affects the key areas of the university's activity: educational, research, innovation, organizational and management [8;9]. Information systems, software, digital platforms, and mobile applications can significantly optimize processes in the university environment by increasing their efficiency and rational use of resources [10, p.31].

The digitalization of the external relations of the university ecosystem deserves special attention. Optimization of interaction with external actors is achieved through the use of digital tools, in particular, communication platforms and common digital platforms for collaboration [11, p.257]. Since mutually beneficial cooperation is the foundation of the ecosystem approach, digital solutions that strengthen the interaction between universities and their partners are key drivers of the development of educational ecosystems in the context of digital transformation.

Moreover, it is worth emphasizing the growing role of the digital component in the formation of an efficiently functioning university ecosystem through the development and dissemination of the digital ecosystem of higher education [3;12]. In this context, digitalization and digital solutions not only have a positive impact on improving the internal processes of the higher education institution ecosystem but also become the basis for the formation of the “digital ecosystem” concept, which reflects the complexity and multilevel connections in the digital environment of the higher education institution.

Considering this, it can be argued that digital solutions implemented in the main processes of universities play an important role in the development of efficient, dynamic, and adaptive ecosystems that help strengthen the competitive position of higher education institutions in the digital environment.

The research should identify the main groups of digital solutions used to develop university ecosystems (Table 1). Digital solutions are a set of digital technologies and tools used to optimize and improve the efficiency of key business processes of organizations [5, p. 54].

Table 1

Groups of digital solutions for the development of the higher education institution ecosystem

Group of digital solutions	Examples of digital products
Management information systems	ERP systems, CRM systems, document management systems
Learning platforms	Moodie, Google Classroom, Coursera, OpenEdX
Analytical and monitoring tools	Power BI, Google Analytics, Tableau, Big Data Tools
Platforms for research and innovation	Scopus, Web of Science, ResearchGate, GitHub
Digital communication and collaboration tools	Zoom, Microsoft Teams, Slack, Trello
Digital services for student experience	Personal student accounts, mobile applications
Educational quality management tools	LMS analytics, digital performance indicators

For a qualitative assessment of the risks of implementing previously determined digital solutions, it is necessary to identify the specific risks that accompany the digitalization process. For this purpose, the risks are classified according to the environment of their occurrence and the type of resource support for the digital transformation process.

As a result, seven generalized groups of risks were identified that most often arise in the context of the digital transformation of higher education institution ecosystems (Table 2).

As we can see from Table 2, the risks of digital transformation cover a wide range of factors that affect both the internal environment of a higher education institution and its external relations. The most critical risks are material and technical, personnel, and information risks that directly affect the ability of universities to implement modern digital solutions. In

particular, the digital divide, lack of technical resources, and lack of appropriate digital qualifications of employees significantly slow down the transformation process.

Table 2.

Classification of digital transformation risks of HEI ecosystems

No.	Group of risks	Main risks
1	Material and technical risks	- lack of technical resources; - data loss/leakage; - equipment obsolescence or failure.
2	Organizational and management risks	- decrease in the quality of communication between participants in the educational process; - reassessment of quantitative indicators of transformation.
3	Political and legal risks	- uncertainty in the legal framework of digitalization; - risk of sanctions; - excessive state intervention.
4	Financial risks	- lack of investment; - inefficient use of funds; - rising cost of educational services.
5	Information risks	- digital divide; - lack of soft skills; - information overload.
6	Personnel risks	- low level of digital qualifications of personnel; - resistance to digital changes; - personnel shortage of specialists.
7	Social and psychological risks	- alienation of participants in the educational process; - decrease in the effectiveness of interaction; - resistance to changes.

