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ECONOMIC SUSTAINABILITY OF A DIGITAL UNIVERSITY

Summary

The article explores the concept and structure of economic sustainability of a digital university, which ensures its ability to function and develop in a dynamic environment. The article analyzes the differences between economic and financial sustainability, focusing on the specifics of digital universities as socio-economic systems. The existing scientific approaches to the definition of economic sustainability are considered, and their advantages and limitations are highlighted. The key subjects and objects of economic sustainability management of universities are identified, and a multi-level approach to harmonizing economic and educational indicators is proposed. Tools to ensure the sustainability of digital universities, including mechanisms for managing resources, innovations, and stakeholder engagement, have been developed. Particular attention is paid to strategic planning as a tool for university adaptation to a changing environment. The results obtained can be used to increase the competitiveness of higher education institutions by integrating economic sustainability into their activities.

Introduction

The economic sustainability of a digital university is an actual scientific problem that determines its ability to function and develop in a dynamic environment. In the digital transformation era, educational institutions are becoming complex socio-economic systems where sustainability depends not only on financial performance but also on adaptability, innovation potential, and interaction with stakeholders. This concept is of particular importance in the context of ensuring the stability and quality of educational services against the backdrop of modern challenges, including globalization, crisis phenomena, and growing competition between educational institutions.

Scientific approaches to determining the economic sustainability of digital universities remain under-researched. Many studies focus on financial sustainability as a component of it, but the limitations of this approach narrow the understanding of the complexity of universities as multi-level systems.

An analysis of the literature shows that the interdependencies between the economic, social, and innovative aspects of digital universities are not sufficiently taken into account, which requires expanding the research framework.

It is also important to note the specifics of digital universities, which operate in an environment where technologies, management approaches, and stakeholder requirements are rapidly changing. On the one hand, this creates new opportunities for growth and development. On the other hand, it increases dependence on external factors, such as regulatory policy, socio-economic changes, and the market conditions for educational services. Such conditions place special demands on the formation of economic sustainability.

The problem lies in the insufficiently developed theoretical and methodological basis for assessing the economic sustainability of digital universities. Most approaches are based on analogies with the activities of commercial organizations, which does not take into account the specifics of the educational process, including the long-term nature of the results and dependence on social factors. Therefore, it is necessary to develop a systematic approach that takes into account the multifaceted nature of this concept.

The aim of this study is to analyze the essence of economic sustainability of digital universities, identify its structural elements, and justify approaches to its assessment and management. To achieve this aim, the existing concepts of economic and financial sustainability, their advantages, and limitations in the context of digital education are considered.

The article also focuses on the subjects and objects of economic sustainability management of digital universities, taking into account their interaction at different levels of management. The issue of harmonization of economic and educational indicators in the strategic planning of a university is of particular interest. This allows us to determine the balance between maintaining stability and introducing innovations.

Therefore, the study is aimed at revealing the current challenges and prospects for the formation of economic sustainability of digital universities as a basis for their sustainable development in the context of global change.

Chapter 1. The concept of economic sustainability of a digital university

Frequently, the concepts of economic and financial sustainability are used synonymously, which can lead to logical and managerial mistakes. This is facilitated by the greater development of methods for assessing financial sustainability, while economic sustainability has been studied less thoroughly and is characterized by complexity in assessment. Most researchers in their works rely on analogies with the activities of commercial organizations [1; 2]. Due to the difficulties in defining economic sustainability, these concepts are mistakenly used interchangeably, although their difference is proven: financial

sustainability is a narrower concept and is a component of economic sustainability. Economic sustainability covers a wider range of management decisions and objects [3, p. 54].

Since the scientific literature usually takes into account the specifics of commercial organizations when considering economic sustainability, it is advisable to turn to universal approaches to the sustainability of socio-economic systems (Figure 1).

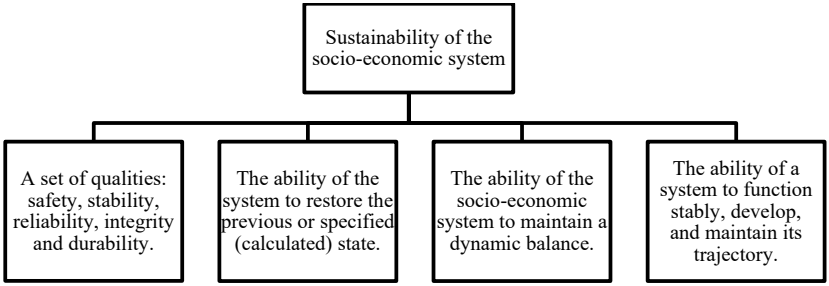

Figure 1. Four approaches to determining the sustainability of socio-economic systems

Source: based on [1; 14]

Researchers who distinguish four approaches [5; 6] use definitions that are common in the theory of technical system sustainability, but can be valid for both dynamic and stationary systems [6, p. 44].

