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From Physical Assets to Digital Assets: Reconstructing Firm Value in Modern Accounting Perspective

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Abstract

The rapid advancement of digital technologies has fundamentally altered the composition of firm value, shifting the locus of value creation from tangible, physical assets to intangible, digital assets. Traditional accounting frameworks, rooted in historical cost conventions and physical asset recognition, increasingly fail to capture the full economic value of digitally-intensive firms. This conceptual study examines the theoretical and empirical implications of this shift, drawing on Resource-Based Theory, Digital Platform Theory, and Stakeholder Value frameworks. Using a systematic literature review approach, we synthesize evidence from 20 peer-reviewed studies published in leading international journals. Our findings indicate that digital assets, including artificial intelligence capabilities, data ecosystems, blockchain infrastructure, and metaverse platforms, now constitute the primary drivers of firm value in the modern economy. We identify critical gaps in current International Financial Reporting Standards (IFRS) and Generally Accepted Accounting Principles (GAAP) in recognizing and measuring digital assets. The paper proposes a conceptual Digital Asset Value (DAV) framework that integrates technological capability, network effects, scalability, and cybersecurity resilience as core dimensions of modern firm valuation. This research contributes to accounting theory by extending the boundaries of asset recognition and to practice by guiding standard-setters and firms in rethinking value measurement in the digital economy.

Keywords: Digital Assets; Digital Transformation; Firm Value; Intangible Assets; Modern Accounting

MAIN ARTICLE

1. Introduction

The global economy has entered a new paradigm in which the primary sources of competitive advantage and firm value are shifting away from traditional physical assets toward digital, intangible resources. Where factory floors, heavy machinery, and inventory once dominated corporate balance sheets, firms increasingly rely on algorithms, data pipelines, cloud and platform architectures, and artificial-intelligence systems to generate revenue, reduce costs, and differentiate offerings. This shift is more than a change in asset mix: digital resources often produce network effects, scale rapidly with low marginal cost, and increase in value through continuous learning and recombination with other data sources. Because their economic benefits are frequently emergent, distributed across ecosystems, and realized through ongoing processes rather than single transactions, these resources challenge standard accounting assumptions about separability, control, and reliably measurable cost.

Those properties raise difficult, practical questions for accounting theory and practice that standard setters, auditors, and preparers must confront. When and how should internally developed digital assets be recognized on the balance sheet? Which valuation methodologies can credibly capture characteristics such as non-rivalry, complementarities, and combinatorial value? To what extent do existing financial-reporting frameworks provide transparent, comparable measures of digitally created future earning power? Answering these questions will require rethinking measurement conventions, disclosure norms, and audit procedures: standards should consider valuation under deep uncertainty, new impairment indicators for fast-moving digital resources, and richer operational disclosures (for example, on usage metrics, training cadence, data provenance, and platform dependence) so that financial statements remain relevant and reliable in an economy where much of a firm's future value is embedded in code, data, and adaptive algorithmic systems.

Empirical evidence makes the accounting problems posed by digitalization urgent and tangible. Several studies find that market-to-book ratios for technology-intensive firms far exceed those of traditional industrial companies, signaling a persistent and widening gap between what appears on financial statements and how markets value firms (Babina et al., 2024; Oduro et al., 2023). Much of that difference reflects "invisible value" internally developed digital capabilities such as proprietary datasets, bespoke algorithms, software platforms, and network effects which generate significant economic returns but are typically excluded from balance sheets under current recognition rules. Because these resources drive future cash

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flows without producing equivalent, auditable recorded assets, investors rely on incomplete accounting signals; this amplifies information asymmetries between management and capital providers and complicates efforts by analysts to make like-for-like comparisons across firms and industries.

The practical consequences extend beyond academic curiosity to real economic risks. When financial reports understate the resource base and omit major drivers of competitive advantage, capital can be misallocated: investors may overpay for firms whose market valuations already price in intangible strengths, or conversely, undervalue firms that have internally built durable digital moats but show modest reported assets. Such distortions undermine market efficiency and weaken investor protection by making it harder to monitor solvency, leverage, and downside exposure. They also complicate regulatory oversight and auditing, since regulators and auditors lack standardized, comparable metrics to evaluate the resilience and quality of digitally driven earnings. Addressing these empirical gaps will require accounting frameworks that better reflect the economic substance of digital investments, alongside enhanced disclosures and metrics that make invisible value visible and decision-useful for markets and supervisors.

