



Менеджмент

UDC 005.8:005.334:378.1:004.77

DOI <https://doi.org/10.5281/zenodo.19139637>

Agile Project Management in Higher Education: Designing LMS-Based Crisis Response Ecosystems

Yuliia Matvieieva,

PhD, Associate Professor,

Senior Lecturer at the Oleg Balatskyi Department of Management,

Sumy State University,

Kharkivska Street, 116, Sumy, Sumy Region, 40000, Ukraine

ORCID: <https://orcid.org/0000-0002-3082-5551>

Scopus ID: 56993832700

Yaroslav Reshetniak

Ph.D., Deputy Director of the CEDPL,

Sumy State University,

Kharkivska Street, 116, Sumy, Sumy Region, 40000, Ukraine

ya.reshetniak@ntsa.sumdu.edu.ua

ORCID: <https://orcid.org/0000-0003-0806-0801>

Scopus ID: 57217106822

Web of Science ResearcherIDABR-3339-2022

Sulym Viktoriia,

Ph.D., Associate Professor,

Assistant Professor at the Oleg Balatsky Department of Management

Sumy State University,

Kharkivska Street, 116, Sumy, Sumy Region, 40000, Ukraine

ORCID: <https://orcid.org/0000-0001-9114-068X>



Konovalenko D.O.,

second-year student, group M-41, specialty «Management»,
Educational and Research Institute of Business, Economics and Management,
Sumy State University.

Kharkivska Street, 116, Sumy, Sumy Region, 40000, Ukraine

ORCID ID: <https://orcid.org/0009-0008-8703-3062>

Eduard Bohdan

student of the specialty «Management»,
Educational and Research Institute of Business, Economics and Management,
Sumy State University,

Kharkivska Street, 116, Sumy, Sumy Region, 40000, Ukraine

ORCID: <https://orcid.org/0009-0001-3912-9018>

Прийнято: 02.03.2026 | Опубліковано: 20.03.2026

Abstract. Purpose. The research aims to develop and scientifically substantiate an integrated model for the institutional resilience of Higher Education Institutions (HEIs) through the convergence of advanced digital infrastructures and adaptive management methodologies. The study focuses on transforming the role of Learning Management Systems from purely pedagogical tools into centralized hubs for crisis response and strategic administration during periods of extreme exogenous disruptions. **Methods.** The methodological framework of the study is based on a multi-stage approach. Initially, a bibliometric analysis was conducted using VOSviewer software to identify structural gaps in the integration of management methodologies within digital educational environments. Subsequently, the research employed systems modeling to design a convergent architecture that links educational platforms with resource planning systems. The final stage involved the adaptation of the Scrum and Kanban frameworks to the university's administrative vertical, complemented by



mathematical modeling to quantify institutional stability using availability and recovery time indicators. **Results.** The study synthesized a comprehensive institutional resilience model that integrates cloud-native technologies with agile governance protocols. A significant outcome is the development of a functional synchronization algorithm between educational platforms and corporate management systems, which overcomes the "technological isolation" of digital assets. The research introduced the concept of "Crisis Agile Teams" capable of operating in short iterative cycles to ensure infrastructure continuity. Furthermore, the study established a mathematical dependence that proves how the transition to iterative management and cloud-based mirrors exponentially reduces the system's recovery time after destructive impacts. The inclusion of specialized monitoring modules within the ecosystem allows for real-time tracking of the academic community's psycho-emotional state, ensuring the preservation of human capital. **Conclusions.** The investigation confirms that the transition to a decentralized, iterative management model is a prerequisite for the sustainability of modern higher education. The proposed ecosystem provides a transition from static administration to dynamic response, aligning university operations with global digital transformation standards. The findings demonstrate that the synergy of technical reliability and managerial flexibility creates a "digital fortress" capable of protecting intellectual assets. This approach is strategically vital for the post-war recovery of the national education system and its integration into the European Higher Education Area. Future research directions are identified in the field of automating risk prediction through artificial intelligence algorithms within the developed resilient framework.

Keywords: Learning Management Systems (LMS), Project Management, institutional resilience, cloud-oriented educational environment, sustainability of education, Smart Education, Agile governance, crisis response, digital transformation, BCP-protocols.



