INTANGIBLE ASSETS IN THE DIGITAL ECONOMY: CORPORATE VALUE, ARTIFICIAL INTELLIGENCE AND RESILIENCE

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Abstract. Global digital transformation, the rapid advancement of artificial intelligence technologies, the expansion of the knowledge economy, and the integration of ESG principles are fundamentally reshaping the role of intangible assets in creating corporate value and ensuring the long-term resilience of companies. At the same time, traditional approaches to the valuation and accounting recognition of intangible assets fail to fully capture contemporary sources of economic value creation, highlighting the need to reconsider their functional role within modern business models. *The purpose* of this study is to provide a comprehensive examination of the role of intangible assets in the formation of corporate value and resilience through the analysis of their interaction with artificial intelligence, contemporary valuation models, and the sustainable development paradigm. *Methodology.* The study is based on a systemic, evolutionary, and interdisciplinary research framework. The methodological toolkit includes comparative analysis, generalisation, structural and logical modelling, conceptual synthesis, and a critical review of contemporary international approaches to the valuation of intangible assets, corporate value creation, and ESG-driven business transformation. *Results.* The study substantiates the interdependence between the development of artificial intelligence and the accumulation of intangible assets as mutually reinforcing drivers of economic value creation. Contemporary models for measuring the intangible value of businesses are systematized, and their role in supporting the information base for strategic management is identified. Furthermore, the evolution of the concept of intangible assets within the sustainable

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development framework is examined, demonstrating the importance of integrating intangible assets into corporate resilience systems as strategic resources that enhance adaptability, innovation capacity, and the long-term development of businesses. *Practical implications.* The findings may be applied to improve corporate governance systems, develop methodologies for measuring intangible value, enhance integrated and non-financial reporting practices, and support the design of digital transformation strategies, intellectual capital management frameworks, and the implementation of ESG-oriented business practices. *Value/Originality.* The scientific contribution of the study lies in the development of an integrated conceptual framework that positions intangible assets as strategic resources simultaneously underpinning corporate value creation, the advancement of artificial intelligence technologies, and corporate resilience. Unlike traditional approaches, which primarily consider intangible assets as accounting objects or individual components of intellectual capital, this study proposes an integrated perspective that recognises intangible assets as a fundamental element of the digital economy and sustainable development.

INTRODUCTION

In the modern economy, the sources of corporate value creation are increasingly shifting from tangible resources towards intangible assets that underpin innovation-driven development, digital transformation, and the long-term competitiveness of businesses. The rapid proliferation of artificial intelligence technologies, the development of the knowledge economy, digital platforms, and ESG-oriented management models are substantially transforming approaches to understanding the economic nature of such assets and their role in business operations.

Intangible assets occupy a leading position in the contemporary system of corporate value creation and corporate sustainability. They generate long-term competitive advantages that cannot always be measured using traditional financial indicators. Brands, reputation, patents, software, and human capital form the foundation of market capitalisation, which often exceeds the book value of tangible resources. It is precisely through intangible assets that companies are able to retain customer loyalty and ensure stable cash flows.

Intangible assets underpin innovation-driven development, as knowledge and intellectual capital enable the continuous renewal of products and technologies. Social capital, in the form of partnerships and stakeholder trust, contributes to greater business resilience in the face of crises. Intangible assets also serve as a means of protection against competition, as patents and copyrights create barriers to entry for new market players.

At the same time, traditional accounting and financial reporting systems are predominantly oriented towards reflecting tangible resources, resulting in a gap between the book value and market value of companies. This highlights the need to reconsider the role of intangible assets in value creation processes, the assessment of business performance, and the achievement of long-term corporate sustainability. Particular importance is attached to investigating the relationship between the development of intelligent technologies, the accumulation of intangible resources, and the transformation of contemporary business models. There is a growing need to improve methodological approaches to measuring the economic value of intangible assets, which increasingly determine companies' investment attractiveness and market capitalisation.

Another important area of research is the integration of intangible assets into the concept of corporate sustainability, which involves a balanced combination of economic, social, and environmental aspects of development. In this context, intangible assets should be regarded not merely as accounting objects or outcomes of intellectual activity, but as a strategic resource capable of fostering adaptability, innovation potential, and long-term business value. Therefore, a comprehensive examination of their role in corporate value creation, the development of contemporary valuation models, and the achievement of corporate sustainability is of particular theoretical and practical significance. Consideration of these aspects makes it possible to develop a comprehensive understanding of the transformation of the functions of intangible assets in the digital economy and to identify promising directions for the development of corporate governance, financial reporting, and investment policy.

1. Artificial Intelligence and Intangible Assets: Interdependence and Value Creation

The most valuable component of corporate value lies in invisible assets embedded in lines of code, neural networks, and the collective knowledge

of technical teams. Financial reporting is well suited to capturing the value of tangible assets, but it does not show the true value of artificial intelligence (AI) capabilities, which are increasingly driving corporate success. Artificial intelligence highlights the fact that most corporate value is derived from intangible assets. In 1975, tangible assets accounted for 83% of the market value of *S&P 500 companies* [1], while intangible assets accounted for only 17%. By the end of 2025, this proportion has changed dramatically: intangible assets account for about 92% of the S&P 500 market capitalization, while tangible assets have decreased to 8%. In the current economic environment, companies generate a share of their cash flows from intangible assets. They underpin firms' ability to compete, invest, sustain cash flows, generate profit growth, and deliver returns to investors.

From an accounting perspective, IAS 38 "Intangible Assets" [2] defines an intangible asset as an identifiable non-monetary asset without physical substance. For an intangible asset to be recognised in the financial statements, it must satisfy the relevant recognition criteria, including identifiability, control, and the probability of future economic benefits. Brand Finance's Global Intangible Finance Tracker (GIFT™) [3] uses the concept of *"implied (or undisclosed) intangible assets"* to refer to them. They do not have a clearly defined legal form or documented evidence, but they can have a significant impact on economic value creation.

Implied intangible assets do not arise independently; rather, they emerge from coordinated actions and the efforts of individuals and teams within a company. An IT worker writes programme code, a sales manager builds relationships with customers, a researcher documents discoveries, a marketing team develops a new brand – all of these activities contribute to the creation of intangible value. These assets are not static inventories that are stored in a warehouse. They are products of human cooperation, formed on the basis of decisions, actions and organisational learning. This human dimension is essential for understanding implied intangible assets in the context of artificial intelligence. Their creation requires a clear alignment between functions, incentives and capabilities. AI does not replace human activity; it interacts with it and amplifies it. Artificial intelligence systems and models learn from human-generated outputs, while their outputs influence human decisions. Together, these interactions create a continuous cycle of human-AI collaboration and value creation.

Artificial intelligence provides computers and machines with the ability to simulate intelligent functions and solve complex problems. As part of the study, the *World Intellectual Property Organization (WIPO)* and *Luiss Business School (LBS)* presented a specific investment model [4], which explains the rapid growth of both tangible and intangible assets in sectors that create and use artificial intelligence tools. The model identifies several waves of investment:

1) *in tangible* assets that ensure the physical deployment of artificial intelligence technologies (servers, data centres, equipment, energy infrastructure);

2) *investment in three groups of intangible assets*: digitised information (big data, knowledge bases, digital archives); innovative property (patents, algorithms, software); and economic competencies (personnel skills, organisational practices, managerial knowledge).

The future development and use of AI depend equally on investment in intangible assets (Table 1, Table 2):

– *digital information:* data are a critical element for artificial intelligence, along with computing software. AI companies are investing in machine learning tools, training databases, and proprietary platforms. Sectors using AI are digitising information and implementing industry tools;

– *innovative property:* AI developers engaged in prototype research, microchip design, and patent portfolio building; users integrate artificial intelligence into products and services, while protecting industry knowledge;

– *economic competencies:* artificial intelligence drives investment in human potential and institutional transformation. AI developers and users focus on talent development, process transformation, trust building, and restructuring with AI-integrated workflows in mind.

Intangible assets power AI, and artificial intelligence creates intangible assets. As *Paul Adams and Jason Strimpel* note*,* "the relationship between artificial intelligence and intangible assets is not a one-time transaction, but a continuous cycle" [5]. The authors refer to such relationships as the *"flywheel effect",* which increases the competitive advantage for those who manage it – and accelerates decline for those who do not. The key stages of the relationship between intangible assets and artificial intelligence are:

1) *Generation of proprietary microdata (internal data and information)*: the company's existing intangible assets – its customer relationships,

operational processes, industry expertise, content – generate flows of its own data. This is not publicly available data, such as information from Wikipedia, public datasets, or industry benchmarks; rather, it is company-specific data: transaction patterns, customer behaviour, operational anomalies, decision history. This is critical – universal AI trained on public data provides capabilities that competitors can replicate. AI trained on its own microdata generates differentiated insights that create a sustainable competitive advantage.