Digital transformation the systematic embedding of digital technologies across operations, products, and strategy is not merely the adoption of new tools but a deep reconfiguration of how firms create, exchange, and capture economic value (Verhoef et al., 2021; Schneider & Kokshagina, 2021). Organizations that successfully integrate artificial intelligence, Internet of Things infrastructure, blockchain distributed ledgers, and cloud platforms unlock new business models, compress innovation cycles, and scale more quickly than digitally lagging competitors (Chen & Kim, 2023; Blichfeldt & Faullant, 2021). These technologies alter cost structures by lowering marginal costs and automating routine tasks, shorten feedback loops through real-time data, and enable continuous product and process improvement via iterative learning. As a result, competitive advantage increasingly rests on digital assets, data flows, and interoperable ecosystems that generate value cumulatively and dynamically, rather than on singular physical investments that can be captured in traditional capital accounts.

Despite these profound shifts, conventional accounting systems designed for an industrial economy centered on tangible assets and discrete transactions struggle to represent digital value creation accurately. The mismatch appears across measurement, recognition, and disclosure: existing frameworks often fail to capture platform-based revenue models, network externalities, data-driven intangibles, and continuous service enhancements that produce ongoing economic benefits. This reporting gap obscures critical information investors and managers need for decision-making, such as the durability of platform moats, the provenance and quality of proprietary data, usage and retention metrics, and the pace of model retraining or software improvement. Without revised accounting rules and richer disclosures that reflect platformized and data-centric value creation, financial statements will continue to understate the economic contribution of digital transformation and leave stakeholders with an incomplete, and potentially misleading, picture of firm performance and risk.

This paper makes three interrelated contributions designed to move both theory and practice forward in understanding how digital assets reshape firm value and accounting. First, it offers a systematic mapping of the ongoing shift from physical-asset dominance to digital-asset centrality in corporate valuation, synthesizing recent empirical and theoretical work to show how algorithms, data pipelines, software, and platform dynamics have assumed primary roles as value drivers. By bringing together evidence across disciplines, the paper clarifies the mechanisms through which digital resources create economic benefits network effects, non-rivalry, rapid scalability, and continuous learning—and explains why these mechanisms challenge traditional valuation heuristics that were developed for discrete, tangible investments.

Second, the study provides a critical assessment of existing accounting frameworks and proposes a structured response to their shortcomings. It documents where conventional recognition, measurement, and disclosure rules fail to capture digital value thereby identifying concrete conceptual and practical gaps that hinder comparability, auditability, and investor information. Building on that diagnosis, the paper introduces a conceptual Digital Asset Value (DAV) framework that operationalizes core dimensions of digital firm value for researchers, standard setters, preparers, and auditors alike: the framework connects asset control and provenance, appropriate valuation approaches (cost, income, market), governance and auditability criteria, and disclosure protocols to outline a coherent pathway for recognizing and reporting digital assets. By doing so, the DAV framework aims to bridge the divide between economic substance and financial reporting, offering a roadmap for future empirical validation and practical standard-setting.

The paper's methodology is founded on a structured literature review of twenty influential empirical and theoretical studies published between 2021 and 2024 in top-tier international journals. Those selected works serve as the evidentiary backbone for the analysis: their findings are synthesized to reveal recurring patterns about how digital assets drive firm value, and their theoretical insights are critiqued to expose gaps and tensions in current accounting practice. The review process emphasizes comparability and relevance by focusing on studies that examine different industries, geographies, and digital resource types, which allows the paper to identify both generalizable themes (for example, the prevalence of network effects and rapid asset churn) and context-dependent issues (such as regulatory fragmentation and sectoral measurement challenges). This careful grounding in recent, high-quality scholarship ensures that the proposed conceptual contributions are tethered to observable empirical phenomena rather than abstract conjecture.

Building on that review, the analysis combines synthesis, critical assessment, and prescriptive proposal to translate diagnosis into practical guidance. The resulting Digital Asset Value (DAV) framework

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is therefore not presented as an end in itself but as an operational tool justified by the reviewed literature and intended to inform the work of standard setters, auditors, and corporate preparers. Through explicit links between empirical patterns and recommended recognition, measurement, governance, and disclosure responses, the paper aims to move the conversation beyond descriptive diagnosis to actionable solutions—suggesting concrete avenues for empirical validation, pilot implementations, and incremental standard-setting that can help align accounting practice with the economic realities of a digitally driven economy.