Referring to the experience of leading universities, it should be noted that the risks of the digital transformation of ecosystems are universal and manifest even in developed countries with a high level of digital infrastructure. Thus, in the research of A. Gogollari, S. Mitchell and S. Guttormsen devoted to the analysis of the transition of medical faculties of Swiss universities to online learning during the COVID-19 pandemic, a number of structural and operational problems were identified that significantly affected the effectiveness of digital transformation [1]. These include limited access to the necessary technical equipment among students and teachers, teachers' unreadiness to use digital tools due to a lack of digital competencies, lack of adequate organizational support and clear institutional strategies. In addition, there was a high level of cognitive and emotional

overload among participants in the educational process caused by the inconsistency of new digital platforms and educational formats [1, p.244].

According to the researchers, these factors have had a negative impact on the quality of education, students' academic motivation, and the role of the teacher in the new digital model, which leads to the conclusion that the risks of digital transformation are complex, even in countries with developed educational ecosystems.

In turn, researches on the experience of American universities also emphasize the systemic nature of the risks of higher education digital transformation. In particular, the work of M. Laufer et al. based on surveys of the heads of leading US higher education institutions found that the key obstacles to digital transformation are most often identified as: lack of technical resources and access to ICT infrastructure, inequality of digital access among students (the so-called digital divide), low level of digital competencies of personnel, lack of a single digitalization strategy, and risks of losing sensitive data [2, p.51].

The researchers pay special attention to the fact that in the context of an emergency transition to a distance format, universities often had to act without sufficient institutional planning, which led to fragmented technological solutions that did not change the essence of the educational process but only its form.

The generalization of the US experience also shows that the risks of digital transformation are associated not only with infrastructure and technical limitations but also with deep management problems. Researchers emphasize the risk of “digital optimism”, which is an overestimation of the capabilities of digital technologies without sufficient pedagogical and organizational support [3, p.748]. In addition, the threat of replacing qualitative indicators of digitalization with quantitative metrics, namely the number of implemented platforms or online courses without analyzing their impact on learning outcomes, was identified. Equally critical is the risk of losing the autonomy of universities in making strategic decisions as a result of increased external administrative regulation of digital processes. These conclusions coincide with the results of studies

conducted in other educational systems and indicate that successful digital transformation of higher education is impossible without a systemic policy focused on risk management.

Therefore, the results of the analysis make it possible to specify the risks that have the most significant impact on the digital transformation of higher education institution ecosystems. Their criticality is determined not only by their prevalence in the current practice of university functioning but also by their potential to significantly disrupt sustainable management mechanisms, complicate the implementation of strategic digitalization goals, and reduce the quality of educational services. In particular, the following risks should be considered the most threatening: lack of technical resources of the educational institution, which makes it impossible to effectively implement digital solutions; risk of substituting qualitative indicators of digital transformation with quantitative indicators; limited access to relevant information and methodological resources; manifestations of “digital optimism” that involve overestimation of technological capabilities without sufficient critical analysis; risk of identifying digitalization with simple digitization of processes that does not change the essence of the educational model; risk of data leakage or loss that threatens cybersecurity; and risk of excessive state interference in autonomous digital processes of universities.

The group of risks with a high level of potential harm that may cause systemic challenges in the medium term also includes the risk of global changes in the requirements for the competencies of specialists; the risk of losing live communication between participants in the educational process, which affects the social component of the educational environment; the risk of reducing the level of soft skills development among students due to excessive automation of learning; the risk of economic instability associated with changes in exchange rates and interest rates; and the risk of teachers being ousted from educational process. These risks are complex and multidimensional and require a systematic management response. That is why the next section of the article presents a set of practical recommendations aimed at minimizing the likelihood of the

implementation of these risks and neutralizing their negative impact on the strategic goals of digital transformation in higher education.

Practical recommendations for minimizing the risks of implementing digital solutions in higher education institutions are presented in Table 3.

Table 3.