The first three definitions presented in Figure 1 are partially applicable to assessing the sustainability of dynamic evolving systems and are more related to quasi-stationary states. This means that such approaches are relevant when the system parameters change only slightly and the internal and external links of the system remain stable.

Therefore, these three approaches are relevant for periods of 2–3 years and are appropriate for analyzing the financial sustainability of modern higher education institutions (HEIs). In the context of transformational changes in the higher education system, the fourth approach is the key approach for universities focused on advanced development. It defines sustainability, in particular economic sustainability, as the ability to develop sustainably and to ensure the implementation of programs of functioning and development while maintaining stability.

This approach correlates with the concept of dividing approaches to economic sustainability into process-behavioral and structural. The structural approach focuses on the interpretation of economic sustainability as the ability of the system to ensure reliability and stability by preserving key characteristics

and performing functional tasks within a certain spacetime interval. Despite its relevance in assessing the sustainability of dynamic and self-organized systems that adapt to change [8, p. 30], this approach does not sufficiently take into account the need for continuous transformation. Therefore, in the context of current challenges for Ukrainian HEIs, the structural approach is losing its relevance.

The process-behavioral approach allows changing the parameters of the system under the condition of preserving its ability to perform basic functions [9, p. 113]. This approach can be complemented by the logic of "sustainable development", when the system, despite the instability of the external environment, can maintain positive trends of change [10, p. 724]. Therefore, if we do not consider economic sustainability within the framework of the structural approach, the transition to a qualitatively new state, if required by the conditions in which the system functions, is taken into account by the concept of "economic sustainability".

When considering a digital university in the context of an open deterministic competition, we rely on the interpretation of the socio-economic system as a dynamic one, i.e. constantly changing, open (with the interaction of the external and internal environment), and dynamic (permanent change of characteristics and properties, the dilemma of development or degradation). At the same time, the desire for homeostasis, which is interpreted as harmony, a balance between internal and external factors, may be preserved. However, the homeostasis of socio-economic systems is inevitably accompanied by bifurcations – states in times of shocks, when further development becomes unpredictable [11, p. 261].

A comparison of approaches has shown that the economic sustainability of a digital university in an open deterministic competition should be interpreted not as a balance and the ability to return to a state of homeostasis, but as the ability of the system to develop under conditions of uncertainty, and, if necessary, to transform, but to perform its basic functions. Universities as organizations with strong traditions are objectively between two alternatives – sustainable growth or sustainable degradation. This makes it necessary to include in the concept of economic sustainability not only the ability to maintain the required state (fulfill obligations) but also to create a financial and other basis for the implementation of development measures of HEIs.

Other authors propose to distinguish five groups of approaches:

- those that analogize economic sustainability to financial sustainability;
- reproductive;
- innovative;
- innovation and logistics;
- approach, which focuses on the external and internal environment [12].

These approaches are relevant within the framework of the tasks for which they were developed. For us, there is a useful classification that distinguishes the areas of sustainability by areas of activity: financial, marketing, human resources, and industrial [13, p. 98].

To determine the integral indicator of economic sustainability of an organization, according to the author of this classification, it is necessary to develop a system of indicators that characterize each of the proposed areas. As in the case of competitiveness, there is a practical significance of approaches that detail the subject components: "a set of properties of organizational, innovation, logistics, industrial, financial and credit activities, taking into account their interaction and mutual influence" [14, p. 65].

A relevant view of the essence of economic sustainability of a digital university based on the resource approach is as follows: "the sufficiency of financial, personnel, material and technical, information, and innovative resources balanced at each moment of time to ensure long-term expanded reproduction" [15, p. 63]. In the context of increasing the competitiveness of HEIs, the following definition of economic sustainability is acceptable: "the state of all resources in which the organization is able not only to maintain its quality in a dynamic environment and internal transformations but also to ensure the development and achievement of certain goals" [8; 11].