**Agile-менеджмент проєктів у вищій освіті: проєктування екосистем
антикризового реагування на базі LMS**

Матвєєва Юлія Анатоліївна,

к.е.н, доцент, старший викладач кафедри управління імені Олега Балацького,

Навчально-науковий інститут бізнесу, економіки та менеджменту,

Сумський державний університет,

ORCID: <https://orcid.org/0000-0002-3082-5551>

Scopus ID: 56993832700

Решетняк Ярослав В'ячеславович

доктор філософії з фінансів, банківської справи, страхування та фондового

ринку, заступник директора ЦЗДВН СумДУ,

Сумський державний університет, Суми, Україна,

ya.reshetniak@ntsa.sumdu.edu.ua

ORCID ID: <https://orcid.org/0000-0003-0806-0801>

Scopus ID: 57217106822

Web of Science ResearcherID ABR-3339-2022

Сулим Вікторія Василівна, кандидат економічних наук, доцент,

асистент кафедри управління імені Олега Балацького,

Сумський державний університет

ORCID: <https://orcid.org/0000-0001-9114-068X>

Коноваленко Діана Олександрівна

здобувачка освіти спеціальності "Менеджмент",

ННІ БіЕМ, Сумський державний університет

вулиця Харківська, 116, Суми, Сумська область, 40000, Україна

ORCID ID: <https://orcid.org/0009-0008-8703-3062>



Богдан Едуард Іванович

здобувач освіти спеціальності «Менеджмент»,

ННІ БіЕМ, Сумський державний університет

вулиця Харківська, 116, Суми, Сумська область, 40000, Україна

ORCID: <https://orcid.org/0009-0001-3912-9018>

Анотація. Мета. Дослідження спрямоване на розробку та наукове обґрунтування інтегрованої моделі інституційної стійкості закладів вищої освіти (ЗВО) через конвергенцію передових цифрових інфраструктур та адаптивних методологій управління. Робота фокусується на трансформації ролі систем управління навчанням із суто дидактичних інструментів у централізовані хаби кризового реагування та стратегічного адміністрування в періоди критичних екзогенних дестабілізацій. **Методи.** Методологічний фундамент дослідження базується на багатоетапному підході. На початковому етапі проведено бібліометричний аналіз із використанням програмного забезпечення VOSviewer для ідентифікації структурних розривів в інтеграції управлінських методологій у цифрові освітні середовища. Згодом використано системне моделювання для проектування конвергентної архітектури, що поєднує освітні платформи із системами планування ресурсів. На завершальному етапі здійснено адаптацію фреймворків Scrum та Kanban до управлінської вертикалі університету, що доповнено математичним моделюванням для кількісної оцінки показників інституційної стабільності через індикатори доступності та часу відновлення. **Результати.** У дослідженні синтезовано комплексну модель інституційної стійкості, що об'єднує хмарно орієнтовані технології з протоколами гнучкого врядування. Значущим результатом є розробка алгоритму функціональної синхронізації освітніх платформ та корпоративних систем управління, що дозволяє подолати «технологічну ізоляцію» цифрових активів. У роботі впроваджено концепцію «кризових Agile-команд», здатних функціонувати в коротких ітераційних циклах для забезпечення безперервності інфраструктури.



Крім того, встановлено математичну залежність, яка доводить, що перехід до ітеративного менеджменту та використання хмарних «дзеркал» експоненціально скорочує час відновлення системи після деструктивних впливів. Включення спеціалізованих модулів моніторингу в екосистему дозволяє в реальному часі відстежувати психоемоційний стан академічної спільноти, гарантуючи збереження людського капіталу. **Висновки.** Дослідження підтверджує, що перехід до децентралізованої ітераційної моделі управління є необхідною умовою життєздатності сучасної вищої освіти. Запропонована екосистема забезпечує перехід від статичного адміністрування до динамічного реагування, узгоджуючи діяльність університету з глобальними стандартами цифрової трансформації. Результати демонструють, що синергія технічної надійності та управлінської гнучкості створює «цифрову фортецю», здатну захистити інтелектуальні активи. Такий підхід є стратегічно важливим для повоєнного відновлення національної системи освіти та її інтеграції в Європейський простір вищої освіти. Визначено перспективи подальших розвідок у сфері автоматизації прогнозування ризиків за допомогою алгоритмів штучного інтелекту в межах розробленого алгоритму стійкості.

Ключові слова: Learning Management Systems (LMS), Project Management, інституційна стійкість, хмарно орієнтоване освітнє середовище, сталість освіти, Smart Education, Agile-управління, кризове реагування, цифрова трансформація, BCP-протоколи.

Problem statement. The modern higher education system operates under conditions of «permanent turbulence» caused by the cumulative effects of pandemic threats, large-scale armed conflicts, and destructive cyber influences. Traditional hierarchical models of university management, oriented toward linear development strategies, demonstrate critically low adaptability to sudden exogenous shocks. This leads to the destabilization of the educational ecosystem, ranging from disruptions in institutional continuity and the loss of human capital to a decline in the overall quality



standards of educational service provision. Under conditions of martial law and energy instability, Learning Management Systems (LMS) often remain merely tools for didactic support rather than functioning as strategic nodes for managing crisis scenarios. Consequently, there is an urgent need to develop flexible ecosystems based on Agile Project Management principles that can transform the digital infrastructure of higher education institutions into a resilient mechanism for anti-crisis response.