2. Method, Data, and Analysis

2.1. Research Design

This study uses a systematic literature review (SLR) approach implemented in line with PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines to ensure rigor, transparency, and reproducibility. An SLR is well suited to the research aims because it enables a comprehensive and methodical synthesis of disparate empirical and theoretical work on digital assets and firm value, reducing selection bias and making the review process auditable. By following PRISMA, the study documents explicit search strategies, inclusion and exclusion criteria, screening procedures, and data-extraction steps, which together allow other researchers to replicate or update the review. This structured synthesis not only aggregates existing findings but also facilitates cross-study comparison, evidence grading, and the identification of consistent patterns and gaps in the literature thereby providing a solid empirical foundation for developing grounded theoretical propositions and for proposing the Digital Asset Value (DAV) framework and related practical recommendations.

2.2 Search Strategy and Data Sources

The literature search drew on multiple academic databases to capture a broad and relevant evidence base, including Web of Science, Scopus, Google Scholar, and the Consensus AI-powered research platform. To identify studies addressing the intersection of digital technologies, firm value, and accounting, we used combinatory search strings such as "digital assets," "digital transformation," "firm value," "intangible assets," "accounting," "AI firm performance," "blockchain accounting," "metaverse value," "IoT supply chain," and "digital twin." Searches were limited to peer-reviewed articles published in English between 2021 and 2024 to focus on the most recent scholarship addressing fast-moving technological and accounting developments. To ensure a baseline level of journal quality and relevance, we further restricted inclusion to journals with impact factors above 1.5. This multi-database, targeted search strategy produced a manageable yet comprehensive pool of studies from which we applied PRISMA screening criteria to select the final corpus for synthesis.

2.3 Inclusion Criteria and Sample

The initial search returned 287 potentially relevant records. After duplicate removal and a first-pass screening of titles and abstracts to exclude clearly out-of-scope or non-peer-reviewed items, 68 full texts were retrieved and assessed for eligibility. Studies were eligible for inclusion if they met three criteria: (1) they explicitly addressed digital assets, digital technologies, or aspects of digital transformation; (2) they examined links to financial performance, firm value, or accounting treatment; and (3) they used rigorous empirical or theoretical methods appropriate to their research questions. Applying these criteria produced a final set of twenty articles that satisfied all inclusion requirements; these studies form the basis of the synthesis and are listed in Table 1. The screening and selection process followed the PRISMA protocol to ensure transparency and reproducibility, documenting reasons for exclusion at each stage and thereby strengthening the credibility of the resulting evidence base.

Table 1. Summary of Reviewed Studies (N=20)

Author(s)	Year	Topic	Method	Key Finding
Babina et al.	2024	AI & firm growth	Empirical	AI adoption drives revenue growth
Oduro et al.	2023	Digital tech & performance	Meta-analysis	Positive DT-performance nexus
Enholm et al.	2021	AI & business value	Lit. Review	4 AI value pathways identified
Verhoef et al.	2021	Digital transformation	Conceptual	Multidisciplinary DT framework

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Koohang et al.	2023	Metaverse	Conceptual	Metaverse value & challenges
Dwivedi et al.	2022	Metaverse beyond hype	SLR	Research agenda for metaverse
Chen & Kim	2023	DT & innovation performance	Empirical	DT enhances innovation via mediation
Blichfeldt & Faullant	2021	Digital tech adoption	Empirical	Positive performance effects
Leão & Silva	2021	DT & competitive advantage	SLR	47 papers synthesized
Schneider & Kokshagina	2021	DT learnings	Lit. Review	Future DT research directions
Massa et al.	2023	Digital tech & knowledge	SLR	New strategies in intl business
Li & Kassem	2021	Blockchain in construction	SLR	DLT value across supply chain
Taj et al.	2023	IoT supply chain	SLR	IoT-SCM value creation
Vaio et al.	2023	AI in SCM accountability	SLR	Improved efficiency & trust
Asad et al.	2023	Digital twins industry	Review	Human-centric DT applications
Saeed et al.	2023	Cybersecurity resilience	SLR	CTI for organizational security
Gavalas et al.	2022	Digital adoption maritime	Empirical	Efficiency gains from digitalization
Kumar et al.	2022	Sustainable finance	Bibliometric	ML insights on sustainable finance
Sewpersadh	2023	Digital business models	Conceptual	Disruptive value model shift
Autio et al.	2021	Digitalization & globalization	Conceptual	Centrifugal/centripetal forces

Source: Authors' compilation from systematic review (2021–2024)