At the same time, economic sustainability includes the concept of "financial sustainability" [15, p. 66]. However, such an interpretation ignores the interests of stakeholder groups, especially external ones, reducing their role to the subjects of the external environment, which limits the possibility of open economic growth through their involvement in the processes of a university.

We believe that the need to define economic sustainability as a capability, not a state, has been proven. We have systematized the features of different approaches in the form of a table (Table 1).

In the context of our study, the economic sustainability of a digital university can be defined as its long-term ability to provide (attract, use, reproduce, preserve) the resources necessary and sufficient for the sustainable improvement of the quality of educational services and target indicators, stable fulfillment of obligations to interested parties, implementation of the development program and timely changes in a dynamic environment.

In other words, the economic sustainability of a digital university is its long-term ability to implement a model of open, rapid growth by attracting sufficient financial, material, and human resources under conditions of growing stakeholders' demands, socio-economic changes, and crises.

Table 1

Grouping approaches of the "economic sustainability" concept

No. i/o	Content value	Key provisions of a definition
1	The relative immutability of the main parameters of the territorial socio-economic system, its ability to maintain them within the specified limits under deviating influences (both negative and positive) from outside and inside.	Sustainability is the relative immutability under external and internal influences, the balance.
2	The economic system activity will be economically sustainable if the system corresponds to the formed resulting vector of goals, and possible unfavorable situations are neutralized by an adequate response of the system due to the created reserves.	Sustainability is the state of an object in relation to external influences.
3	The economic sustainability of an enterprise is the availability of innovative potential for sustainable development and its effective use to neutralize external influences and destabilization factors.	
4	A sufficient amount of financial, human, material and technical, informational, and innovative resources is balanced at each moment of time to ensure long-term expanded reproduction.	Organization sustainability as a complex of stability and balance of elements and resources
5	A set of properties of organizational, innovation, logistics, industrial, financial, and credit activities, taking into account their mutual influence and interaction	
6	Economic sustainability is an integral part of marketing, financial, industrial, and human resources sustainability.	

Source: based on [1; 4; 8; 10; 12; 14]

Chapter 2. The concept of financial sustainability of a digital university

The financial sustainability of any university, including a digital one, is a key factor in ensuring its stable functioning and development. This concept covers the ability of an institution to maintain a balance between income and expenses, to ensure the fulfillment of its financial obligations, and to attract resources for investment in strategic projects. In the context of a digital university, financial sustainability determines not only financial capacity but also the effectiveness of financial flow management and the ability to adapt to changes in the external environment. The analysis of references demonstrates a variety of approaches to the definition of this concept, which is due to differences in the specifics of the activities of HEIs compared to commercial and non-profit organizations (Table 2).

Table 2

Grouping approaches of the "financial sustainability" concept

No. i/o	Content value
Universal approaches to the concept developed for enterprises and commercial organizations	
1	Such a state of cash resources that ensures the development of an enterprise mainly at the expense of its funds while maintaining solvency and creditworthiness with a minimum level of business risk
2	The ability of an entity to function and develop, to maintain the balance of its assets and liabilities in a changing internal and external environment, which guarantees its continued solvency and investment attractiveness within the acceptable level of risk
3	A financially stable entity is one that covers the funds invested in assets (fixed assets, intangible assets, working capital) at its own expense, does not allow unjustified receivables and payables, and pays its obligations on time.
Approaches developed for non-profit organizations	
4	The problem of ensuring financial sustainability is related to finding the necessary financial resources to compensate for the future costs of producing a public good. Financial sustainability can be said to be achieved if revenues are sufficient to cover expenses over a long period of time, for example, within three to five years.
5	The authors propose to use a modernized financial sustainability ratio that demonstrates the share of dedicated funding across all sources of funding.
Approaches developed for HEIs	
6	The financial sustainability of a university is seen as its ability, on the one hand, to provide financial resources for its current functioning, and, on the other hand, to finance long-term projects and development programs, taking into account forecasts of possible scenarios and risks of financial support.
7	The state of financial resources, their distribution, and use, which ensure the implementation of the main activities and development of a university based on equity growth at the expense of budgetary and extra-budgetary revenues while maintaining solvency under the conditions of an acceptable level of risk
8	Priority of university income from educational, scientific, and other activities, as well as state budget funds, over the institution's expenses for salaries with accruals, property maintenance, and other payments both at a particular time and in the strategic perspective

Source: based on [2; 3; 5; 8; 9; 10; 12; 13; 14; 15]

According to Table 2, the analysis of approaches to defining financial sustainability – from conditionally universal (developed mainly for enterprises and commercial organizations) to specific (developed for higher education institutions) – allows us to conclude that they are fragmented and operational. Each of the authors focuses on a particular operational aspect of the concept, for example, the predominance of own funds over borrowed funds or income over expenses.