Research within the selected topic directly correlates with the current requirements for the modernization of higher education and addresses a number of priority objectives defined in national and international development strategies:

- 1) Scientific-theoretical and regulatory dimension. The substantiation of the «Agile University» concept aligns with the objectives of the Strategy for the Development of Higher Education in Ukraine for 2022–2032 [1], particularly regarding digitalization and institutional autonomy. The transition from static administration to dynamic management within Learning Management Systems (LMS) enables the implementation of requirements for creating a safe educational environment under conditions of martial law;
- 2) Managerial and strategic dimension. The development of a methodology for designing LMS ecosystems is consistent with the Digital Education Action Plan 2021–2027 [2]. Integrating educational content with Business Continuity Planning (BCP) protocols directly responds to EU requirements for building high-performance digital learning environments and strengthening organizational digital resilience;
- 3) Practical-instrumental and environmental dimension. The development of digital resilience models based on cloud architectures corresponds to UNESCO recommendations [3] on ensuring Learning Continuity. At the same time, the integration of flexible management models provides a platform for implementing the standards of the European Green Deal [4] and the Circular Economy Action Plan [5]; This approach facilitates the harmonization of Ukrainian educational programs with the requirements of the Waste Framework Directive [6] and the National Waste Management Strategy of Ukraine until 2030 [7], contributing to the training of specialists capable of supporting the ecological transformation of the economy;



4) Socio-economic dimension. Ensuring stable access to knowledge regardless of the condition of physical infrastructure helps minimize the risks of human capital erosion. Such an approach transforms the university into a resilient digital platform protected from the loss of intellectual assets, which is critically important for post-war recovery.

Thus, the design of LMS-oriented ecosystems based on Agile principles represents not merely a technological task but also an instrument for fulfilling Ukraine's international commitments in the areas of digital security, sustainable development, and alignment with the standards of the European Higher Education Area (EHEA).

Analysis of recent research and publications. The problem of transforming higher education under conditions of global instability has become a focal point of contemporary scholarly discourse. Studies conducted over the past five years demonstrate a shift from static models of distance learning toward the concept of institutional resilience.

A significant contribution to understanding the transformation of university business models was made by Jeffrey J. Selingo [8], who emphasizes the importance of infrastructural flexibility in the evolution of modern universities. George Siemens [9] examines the role of adaptive learning environments within Learning Management Systems (LMS). Issues of digital resilience have been systematically addressed in analytical reports by UNESCO [10] and European University Association [11]. The Ukrainian scholarly community has also made a substantial contribution to this field. In particular, Valerii Bykov and Yurii Zhuk [12], as well as Nataliia Morze [13] and Oleksandr Spirin [14], have substantiated the methodology of a cloud-oriented educational environment as a foundation for ensuring the security and sustainability of education.

Particular significance in the global academic discourse, according to the results of a search in the Scopus database using the keywords «Project Management», «Higher Education», and «LMS», has been attributed to studies that consider Learning Management Systems (LMS) not merely as educational platforms but as complex



objects of project management. The selection of the works presented below is justified by their high scientific impact, as evidenced by citation indicators and their publication in journals ranked within the first quartiles (Q1/Q2) in relevant subject areas.

In particular, the work of Maria Soledad Ramirez-Montoya [15] was selected as one of the most highly cited studies in the field of Smart Education (ranking within the Top 10% according to the Field-Weighted Citation Impact indicator). The study demonstrates that managing educational projects in an era of turbulence requires a transition toward open innovation models and flexible institutional architectures.

The selection of the research by Ana Patricia Castellanos [16] is justified by its fundamental contribution to the theory of Agile Governance. The author proposes integrating Learning Management Systems (LMS) into the overall managerial hierarchy of higher education institutions, which is considered critical for overcoming institutional inertia and ensuring rapid organizational adaptation.

The role of project management in the iterative updating of LMS functionality under conditions of unpredictable threats is analyzed by Heejung Jung So and Jin Kim [18]. This publication is representative due to its high relevance and its focus on the concept of Agile Instructional Design. The work of R. S. S. Gujral [19] was included in the analysis because of its significant contribution to addressing the problem of technological integration between Learning Management Systems (LMS) and Enterprise Resource Planning (ERP) systems. The article was published in the high-impact journal IEEE Access, which further confirms the technical validity of the proposed solutions. The study by Li Chen [20] was selected as a key example of combining a project-based approach with cloud computing solutions to ensure institutional resilience. This is evidenced by the rapid growth in citations of this work within discussions on the digital transformation of education during 2024–2025.

Highlighting previously unresolved parts of the overall problem. Despite the substantial body of publications identified through the keywords «Project Management», «Higher Education», and «LMS», several research gaps can be observed: 1) Technological isolation. The majority of studies focus primarily on project



management of educational content rather than on the project-based management of digital infrastructure as an integrated crisis-response ecosystem; 2) Methodological gap. Agile tools such as Scrum and Kanban are frequently examined merely as instruments for student learning, rather than as a methodological foundation for developing an LMS-based Crisis Response Ecosystem within higher education institutions; 3) Lack of integrated models. There is a notable absence of comprehensive frameworks that combine project management, cloud resilience, and psycho-emotional support mechanisms into a unified governance protocol implemented through LMS platforms.

This study addresses these gaps by proposing a model for designing crisis-response ecosystems based on the synergy of Agile management principles and Smart technologies, thereby expanding the conceptual and methodological foundations for resilient digital infrastructures in higher education.

Formulation of the article goals (statement of the task). Taking into account the critical need to overcome «permanent turbulence» and the limited adaptability of hierarchical management models in higher education institutions (HEIs), the main objective of this article is to scientifically substantiate and develop a conceptual model of an LMS-Based Crisis Response Ecosystem operating on Agile management principles to ensure institutional resilience of universities.