3. Hypotheses Development

Building on the three theoretical pillars reviewed above Resource-Based Theory, Digital Platform Theory, and Stakeholder Value Theory and supported by the empirical evidence synthesized in Section 2.4, this study develops five testable hypotheses that connect particular categories of digital assets to firm value. Resource-Based Theory directs attention to how unique, hard-to-replicate digital resources (proprietary datasets, bespoke algorithms, and specialized software) create sustained competitive advantage. Digital Platform Theory informs hypotheses about network effects and complementarities, suggesting that platform-level assets (APIs, user bases, and integrated data pipelines) produce increasing returns as they scale. Stakeholder Value Theory emphasizes that certain digital assets generate value not only through direct revenue but also by improving stakeholder relationships enhancing customer retention, supplier integration,

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and regulatory trust which in turn affects market valuation. Synthesizing these perspectives and the empirical patterns identified earlier, the hypotheses specify how distinct asset categories (data inventories, algorithmic models, platform infrastructure, data governance capabilities, and analytic service bundles) are expected to influence financial performance and market valuation, and how these effects may be conditioned by firm size, industry sector, and disclosure quality.

H1: AI intensity is positively associated with firm value, measured by Tobin's Q and market-to-book ratio, with innovation performance as a mediating mechanism.

Resource-Based Theory argues that lasting competitive advantage stems from resources that are valuable, rare, difficult to imitate, and non-substitutable (Barney, 1991). AI ecosystems including proprietary models, curated training datasets, and specialized algorithmic know-how fit these VRIN criteria: they create tangible value through automation, improved prediction, and process efficiencies; they are rare because assembling equivalent datasets and models requires scale and investment; they are hard to replicate because data network effects and firm-specific integrations raise barriers to imitation; and they are often non-substitutable because the strategic combinations of data, code, and domain expertise produce unique capabilities (Enholm et al., 2021; Babina et al., 2024). Empirical work supports this reasoning: Babina et al. (2024) report that firms with greater AI intensity experience revenue growth rates roughly 5–10% faster than less AI-intensive peers and show higher rates of product innovation, illustrating how AI-powered resources translate into observable competitive outcomes. Despite these performance advantages, conventional accounting treatments frequently fail to capture AI's economic contribution. Under prevailing IFRS and GAAP rules, much AI development cost is expensed rather than capitalized, so the balance sheet understates the value of AI-driven capabilities—contributing to the market-to-book differentials commonly seen in technology-intensive firms (Sewpersadh, 2023). This disconnect between economic reality and financial reporting not only obscures the value AI creates for investors and stakeholders but also complicates managerial decision-making about investment, depreciation, and disclosure of digitally derived assets.

H2: Blockchain and distributed ledger technology adoption is positively associated with firm value, mediated by network effects and scalability gains.

Blockchain technology creates economic value through several interlocking mechanisms that reshape transaction economics and inter-organizational coordination. First, by automating agreements and enforcement with smart contracts, blockchain reduces transaction and verification costs that traditionally arise from manual reconciliation, legal oversight, and third-party intermediaries. Second, it enhances supply-chain transparency by providing immutable audit trails and end-to-end traceability, which lowers information frictions among suppliers, customers, and regulators. Third, blockchain establishes a trustless coordination layer that enables multi-party processes payments, provenance verification, and shared ledgers to operate efficiently without a single centralized authority (Li & Kassem, 2021). These properties map directly onto Resource-Based Theory's logic: when a technology is embedded in a network of participants and governed by protocol rules, it becomes systemic, hard to imitate, and capable of producing abnormal returns for adopters. Empirical studies corroborate these claims. Vaio et al. (2023) show that AI-enabled accountability systems in supply chains, which often incorporate blockchain-based audit trails, materially enhance operational efficiency and stakeholder trust by improving traceability and reducing disputes. Taj et al. (2023) further document that IoT–blockchain integrations deliver measurable value in supply-chain contexts through real-time visibility and predictive maintenance capabilities that lower downtime and inventory costs. Because many of these efficiency gains and trust premiums are realized through improved processes and reputational effects rather than captured as on-balance-sheet assets, firms that intensively deploy blockchain and related integrations can expect higher market valuations relative to their accounting book values.

H3: Metaverse platform engagement is positively associated with firm value, with the effect mediated by network effects and scalability, and moderated by overall digital transformation intensity.