2) *Artificial intelligence processes and learns from microdata:* AI systems absorb their own microdata, discovering patterns, relationships, and predictions that would be invisible to human analysts. The effectiveness of this training is critically dependent on the quality, depth, and historical continuity of the data. AI requires dynamic time-series data – long-term records that reflect how variables change over time – to benchmark performance, identify trends, and improve forecasts. Companies that systematically collect and store historical data are better positioned to benefit from AI than those whose data practices are episodic or fragmented.

3) *AI outputs and intangible assets*: better solutions, new products, operational efficiency, predictive capabilities – increase the value of existing intangible assets and create new ones. Customer relationships become more valuable when AI-powered personalisation increases customer retention. A dataset becomes more valuable when AI-generated insights reveal previously hidden business opportunities. Software becomes more valuable when AI optimises performance.

4) *Improved intangibles generate more valuable data*: Intangible assets based on AI models generate better, more valuable data streams (which go back to the first stage). Customer relationships that have been strengthened by AI-powered personalisation generate more granular behavioural data. An optimised business process generates more accurate operational telemetry. The flywheel is accelerating – each stage of this cycle increases corporate value and increases the value of intangible assets. Companies that activate the flywheel early and manage it effectively gain an advantage over their competitors. Those who do not activate the flywheel – or fuel it with weak foundations of intangible assets – gradually find themselves at a disadvantage. Figure 1 shows the model of interaction between the company's intangible assets and artificial intelligence.

Table 1

Investment in Intangible Assets in the Production of Artificial Intelligence Tools

Category	Short-term perspective	Long-term perspective
Digital information (software and databases)	Machine learning tools and training data	Proprietary AI platforms, training systems
	Cloud data licensing	Large-scale datasets, data management
	Data infrastructure	
Innovative Property (R&D, IP, design, financial products)	Research and development at the prototype level	Algorithms, chips, patent and intellectual property portfolios
	Early chip development and patent filing	AI-based interfaces and industrial systems
	User Experience (UX) modelling	New risk financing instruments
Economic competencies (market research, branding, training, skills)	AI product landscape analysis, identification of new branding opportunities	Building leading brands and developing an ethical positioning strategy for AI
	Experimental groups for AI development	Integration of AI across organisational units and deployment of AI services on the platform
	Recruitment and engagement of AI development personnel and initial training	Continuous learning and AI academies

Source: constructed by the author based on information [4]

This flywheel effect explains why investing in AI without visibility into intangible assets is strategically disadvantageous. If a company does not know what assets it possesses, it cannot effectively fuel the flywheel. If microdata are not systematically collected and stored, the flywheel cannot accelerate effectively. And if a company does not value assets created using AI tools, the company underestimates its long-term value-creation potential and, accordingly, will not be able to allocate capital wisely to maintain its momentum.

Table 2

Investment in Intangible Assets in Sectors Using Artificial Intelligence Tools

Category	Short-term perspective	Long-term perspective
Digital information (software and databases)	Implementing industry-specific AI tools	Real-time data integration systems
	Digitisation of workflows and collection of operational data	Digital twins and interoperable data infrastructures
	Training data	
Innovative Property (R&D, IP, design, financial products)	AI integration in products and processes	Intelligent product lines and proprietary AI models that can be customised to meet customer needs
	Pilot industry implementation of design	AI-enabled industrial development and financial services
Economic competencies (market research, branding, training, skills)	AI services market research	End-to-end branding of AI-based services
	Joint pilot projects with infrastructure partners	Organisational reorganisation to adapt to AI-based activities
	AI testing workflows, AI recruiting	Scaling continuous AI learning, training, and enhancing functional skills across all organisational units

Source: constructed by the author based on information [4]

Modern tools and platforms have greatly simplified the process of prototyping AI-based solutions; however, the transition from experimental development to large-scale deployment remains challenging. Particular difficulties arise in ensuring the stability, security and responsible functioning of such systems in real business processes. Scaling AI requires not only technical sophistication and performance of AI models, but also robust system architecture, reliable engineering infrastructure, and systematic risk management. A proof of concept usually focuses on demonstrating the capabilities of the technology; however, this is not enough to generate practical value for the company. Developing viable AI-powered products and services requires integrating technological, organisational, and legal aspects. Additionally, it is necessary to take into account ethical principles,

requirements for transparency and data protection, as well as employees' readiness to work with new tools. Effective implementation of AI involves a comprehensive approach to management that covers the entire life cycle of the system – from initial concept to operational deployment. In this context, AI should not be viewed as a standalone technological experiment but as a strategic intangible asset requiring long-term planning and responsible stewardship.

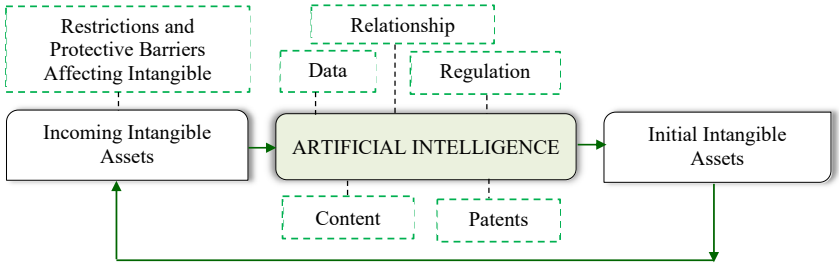


Figure 1. Model of the Relationship between Intangible Assets and Artificial Intelligence

Source: built by the author based on information [5]м

Despite significant initiatives in talent, infrastructure, and experimentation, most AI initiatives never scale. According to the results of a *McKinsey survey* [6], almost two-thirds of enterprises remain in the experimental phase, unable to implement AI in core operations, where it can significantly affect productivity. The adoption and scaling of enterprise AI in large, organisationally complex companies face obstacles including strict regulatory requirements, legacy technology platforms, and functionally siloed workflows. The pattern is consistent: companies are trying to scale AI as a technology initiative, while the real success factor is the alignment of leadership and the operating model built for enterprise adoption.

Achieving a positive return on investment in intangible assets does not necessarily require complex or excessively costly interventions, but requires a systematic and balanced approach. It is advisable for management to start by clearly aligning AI initiatives with defined strategic or operational outcomes and establishing performance evaluation criteria in advance.

Defining success indicators at the planning stage creates the basis for an objective analysis of the feasibility of implementing models. When the objective is to reduce customer churn, it is advisable to use predictive tools that identify loyalty factors and customer attrition risks. In the presence of a clearly defined baseline, such models can demonstrate practical value within a relatively short period. If the priority is to improve operational efficiency, a systematic analysis of current processes, cycle times and error rates is the basis for further improvements. Linking AI initiatives to business goals ensures transparency of investment decisions and increases the likelihood of generating sustainable economic benefits.

Companies that invest in responsible AI generate business value in the form of innovation, efficiency, and trust. The integration of responsible practices creates systems that scale, provide measurable impact, and gain the trust of stakeholders. According to the results of a survey of 310 US business leaders, *PwC* [7] identifies key benefits (business outcomes) that can be derived from responsible AI management practices:

1) increased return on investment in AI (58% of respondents);
2) more efficient customer engagement (55%);
3) enhanced innovation (55%);
4) stronger cybersecurity and data protection (51%);
5) greater transparency of information and information flows (41%).

Also, the results of the *PwC* survey [7] focus on the barriers that arise in the process of implementing responsible artificial intelligence: (1) the complexity of converting principles into scalable and operational processes (50% of respondents); (2) cultural resistance to change (40%); (3) limited budgets or resources (38%); (4) lack of technological tools or technical factors (37%). A responsible approach to the use of artificial intelligence is a key prerequisite for ensuring long-term economic returns on investments in relevant technologies. Companies need to establish corporate governance systems capable of adapting to the pace of technological change and maintaining appropriate standards over time. Such governance should be based on the integration of ethical norms, internal regulations and monitoring mechanisms that ensure the consistency of technological solutions with strategic priorities and societal expectations.