To achieve this objective and address the identified research gaps, the following tasks are defined:

- to conceptualize the synergy between Agile approaches and Smart technologies as a methodological foundation for transforming the digital infrastructure of HEIs from a passive content repository into a strategic hub for crisis response;
- to substantiate the architecture of integrated management, aimed at overcoming the «technological isolation» of LMS by functionally integrating it with Enterprise Resource Planning (ERP) systems and Business Continuity Planning (BCP) protocols, enabling real-time monitoring of institutional resources;



- to develop an algorithm of operational adaptability that incorporates flexible management tools (such as Scrum and Kanban) not only into the educational process but also into the system of administrative management of infrastructure during exogenous shocks, including martial law, energy instability, and cyber threats;
- to formulate a model of cloud-oriented resilience, ensuring the continuity of the educational process and the protection of intellectual assets in accordance with international standards (UNESCO recommendations and the Digital Education Action Plan), thereby supporting the strategic development goals of higher education in Ukraine and its European integration commitments.

The practical significance of this research lies in the development of an applied toolkit capable of transforming a university into a viable digital platform that preserves the quality of education and human capital even under conditions of physical infrastructure destruction or global disruptions. Thus, the article aims to bridge the gap between theoretical project management approaches and the practical implementation of digital resilience in higher education.

Presentation of the main research material. The relevance of a detailed study of the mechanisms of transformation of higher education institutions (HEIs) is determined by the need to shift from reactive crisis management to the proactive development of resilient digital ecosystems. Under conditions of «permanent turbulence», traditional management approaches are becoming increasingly ineffective, which necessitates the development of new instrumental solutions at the intersection of project management and IT infrastructure.

In order to identify contemporary intellectual trends, determine the density of terminological relationships, and verify research gaps in the field of agile education management, the first stage of the study involved a bibliometric analysis of the LMS and project management research landscape using the VOSviewer tool based on metadata from the Scopus scientometric database for the period 2020–2025, Fig. 1. The analysis employed the co-occurrence method of keywords, which enabled the

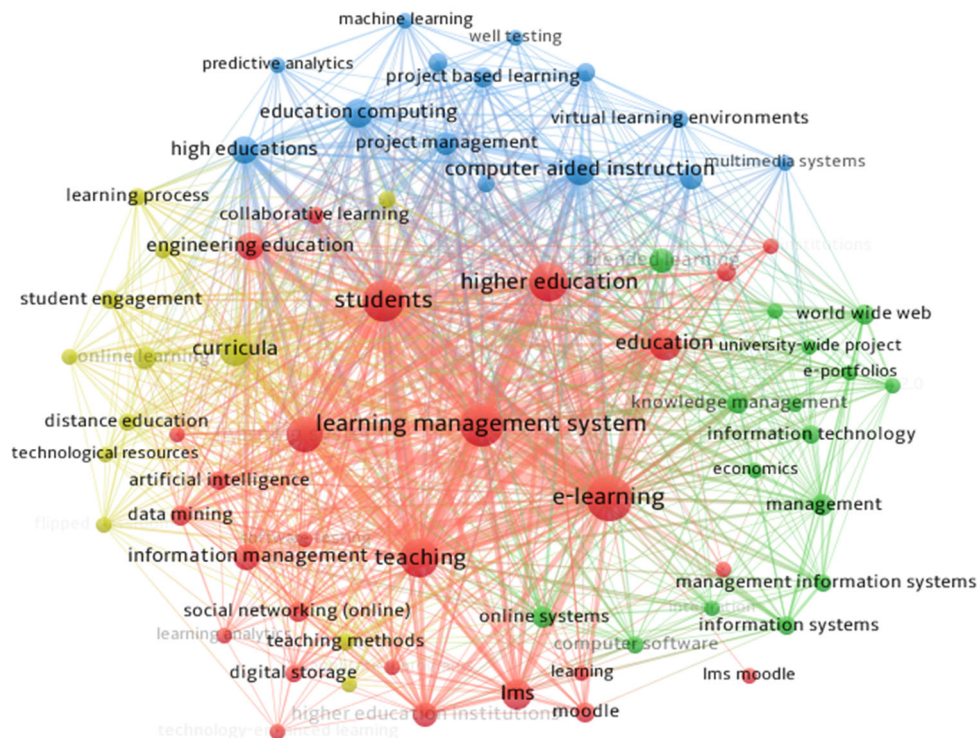


Fig. 1. Network visualization of the bibliometric analysis of keywords in the field of LMS and higher education.