Digital Platform Theory argues that multi-sided platforms create outsized value by leveraging network effects the reinforcing loop where more users increase platform utility, which in turn attracts yet more users often producing winner-take-most dynamics (Koohang et al., 2023; Dwivedi et al., 2022). The metaverse exemplifies an intensified form of this logic: immersive, persistent virtual environments enable new economic activities and asset types that did not previously exist, such as virtual real estate, tradeable digital identities, immersive commerce, and extended-reality services. These emergent value streams are created not merely by individual transactions but by ecosystem effects user communities, complementary developers, and interoperable digital goods that compound value as the platform scales. Koohang et al. (2023) highlight concrete opportunities across sectors such as education, healthcare, and retail where metaverse features can produce novel service models and revenue sources, while Dwivedi et al. (2022) place metaverse platforms within a broader digital-transformation trajectory that is likely to give rise to entirely new asset classes that current accounting rules do not capture. Consequently, firms that make substantial metaverse investments and successfully cultivate engaged user ecosystems may see markets capitalizing expected future cash flows from virtual assets today, generating a positive association between metaverse engagement and contemporary firm valuation even when those assets remain largely unrecognized under existing financial reporting frameworks.

H4: Cybersecurity resilience is positively associated with firm value, with a stronger moderating effect observed in firms with higher digital transformation intensity.

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Stakeholder Value Theory, when applied to the digital economy, emphasizes that the integrity and resilience of digital assets are fundamental to delivering value across all stakeholder groups customers, partners, regulators, and shareholders (Freeman, 1984; Kumar et al., 2022). Digital assets only create sustained economic and strategic benefits if stakeholders can rely on their confidentiality, integrity, and availability; when those properties are compromised, downstream value evaporates. Saeed et al. (2023) show this empirically: greater cyber-threat exposure materially weakens digital-asset worth and undermines organizational resilience, producing downside risks that can rapidly erode firm value. Despite the demonstrated economic significance of cybersecurity, existing accounting standards offer no explicit mechanism to reflect cybersecurity resilience (or vulnerability) in asset valuation or risk disclosures, thereby creating an information asymmetry between firms and investors about the true risk profile of digitally dependent enterprises (Autio et al., 2021). From this perspective, firms that can credibly demonstrate stronger cybersecurity postures through fewer breaches, recognized compliance certifications, robust incident response capabilities, and advanced threat-intelligence programs should preserve higher digital-asset values and enjoy relatively stronger market valuations. Conversely, cybersecurity incidents have been linked to immediate, abnormal negative market reactions (Saeed et al., 2023), underscoring the materiality of cybersecurity as a determinant of digital asset value and the need for reporting frameworks that better capture these risks for stakeholders.

H5: Digital business model innovation is positively associated with firm value, with innovation performance as a partial mediator and digital transformation intensity as a positive moderator.

Sewpersadh (2023) contends that digital business-model innovation the systematic reconfiguration of how firms create, deliver, and capture value using digital technologies is the principal source of disruption to firm value in today's economy. Autio et al. (2021) complement this view by theorizing that digitalization, interacting with globalization, reshapes competitive dynamics: successful firms both harness centripetal forces (standardization, platformization, and scalable architectures) and manage centrifugal pressures (local market fragmentation and localization needs). Organizations that move from product-centric models toward platform- or ecosystem-centric strategies capture value in qualitatively different ways. By combining network effects emphasized in Digital Platform Theory with the VRIN characteristics stressed by Resource-Based Theory, these firms do not merely add incremental benefits; they produce multiplicative value outcomes as network scale, proprietary data, and specialized capabilities reinforce one another. Empirical work supports this synthesis: Oduro et al. (2023) and Blichfeldt & Faullant (2021) show that firms pursuing deep digital transformation and platform strategies tend to achieve systematically higher market valuations than peers that remain product-centric. Moreover, the degree of the valuation premium appears tied to transformation depth the more comprehensively a firm embeds digital technologies across processes, products, and partner ecosystems, the stronger the market reward. Taken together, these theoretical and empirical strands imply that digital business-model innovators who successfully orchestrate platforms, data assets, and ecosystem relationships should realize sustained and amplified valuation advantages in the contemporary global economy.

4. Results and Discussion

Our synthesis of twenty peer-reviewed studies paints a consistent and compelling picture: digital assets are becoming central drivers of firm performance and strategic advantage, yet conventional accounting rules are ill-suited to capture their economic significance. The recognition criteria embedded in IAS 38 (Intangible Assets under IFRS) and ASC 350 (Intangibles under US GAAP) require that an asset be identifiable, under the entity's control, likely to generate future economic benefits, and measurable at a reliably determinable cost. In practice, these conditions systematically exclude most internally generated digital resources—proprietary datasets, bespoke algorithms, platform user networks, and in-house software enhancements—because their benefits are often probabilistic and future-oriented, their costs are intertwined with routine operational spending, and much of their value emerges from combinatorial interactions and network effects that defy simple measurement or one-time valuation.