Functional approaches, such as focusing on meeting the needs of stakeholders, are much less common. At the same time, the authors agree that

financial sustainability is about the right balance between financial resources and expenses related to the organization's activities and/or development.

Financial sustainability is a component of economic sustainability, but it plays a special role. The observed fragmentation and focus on individual aspects do not allow us to form a holistic vision of managing this characteristic of a university activity as part of economic sustainability within the strategy of increasing competitiveness. This necessitates clarification of definitions.

The tools for financial sustainability management have been largely developed in the context of commercial organizations, which necessitates the use of these developments as a basis for adaptation to the specifics of a digital university. However, the classical definitions of financial sustainability that apply to commercial organizations cannot be directly used for higher education institutions without adaptation due to the legal and regulatory specifics of a university. The latter are mostly non-profit and often budgetary institutions that are not able to use equity tools and financial reserves to the same extent, balance assets and liabilities, and consider profit as a goal or financial benchmark. In addition, financial risk assessment and management tools specific to universities are not sufficiently developed.

For a digital university, specific aspects of financial sustainability are important, namely:

– For universities, as service providers, a significant part of which expenses are labor costs, consistency and harmonization of revenues and payments are of paramount importance, especially their sufficiency for timely payment of salaries.

– The rationality of cash flow management in terms of stability of current activities and ensuring development costs.

– Universities have the opportunity to rely on a specific planning period based on the current procedure of work with the plan of financial and economic activities.

As we can see, the specifics of the financial sustainability of a digital university require the development of separate approaches and tools that take into account their organizational and legal form, the nature of their activities, and their dependence on external sources of funding.

Therefore, we can formulate the following concept of financial sustainability of a digital university: the ability of a digital university to cover growing costs at the expense of revenues in a certain period, to fulfill contractual and reputational obligations to key interested parties, in particular about the quality of educational services and research and development (R&D), as well as to finance university development activities both in a normal economic environment and under force majeure circumstances, primarily through effective management of revenues and payments.

Chapter 3. Subject and object of economic sustainability management of a digital university

The problem of the economic sustainability management of a digital university involves the definition of subjects and objects of management. Similarly, to the analysis of university sustainability factors, which are divided into external and internal, it is advisable to divide the management subjects into external and internal to a university. It is of methodological interest to identify positively interrelated external and internal economic sustainability.

External sustainability is defined as "conflict-free interaction with the environment: consumers, competitors, suppliers, financial and credit institutions, tax and other regulatory authorities" [5; 6].

Internal sustainability is interpreted as "the proportionality of all links of a university that ensure the positive dynamics of the main financial and economic indicators and expanded reproduction" [7; 8].

In practice, external subjects involved in managing the economic sustainability of a university are often ignored. There is a widespread perception that economic, in particular financial, sustainability is the sole responsibility of university management and its financial and economic services. However, practical experience of working with universities that have lost their financial sustainability shows that the reasons for this loss may lie outside a university. They may be related, in particular, to the actions of a founder or regulator.

In both the public and private sectors, a founder is one of the key subjects interested in economic sustainability. This is especially true in cases where he or she not only bears reputational or official responsibility but also has subsidiary responsibility for decision-making or the obligation to provide financial assistance in crisis situations. Public and private universities are included in this typical context because a university is always a legal entity with a defined founding body.

In most state universities, the Ministry of Education and Science or specialized ministries play the role of a founder. In corporate universities, a founder is a parent company, and in private universities, a founder is an individual. Decisions of state authorities on the parameters of state funding (e.g., cost standards or state orders) can deprive a university of economic and financial sustainability for a long time or, on the contrary, contribute to its sustainability.

However, digital universities, with the appropriate tools, can influence these decisions through a dialogue with a founder, which opens up opportunities for interaction and negotiation of economic parameters of development in a changing environment.

The subjects and objects of economic sustainability management of a classical university are shown in Table 3.