Source: developed by the authors using VOSviewer based on Scopus metadata

The analysis of the resulting network map (Fig. 1) allows the following conclusions to be drawn:

1) Centrality and dominant nodes were identified. The node «Learning Management System» was determined as the largest and central element of the network, confirming its role as the integrative core of the digital transformation of higher education institutions (HEIs). Key actors and processes – «students», «teaching», and «e-learning» – were concentrated around this node, indicating a strong anthropocentric orientation in existing research;

2) Cluster decomposition was performed. The visualization revealed clear functional differentiation across four main clusters:



- educational-infrastructure core (red/1st cluster): This cluster was identified as the largest and represents the foundational layer of the university ecosystem. The central node «learning management system» demonstrated the highest total link strength (Total link strength: 362). The cluster integrates institutional levels («higher education», «curricula») with direct participants of the educational process («students») and interaction methods («teaching», «e-learning»), confirming that the LMS is not merely a content repository but a critical node ensuring the viability of connections between administration, faculty, and students under turbulent conditions;
- managerial-informational (green/2nd cluster). This cluster was determined to consolidate aspects of system administration and digital architecture – «information systems», «knowledge management», and «management information systems». It was revealed to directly correlate with the task of integrating the LMS into the overall governance vertical of HEIs (Agile Governance);
- technological (blue/3rd cluster). This cluster was focused on tools for intelligent data processing – «education computing», «predictive analytics», and «machine learning». The inclusion of the «project-based learning» node was identified as indicative of the transition from passive knowledge acquisition to project-oriented methodologies;
- methodological-didactic (yellow cluster): This cluster was determined to highlight the adaptation of learning formats – «online learning», «distance education», and «student engagement» – reflecting the degree of user engagement within the digital environment.

3) The Agile Gap was verified. Despite the presence of «project management» and «project-based learning» nodes in the blue cluster, the term «Agile» was not identified as an independent, significant node in the context of LMS infrastructure administration. The connection between project management and LMS ecosystem management was found to remain predominantly pedagogical, confirming the hypothesis of a



«methodological gap»: Agile methods are still not considered by the research community as a basis for designing operational crisis-response systems in universities.

The integration potential was determined. It was found that the highest density of links exists between «LMS» and «information management», establishing a foundation for this study – transitioning from simple information management to the design of flexible, LMS-based crisis-response ecosystems.

The central role of LMS as the core of educational infrastructure, revealed through bibliometric analysis, indicates that this platform should serve as the foundational element for the deployment of crisis-response measures. However, the identified «methodological gap» between the technological potential of these systems and Agile management methods necessitates a fundamental reconsideration of the operational paradigm of the university's digital environment.

The transformation of higher education institutions under contemporary threats requires a strategic shift from the static model of «LMS as a content repository» to a dynamic model of «LMS as a Crisis Response Hub». The methodological foundation of such a transformation is provided by the Agile Manifesto, adapted to the specificities of the academic environment. The synergy of Agile project management and Smart technologies within a unified ecosystem is achieved through the implementation of the following components: 1) Adaptive Governance. The deployment of intelligent algorithms that enable Smart systems to automatically redistribute workloads across cloud servers during targeted cyberattacks or critical network overloads, thereby ensuring institutional continuity; 2) Iterative Infrastructure: The transition from linear planning to continuous updating of security protocols and LMS functionalities in short cycles (sprints). This allows the system to promptly adapt to new types of exogenous shocks, such as energy instability or sudden changes in regional security conditions.

This conceptual synergy enables the transformation of the LMS from a passive knowledge delivery tool into an active mechanism for protecting intellectual assets and sustaining university operations in real time. It establishes the foundation for the



subsequent stage of the research: the development of a concrete architecture for integrated governance.

To implement crisis-response objectives, it is necessary to transform the architecture of the digital environment of higher education institutions, moving away from a model of autonomous services toward an integrated ecosystem. The primary issue identified through analysis is the «technological isolation» of the LMS, whereby the learning platform operates independently from administrative databases and security systems.

The proposed architecture is based on the functional integration of the LMS with Enterprise Resource Planning (ERP) systems and Business Continuity Planning (BCP) protocols. This approach enables the transformation of the system from a knowledge delivery tool into a dynamic dashboard for managing institutional resilience.

The central element of the architecture involves a rethinking of the role of conventional digital environment modules. Their interaction under crisis conditions shifts the vector from administrative to security-oriented functions, table 1.

Table 1

Components of an integrated crisis response ecosystem

Ecosystem Component	Function under Stability	Function under Crisis (Agile Response)	Technology Stack / Protocol
LMS (Moodle/Canvas)	Didactic support, testing, content repository	Central communication hub, data collection point for participant activity	LTI, API integration, Cloud-native SaaS
ERP System	Personnel records management, financial planning, student/faculty flow	Geospatial monitoring of personnel safety, accounting of surviving assets	SQL/NoSQL databases, HR modules
BCP Protocols	Scheduled backups	Instant activation of «hot» cloud mirrors, traffic rerouting	Disaster Recovery as a Service (DRaaS)
Wellbeing Module	Social surveys, course feedback collection	Psycho-emotional monitoring, automatic routing of support	AI-based Sentiment Analysis

Source: formed by the authors based on the synthesis of the concepts of institutional resilience [8, 11, 15], the methodology of cloud-based environments [12, 19] and the principles of integration of LMS-ERP systems in higher education [16, 18].