Intangible assets – data, intellectual property, branding, workflows, human capital – transform hardware into intelligent, reliable performance

systems. The combination of physical infrastructure and intangible capabilities generates the economic value of artificial intelligence, and the investment structure reflects a dual nature: physical infrastructure and general-purpose technology. The global growth in software investment reflects not only the ever-accelerating digital transformation, but also the convergence of AI-powered technology development. In this case, AI acts as fuel, and software acts as a machine.

Software spending will grow steadily, driven by the introduction of AI tools, a steady stream of investment in cloud infrastructure, and the growing importance of scalable, intelligent software in various sectors of the economy. In practice, AI is based on a multi-level architecture, which includes:

1) data infrastructure for collection and labelling;

2) an environment for training models (such as TensorFlow and PyTorch);

3) deployment environments based on CI/CD pipelines using Docker and Kubernetes for scalable real-time operation.

In 2024, global software spending reached $675.0 billion (excluding inflation), representing an increase of almost 50% compared with 2020 ($454.0 billion) [8]. This trend shows a significant increase in investment in software development and improvement, which began following the end of the pandemic. The increase in investment flows comes at the same time as the expansion of the e-commerce sector and the development of artificial intelligence technologies. This growth is not a one-time leap; it is an established "new normal" in the digital economy: annual software spending remains high, with no substantial decline expected.

The United States remains the leading investor in software. In 2024, it invested $368.5 billion, exceeding the combined software expenditure of all other countries. This was approximately six times China's expenditure and 16 times Germany's expenditure. US investment in software also exceeds total software expenditure in the European Union (EU). EU spending in 2024 amounted to $117 billion, which was less than one-third of US expenditure. The United States spends more than twice as much on software as the EU and China combined (Figure 2).

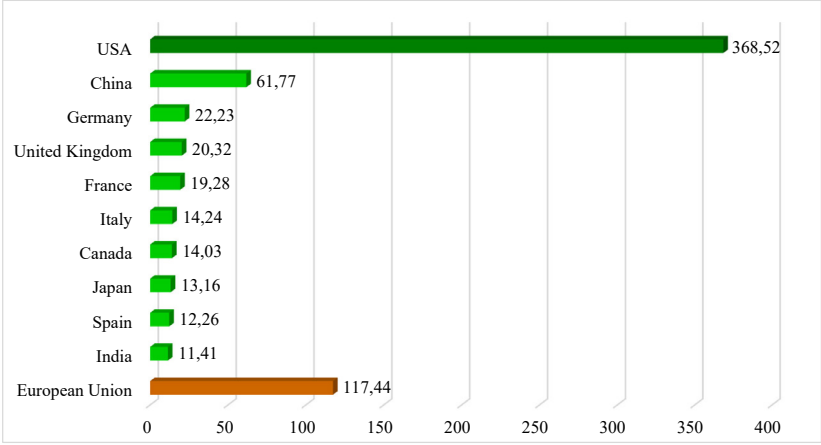


Figure 2. Software Investment in the World's Leading Economies (US$ billions), 2024

Source: based on information from [8]

With its distinctive AI-powered software ecosystem, the United States has further strengthened its advantage in software investment. Companies such as OpenAI, Google, Microsoft, Amazon, Meta are not only developing cutting-edge AI models but also integrating them into major software platforms. In addition, the US has the resources to scale innovative solutions such as infrastructure with embedded AI, automated machine learning, and explainable AI (XAI). China, whose software spending reached $61.77 billion in 2024, retains its status as the second-largest software investor. China has a large domestic market for the adoption of AI-based technologies – from fintech and logistics to smart cities and surveillance technologies. Companies such as Baidu, Alibaba, Tencent, Huawei have substantial capabilities for developing AI-integrated software at scale. Germany ranks third in the world in terms of software investment at $22.23 billion in 2024. The United Kingdom ranks fourth globally in software investment, at $20.32 billion, and is a European leader in AI development. In 2024, France invested $19.28 billion in software, underscoring its ambition to become one of the world's leaders in artificial intelligence. Innovation hubs such as Station F, together with initiatives

such as La Mission French Tech, have contributed to a dynamic start-up ecosystem that includes prominent AI companies such as Mistral AI and Hugging Face.

According to WIPO's 2025 findings [9], leadership in the global intangible economy remains multifaceted:

1. The United States dominates in absolute investment ($4.9 trillion), followed by Japan ($810.0 billion), Germany ($727.9 billion), France ($663.5 billion), and the United Kingdom ($610.2 billion).

2. Sweden leads in terms of intangible investment intensity as a share of GDP (17.4%). It is followed by the United States (15.6%), France (15.2%), Denmark (14.9%), and Finland (14.8%).

3. India shows the fastest growth in intangible investment among the 15 largest economies (7.9% during 2024-2025). Japan follows at 4.8%, followed by the Philippines (4.6%), the United States (4.4%), and Germany (3.3%).

Software and data are the fastest-growing categories of intangible assets, driving productivity growth, especially in service industries and sectors that use artificial intelligence (AI) tools. In relation to this group of assets, according to *the WIPO Report* [9], investment growth in 2025 was observed in the following countries: Brazil, Bulgaria, Canada, Czech Republic, Estonia, Finland. The highest shares of research and development (R&D) expenditure in total intangible investment were recorded in Japan and Germany, at 33.5% and 30.8%, respectively, which is consistent with their strong industrial and manufacturing base. Denmark (28.8%), Croatia (28.4%) and the United States (22.7%) also have high shares in R&D, while the United Kingdom (13.5%) and France (13.4%) have more moderate shares. R&D has a much smaller share in middle-income economies: 12.7% in India, 6.6% in Brazil and 5.5% in the Philippines.

Among the 29 economies covered in this report, representing 57 percent of global GDP, intangible investment in 2025 reached an all-time high of more than US$10 trillion [9]. Investments in intangible assets such as software and databases, intellectual property, research and development (R&D), brands, and design account for the dominant and growing share of global gross domestic product.

In the context of global economic competition, intangible assets have a significant impact on the performance and prospects of both companies

and countries. Investing in intangible assets allows companies to strengthen competitive advantage, accumulate intellectual property, drive innovation and growth, attract top talent, build customer loyalty, and ultimately ensure success in the market. Although intangible assets are often less visible than physical assets, they have a significant impact on everyday life, contributing to improved economic prospects, the creation of higher-paying jobs, and improved product quality and reliability.

2. Models for Measuring the Intangible Value of a Business

Financial reporting information systematically understates both corporate profits and the book value of companies, particularly when they actively invest in intangible assets, including but not limited to artificial intelligence. This manifests itself in the following ways:

1) *Distortion of reported performance (particularly in terms of profit)*:

– research expenditure is recognised immediately as an expense, while qualifying development expenditure is capitalised and subsequently amortised;

– expenditure on employee training and development reduces current earnings despite contributing to the creation of future value;

– marketing expenditure aimed at building brand value is treated as an expense, despite contributing to the development of long-term customer relationships;

2) *Cash flow-related issues*:

– periods of high initial investment result in negative free cash flow, despite the development of valuable future capabilities;

– traditional free cash flow metrics do not distinguish between growth investment and maintenance investment;

– working capital metrics do not capture investments in data and intellectual property;

3) *Understatement of the company's book value:*

– successfully developed internally generated software is effectively assigned a book value of zero; consequently, even when a company creates a valuable tool for its own use, it is not recognised in financial reporting as an asset with a monetary value;

– accumulated organisational knowledge is not reflected in the balance sheet and is therefore effectively assigned a value of zero;

– the value of a brand created through marketing is not recognised as a company asset and is not presented in the financial statements.

Intangible assets are a dominant yet largely invisible source of contemporary corporate value. This invisibility creates significant challenges for capital allocation, management, and valuation. At the same time, artificial intelligence is fundamentally changing how these assets are created, enhanced, and deployed, while also relying on them to achieve its own effectiveness. Artificial intelligence is not merely a tool that interacts with and operates with intangible assets. Rather, it is a driver of transformation that reshapes data collection processes, knowledge organisation, and decision-making.

Companies that do not understand the capabilities of their intangible assets will be unable to objectively assess the effects of AI implementation. Conversely, companies that incorporate AI tools into their business processes but fail to fully recognise the outcomes they generate may face problems related to inefficient capital allocation and the underestimation of risks. In this context, the relationship between intangible assets and AI is interdependent. Intangible assets fuel AI, while artificial intelligence creates intangible assets. *Paul Adams* and *Jason Strimpel* [5] refer to this interrelationship as the "flywheel effect", which was discussed in the previous section.