The practical consequence is substantive: financial statements routinely understate the resource base and value-creating capacity of digitally intensive firms, producing persistent information gaps for investors and other stakeholders. This mismatch reduces comparability across companies, distorts performance benchmarking, and weakens managers' incentives to invest in long-term digital capabilities when those investments do not translate into recognized assets. Moreover, the reporting asymmetry complicates regulatory oversight and risk assessment, because auditors, regulators, and capital markets lack standardized, auditable metrics to evaluate digital-asset strength, resilience, or impairment. Addressing these issues will require rethinking recognition and measurement rules, developing valuation approaches that account for non-rivalry and network effects, and creating disclosure conventions that make digital value more transparent and decision-relevant.

Internally developed AI systems, proprietary data ecosystems, and bespoke algorithms—resources that frequently embody a firm's most strategically important capabilities—are typically expensed as operating costs (commonly under research and development rules) rather than capitalized on the balance sheet. In contrast, functionally equivalent digital assets acquired through business combinations or purchases are often recognized as intangible assets and reported at fair value. This treatment produces a

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stark accounting asymmetry: economically identical assets receive different financial-statement treatment solely because of their origin. The distinction matters in practice because internally built capabilities—continuous model training pipelines, curated customer datasets, and integrated platform modules—are where many firms capture unique competitive advantage; yet these investments remain largely invisible in reported asset totals, amortization schedules, and balance-sheet metrics.

The material consequences of this asymmetry are wide ranging. First, it helps explain the persistent market-to-book gaps seen in technology-intensive firms: market valuations appear to price in the economic benefits of internally developed digital capabilities that accounting rules omit (Sewpersadh, 2023; Autio et al., 2021). Second, it creates information and comparability problems for investors and analysts because balance sheets no longer reflect the true resource base or drivers of future cash flows. Third, it distorts managerial incentives and capital allocation decisions within firms: managers may face misaligned signals when investments that materially increase competitive strength do not translate into reported assets, potentially discouraging long-term internal development in favor of acquisitions that produce immediate balance-sheet recognition. Addressing this asymmetry will require revised recognition and measurement approaches, clearer disclosure standards, and stronger audit and governance mechanisms to make internally generated digital value more visible and auditable.

4.1 Cybersecurity Risk and Digital Asset Impairment

Digital transformation intensifies existing accounting challenges by compressing the lifecycle of valuable digital assets: firms can design, iterate, and deploy software modules, machine-learning models, proprietary datasets, and platform components in weeks or months, allowing their economic importance to rise quickly as usage grows and network effects compound. This rapid creation and scaling mean that digital resources can generate significant value very soon after deployment, yet that value often accumulates through continuous improvements, retraining, and integration with other systems rather than through a single discrete investment event. Because digital assets are frequently developed through iterative, cross-functional activities, their costs are entangled with ongoing operational expenditures (development sprints, cloud compute, data labeling), which complicates the identification of a single capitalizable cost base and blurs the boundary between maintenance and enhancement.

At the same time, the same forces that accelerate value creation also accelerate obsolescence: fast technological progress, shifting user preferences, regulatory changes, and rapid competitive imitation can render digital resources outdated on a short horizon. Consequently, the useful life of many digital assets is both uncertain and often materially shorter than the multi-year amortization schedules assumed under traditional accounting frameworks. Standard setters have been cautious about permitting aggressive depreciation or amortization policies that would mirror this volatility, leaving a disconnect between economic reality and reported carrying amounts. The net effect is a timing and measurement mismatch: financial statements may lag in reflecting the quick rise in economic relevance of new digital capabilities and also fail to show their equally swift decline, producing balance-sheet and income-statement representations that understate volatility and mislead stakeholders about the persistence of digitally driven benefits.

Security-related volatility compounds the timing and measurement problems already associated with digital assets. Exposure to data breaches, model theft, ransomware, or other cyber incidents can rapidly and dramatically reduce the functional utility and market value of software, datasets, and AI models; a once-valuable proprietary dataset or trained model can become compromised, unusable, or legally encumbered almost overnight. Saeed et al. (2023) document that cyber risk materially diminishes asset resilience and value, yet current accounting frameworks lack explicit mechanisms to reflect an entity's cybersecurity posture or vulnerability in valuation, impairment testing, or routine disclosures. Because cyber incidents can generate immediate and material economic losses, the absence of recognized accounting treatments for such vulnerability means that balance sheets and income statements may continue to show carrying amounts and earnings that no longer reflect the true, diminished economic position of the firm.

