

CLASSIFICATION, PRINCIPLES, AND DETERMINANTS OF THE VALUATION OF DIGITAL INTELLECTUAL ASSETS OF THE UNIVERSITY

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Introduction. The digital transformation of higher education is radically changing the structure of universities' intangible capital: the share of assets that exist in the digital environment, are integrated into information systems, and create measurable economic value for educational, scientific, and management processes is growing. In these conditions, there is a need for verified approaches to inventorying, classifying, and valuing digital intellectual assets, as they determine the investment attractiveness of an institution, its competitiveness, ability to scale educational services, and the effective monetization of the results of intellectual activity. At the same time, practice lacks agreed criteria for classifying digital resources as intellectual assets; there are methodological gaps between economic, technological, and organizational and managerial dimensions, and the quality of data management and access rights remains uneven.

The relevance of the research is determined by the need for universities to make value-based decisions regarding digital asset portfolio management: planning investments and expenses to support platforms, determining priorities for data infrastructure development, designing licensing and partnership commercialization schemes, and preparing transparent reporting for stakeholders. Additional challenges include the nonlinear nature of value creation in digital ecosystems (network effects, scale effects, and two-sided markets), the optional nature of many digital assets (scalability, modular extensions, and technology transfer), and the correlation of openness regimes with the intellectual-property and financial strategies of the university.

Analysis of recent research and publications. Research on the digital transformation of universities covers both the behavioral aspects of educational service consumption and the methodology of managing digital resources and investments. For example, in their research, G. Kortemeyer, N. Dittmann-Domenichini, and C. Merki emphasize the relationship between students' choice of full-time, hybrid, or online formats and learning outcomes, highlighting usefulness and expected benefits as key determinants of the value of digital educational products [1]. The conceptual foundations of digital transformation proposed by N. Verina and J. Titko structure maturity levels, process changes, and management implications, providing a methodological framework for classifying digital assets and choosing approaches to their evaluation [2].

In terms of investment decisions, C. Safarli et al. consider the risks of globalization and cross-border restrictions that directly affect risk premiums, discount parameters, and forecasting horizons when evaluating universities' digital assets [3]. The economic feasibility of digitalization through automated systems is substantiated by P. V. Huk and O. V. Skliarenko, which is relevant to the cost-based approach and the determination of efficiency thresholds for infrastructure solutions [4]. The practice of developing

innovative business ideas using digital services is highlighted by Ya. O. Kolodinska, O. V. Skliarenko, and O. Yu. Nikolaievskiy, emphasizing monetization models, content life cycle, and metrics of digital product liquidity and turnover [5].

The impact of interactive technologies on engagement and learning outcomes is demonstrated by O. O. Khomenko, M. V. Paustovska, and I. A. Onyshchuk, who refine the metrics of usefulness (engagement, learning gain) in an income approach to evaluating educational platforms [6]. Publication [7] analyzes the architectural and organizational dimensions of university digitalization and emphasizes the importance of data standardization and access control as value drivers of digital intellectual assets.

The socio-economic context of digital transformation is supplemented by A. Kozhyna, showing how inclusive approaches to development affect the reputational capital and social value of university digital solutions [8]. The institutional conditions for the formation of innovation potential in different countries are revealed by S. I. Kubiv et al., H. N. Lopuschnyak, O. Chala, O. Poplavska, L. A. Leiva, M. Matera, and J. Schöning, who set the framework of external determinants for assessing assets in HEIs [9;10;11].

Objectives of the article is to provide theoretical and methodological substantiation for classifying the university's digital intellectual assets and to develop the foundations for their valuation by systematizing principles and identifying value determinants within the educational and economic environment.

The main material of the study. In general terms, digital assets should be understood as intangible assets that exist in a digital environment, are stored and circulated in information systems, and represent economic value for their owners and users. This category encompasses data and datasets, digital content and media, software modules and platforms, digital identifiers, access rights, certificates, and tokenized forms of rights. They can perform both financial and non-financial functions; their value is determined by their usefulness to the user, uniqueness/scarcity, network effects, and degree of legal certainty and liquidity in the relevant markets, as well as the quality, security, and scalability of the technological infrastructure. Unlike traditional intangible assets, digital assets are infrastructure-dependent on the rules and protocols of information systems, which determine the specifics of their creation, circulation, licensing, and measurement of usefulness through usage metrics.