AI intersects with intangible assets in a distinctive way: intangible assets simultaneously serve as *inputs to* AI workflows and as *outputs* of investment and use. This creates a feedback loop – a flywheel – in which intangible assets generate proprietary data, AI consumes and learns from this data, AI outputs enhance intangible value through better decisions and new products, and improved intangible assets generate richer data, thereby continuing the cycle.

Each AI initiative delivers not only immediate operational benefits but also residual intangible assets, including data, software, and know-how, that persist beyond the scope of the project. This relationship highlights the critical importance of understanding and accurately valuing intangible assets.

Myron Scholes, an adviser to the Andersen Institute, notes: "Intangible assets now account for the majority of enterprise value, yet they remain largely invisible in financial reporting. AI systems consume these assets

as key inputs and transform them into new sources of value. As AI becomes central to business performance, leaders must understand which intangible assets the enterprise controls and how they contribute to value creation. Without rigorous measurement of this relationship between AI and intangible assets, capital allocation to AI will remain driven more by assumptions than by evidence" [5].

Unrecognised intangible assets and assets created using AI models have a tangible impact on the corporate value of businesses across various sectors:

1) Software and technology:

– AI-based language models developed by *Google*, such as BERT and LaMDA, require substantial investment in research and development, which is recognised as an expense despite contributing to the development of foundational technologies that generate significant sources of revenue;

– expenditure on the development of *TikTok's* recommendation algorithms is expensed immediately, although this AI system generates unprecedented levels of user engagement and advertising value;

– *NVIDIA's* development of AI-based software is recognised as current expenditure, despite creating long-term competitive advantages in AI acceleration;

2) Media and entertainment:

– *Disney's* investments in AI-based content recommendation and production tools are reflected as expenditure, despite increasing customer engagement with its streaming services;

– *Netflix's* expenditure on artificial intelligence for content personalisation and optimisation reduces current profits but creates valuable predictive capabilities;

– the development of *Meta's* AI-based content moderation system is treated as expenditure, despite creating value for the platform;

3) Retail:

– *Costco's* investments in AI-based inventory management and demand forecasting reduce reported profits while simultaneously delivering sustained improvements in operational efficiency;

– expenditure on the development of *Nike's* AI-based platforms obscures the company's future revenue potential;

– *Amazon's* investments in robotics and AI-driven logistics are treated as expenditure, despite creating substantial automated order-fulfilment capabilities.

More than 90% of the value of modern companies is underpinned by intangible assets. However, most companies are unable to fully identify, measure, or manage these assets. Traditional accounting frameworks, such as IFRS 3 [10] and IAS 38 [2], capture only a proportion of these assets – typically 20–40% of total intangible value. The remainder represents strategic value that remains unmeasured. Table 3 presents the benefits of making intangible assets visible in corporate reporting and the consequences of their remaining unrecognised.

Table 3

Value and Risks of the Invisibility of Intangible Assets in Financial Reporting

Aspects	Benefits of Visibility	Consequences of Invisibility
Transparency	Investors and partners can see the actual structure of the company's value	Lack of confidence in financial reporting; risk of business undervaluation
Company valuation	Provides a more accurate reflection of market capitalisation and growth potential	The company may appear less valuable than it actually is
Investment attractiveness	Demonstrates innovation, a strong brand, and a customer base	Investors may underestimate the company's prospects and decide not to invest
Asset management	Management has the tools to allocate resources effectively	Strategic decision-making becomes more difficult, increasing the risk of losing valuable resources
Tax implications	Amortisation of intangible assets may reduce taxable profit	The business loses opportunities to optimise its tax position
Corporate reputation	Highlights the strengths of the business (brand, culture, and innovation)	The actual value of the brand and corporate culture remains "invisible" to external stakeholders

Source: compiled by the author based on the findings of the study

To assess the intangible assets that create corporate value, specialists at *Opagio Intangibles* [11] have developed a comprehensive methodology –

the *Opagio 12™ Framework*. It provides a taxonomy of 12 strategic drivers (Table 4) covering the full spectrum of intangible value. Its purpose is to identify and structure the intangible assets that account for 90% of the value of modern companies.

Table 4

Structure of the Opagio 12™ Framework

№	Driver (category)	Types of assets included in the driver
1	*Brand & Reputation*	Registered trademarks, brand equity, domain names, market recognition, and reputation capital
2	*Customer Capital*	Customer contracts, relationships and loyalty, and retention rates
3	*Network Effects & Platforms*	Multi-sided marketplaces, platform ecosystems, viral growth, API networks, and user-generated content
4	*Technology & Innovation*	Patents, proprietary software, R&D capabilities, trade secrets, and technical architecture
5	*Data & Intelligence*	Proprietary datasets, predictive models, customer behavioural data, and competitive intelligence
6	*Human Capital*	Team talent, specialised expertise, institutional knowledge, training programmes, and the value of key professionals
7	*Organizational Capital*	Documented processes, guidelines, management frameworks, operational efficiency, and decision-making systems
8	*Ecosystem & Partnerships*	Strategic partnerships, distribution networks, platform integrations, co-marketing relationships, and consultant networks
9	*Content & IP*	Published content, research, proprietary frameworks, copyrights, educational content, and thought leadership
10	*Regulatory & Compliance Capital*	Operating licences, regulatory approvals, certifications (ISO, SOC 2), legacy data, and compliance infrastructure
11	*Switching Costs & Lock-In*	Contractual lock-in, depth of integration, retraining costs, data migration friction, and ecosystem dependencies
12	*Culture & Ways of Working*	Company values, a culture of innovation, psychological safety, customer orientation, and organisational structure

Source: compiled by the author based on information from [11]

Taken together, these 12 categories provide a comprehensive map that enables the identification and management of modern corporate assets and, accordingly, becomes a driving force for value creation in the AI era.

This model differs substantially from those used in Purchase Price Allocation (PPA). Under IFRS 3, purchase price allocation (PPA) is required for business combinations, where the purchase price paid for a company is allocated to the identifiable assets acquired and liabilities assumed at their fair values, with the residual amount recognised as goodwill. This is important for the transparency of financial reporting and the accurate recognition of future amortisation expenses. PPA frameworks are generally retrospective and compliance-oriented.

Each *Opagio 12*™ driver corresponds to established classification systems – the Corrado-Hulten-Sichel (CHS) framework, the types of intangible assets recognised under international accounting standards, and the *Six Capitals* model – thereby providing a comprehensive spectrum of business value.

The *Six Capitals* model provides a systematic framework for understanding and reporting on value creation by tracking stocks of financial, manufactured, intellectual, human, social and relationship, and natural capital required for the sustainable health of the planet. It serves as an accounting identity for planetary stewardship and requires companies and countries to track their depletion or accumulation through interconnected forms of wealth. This concept directly challenges the externalisation of costs that characterises industrial economies, recognising that the depletion of one form of capital may be temporarily concealed by gains in another. *The Six Capitals model offers a rethinking of organisational wealth, asserting that value is preserved not only in balance sheets but also in living stocks of natural, social, and human resources.* The *Six Capitals* model groups value-generating resources into six categories, four of which are covered by *Opagio 12*™ (Table 5).

IFRS 3 [10] identifies five classes of identifiable intangible assets for purchase price allocation (PPA). Not all 12 *Opagio 12*™ drivers correspond to the requirements of this standard. Within this methodology, they reflect hidden forms of value that are not captured in traditional accounting: human capital (*Human Capital*), organisational capital (Organizational Capital), and culture and ways of working (*Culture & Ways of Working*).

Table 5

Relationship between *the Six Capitals Model* and Opagio 12™ Drivers

Six Capitals Model Categories	Opagio 12™ Drivers
Intellectual Capital	*Technology & Innovation* *Data & Intelligence* *Organizational Capital* *Content & IP*
Social and Organisational Capital	*Brand & Reputation* *Customer Capital* *Network Effects & Platforms* *Ecosystem & Partnerships* *Switching Costs & Lock-In*
Human Capital	*Human Capital* *Culture & Ways of Working*
Natural Capital	Regulatory & Compliance Capital

Source: compiled by the author based on information from [11]

The *Corrado-Hulten-Sichel (CHS)* framework is a widely used academic taxonomy for intangible investment. It groups intangible assets into categories that reflect strategic business decisions rather than accounting standards. The CHS framework is an economic measurement methodology that expands the traditional concept of capital by treating investment in intangible assets as equivalent to investment in tangible capital. It demonstrates that business expenditure on innovation, brands, data, and human capital should be treated as investment rather than current expenditure. CHS illustrates that official measures of GDP and productivity underestimate actual growth when intangible investment is not taken into account. Table 6 presents the relationship between the *Opagio 12*™ drivers and the categories of intangible assets identified by CHS.