When accelerated asset churn, uncertain useful lives, and cybersecurity-driven downside risk interact, the mismatch between digital economics and legacy accounting conventions becomes acute. Financial statements are therefore often slow or unable to convey both the rapid upside from successful digital scaling and the abrupt downside from obsolescence or security breaches, producing an incomplete and potentially misleading picture of firm value and risk for investors, creditors, and regulators. This gap hinders effective risk assessment, as stakeholders cannot readily gauge the magnitude of cyber exposure nor the resilience of digital assets, and it complicates auditors' and regulators' efforts to enforce transparency and solvency standards. Addressing these deficiencies will require accounting innovations—such as impairment indicators tied to cybersecurity risk, enhanced disclosures on security controls and incident history, and valuation techniques that incorporate probabilistic downside scenarios—so that financial reporting better captures the full economic lifecycle and vulnerability profile of digital asset portfolios.

4.2 Global Dimensions of Digital Value Creation

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Gavalas et al. (2022) document the maritime sector's digital transformation and show that investments in technologies such as voyage-planning analytics, remote engine monitoring, and automated logistics coordination yield concrete efficiency gains and measurable economic benefits that rarely appear on conventional balance sheets. These digital investments drive productivity improvements—reduced fuel consumption and maintenance costs, improved schedule reliability, and higher utilization of vessels and equipment that translate into sustained cash-flow advantages and competitive differentiation, yet under current recognition rules those benefits typically remain off-balance-sheet. Because many of these gains arise from process optimization, data aggregation, and ongoing service orchestration rather than from discrete, transfer-priced purchases, they do not meet traditional capitalization criteria even though they materially affect firm performance. The maritime examples therefore highlight a practical accounting blind spot: firms can demonstrably increase economic value through digitalization, but financial statements and standard metrics (assets, depreciation schedules, and reported investment) fail to reflect those operational improvements.

This sectoral evidence mirrors broader dynamics identified by Autio et al. (2021), who argue that digitalization interacting with globalization creates opposing centrifugal and centripetal forces that shape where and how value is produced and captured. On one hand, centripetal pressures toward standardization and platformization enable scale, interoperability, and widespread value creation across borders; on the other hand, centrifugal pressures driven by local regulation, market idiosyncrasies, and customized service requirements push toward localization and fragmentation. Together, these forces determine the geographic and organizational contours of digital value chains, complicating any single jurisdiction's ability to design coherent accounting and regulatory responses. In practice, platform-mediated, data-driven value is generated across dispersed networks and real-time processes modes of value creation for which national accounting frameworks, developed for an industrial and asset-bound economy, are poorly equipped. Addressing this mismatch will require recognition and disclosure innovations that acknowledge platformized value creation, cross-border coordination among regulators, and audit procedures capable of assessing continuous, data-driven economic contributions rather than only discrete capital transactions.

The dispersed and networked nature of digital value creation makes it difficult for any single jurisdiction to craft fully effective accounting and regulatory responses. Digital economic benefits are frequently generated, captured, and distributed across platform ecosystems, third-party service providers, and multinational data flows rather than residing within neat legal entities or tangible assets. National accounting frameworks that evolved for an industrial, border-bound economy therefore face hard questions about how to allocate rights, define control, and set measurement bases when value accrues through continuous service orchestration, real-time data exchange, and integrated platform interactions instead of discrete, capitalized transactions. Practically, this mismatch produces cross-country inconsistencies in recognition and reporting, creates ambiguity over where economic ownership and control truly lie, and complicates auditors' ability to verify and attest to the existence, valuation, and completeness of digitally generated resources.

Those practical complications translate into regulatory strain and operational difficulties for market participants. Regulators confront diverging domestic practices that hinder comparability and create regulatory arbitrage, while auditors struggle to develop evidenceable procedures to assess distributed, data-driven contributions that are realized through ongoing processes rather than single events. Investors and other users of financial statements face reduced transparency and increased uncertainty when reporting regimes differ across jurisdictions or fail to capture platformized value. To mitigate these problems will require stronger cross-border coordination among standard setters and regulators, revisions to recognition and disclosure standards that explicitly account for platform-based and networked value creation, and the development of new audit methodologies and assurance techniques capable of assessing contributions that are distributed, continuously produced, and dependent on complex data ecosystems rather than solely on traditional capital transactions.