Table 3

Subjects and objects of economic sustainability management

Subject	Object	Management parameters	Documents
Regulator	The system of higher education	Financial condition, scope of activity, quality of services, control figures for admission	Activity procedures, regulations, state task
Founder	Network of subordinate HEIs, university	Financial condition, scope of activities, quality of services	Development program, financial and economic activity plan
Supervisory board	University	Financial condition, scope of activities, quality of services, a combination of resources and methods of their attraction	Development program, financial and economic activity plan
Rector	University	Financial condition, scope of activities, quality of services, combination of resources and methods of their attraction, composition of academic units	Charter, development program, financial and business activity plan
Head of an academic unit	Institute, faculty, department	Financial condition, scope of activities, quality of services	Budget, development plan
Project manager	Project, incl. grant	Efficiency and targeted nature, quality of results	Project passport or contract, budget
Head of a separate unit or branch	Separate unit, branch	Financial condition, scope of activities, quality of educational and other services	Budget, development plan
Head of the educational program	Educational program	Scope of activities, quality of educational services, number of students, educational outcomes	Documentation of the educational program
Head of the unit responsible for the process	Process	Cost level, composition, and quality of internal services and facilities	Estimates for the subdivision, regulations on the subdivision

The analysis results of the relations between subjects and objects show that each “subject-object” pair has its unique management practices and mutual influence. In theoretical sources, this topic is usually covered from the perspective of a rector or heads of services, while other approaches are rare,

which do not correspond to the real situation. The analysis has shown that at several management levels, both inside and outside a digital university, there are real levers of influence and functions for managing the economic sustainability of the entire institution or its individual parts (projects, departments, programs). These levers are often formally enshrined.

This necessitates taking into account the multiplicity of management objects in the form of organizational units and processes that often intersect. Decisions with long-term economic consequences are made at all levels. For example, auxiliary services can make decisions that undermine the economy of a unit and a university as a whole: purchasing expensive equipment with government subsidies or concluding financially unreasonable repair contracts at an inflated price. From a short-term perspective, such decisions may not affect the financial sustainability of a university, but they significantly impair its medium-term economic sustainability.

Local decisions are often not directly related to financial management but have significant economic consequences. The most important ones for economic sustainability include opening new educational programs and adjusting the level of quality of higher education both in terms of the conditions of educational service provision and in planning the expected learning outcomes.

Questions may be raised about the ability of a regulator to make decisions based on financial statements. However, forms of external reporting, including regular financial and statistical reporting, as well as efficiency monitoring systems and financial management quality ratings, provide a detailed picture of the condition and activities of digital universities. These indicators allow a regulator, for example, the relevant ministry, to make informed decisions and monitor their implementation.

The researcher S.O. Karpliuk emphasizes that the analysis of the practice of interaction at different levels of management (groups of subjects) shows that the concept of economic sustainability is applicable to most levels of management, taking into account the five-year development perspective [7, p. 189]. While there are differences between universities and levels of government, they relate to the degree of formalization, terminology, and development of information systems. Particularly large differences are observed in the approaches to describing the financial structure, assessment methods, and the scope of authority at each level.

Responsibility for financial sustainability is the most clearly defined in the documents, while responsibility for economic sustainability is not yet sufficiently formalized. Since the economic sustainability of a university is determined by numerous decisions at different levels of responsibility, it is of particular importance that the interests of different responsibility centers and their leaders are coordinated and balanced. In this context, the decentralized

participatory model of economic governance is becoming increasingly relevant, and its applied aspects are already being actively discussed by experts [3; 14].

According to the proposed definition of economic sustainability, it is important that each level of management can attract stakeholder resources or significantly influence this process through the quality of services provided and the existence of common interests for cooperation.

In turn, *the specificity of a digital university lies in the multi-role nature of stakeholders (graduates, employers, parents). This creates unique opportunities for interaction at all levels of a university*. For "dual" external stakeholders, i.e. those who have a personal interest in the quality of higher education, guarantees of the quality of educational services provided by a university are of particular importance.

Accordingly, tools that reduce the risk of deterioration in the quality of services in order to achieve economic performance, harmonizing economic sustainability with quality indicators at different levels of management, should be an important component of the strategy for increasing the competitiveness of a digital university and its implementation.