The practical application of the *Opagio 12*™ *Framework* for measuring intangible assets provides a systematic approach to their identification and assessment. It enables companies to structure their intangible resources into twelve categories, thereby facilitating a more accurate representation of the sources of corporate value creation. This increases the transparency of corporate reporting and makes businesses more attractive to investors by demonstrating their actual economic strength beyond the balance sheet. The model helps management make strategic decisions based on intangible

drivers of competitiveness. In the long term, this contributes to building a strong and sustainable reputation and enhancing a company's ability to adapt to the challenges of the digital economy.

Table 6

Relationship between Corrado-Hulten-Sichel (CHS) Categories and Opagio 12™ Drivers

CHS Categories	Opagio 12™ Drivers
Brand	*Brand & Reputation* *Customer Capital*
Technology	*Network Effects & Platforms* *Technology & Innovation* *Data & Intelligence* *Switching Costs & Lock-In*
Human Capital	*Human Capital* *Culture & Ways of Working*
Organisational Capital	*Organizational Capital* *Ecosystem & Partnerships* *Regulatory & Compliance Capital* *Culture & Ways of Working* *Switching Costs & Lock-In*
Intellectual Property	*Content & IP*

Source: compiled by the author based on information from [11]

In contemporary economic research and management practice, intangible assets are regarded as key sources of corporate value creation. However, different research and methodological approaches propose their own frameworks for identifying and measuring these assets (Table 7).

The *Corrado-Hulten-Sichel (CHS) Framework* focuses on the macroeconomic measurement of investment in intangible resources, whereas the *Six Capitals* model integrates economic, social, and environmental aspects into reporting; the *Opagio 12™ Framework* offers a detailed taxonomy of intangible assets at the individual company level. A comparison of these three models highlights their complementarity, ranging from macroeconomic analysis to corporate management and integrated reporting.

Table 7

Models for Measuring Intangible Assets: A Comparative Analysis

Model	Essence	Methodology	Economic Focus	Strengths
Corrado-Hulten-Sichel (CHS) Framework	Expands the concept of capital by treating expenditure on intangible assets as investment	Use of national accounts; classification of expenditure on R&D, brands, organisational and human capital	Macro-economic measurement of productivity and GDP	Demonstrates the actual contribution of intangible assets to economic growth
Six Capitals	Reflected in integrated reporting and comprises six types of capital: financial, manufactured, intellectual, human, social, and natural	IIRC methodology; focus on long-term value creation and sustainability	ESG reporting; balancing economic, social, and environmental outcomes	Provides a multi-dimensional view of business value; aligned with the SDGs
Opagio 12™ Framework	Taxonomy of 12 intangible asset drivers	Systematic classification of assets, combining accounting standards and economic models	Micro-economic level – valuation of companies in M&A and PPA	Makes invisible assets visible and supports strategic management

Source: compiled by the author based on the findings of the study

In models for measuring the intangible value of a business, intellectual property serves as a key driver of innovation and competitiveness. Its proper assessment makes it possible to transform invisible assets into tangible economic strength. It provides legal protection and opportunities for the commercial use of the results of creative and scientific activities. For businesses, this involves not only value creation but also the development of a long-term competitive strategy.

In the digital era, intellectual property encompasses not only traditional objects, such as patents, copyrights, and trademarks, but also digital assets, including algorithms, software, databases, digital content, and artificial

intelligence. As artificial intelligence technologies develop, new challenges are emerging regarding the determination of authorship and the protection of rights to AI-generated outputs.

Intellectual property is not merely a legal construct but also a strategic resource that determines the level of innovative development and economic growth in the contemporary world. It is a key factor in the monetisation of intangible assets, contributing to investment attraction, the development of technological ecosystems, and the creation of competitive advantages. Through commercialisation, licensing, and integration into business processes, intellectual property becomes an instrument for stimulating innovation and enhancing global competitiveness.

Intellectual property as an economic category has a multi-layered nature. In addition to its basic (classical) characteristics – functionality, a two-level structure, and a system of rights and obligations – its essence is revealed through additional aspects, including market valuation, legal regulation, its impact on competitiveness, and commercialisation mechanisms (Figure 3). Taking these factors into account makes it possible to assess more accurately the role of intellectual property in the contemporary economy and to determine strategies for its effective use.

The development of digital technologies makes it possible to identify specific characteristics of intellectual property that can help address contemporary challenges and assess the opportunities and risks associated with its use:

1) Digital replication and scalability are distinctive features of intellectual property in the contemporary economy. Thanks to digital technologies, intellectual property objects such as software, algorithms, databases, NFTs, and elements of artificial intelligence can be copied, transferred, or modified instantaneously without physical limitations. They differ substantially from traditional intangible assets because digital products are not subject to depletion and can be used indefinitely without losing their value. This opens up new opportunities for monetisation through subscription-based models, licensing, and global digital markets. However, there is another side to this: the ease of copying creates risks of uncontrolled distribution, increasing the importance of digital protection, the use of blockchain technologies, and new approaches to intellectual property rights management. As a result, approaches to IP valuation are changing, with factors such as the level of

protection, the uniqueness of an algorithm, and its scalability in the global environment playing an important role.

2) Automated generation and use of intellectual property in the era of artificial intelligence (AI) and Big Data is changing traditional notions of authorship and the legal status of intangible assets. Machine-learning algorithms are capable of creating unique texts, images, music, software code, and other objects that were previously considered exclusively products of human creativity. This raises questions regarding the allocation of rights among the algorithm developer, the user, and the AI system itself. From an economic perspective, the automated generation of intellectual property creates new opportunities for business scalability, lower development costs, and faster innovation. At the same time, legal uncertainty surrounding the regulation of such objects complicates their commercialisation and creates risks of unauthorised use. This creates a need to develop international standards and mechanisms for protecting intellectual property rights in AI-generated outputs to ensure their effective economic use.

3) Global accessibility and the digital transboundary nature of intellectual property are distinctive features of the digital era. Thanks to the development of the internet and cloud technologies, intellectual property objects such as software, digital content, algorithms, and data can be distributed instantaneously worldwide. This creates opportunities for business scalability, access to international audiences, and increased revenues through global digital platforms. The transboundary nature of intellectual property complicates its legal regulation because copyright, patent protection, and trade secret laws vary across countries. At the same time, risks arise in connection with piracy, uncontrolled use of content, and the need to harmonise international legal norms. Effective management of digital assets requires the use of global licensing agreements, blockchain technologies, and mechanisms for protecting intellectual property rights.

4) Cybersecurity and threats of digital piracy constitute a challenge associated with the protection of intellectual property. The rapid dissemination of digital content through the internet and the development of artificial intelligence technologies significantly facilitate the unauthorised use of copyrighted materials, software, and trade secrets. Cybercriminals actively employ hacking, illegal copying, and the distribution of content through the dark web and file-sharing platforms, causing billions in losses to rights holders. To combat digital piracy, advanced technologies are used,

including: 1) *blockchain*, which enables transparent recording of ownership rights; 2) *smart contracts*, which automatically regulate the conditions for the use of digital assets. Companies also implement *AI algorithms for content monitoring*, digital watermarks, and encryption to make unauthorised copying more difficult.

5) Intellectual property as an element of digital platforms and ecosystems – the uniqueness of this process lies in the fact that a significant proportion of intellectual property is created not only by corporations but also by their users, through content, data, reviews, software development, and even interactions with artificial intelligence algorithms. Accordingly, new challenges arise for traditional notions of ownership, particularly in relation to rights to user-generated content, algorithmic recommendations, and collected data. Digital platforms gain a competitive advantage by monetising these assets through advertising mechanisms, Big Data analytics, and personalised services. Ensuring a fair distribution of rights and benefits requires modern legal regulation that takes into account both the interests of companies and users' rights to their digital contributions. This makes intellectual property not only a legal but also a socio-economic category that is shaping new rules of the game in the global digital environment.