The digital intellectual assets of an educational institution are a specific type of intangible resources that arise from the use of digital technologies, exist in digital form, and realize their economic value in information systems. Such assets include, in particular, educational and methodological content and multimedia courses, software products and source codes, databases and data sets, analytical models and AI algorithms, 3D models of laboratories, VR/AR scenarios, teachers' digital avatars, distance learning platforms, domain names, brand elements, and other results of intellectual activity in the digital environment. Their key feature is turnover capacity: the possibility of commercialization, licensing, transfer of rights, integration into partnership projects, and use as investment targets [7;9].

A digital asset at a university combines three interrelated entities: economic (value), legal, and technological. The economic entity manifests itself through the generation of cash flows or cost savings, increased competitiveness, and capitalization; the legal entity through the existence and scope of intellectual property rights and contractual rights; and the technological entity through the architecture, scalability, security, and interoperability of the asset.

To manage a portfolio of such assets and accurately assess their value, it is advisable to use a classification that groups digital assets according to key characteristics relevant to the educational environment (Table 1).

It should be noted that certain types of digital assets are multifunctional in nature and may partially overlap with each other, which complicates the development of a comprehensive classification and unified assessment approaches. The list of classification criteria is not exhaustive and will require further refinement as the regulatory field evolves, monetization practices develop, and the applications of digital resources in the economic circulation of higher education institutions expand.

In our research, we understand a digital intellectual asset (DIA) to be an economic asset in the form of the result of intellectual activity, together with the corresponding intellectual property rights, which:

- has a digital form;
- is created using digital technologies;
- demonstrates its value within information systems (through usefulness, demand, network effects, usage metrics);
- is marketable in economic circulation (licensed, transferred, commercialized).

Table 1

Classification of university digital intellectual assets (for management and valuation purposes)

No.	Classification criteria	Classes and examples
1	By functional nature (method of use)	<ul style="list-style-type: none"> – financial (tokenized access rights/settlement tokens in the campus ecosystem); – non-financial (educational content, software, data sets, AI models, 3D/VR objects, digital avatars, NFT certificates/badges, digital training certificates)
2	By legal regime certainty	<ul style="list-style-type: none"> – clearly defined regime (registered domain names, trademarks, licensed software, issued copyright certificates); – partially defined (composite objects – databases, 3D models, video lectures, where rights are shared between authors and the institution); – relatively undefined/new (virtual objects in VR/metaverse environments, parameters, and “behavioral models” of digital avatars)
3	By relation to the object of valuation	<ul style="list-style-type: none"> – property rights (copyright, related rights, patent rights, license rights to digital objects); – digital assets related to other property (digital twins of equipment/laboratories, digital campus models that increase the value of physical assets)
4	By turnover speed	<ul style="list-style-type: none"> – non-current (strategic LMS platforms, brand assets, long-term licenses, data lakes); – current (individual courses/modules, annual subscriptions, short-term content licenses, per-operation access to API/data)
5	By degree of liquidity	<ul style="list-style-type: none"> – highly liquid (massive online courses with a broad market, domains, popular software modules); – medium liquidity (specialized content packages, niche data sets); – low liquidity (narrow-profile models or content with limited demand/access rights)

Source: compiled by the author based on [7; 9]

Like any digital asset, DIA integrates three interrelated entities: economic (the ability to generate cash flows or cost savings, increase capitalization and competitiveness), technological (architecture, scalability, security, interoperability), and organizational-managerial/legal (existence and scope of rights to use, manage, and externalize knowledge within partnership models).

It is also important to note that despite their intangible nature and digital form, not all digital assets automatically meet the criteria for recognition as intangible assets for reporting purposes within an institution (in particular, regarding useful life, identifiability, control, and expected economic benefits in accordance with established standards). Some of these assets, which do not meet the above criteria or are held primarily for investment purposes, are classified as financial instruments/investments [1, c.94]. Therefore, in the practice of higher education institutions, it is advisable to distinguish between digital assets that are recognized as intangible and digital assets that are reflected as financial investments: this affects the choice of assessment approach, forecasting horizons, and discount rates.

For portfolio management and valuation purposes, we propose a classification of digital assets by mode of operation (Figure 1).

It is evident that the majority of non-financial digital assets in the context of higher education belong to digital intellectual assets. At the same time, the inclusion of social media content and certain web resources in the category of DIA remains a matter of debate, as does the status of Big Data. The problem arises at the intersection of two conceptual boundaries: first, between digitally created content and digitized copies of analog materials; second, between data as facts and databases as the result of intellectual organization.