Digital universities demonstrate significant potential for strategy adaptation through the implementation of data management technologies. Information and analytical systems based on big data processing enable the real-time monitoring of the university's financial stability, identification of risks, and forecasting of their impact. Specifically, the analysis of financial flow structures, the efficiency of educational programs, and the correlation between expenditures and the quality of services provided creates a foundation for informed managerial decisions. This approach not only helps maintain a balance between short-term economic objectives and long-term stability but also supports the strategic development of the university in an unstable external environment.

The integration of digital technologies into the management of economic sustainability promotes the development of innovative collaboration mechanisms with external stakeholders, including employers, financial institutions, and education sector partners. The use of electronic platforms for project coordination, joint educational initiatives, and assessment of educational outcomes establishes a transparent and efficient interaction system. This, in turn, facilitates the attraction of additional resources and enhances stakeholders' trust, which is a crucial factor in ensuring financial stability.

International cooperation plays a significant role in shaping the financial and economic sustainability of digital universities. Participation in global academic initiatives, research consortia, and grant programs provides access to additional financial resources and the exchange of best practices. In particular, the implementation of efficiency assessment methodologies tested in leading

higher education institutions helps optimize internal processes and improve the university's competitiveness on the international stage.

At the same time, ensuring synergy between external and internal management entities is critically important for forming an integrated strategy for economic sustainability. A lack of coordination among departments may result in inefficient resource use or the risk of functional duplication. In this context, the development of mechanisms for horizontal coordination and interaction between various management levels is a key requirement, contributing to the alignment of actions and the achievement of strategic goals.

The high level of adaptability of a digital university to changes in the external environment depends on its ability to timely identify key trends and forecast their impact on financial stability. The dynamic development of the educational services market, increasing demands for the quality of education, and growing competition for financial and human resources necessitate flexible management approaches. Adaptive planning based on analytical forecasts enables not only a response to challenges but also the anticipation of their consequences for the university's long-term development.

Given the complexity of university management due to the regulation of procedures and the large number of actors involved (including both internal and external stakeholders), it becomes obvious that an organizational culture of economic sustainability management needs to be formed. It is also important to define clear and transparent economic goals that will be accepted by the university's internal stakeholders.

The key objective is to build a mechanism of internal economic relations. Taking into account the external component, the mechanism for ensuring the economic sustainability of a digital university should include the following elements:

1. Economically oriented strategic goal-setting is the definition of long-term economic goals a digital university has that are consistent with overall strategic priorities, including the quality of educational and research services.

2. The objective choice of an economic model of activity is the assessment and adaptation of economic approaches that meet the specifics of a digital university, its resource base, and external conditions.

3. Implementation of a transparent and coherent financial and economic policy is the creation of mechanisms that ensure clear allocation of financial resources, accountability, control, and the ability to adapt to a changing environment.

4. A multi-level and decentralized participatory system of financial and economic management is the involvement of different levels of management and stakeholders in the economic decision-making process, which contributes

to the efficiency of management by taking into account the interests of all parties.

Therefore, the proposed tools help to ensure a balance between economic sustainability and the quality of educational and research services, increasing the competitiveness of a digital university in a dynamic educational environment.

Conclusions

The study defines the essence of the economic sustainability of a digital university as the ability of a higher education institution to function and develop in a dynamic environment. This ability is ensured by attracting, using, and preserving the resources necessary for sustainable improvement of the quality of educational services, stable fulfillment of obligations to interested parties, and implementation of development programs. An important aspect is the ability to adapt a university to external challenges and transformations.

It is proved that economic sustainability is a broader concept than financial sustainability and includes a set of structural and process-behavioral characteristics. The differences between these concepts are determined not only by the object and subject of management but also by the specifics of educational institutions, which are socio-economic systems with a long-term impact on society.

It has been established that modern digital universities require a multi-level approach to managing economic sustainability, which includes financial, organizational, human, information, and innovation resources. Of particular importance are the mechanisms for harmonizing economic and educational indicators that contribute to the sustainable development of universities and increase their competitiveness.

A classification of approaches to assessing economic sustainability has been developed, including universal, innovative, and specific models for higher education institutions. Adapted assessment tools are proposed that take into account the peculiarities of digital universities, their dependence on external sources of funding, and socio-economic changes.

Based on the analysis, recommendations for the implementation of strategic economic management of digital universities are developed. In particular, mechanisms for increasing economic sustainability through the integration of innovative approaches, the development of participatory management, and decentralized financial policy are proposed. The results obtained can be used to optimize the management of digital universities in the context of growing global competition.

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