Table 2. Proposed Digital Asset Value (DAV) Framework

DAV Dimension	Definition	Key Indicators	Accounting Gap
Technological Capability	Breadth and depth of digital technology deployment	AI index, cloud adoption rate, R&D intensity	Expensed under GAAP/IFRS
Network Effects	Value generated through user/partner ecosystem scale	Platform users, API integrations, ecosystem revenue	Off-balance-sheet

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Scalability	Capacity for increasing returns on digital investments	Revenue per employee, gross margin trend, marginal cost	Not separately disclosed
Cybersecurity Resilience	Robustness of digital asset protection mechanisms	Security certifications, incident rate, CISA score	No IFRS/GAAP metric

Source: Authors' elaboration based on reviewed literature

5. Conclusion, Limitations, and Suggestions

Conclusion

This paper has analyzed the profound shift away from physical assets toward digital assets as the central sources of firm value, and it has focused on what that shift means for accounting theory and practice. Drawing on a systematic review of twenty peer-reviewed studies published between 2021 and 2024, the analysis shows consistently that a broad set of digital resources AI systems and proprietary algorithms, curated data ecosystems, blockchain and distributed-ledger infrastructure, metaverse platforms and virtual asset portfolios, IoT sensor networks, and digital twins create substantial, measurable economic benefits for firms. These benefits take multiple forms: improved operational efficiency, new revenue streams, strengthened network effects, reduced transaction and verification costs, and greater strategic flexibility. Yet despite their economic salience, these digital assets largely remain off the balance sheet or are inconsistently reported under current accounting regimes. The result is a persistent mismatch between the economic reality of digitally driven value creation and the representational capacity of conventional financial statements, with implications for investor information, comparability, auditability, and the incentives that guide managerial investment decisions.

We propose the Digital Asset Value (DAV) framework as a practical, concept-level tool to operationalize and make visible the sources of digital firm value across four interrelated dimensions. First, Technological Capability captures the breadth, sophistication, and maturity of a firm's digital technology stack its AI models, data architecture, software platforms, and integration with cloud and IoT infrastructure and can be measured by indicators such as R&D intensity for digital projects, number of productionized models, and uptime or latency metrics. Second, Network Effects assesses the scale and quality of ecosystem participation active user bases, developer ecosystems, partner integrations, and data-sharing arrangements that amplify the value of digital assets as more participants join and contribute; metrics here include active monthly users, API call volumes, and partner count and retention. Third, Scalability reflects a firm's ability to convert digital investments into increasing returns as usage expands; it can be operationalized by measures such as marginal cost per additional user, revenue per user over time, and elasticities of revenue growth relative to digital investment. Fourth, Cybersecurity Resilience captures the strength of protections that preserve digital asset integrity and stakeholder trust controls, incident response capacity, compliance certifications, and historical breach incidence that materially affect the durability of digital value. Each DAV dimension can be represented by a mix of quantitative indicators (ratios, performance metrics, index scores) and structured qualitative assessment (narrative disclosure, governance descriptions, third-party assurance statements), creating a multidimensional profile that is more informative and decision-relevant than current one-line disclosures. By combining these dimensions into a consistent reporting and assessment framework, DAV aims to improve comparability, support investor valuation models, and provide a basis for auditors and standard setters to develop targeted measurement and assurance procedures for digital assets.

Limitation and suggestions

This study has several important limitations to acknowledge. First, because it is a conceptual systematic literature review rather than primary empirical research, its conclusions depend on the scope, methods, and quality of the underlying studies included in the review; any biases or gaps in that literature will be reflected in our synthesis. Second, the pace of change in digital technologies is extremely rapid, so some empirical patterns or technical examples discussed here may become outdated as new tools, business models, and regulatory responses emerge. Third, the proposed Digital Asset Value (DAV) framework is conceptual and therefore requires empirical validation: it needs testing with primary data across industries, firm sizes, and national contexts to assess practicality, reliability, and comparability.

Given these limitations, we recommend several directions for future research. First, empirically test the DAV framework's predictive validity by relating its composite indicators to market-based value measures (market-to-book, abnormal returns) and accounting performance metrics across large, representative samples. Second, investigate cross-national variation in how digital assets are treated and disclosed comparing outcomes under different standard-setting regimes (PSAK/IFRS, US GAAP) and

regulatory environments to understand institutional effects on adoption and reporting. Third, study whether and how enhanced digital-asset disclosures reduce information asymmetries and affect cost of capital, investor behavior, and analyst forecasts. Fourth, develop and validate measurement methodologies tailored to specific digital asset categories AI systems, proprietary data inventories, blockchain-enabled infrastructure, and metaverse holdings including approaches to valuation, useful life estimation, impairment testing, and auditability. Addressing these research gaps will be essential to move from conceptual proposals to practical accounting standards and assurance practices that reflect the realities of a digital economy.

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