The content of social networks or websites is often a digital representation of texts, images, or audiovisual materials that could potentially exist outside the digital environment. In such cases, copyright-protected works are present, but the mere fact of their digital form does not guarantee their status as DIA in the economic sense. Additional conditions are required for the content of an educational institution's DIA to be recognized: originality and creative novelty, controlled access and management of usage rights, institutional ties to educational or scientific processes, the possibility of monetization, or the creation of measurable economic benefits (audience retention, increased enrollment conversions, growth in partnerships, etc.). Digitized copies without added value (metadata, interactivity, updatability, usage analytics) should be considered as auxiliary resources rather than full-fledged DIA.

With regard to Big Data, the key issues here concern the sources of origin and the scope of authority. Data as such, particularly when collected from open sources, does not usually create exclusivity [9, c.253]; however, a database with significant investments in collection, validation, normalization, ontology construction, access

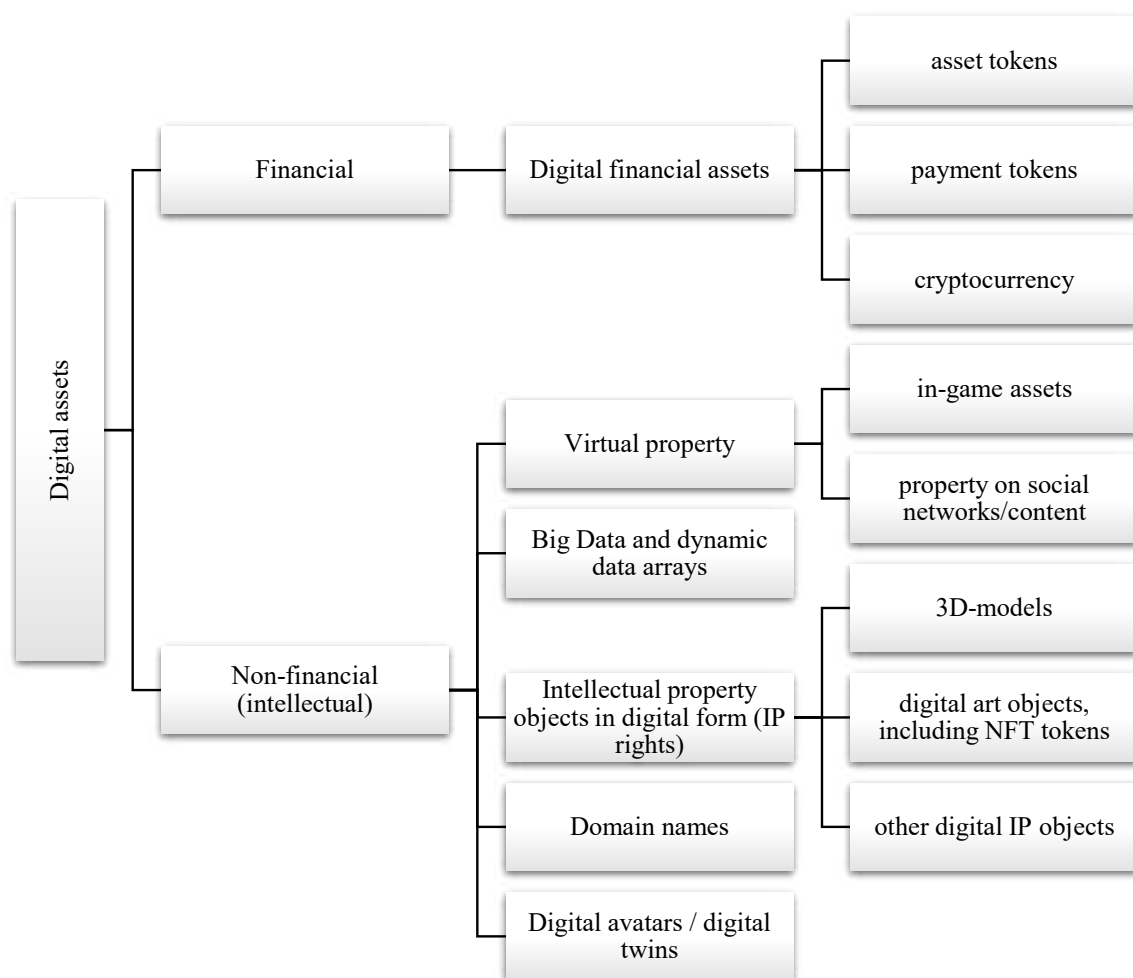


Figure 1. Classification of digital assets by mode of operation

Source: compiled by the author based on [3; 5; 7]

scheme development, and quality assurance acquires the characteristics of an intellectual result with its own economic value. University data repositories, LMS learning analytics, and experimental datasets are classified as DIAs if they have:

- a unique structure and selection methodology;
- stable usage metrics and reusability;
- managed licenses (e.g., CC family, ODbL) and access policies;
- predicted benefits (licensing, consulting, etc.) [1; 3; 10].