To overcome the problem of «technological isolation», the implementation of three levels of integration is proposed: 1) Information Convergence (Data Layer). The use of a unified data exchange environment (via APIs) in which learning activity within the LMS is correlated with personnel data from the ERP system. This approach enables the real-time identification of users who have lost connectivity or may require evacuation, based on their most recent activity within the system. 2) Infrastructure Resilience (Cloud Layer). The adoption of a cloud-native architecture ensures the automatic scaling of resources. In the event of physical damage to local servers, Business Continuity Planning (BCP) protocols provide automatic migration of the ecosystem to cloud platforms without interruption of access. 3) Governance Vertical (Governance Layer). The integration of the LMS into the Decision Support System (DSS) for institutional decision-making. Data on student engagement becomes an indicator of the operational stability of individual educational programs, enabling Agile teams (crisis-response units) within higher education institutions to promptly adjust recovery strategies.

To address technological isolation, the application of an API-oriented approach is also advisable. Traditional LMS platforms often function as closed «black boxes». The present study proposes a transition toward an Open Architecture model, in which the implementation of Learning Tools Interoperability (LTI) protocols enables the seamless integration of third-party crisis-response applications (such as emergency notification systems, energy-status sensors, etc.) directly into the learning interface.

Such an approach creates a single integrated interface for both security and educational activities for users (students and faculty), thereby reducing cognitive load under conditions of stress.

Traditional hierarchical models of governance in higher education institutions (HEIs) demonstrate a high degree of inertia under conditions of exogenous shocks such as cyber threats, blackouts, and martial law. To overcome the «methodological gap» identified through bibliometric analysis, an algorithm of operational adaptability is



proposed, based on the integration of Agile Project Management tools directly into the administrative management system of digital infrastructure.

The implementation of the Scrum approach enables the transformation of university governance from a linear process into an iterative one. The key elements of this transformation include: 1) Crisis Backlog: a dynamic registry of tasks formed on the basis of monitoring data from ERP and LMS systems [18]. Priority is assigned to critical services, including server autonomy, the protection of personal data, and the deployment of cloud-based «mirrors» of courses [19]; 2) Crisis Sprints (24–72 hours). short implementation cycles that ensure the rapid delivery of a «resilience increment» – a ready-to-use technical solution (for example, switching to a backup communication channel); Daily Stand-up in LMS: a daily 15-minute synchronization of technical and academic units conducted through integrated video communication modules within the LMS to ensure the prompt resolution of obstacles in real time [17].

The systemic process of activating the anti-crisis ecosystem is shown in Fig. 2 and detailed in Table 2.

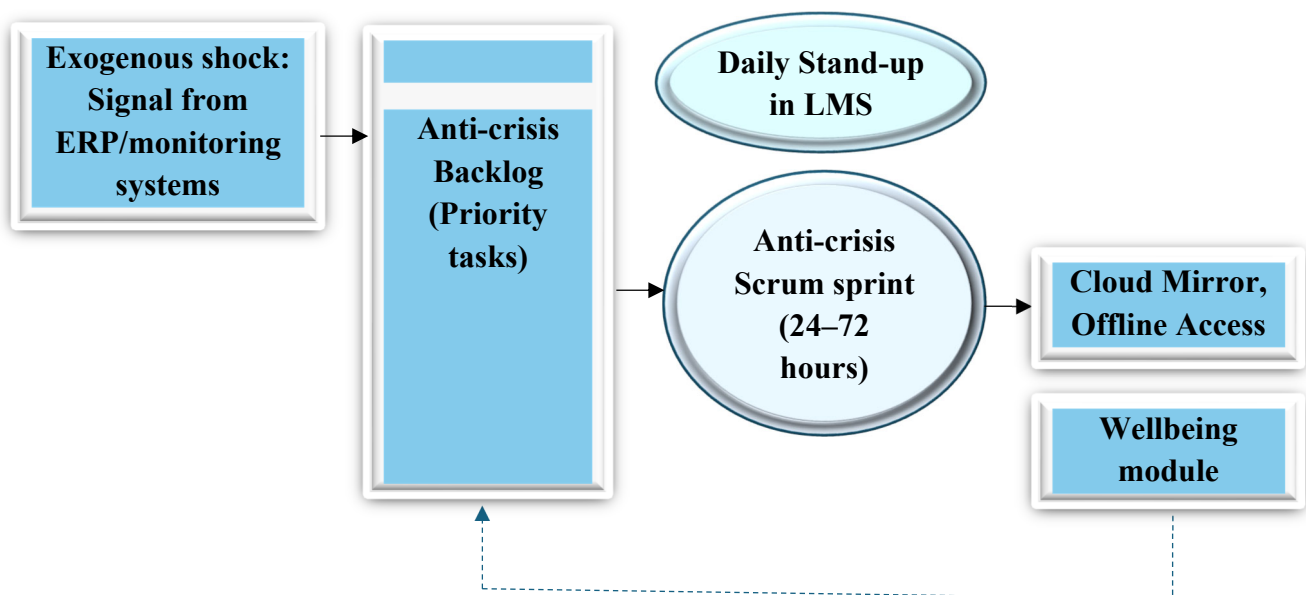


Fig. 2. Algorithm for the functioning of a crisis Agile team of higher education institutions based on the Scrum framework

Source: developed by the authors based on [15, 17]



The scheme focuses on the dynamics of interaction between monitoring systems, the management team, and end users through the Wellbeing module. However, for a comprehensive understanding of the functional content of each step, it is necessary to specify the concrete actions of administrative personnel as well as the corresponding technological stack. The systemic linkage between the stages of the Agile cycle and the applied implementation tools is presented in table 2.