The rapid development of digital technologies is changing approaches to understanding intellectual property and its place and role in the business processes of an enterprise. In the context of the present study, the category of ***"intellectual property"*** is proposed to be defined *as the outcomes of human intellectual, creative, innovative, and digital activities that acquire economic value through their legal protection, commercialisation, and integration into business processes; serve as a strategic, financial, and competitive resource of an enterprise in the form of an intangible asset; contribute to the development of the digital economy, the formation of global technological ecosystems, and the achievement of competitiveness amid rapid digital transformation.*

The market valuation and liquidity of intellectual property make it possible to regard it as a strategic financial asset. In high-tech industries, such as IT, pharmaceuticals, and biotechnology, a significant proportion of companies' market capitalisation is based precisely on such assets. At the same time, the economic value of intellectual property depends to a considerable extent on the effectiveness of legal protection, confirming the need to improve national and international legislation in this area.

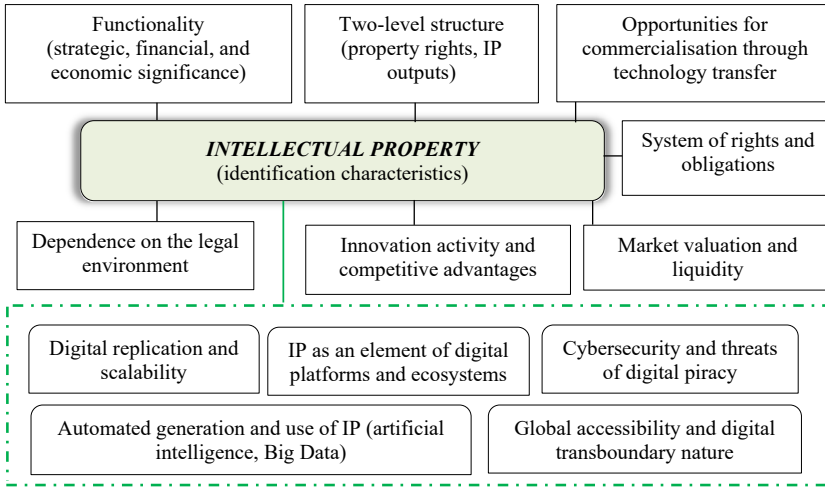


Figure 3. Identification Characteristics of Intellectual Property in the Era of Digital Technologies and Artificial Intelligence

Source: developed by the author based on information from [12]

3. Intangible Assets as a Foundation for Corporate Sustainability and Sustainable Development

Intangible assets in the context of sustainable development represent non-physical elements that underpin ecological health, social cohesion, and economic resilience. They form the foundation of functioning socio-ecological systems, providing value that cannot be readily quantified based on information disclosed in corporate reporting but is indispensable for long-term well-being. Consider, for example, the complex network of trust that enables communities to cooperate, the deep knowledge of local ecosystems held by Indigenous peoples, or robust governance structures that ensure the equitable distribution of resources. These are not merely by-products of the development of human societies, communities, and businesses. Rather, they are active, generative forces that enable natural and human systems to adapt, persist, and thrive.

At a fundamental level, *intangible assets* are the capabilities and qualities that enable an ecological, social, or economic system to function effectively

over time and remain sustainable. They constitute an invisible architecture that supports visible structures. Consider the resilience of a forest ecosystem not only in terms of its timber volume, but also its biodiversity, soil health, and complex interactions among species. This resilience is an intangible asset that is critical to its ability to withstand shocks such as drought or disease. Similarly, a society's capacity for innovation, its cultural heritage, and the strength of its democratic institutions are all forms of *intangible assets* that contribute to its long-term viability and ability to address complex challenges such as climate change. The fundamental importance of intangible assets lies in their ability to provide systemic resilience and adaptive capacity – qualities that are essential for overcoming the challenges of sustainable development. Table 8 presents a pathway towards the recognition and integration of intangible assets within the framework of sustainable development.

Table 8

Periodisation of the Integration of Intangible Assets within the Framework of Sustainable Development

Period	Event	Impact and Implications
1	2	3
Late 1980s – early 1990s	Emergence of corporate social responsibility (CSR) reporting	Attempts, often qualitative, to communicate non-financial performance by addressing reputational assets, stakeholder relationships, and ethical behaviour. This signalled initial efforts to move beyond financial metrics.
1997	Launch of the Global Reporting Initiative (GRI)	The first widely adopted framework for sustainability reporting, encouraging companies to disclose performance across economic, environmental, and social dimensions, thereby promoting consideration of related intangible factors such as governance quality and stakeholder engagement effectiveness.
Early 2000s	Rise of the "Triple Bottom Line" concept (People, Planet, Profit)	Promotion of the idea that corporate success should be measured holistically by assessing social and environmental outcomes alongside financial profitability, thereby placing greater emphasis on the intangible assets underpinning social and environmental outcomes.

End Table 8

1	2	3
Mid-2000s	Increased attention to climate change and carbon accounting	The strategic importance of innovation potential (for low-carbon technologies), adaptive management capabilities, and reputational risks and opportunities associated with climate action was highlighted. Carbon markets sought to internalise externalities, indirectly highlighting the value of emissions-reduction opportunities.
2013 (updated in 2021)	Launch of the *International Integrated Reporting Framework*	A global corporate reporting framework that combines financial and non-financial information to reflect the creation, preservation, or erosion of corporate value over the short, medium, and long term. Non-financial reporting provides information on different forms of "capital", including intellectual, human, social, organisational, and natural capital, thereby directly incorporating key intangible assets into the value-creation narrative.
2015	Adoption of the UN Sustainable Development Goals (SDGs)	Provided a universal framework for sustainable development, requiring substantial investment in and use of intangible assets such as education (human capital), innovation, institutional capacity, and global partnerships (social/organisational capital) to achieve the Sustainable Development Goals.
Late 2010s / early 2020s	Integration of ESG investing (environmental, social, and governance)	Investor demand for ESG data significantly increased pressure on companies to measure, manage, and report on factors that have a substantial impact on intangible assets, such as corporate culture, board effectiveness, data protection protocols, and community relations. This further linked intangible outcomes to financial valuation.

Source: developed by the author based on the findings of the study

Understanding intangible assets within the framework of sustainable development requires moving beyond traditional economic indicators. Their main types can be broadly classified, while also overlapping and interacting dynamically:

– *social capital:* encompasses bonds, norms, and trust that facilitate cooperation and collective action within and between communities. It

brings societies together, enabling them to address problems collectively and provide mutual support;

– *knowledge and information*: includes scientific understanding, traditional ecological knowledge, technological knowledge, as well as the capacity for learning and innovation. It is the intellectual engine that drives adaptation and progress;

– *institutional and governance frameworks*: rules, laws, policies, and organisational structures that govern behaviour and resources and ensure accountability. Effective governance is an asset that contributes to stability and equity;

– *cultural heritage and values*: refers to shared beliefs, traditions, artistic expressions, and ethical frameworks that shape identity and guide collective decision-making. Cultural values provide meaning and a sense of belonging, influencing how societies interact with their environment;

– *ecological integrity*: often associated with natural capital (the inherent health, biodiversity, and functional capacity of ecosystems). The capacity to provide essential ecosystem services can also be regarded as an intangible asset. It reflects the inherent quality and potential of a system.

These components are not static; rather, they are dynamic and interdependent. For example, strong social capital can facilitate the exchange and application of knowledge, while robust governance can protect cultural heritage and ecological integrity. Recognising and developing these assets is a key aspect of any meaningful agenda underpinned by sustainable development.

The conceptual dimension of intangible assets, particularly in the context of sustainable development, does not follow a single linear trajectory. It brings together diverse intellectual currents that have gradually recognised the limitations of purely materialistic perspectives. Although the term "intangible assets" has a long history in accounting and finance, its application to socio-ecological systems is more recent and stems from critiques of industrial society and a growing awareness of the interconnectedness of human and natural systems. As noted by the authors of the sustainable development handbook, "*recognising intangible assets for sustainable development* represents a gradual awakening from a materialistic dream, acknowledging that true wealth lies in the health of our relationships, knowledge, and the living planet itself" [13].

The theoretical foundations of intangible assets within the discourse of sustainable development are grounded in systems thinking, complexity theory, and a fundamental re-evaluation of value beyond purely economic or material terms. These assets do not function in isolation but rather as interconnected components of broader socio-ecological systems, influencing their behaviour, resilience, and adaptive capacity. Their theoretical significance lies in their ability to explain phenomena that are difficult to understand within the traditional economic model: why some communities thrive under conditions of stress while others collapse, or how innovation can occur even in the presence of limited material resources. The theoretical foundation provides a basis for arguing that intangible assets are generative forces within socio-ecological systems. They support resilience and adaptation through interconnectedness, which is manifested in the following:

1) *system dynamics:* considers intangible assets as critical variables within feedback loops. For example, investment in education, where knowledge constitutes an intangible asset, lays the foundation for increased innovation, which can generate economic returns in the future and contribute to greater investment in education. Conversely, the erosion of social capital can create feedback loops of distrust and conflict, undermining the stability of the system.