Therefore, the criteria for classifying non-financial digital resources as DIAs at a university are:

- digital origin or added value resulting from the digital transformation of the object;
- intellectual organization (structuring, modeling, algorithmization);
- the possibility of controlled circulation of rights and access;
- the presence of measurable utility and economic effect.

This differentiation eliminates methodological uncertainty regarding social content and Big Data, while at the same time providing a basis for further value assessment: for content with proven uniqueness – income and royalty relief approaches; for curated data assets – a combination of cost and option approaches with adjustments for liquidity, quality risks, and scalability of use.

The next step is to outline the principles for assessing the value of digital intellectual assets. The set of such principles serves as a systematic toolkit that establishes the methodological framework for applying approaches and methods, provides a comprehensive analysis of the value of an object, and allows for identifying the factors that shape this value. In scientific discourse, principles derived from user perceptions, principles related to the operation of the asset, and principles determined by the external market environment are traditionally

distinguished; the principle of highest and best use (HBU) is considered separately [1;4]. In different sources, the composition and grouping of these principles vary; sometimes the HBU principle is attributed to the block of market principles, and the content of the “operational” and “market” groups varies [11].

With regard to digital intellectual assets, principles based on user perception are fully implemented: usefulness is measured in terms of educational, scientific, and managerial value; substitution is interpreted through the availability of functional analogues – from alternative platforms to comparable data sets; expectations reflect future benefits in the form of revenue, economies of scale, reach, and audience retention. Within the principles related to the operation of the asset, it is appropriate to apply the principle of optimality alongside the principle of balance: maximizing the value of the DIA is determined by the consistency and optimal characteristics of all components of the asset system – the quality and updatability of content, the manageability of access and usage rights, the scalability and interoperability of the platform, and the reliability of metrics and application analytics [4, c.105]. The principles of the market environment are relevant to the DIA, considering the characteristics of digital markets – network effects, compatibility standards, and the dynamics of demand for online programs and digital services [1;2].

The principle of HBU deserves special attention. Its implementation involves modeling alternative scenarios for the use of an asset and choosing the one that, under realistic assumptions, provides the maximum market value. The analytical procedure covers assessing the market acceptability of the proposed use, verifying the regulatory and contractual prerequisites regarding the existence and scope of rights of use and licensing, examining technological parameters – architecture, scalability, security, cryptographic integrity, API interoperability, reliability of metrics tracking – as well as financial justification in the form of expected cash flows, their amounts and timing, efficiency of use, structure of tangible and intangible costs for creation and support. These components are directly related to the commercialization of the DIA and determine the choice of valuation approach and discounting parameters.

In summary, it can be stated that the basic determinants of the value of digital intellectual assets include the size and time profile of the income generated by the asset, the costs of creation and operation, technological characteristics – quality, security, scalability, and interoperability – as well as market benchmarks for comparable objects. External conditions also have a significant impact: the state of the macroeconomy, political stability, the quality of the regulatory environment, and the dynamics of prices and tariffs in related markets. At the same time, special factors inherent to digital assets are essential for the DIA: the level of development of information technology and digital infrastructure of the university, the digital maturity of data governance processes and practices, the qualifications of developers and users, the intensity and consistency of updates, the uniqueness of content and models, the chosen licensing scheme, the level of cybersecurity, brand strength, and reputation capital in relevant academic and professional communities.

For further methodological work, it is advisable to systematize the value factors along two axes – internal and external to the asset, and traditional and specific to digital intellectual assets. Such systematization creates a transparent basis for choosing a combination of cost, income, market, and option approaches, as well as for formulating a policy for managing the university’s DIA portfolio, focused on increasing capitalization, investment attractiveness, and long-term economic sustainability.

Conclusions. The research confirms that distinguishing between the general category of digital assets and the subset of digital intellectual assets of a university is a necessary prerequisite for the correct valuation and management of the portfolio of intangible resources of a higher education institution. The proposed classification, based on functional nature, legal regime certainty, relationship to the object of valuation, turnover rate, and liquidity, provides a methodological basis for choosing relevant valuation approaches. It has been shown that the value of DIA is formed in three dimensions – economic, technological, and organizational-managerial – and is determined not only by the potential to generate cash flows, but also by the scalability and security of digital infrastructure, manageability of access rights, and interoperability.