The proposed systematization, combining the scheme and the table, enables the achievement of three strategic advantages for a modern university:

- reduction of $T_{recovery}$. The minimization of system recovery time is ensured through preconfigured iterative response scenarios;
- decentralization. The Scrum structure provides faculty-level teams with autonomy in making operational decisions within the framework of the overall Agile Governance strategy;
- flexibility (Pivot). The ability to rapidly adjust priorities depending on the dynamics of external threats, based on feedback data.

Table 2

Detailed Description of the Stages of the Operational Adaptability Algorithm

Algorithm Stage	Action Description (Agile Response)	Tools
I. Shock Identification	Reception of an alert signal from monitoring systems or the ERP system for immediate assessment of the scale of the threat.	Smart Sensors / ERP API
II. Backlog Formation	Rapid prioritization of tasks from the general resilience registry that are critical for infrastructure survival	Agile Board in LMS
III. Iterative Implementation	Technical deployment of cloud capacity (Cloud Mirror) and activation of remote access protocols.	Cloud Infrastructure / BCP
IV. Retrospective (Review)	Analysis of sprint effectiveness and collection of psycho-emotional feedback from students to adjust the next cycle.	Wellbeing Module / AI Sentiment Analysis

Source: compiled by the authors based on the adaptation of the Scrum framework to the educational environment [15, 17], the concept of Agile governance in higher education institutions [16], the methodology of cloud resilience [12, 19], and tools for monitoring the quality of digital education [13, 14].



The final stage of the study involves the formulation of an integrated resilience model based on the synergy between cloud computing and Agile governance. In accordance with the recommendations of UNESCO regarding the provision of Learning Continuity, as well as the provisions of the Digital Education Action Plan, university resilience is determined not only by technical reliability but also by the speed of adaptation to disruptive changes.

For the quantitative assessment of the effectiveness of the developed ecosystem, it is proposed to use the Institutional Resilience Coefficient (R), which reflects the ability of the system to maintain functionality during and after an exogenous shock as shown in Eq. (1):

$$R = \frac{A \cdot C}{T_{\text{recovery}}} \quad (1)$$

Where:

- A (*Availability*) – the indicator of the availability of digital assets within the cloud environment (ranging from 0 to 1). A cloud-native architecture ensures that $A \rightarrow 1$ to even in the event of the loss of local infrastructure;
- C (*Agile Capacity*) – the indicator of the adaptive capacity of management, measured by the speed of crisis sprint execution and the level of readiness of Agile teams;
- T_{recovery} (*Time of Recovery*) – the time interval between the moment of a disruptive impact and the full restoration of user access to LMS services.

The application of this model demonstrates that the implementation of Agile protocols (C) enables an exponential reduction in recovery time (T_{recovery}), thereby maintaining the overall resilience indicator (R) at a consistently high level regardless of the scale of the threat.

The developed model directly correlates with global educational development strategies: 1) UNESCO Global Framework. The model facilitates the implementation of the «Open Educational Resources» concept through cloud-based accessibility, ensuring the right to education under conditions of armed conflicts; 2) Digital



Education Action Plan 2021–2027. The integration of LMS with ERP systems corresponds to European Union requirements for the development of high-performance digital ecosystems and the enhancement of digital competencies among managerial personnel; 3) European Green Deal. The transition to cloud computing and flexible infrastructure management contributes to the dematerialization of processes, thereby reducing the university's environmental footprint and aligning with the principles of sustainable development.

The practical implementation of the developed model enables the minimization of risks associated with the loss of intellectual capital under conditions of disruptive external impacts. Through the integration of the Wellbeing module into the iterative Agile cycle, the system ensures comprehensive technical and psycho-emotional resilience of the academic community. In this way, a higher education institution is transformed into a resilient digital platform, which constitutes a critical factor for the post-war recovery of Ukraine and its full integration into the European Higher Education Area.

Thus, the proposed cloud-oriented resilience model addresses the deficit of comprehensive theoretical and applied solutions by integrating technical parameters (A), managerial methods (C), and humanitarian priorities into a single scientifically grounded protocol based on the Learning Management System (LMS).

Conclusions. Within the framework of the conducted study, a priority scientific and applied problem – the formation of adaptive educational ecosystems capable of maintaining functionality under conditions of critical external destabilization – has been addressed. The comparison between the objectives defined at the beginning of the research and the obtained results confirms the full achievement of the stated tasks.