2) *network theory:* social capital is often analysed through network theory, which examines the structure and quality of relationships. Stronger and more diverse networks (intangible assets) can facilitate the flow of information, resources, and support, enhancing the system's capacity to respond to challenges.

3) *measurement and proxy challenges:* a key theoretical challenge is the quantitative assessment of these assets. Unlike physical assets, their value is context-dependent and difficult to measure directly. Theories explore various proxy indicators, such as measures of social cohesion, patent applications, or governance quality indices. This gives rise to ongoing debates about how to establish an objective assessment of these assets and make them visible in corporate reporting without losing sight of corporate value.

4) *interconnectedness theory:* intangible assets are closely linked to other forms of capital (Table 9). The theory emphasises that sustainable development requires a holistic approach that recognises and cultivates these interdependencies.

Table 9

Alignment of Intangible Asset Categories with Key Sustainable Development Goals (SDGs)

Category of intangible assets	Sustainable Development Goals (SDGs)	Manifestation of impact
Human capital	SDG 3 (Good Health and Well-being), SDG 4 (Quality Education), SDG 8 (Decent Work and Economic Growth)	Investments in employee training and development contribute to higher productivity and social resilience
Organisational capital	SDG 9 (Industry, Innovation and Infrastructure), SDG 16 (Peace, Justice and Strong Institutions)	The implementation of transparent governance practices enhances trust and organisational effectiveness
Social capital	SDG 10 (Reduced Inequalities), SDG 11 (Sustainable Cities and Communities), SDG 17 (Partnerships for the Goals)	Developing partnerships and trust among stakeholders contributes to social integration
Intellectual capital	SDG 7 (Affordable and Clean Energy), SDG 12 (Responsible Consumption and Production)	Innovation and patents enable the development and adoption of environmentally friendly technologies
Natural capital	SDG 13 (Climate Action), SDG 14 (Life Below Water), SDG 15 (Life on Land)	The sustainable use of natural resources reduces the environmental footprint of businesses

Source: developed by the author based on the findings of the study

The landscape of intangible assets in the context of sustainable development is characterised by growing recognition alongside persistent practical challenges. There is an increasing understanding, particularly among leading companies and international organisations, that factors such as brand purpose, stakeholder trust, and innovation potential are critically important. ESG investing has brought these aspects into the financial mainstream, creating demand for better data and more comprehensive disclosure.

Frameworks such as the IIRC and ISSB Standards aim to enhance the quality and informativeness of reporting by providing information on risks and opportunities related to sustainable development. However, significant

gaps remain. Measurement methodologies are still evolving and lack standardisation, resulting in inconsistencies in ESG ratings and difficulties in integrating intangible value into traditional financial analysis. Many companies find it challenging to move beyond reporting towards the active management and strategic development of these assets.

Contemporary approaches to intangible assets focus on their recognition and management through a range of strategies aimed at bridging the gap between their theoretical and economic significance and their practical application in sustainable development efforts. Recognising intangible assets makes it possible to reflect the actual value of human capital, innovation, brands, and social relationships in both financial and non-financial reporting. The management of intangible resources provides strategic control over knowledge, corporate culture, and partnerships, which is crucial for long-term resilience. Such strategies seek to balance economic efficiency with social responsibility, in line with ESG principles and the United Nations Sustainable Development Goals. They help companies mitigate risks associated with environmental and social challenges while simultaneously enhancing investment attractiveness through transparency and innovation. As a result of implementing strategic decisions, intangible assets become not only a source of competitive advantage but also a foundation for the sustainable development of businesses and society (Table 10).

Business strategies focused on sustainable development have a positive impact on financial stability, corporate reputation, and the company's long-term prospects. Their benefits include enhanced competitiveness, cost reduction, attracting investors, stronger brand recognition and customer loyalty, compliance with regulatory requirements, increased productivity and talent attraction, innovative development, and greater resilience to crises and risks. As noted by *Kelsey Miller*, "In line with a business sustainability strategy, data increasingly show that companies with forward-looking ESG performance achieve higher financial returns. Consequently, an increasing number of investors have begun to focus on ESG metrics when making investment decisions" [14].

Table 10

Sustainable Development Strategies for the Recognition and Management of Intangible Assets

Strategic dimension	Strategy implementation approach	Example of effect
Economic dimension	Recognition of innovation, brands, and data as investments; integration of intangible assets into financial reporting	Increased company market value; enhanced investment attractiveness
Social dimension	Management of human and social capital; development of corporate culture and partnerships	Strengthened stakeholder trust; increased employee motivation and productivity
Environmental dimension	Innovation in green technologies; responsible use of natural capital	Reduced environmental footprint; alignment with the Sustainable Development Goals (SDGs)
Integrated dimension	Integration of economic, social, and environmental aspects into a single business model	Development of a sustainable competitive advantage; long-term growth and adaptability

Source: developed by the author based on the findings of the study

The implementation of sustainable development strategies can be manifested through the concept known as the *Triple Bottom Line (TBL)*. This is an approach to assessing business success that goes beyond traditional financial indicators. The concept implies that companies should evaluate not only their financial performance but also the social and environmental impacts of their activities. Business success is determined not solely by profit but also by the extent to which a company contributes to societal well-being and environmental preservation. The concept is based on three key elements, known as the *"three Ps": Profit, People, Planet.* Each of these elements reflects, to varying degrees, the contribution of intangible assets to sustainable development.

Profit ensures a company's financial stability and its capacity for further development. Traditionally, businesses were assessed solely in terms of profitability; however, contemporary companies are increasingly focusing on social responsibility. Within the framework of sustainable development, financial benefits should be generated without causing harm to society or the environment, which requires the implementation of ethical business

practices. The efficient use of resources, responsible treatment of employees and partners, and adoption of innovative technologies contribute to long-term financial stability. Within the Triple Bottom Line framework, profit is not merely an ultimate objective but also a means of creating a positive impact on society and the environment.

People: a company's social impact is measured by its ability to provide fair working conditions, decent remuneration, equal opportunities for career development, and workplace safety. Responsible businesses respect human rights, avoiding labour exploitation, discrimination, and other violations of ethical standards. Companies that pay attention to social responsibility strengthen the trust of customers and partners, which positively affects their reputation and competitiveness. The implementation of ethical business practices entails transparency in business operations, fair treatment of consumers, and consideration of their needs and interests.

Planet: this dimension reflects the environmental responsibility of businesses. Companies should recognise their impact on ecosystems and actively work to reduce harmful emissions, use natural resources efficiently, and minimise waste. This involves transitioning to renewable energy sources, implementing circular economy principles, and developing environmentally friendly technologies. A responsible approach to the environment includes optimising logistics, reducing water consumption, and lowering the carbon footprint of production processes. Investment in *green initiatives* opens up new opportunities for businesses, including through government grants, tax incentives, and cooperation with international organisations. Companies that assume environmental responsibility reduce their adverse impact on nature and contribute to the sustainable development of society as a whole, while ensuring cleaner resources for future generations.

Integration of ESG indicators into a company's strategy plays a key role in the long-term sustainability of a business. The importance of such integration can be observed both in the practices of leading companies and in cases where the neglect of ESG risks results in financial losses and reduced trust among customers and investors. Positive integration practices include the following:

1) *Microsoft* [15] aims to achieve carbon neutrality by 2030 and to offset all carbon emissions generated since its founding by 2050. The company actively invests in renewable energy sources, reduces waste, and lowers the

carbon footprint of its products. Microsoft's efforts include implementing digital tools that help customers measure and reduce their environmental impact. In addition, the development of ESG-related innovations helps the company strengthen its reputation and enhance its investment attractiveness, meeting the expectations of environmentally conscious investors and partners.

2) *Patagonia* [16] has built a strong reputation by integrating environmental and social values into its brand, thereby fostering significant customer loyalty. The company emphasises sustainability through various initiatives, such as the use of recycled and organic materials, ensuring fair labour practices, and supporting activism and environmental engagement. The company's support for environmental initiatives and transparency regarding supply-chain practices further strengthen brand loyalty and differentiate it in the market.