Practical recommendations for minimizing the risks of implementing digital solutions in higher education institutions

Risks of digital transformation	Practical recommendations for minimizing them
Lack of technical resources	Development of targeted programs for financing IT infrastructure; implementation of co-financing models; modernization of the material base.
Lack of information and methodological resources	Creation of internal educational hubs; formation of open digital libraries and sharing platforms.
Low level of digital competencies of teachers and students	Organization of regular training and professional development; creation of digital mentoring centers.
The risk of data leakage or loss	Strengthening cybersecurity; implementation of data management policies; regular backups and personnel training
The risk of replacing digitalization with formal digitization	Development of strategic plans for digital transformation, considering significant changes in the educational process.
The risk of reducing the quality of education	Development of new digital pedagogical models; implementation of tools for monitoring the quality of online education.
The risk of excessive government intervention	Development of autonomy of HEIs in the field of digital solutions; dialogue between universities and regulatory authorities.
The risk of a digital divide	Ensuring equal access to technology and the Internet; implementing social support programs for vulnerable groups of students.
The risk of losing soft skills and live communication	Combining online and offline learning; implementing group work, discussions, and project-based learning in a digital format.
The risk of fragmented management of digital processes	Creation of separate units or offices for digital transformation; centralized strategic planning.

We should consider in more detail the areas of development that help reduce the risks of the digital transformation of universities. First of all, it is necessary to develop a comprehensive strategy for the digitalization of higher education institutions. Clearly formulated goals, objectives, and benchmarks for digital transformation help minimize organizational and management risks, ensure the systematic implementation of digital solutions, and create

conditions for achieving high results. Defining specific indicators of digitalization efficiency also helps to monitor the implementation of the strategy at all levels of management.

The second important area is regular diagnostics of technical equipment and information systems in the educational institution. Monthly technical audits help to identify problems related to equipment wear and tear or failure in a timely manner, which is a key tool for reducing material and technical risks. Systematic checks help prevent unforeseen failures in the digital infrastructure and avoid disruptions in the educational process related to technical problems.

It is also relevant to form a strategy for the digital development of educational programs based on their practical feasibility and compliance with the requirements of future professional activities. Since educational fields have significant differences in content and training formats, the digitalization of educational content should take into account the specifics of each specialty. For example, the use of online courses or virtual simulators can be effective for students of economic specialties but insufficient for training medical specialists. Therefore, digital educational solutions should be adapted to the needs of a particular industry, with a focus on developing those competencies that really matter in the future professional environment.

Conclusions. The results of the study confirm the hypothesis about the multilevel nature of digital transformation risks that arise within the functioning of higher education institution ecosystems. In particular, the classification of risks by the environment of occurrence allowed us to systematize threats, in particular: material and technical, organizational, personnel, information, legal, and socio-psychological components of digital transformation. The obtained results are consistent with the conclusions of previous studies, in particular, the works of Gkrimpizi et al. [1], which also emphasize the importance of identifying barriers to digital changes at the level of infrastructure, management, and personnel. The research of Laufer et al. draws attention to the risks of a digital divide, low digital competence of employees, and a fragmented strategy for implementing digital solutions [2;8], all of which were also confirmed in this research.

In his research, the author expanded on previous scientific developments by integrating approaches to risk modeling, not only taking into account internal threats but also external

challenges related to the interaction of universities with government institutions, business, and society. Particular attention is paid to the risks arising from the gap between quantitative and qualitative indicators of digitalization, the phenomenon of "digital optimism", and the threat of loss of autonomy of HEIs under increased regulatory influence. These aspects are not sufficiently covered in previous works, which emphasizes the scientific novelty of this article.

Despite the detailed classification and analysis of risks, the limitation of this research is the lack of quantitative empirical verification of risks at the level of specific universities due to the lack of representative open data sets. Also, the work does not include an in-depth expert survey, which could serve as an additional tool for ranking risks by their impact. For future research, it is advisable to deepen the empirical component, in particular by involving university administrations in expert risk assessment, conducting case analyses of specific digital transformation strategies, and developing adaptive risk management models, taking into account dynamic changes in the digital environment. Promising areas for further research are the development of mechanisms to ensure an optimal balance between the implementation of digital innovations and the preservation of the fundamental characteristics of the quality of higher education, taking into account the substantive integrity of the educational process, academic standards, and the needs for sustainable development of university ecosystems in the digital environment.

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