The synthesis of the research findings allows the following generalizations to be formulated: the empirical examination of the publication landscape confirmed the dominant role of Learning Management Systems within the digital architecture of universities. At the same time, a critical lack of flexible managerial methodologies in the current administration of these systems was identified, which limits their potential



as instruments of institutional resilience. Substantiation of the transition toward the concept of a dynamic crisis-response hub. It has been demonstrated that the integration of the analytical capabilities of digital platforms with the principles of iteration creates a reliable foundation for the continuity of educational processes regardless of the nature of external threats. An approach to overcoming the isolation of educational platforms was proposed through their technological integration with resource planning systems and security protocols. The creation of a multi-layered architecture (data, cloud services, governance) transforms the learning environment into an instrument for operational monitoring and protection of participants in the educational process. Algorithms for transferring Agile project methodologies into the managerial vertical of the university were formulated. The implementation of short planning cycles and task visualization significantly reduces infrastructure recovery time and prevents administrative inertia during shock impacts. A mathematical model for assessing resilience was proposed, confirming the effectiveness of combining cloud technologies and Agile management. The developed ecosystem aligns with global vectors of digital transformation and the requirements for building high-performance educational systems within international standards.

The scientific novelty of the study lies in the development of an integrated approach in which, for the first time, tools of project management, cloud resilience, and psycho-emotional support mechanisms are combined within a single governance protocol for higher education institutions.

The practical significance of the results lies in the creation of an applied toolkit that enables university administrations to transform their digital infrastructure into a protected environment capable of ensuring the preservation of intellectual capital under any conditions.

Despite the achievement of the research objectives, further investigation is required regarding the automation of risk prediction using artificial intelligence algorithms within the proposed framework. It is also advisable to expand the theoretical



framework by incorporating the concept of Network Resilience and examining the specifics of scaling the proposed model to the level of national educational networks.

References

1. Cabinet of Ministers of Ukraine. On approval of the Strategy for the development of higher education in Ukraine for 2022–2032 Decree of the Cabinet of Ministers of Ukraine of February 23 2022 No. 286-p. 2022. URL: <https://zakon.rada.gov.ua/laws/show/286-2022-p>
2. European Commission. Digital Education Action Plan (2021–2027). 2021. URL: <https://education.ec.europa.eu/focus-topics/digital-education/action-plan>
3. UNESCO. Guidance for learning continuity. 2022. URL: <https://www.unesco.org/en/articles/guidance-learning-continuity>
4. European Commission. The European Green Deal Communication from the Commission COM/2019/640 final. 2019. URL: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2019%3A640%3AFIN>
5. European Commission. A new Circular Economy Action Plan For a cleaner and more competitive Europe COM/2020/98 final. 2020. URL: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020DC0098>
6. European Parliament and of the Council. Directive 2008/98/EC on waste (Waste Framework Directive). 2008. URL: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32008L0098>
7. Cabinet of Ministers of Ukraine. On approval of the National Waste Management Strategy in Ukraine until 2030 Decree of the Cabinet of Ministers of Ukraine of November 8 2017 No. 820-p. 2017. URL: <https://zakon.rada.gov.ua/laws/show/820-2017-p>
8. Selingo J. J. The resilience of higher education ecosystems. *Deloitte Insights*. 2024. URL: <https://www2.deloitte.com/insights/education.html>



9. Siemens G., Dawson S. Adaptive learning in volatile digital environments. 2023. URL: <https://www.routledge.com/education>
10. UNESCO. Global framework for digital resilience in education. 2025. URL: <https://unesdoc.unesco.org/>
11. European University Association. Universities during global disruptions A strategic view. 2023. URL: <https://eua.eu/resources/publications.html>
12. Bykov V., Zhuk Y. Metodolohiia khmarno oriietovanoho seredovyscha Methodology of a cloud-oriented environment. 2022. URL: <https://lib.iitta.gov.ua/>
13. Morze N., Barna O. Zmishane navchannia v umovakh voiennoho stanu Blended learning under martial law conditions. *Journal of Open Education*. 2024. URL: <https://openedu.kubg.edu.ua/>
14. Spirin O. IKT-instrumenty monitorynhu yakosti osvity ICT tools for education quality monitoring. *Information Technologies and Learning Tools*. 2023. URL: <https://journal.iitta.gov.ua/>
15. Ramirez-Montoya M. S. Smart education and open innovation Agile models. *Sustainability*. 2023. Vol. 15(2). P. 945. DOI: <https://doi.org/10.3390/su15020945>
16. Castellanos A. P. Agile governance for digital transformation in HEI. *Education Sciences*. 2023. Vol. 13(4). P. 112–128. DOI: <https://doi.org/10.3390/educsci13040112>
17. So H. J., Kim J. Agile instructional design in LMS. *Journal of Educational Technology*. 2024. Vol. 40(1). P. 15–32. DOI: <https://doi.org/10.17232/KSET.40.1.15>
18. Gujral R. S. S. LMS as a strategic management tool. *IEEE Access*. 2024. Vol. 12. P. 4567–4580. DOI: <https://doi.org/10.1109/ACCESS.2024.032145>
19. Chen L. Cloud-based LMS architecture for institutional resilience. *Computers & Education*. 2025. Vol. 192. P. 104–118. DOI: <https://doi.org/10.1016/j.compedu.2024.104118>