3) *Unilever's Sustainable Living Plan (USLP)* [17] was a pioneering initiative launched in 2010 with the aim of enhancing the company's social impact and reducing its environmental footprint. It included more than 50 targets focused on improving health, reducing waste, and creating a positive social impact at the global level. The plan made a significant contribution to *Unilever's* reputation, enabling the company to stand out in the market as a responsible and sustainable business, particularly appealing to investors interested in environmental, social, and governance (ESG) performance. The key achievements of the *USLP* included a 50% reduction in greenhouse gas emissions from manufacturing, achieving 100% renewable electricity use, and reaching 1.3 billion people through health-related initiatives. Building on the success of the *USLP*, *Unilever* introduced the Unilever Compass strategy, which retains a focus on sustainability by setting ambitious targets for climate action, reducing plastic use, promoting fair pay, and advancing gender equality throughout the supply chain.

The trajectory of intangible assets in sustainable development is characterised by their growing recognition, evolving from being treated as external factors to becoming central pillars of sustainable and equitable systems. This evolution has been underpinned by key stages and developments that have contributed to methodological improvements and their deeper integration into policy and business strategies. The environmental movement brought greater clarity to the concept of

natural capital, although it was initially considered primarily through the lens of resource depletion and pollution. It laid the foundations for assessing non-market aspects of the environment. The formalisation of social capital theory provided a strong academic basis for understanding the value of networks, trust, and norms, challenging the notion that wealth is determined solely by material factors. Growing dissatisfaction with gross domestic product (GDP) as the sole measure of progress led to the development of alternative indicators and frameworks incorporating social, environmental, and intangible dimensions of well-being. The rapid growth of information technology and the knowledge economy highlighted the economic and social value of intellectual property, data, and human knowledge, further reinforcing the importance of intangible assets. The intensification of the climate crisis and growing awareness of systemic risks have strengthened the need for adaptive capacity, social cohesion, and effective governance.

Looking ahead, the trajectory of *intangible assets* in sustainable development is characterised by their growing centrality and complexity. As global challenges such as climate change, biodiversity loss, and social inequality intensify, the ability of societies and economies to adapt and transform will critically depend on their capacity to recognise, cultivate, and strategically utilise these intangible resources. The future is likely to involve deeper integration of intangible asset considerations into all levels of decision-making, from global policy to the actions of local communities.

New trends indicate a shift from simply recognising these assets towards actively designing systems that foster their development and resilience. This involves innovative approaches to: 1) measuring and assessing social and environmental capital; 2) developing new governance models that are more adaptive and inclusive; and 3) using digital technologies to enhance knowledge sharing and collaboration. The concept of intangible assets will evolve to encompass new forms of value, such as the "regenerative capacity" of systems or the "well-being potential" embedded in healthy socio-ecological interactions. The challenge will be to translate this growing understanding into tangible, systemic changes that move humanity towards a truly sustainable and equitable future.

Looking ahead, intangible assets in sustainable development are likely to become increasingly important as key drivers of systemic resilience,

innovation, and equitable well-being in an increasingly complex world. Key development trends in this area may include the following:

1) *reconsideration of approaches to the valuation, recognition, and accounting of intangible assets:* innovations in methods for valuing and accounting for social, cultural, and environmental capital. As a result, this may lead to the development of new integrated reporting frameworks that impose requirements on intangible assets comparable in rigour to those applied to financial reporting indicators, potentially increasing their influence on investment decisions and corporate accountability.

2) *digital platforms for collaboration and knowledge sharing:* technologies such as artificial intelligence, blockchain, and data analytics will play an increasingly important role in knowledge management and sharing, facilitating global collaboration and potentially creating new forms of digital commons and intellectual capital.

3) *design of regenerative systems:* greater emphasis will shift from "sustaining" current levels towards actively "regenerating" degraded systems. This requires a profound understanding and strengthening of intangible capacities such as ecological health, social trust, and adaptive governance that drive regeneration.

4) *policy innovation for social and environmental sustainability:* future policies should be designed not only to mitigate harm but also to build the intangible foundations of resilience. This may include universal basic income to strengthen social capital, substantial public investment in education and research, as well as new legal frameworks for governing common resources.

5) *ethical frameworks for intangible value:* as the sustainable significance of intangible assets grows, ethical considerations related to their distribution, access, and governance will also emerge. Discussions concerning intergenerational equity, digital rights, and the rights of nature will become increasingly prominent.

The challenge lies not only in managing these assets but also in creating an environment in which they can flourish organically, stimulating innovation and resilience in the face of unprecedented change. The success of this transition depends on the willingness to reconceptualise prosperity by moving beyond material accumulation and embracing the profound, generative power of the intangible.

CONCLUSIONS

In the digital economy, intangible assets are becoming a key factor in corporate value creation and the achievement of companies' long-term competitive advantages. The development and scaling of artificial intelligence technologies depend directly on investment in digital information, innovative property, and economic competencies, which form the foundation of the contemporary intangible economy. The cyclical nature of the interaction between artificial intelligence and intangible assets means that accumulated data, knowledge, and intellectual property enhance the performance of AI models, while the outputs generated through their use create new intangible assets and increase their economic value. The model of the relationship between artificial intelligence and intangible assets demonstrates the strategic importance of effective management of data, human capital, content, intellectual property, and regulatory mechanisms in generating a sustainable "flywheel effect" of value creation. An analysis of global trends has demonstrated sustained growth in investment in software, research and development, databases, and digital infrastructure, confirming a shift in the structure of global capital investment towards intangible resources. At the same time, the findings of the study indicate that the competitiveness of countries and companies is increasingly determined not by the volume of tangible resources, but by their ability to create, accumulate, and effectively utilise intangible assets in combination with artificial intelligence technologies. Further research should focus on developing methodological approaches to assessing the economic value of implied intangible assets created or enhanced through the use of artificial intelligence, as well as on improving their recognition and presentation within accounting and corporate reporting systems.

Traditional accounting approaches do not provide a complete representation of intangible assets, as a result of which a significant proportion of corporate value remains invisible to financial reporting and investors. It has been established that, with the increasing adoption of artificial intelligence technologies, the issue of measuring intangible assets is becoming particularly important, as they simultaneously serve as key resources for the operation of AI systems and as outcomes of their use. A comparative analysis of the Corrado-Hulten-Sichel (CHS) framework, the Six Capitals model, and the Opagio 12™ Framework has shown that

they are complementary and cover different levels of intangible value assessment – from macroeconomic analysis to corporate governance and strategic decision-making. Particular attention has been paid to the *Opagio 12*™ Framework, which provides a comprehensive taxonomy of intangible value drivers and enables the systematic identification of assets that are not recognised under current accounting standards. Increasing the visibility of intangible assets contributes to a more objective assessment of the market value of businesses, more efficient capital allocation, greater investment attractiveness, and improved strategic management. Integrating contemporary economic valuation models with traditional accounting systems creates the basis for a more comprehensive representation of corporate value creation processes in the digital economy. Further research should focus on developing methodological approaches to integrating intangible asset valuation models into financial and integrated reporting systems, as well as on developing indicators that would enable the quantitative assessment of the contribution of artificial intelligence to corporate value creation.

The study has demonstrated that intangible assets are a fundamental component of sustainable development. They shape the adaptive capacity, resilience, and long-term value of socio-economic and ecological systems. Human, intellectual, social, organisational, and natural capital constitute interconnected intangible resources that determine the ability of society, governments, and businesses to respond effectively to contemporary global challenges. The evolution of international approaches to corporate reporting, the development of the ESG concept, integrated reporting, and the United Nations Sustainable Development Goals have contributed to the gradual recognition of intangible assets as key drivers of long-term value creation. It has been demonstrated that integrating intangible assets into strategic management enhances innovation potential, strengthens stakeholder trust, increases investment attractiveness, and creates sustainable competitive advantages. Of particular importance is the development of methodological approaches to the valuation and disclosure of information on intangible assets in financial, non-financial, and integrated reporting, which will contribute to greater transparency of corporate activities and improve the quality of management decisions. At the same time, effective management of intangible assets should be based on a comprehensive combination of

economic, social, and environmental objectives, ensuring the implementation of ESG principles and the achievement of the Sustainable Development Goals. Further research should focus on developing integrated models for assessing intangible assets that take into account their contribution to corporate sustainability, regenerative development, and long-term value creation in the context of the digital transformation of the economy.

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