It has been established that the application of the principles of utility, substitution, and expectation is fully relevant to the academic environment, and the development of the principle of balance in the form of the principle of optimality allows for linking the systemic characteristics of an asset with the maximization of its value. The principle of highest and best use serves as a tool for choosing a DIA operating scenario, considering market acceptability, regulatory and contractual prerequisites, technological parameters, and financial feasibility. The feasibility of combining cost, income, market, and option approaches, depending on the type of asset, degree of legal certainty, liquidity, and risk profile, has been substantiated.

Further research should focus on empirical verification of the proposed models on samples of Ukrainian and European universities, as well as on the development of reporting standards for digital intellectual assets within the higher education system.

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Natalia Bobro, Ph.D., Doctor of Philosophy, Director of the Digital Department European University, Director of the “NooLab & AI” Scientific Laboratory of the European University, Private Higher Education Establishment “European University”. **Classification, principles, and determinants of the valuation of digital intellectual assets of the university.**

The article explores the methodological aspects of the digital transformation of the economy and universities, focusing on how higher education adapts to digital technologies. Digitalization is identified as a key driver of economic, social, and educational development, opening opportunities for learning, research, and management. The study highlights the role of mobile platforms, interactive teaching, and electronic services in improving access to resources, fostering individualization of learning, and enhancing management efficiency. It emphasizes the need for strategic planning and institutional support to ensure sustainable development. The findings confirm that digitalization changes the structure of the educational process, improves quality, and strengthens university competitiveness in a globalized environment.

Key words: digital intellectual assets, valuation, digitalization, digital university, digital transformation.

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Стаття присвячена методологічним особливостям цифрової трансформації економіки та університетів, зокрема дослідженню процесів, пов'язаних з адаптацією вищих навчальних закладів до цифрових технологій. У статті визначено, що цифровізація є одним із ключових факторів, які формують розвиток економічних, соціальних і освітніх процесів. Зокрема, цей процес особливо актуальний для вищої освіти, де цифрові технології відкривають нові можливості для навчання, наукової діяльності та управлінської діяльності університетів. Зазначено, що цифровізація дозволяє університетам значно підвищити ефективність навчального процесу, сприяючи кращій підготовці фахівців, здатних працювати в умовах глобальної економіки, де цифрові технології займають домінуючу роль. У статті також розглянуто сучасний стан впровадження цифрових технологій в університети, зокрема технології мобільних платформ, інтерактивних методів навчання, що значно покращують доступ до навчальних матеріалів і дозволяють інтегрувати їх в освітній процес. При цьому зазначено, що застосування таких технологій сприяє індивідуалізації навчання та адаптації освітніх програм до сучасних вимог студентів, а також дозволяє створювати більш гнучкі та адаптивні навчальні програми. Відзначено, що перехід до цифрових форм управління, дозволяє створити ефективну структуру для організації наукової, освітньої та адміністративної діяльності, що сприяє покращенню внутрішніх процесів і полегшує взаємодію з зовнішніми зацікавленими сторонами. Водночас, вказано, що для забезпечення ефективності цифрової трансформації необхідно застосувати нові методи стратегічного управління, що включають розробку та реалізацію довгострокових планів розвитку вищих навчальних закладів з урахуванням використання цифрових технологій. У результаті дослідження було підтверджено, що цифровізація змінює структуру освітнього процесу, сприяє покращенню якості навчання, зокрема завдяки адаптації освітніх програм до нових вимог та створенню більш персоналізованих шляхів навчання для студентів. Важливим аспектом є використання новітніх технологій для підвищення рівня управлінської ефективності університетів, зокрема завдяки автоматизації процесів та впровадженню електронних сервісів для взаємодії з зацікавленими сторонами. Висновки статті підтверджують важливість інтеграції цифрових технологій у всі аспекти діяльності університетів, що дозволяє не лише підвищити ефективність освітнього процесу, а й забезпечити конкурентоспроможність університетів у глобалізованому середовищі. Для цього необхідно реалізувати комплексний підхід до цифровізації, що включає адаптацію освітніх, управлінських і наукових процесів університетів, а також створення відповідної інституційної підтримки для забезпечення сталого розвитку вищої освіти.

Ключові слова: цифрові інтелектуальні активи, вартісна оцінка, діджиталізація, цифровий університет, цифрова трансформація.