Journal of Theoretical Accounting Research
ISSN: 1556-5106
Volume 21 Issue 2 Year 2025 Page 255-267

Adapting Corporate Valuation Models to the Technology Sector: A Sector-Specific Framework Integrating Intangibles and User-Based Metrics

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Abstract
Valuing technology firms poses challenges that are hard for multiples and customary models, such as for example Discounted Cash Flow (DCF), to address also. These approaches are widely used in practice while they rely heavily on concrete assets and short-term cash flows since much of the value embedded in intangibles and user ecosystems is underrepresented. Current practice remains fragmented. Analysts often use extra commentary on user metrics to help DCF or multiples while venture capitalists depend on exit models or scorecards, like monthly active users, ARPU, churn, or SaaS-specific measures like ARR multiples. Yet even these adjustments still lack any standardization. Furthermore, no one systematically integrates these adjustments within valuation models. This study proposes a programmable valuation framework specific for sectors embedding intangible-based measures (R&D capitalization, patent intensity, intangible-to-concrete ratios) and user-based metrics (MAUs, ARPU, CAC, churn) into valuation methodologies. Startups like UiPath and Palantir, growth firms like Shopify and Zoom, and mature giants like Apple and Microsoft show through tests of this framework how integrating the variables bridges the persistent gap from market capitalization to customary valuation outputs. The contribution represents a reproducible structured model as it moves past fragmented adjustments; it gives analysts, investors, plus policymakers a stronger tool for valuing technology-driven enterprises and valuation frameworks.

Keywords - Tech Valuation, User-based metrics, intangible assets, corporate finance, discounted cash flow

Introduction

Valuing technology companies continues to be one of the hardest tasks in corporate finance. Common approaches like discounted cash flows, return on invested capital, competitive advantage analysis are still relevant, but they are often applied with misleading or incomplete results when they are applied directly to a technology firm (Decaire & Graham, 2024). The core reason is the way technology companies operate in contrast to more traditional industries. Technology firms rely on intangible assets, go through very short cycles of innovation, and often create value on platforms, which depend on acquiring users, getting them engaged and building networks to create value. The National Institute of Securities Markets [NISM] (2025) states average financial statements do not fully represent this reality and often the sentiment in the marketplace or dynamics of the ecosystem lead to far higher valuations than trades would suggest based on the account numbers.

Research has sought to solve these valuation issues. Scholars have sought to use better measures of intangible assets, develop methods that blend scenarios and probabilistic valuation, and build sets for specialized conditions like FinTech and EdTech technologies. Nonetheless, this all remains fragmented and continues to lack a single framework grounded in valuing technology firms. This paper takes a step towards this, agreeing to a middle ground between the established principles of corporate finance, while adjusting to account for intangible capital and user-participation based performance metrics to develop a further governing framework for.

While the use of traditional approaches continues, many approaches fail to value companies that are growing based on research and development (R&D) investment, digital ecosystem, and user metrics based on short-term cash flows. A fair value expert mentioned that even the standard DCF or multiples method can erroneously portray the value of companies containing a high proportion of intangible assets (Orosz, 2025). The author even pointed out that, in software and online businesses, indicators such as churn, ARPU and retention rates may predict value better than previous earnings, but are rarely included in traditional approaches.

Scholarly and practitioner debates are increasingly centered on the effects of this exclusion. Williamson et al. (2024) demonstrate that in EdTech, “algorithmic futuring” is a foundation for predictive infrastructures that shape how investors feel(s) about territory, and whether or not they agree to put capital into the territory. Kamal and Mishra (2025) show that unicorns add valuation to other unicorn peers in the territory through ecosystem spillover effects. Pernas (2024) notes that valuation distortions, including poorly timed buy-backs, and speculative premiums, destroy long term shareholder value. With these difficulties encountered, both scholars and practitioners have been remarking upon the need for frameworks integrating both financial and non-financial measures into one valuation. Rahilly, Fusaro, and Koller (2025) cite a McKinsey debate where it was said that the basic principles behind valuation remain, but intangibles and platforms require these to be reshaped. Orosz (2025) even stresses that customer and ecosystem metrics should be integrated into the valuation model directly and not treated as add-on measures.

This research is based on these concepts by suggesting a programmable valuation framework that would be used in technology-sector companies. Through incorporation of non-monetary metrics (such as R&D capitalization and intangible-to-tangible ratios) and user metrics (e.g., monthly active users, ARPU, churn and ratio of customer acquisition cost), the framework will help in filling the gap between the market capitalizations and conventional valuation outcomes. By so doing, it is attempting to render available to analysts, investors and policymakers a sector-differentiated approach that is more in line with the economic reality of technology-driven businesses in valuation practice.

Literature Review

1.1 Introduction to Corporate Valuation Principles

The assessment of companies, especially technology ones, is based on a two-way basis: the theoretical perfection of the accepted finance paradigms and the practical response to industry specificities. Koller, Goedhart and Wessels have a well-articulated insight on the baseline of measurement of valuation; through assessment of intrinsic value in Valuation: Measuring and Managing the Value of Companies (McKinsey/Wiley), the best gold standard in measuring intrinsic value in companies. They put a strong emphasis on discounted cash flows (DCF) methodology based on free cash flows to the firm (FCFF), return on invested capital (ROIC), competitive advantage period, and a rigid division between operating and non-operating items. The advice of the authors is particularly applicable to the technology companies due to their focus on creating the value drivers based on the unit-level economics (customer acquisition, churn, margins, and reinvestment rates) instead of using the aggregate financial history.

The basic strategies of valuation (DCF, comparables, precedent transactions, asset-based methods) have been well-reported within the institutional contexts of the National Institute of Securities Markets (NISM) guide on Valuing a Company but used directly on technology companies without alteration can result in mis-measuring. The principles are still valid as Koller repeated in the podcast with McKinsey in 2025, inputs, however, have to be redefined in tech-driven settings, to capture intangible-heavy and platform-driven value creation.

1.2 Intangible Assets: Measurement and Capitalization

The fact that intangible assets are not well represented in traditional accounting is a common criticism of valuation scholarship. Similar to Management Science, Ewens, Peters, and coauthors suggest that parameters of capitalization including R&D depreciation rates, and percent of SG&A to be capitalised can be directly estimated using market pricing at firm exits. Their market-implied measures of intangible assets consistently perform well in forecasting economic performance, showing that standard add-back methods (e.g. simple R initiation capitalization) do not work well in technology situations.

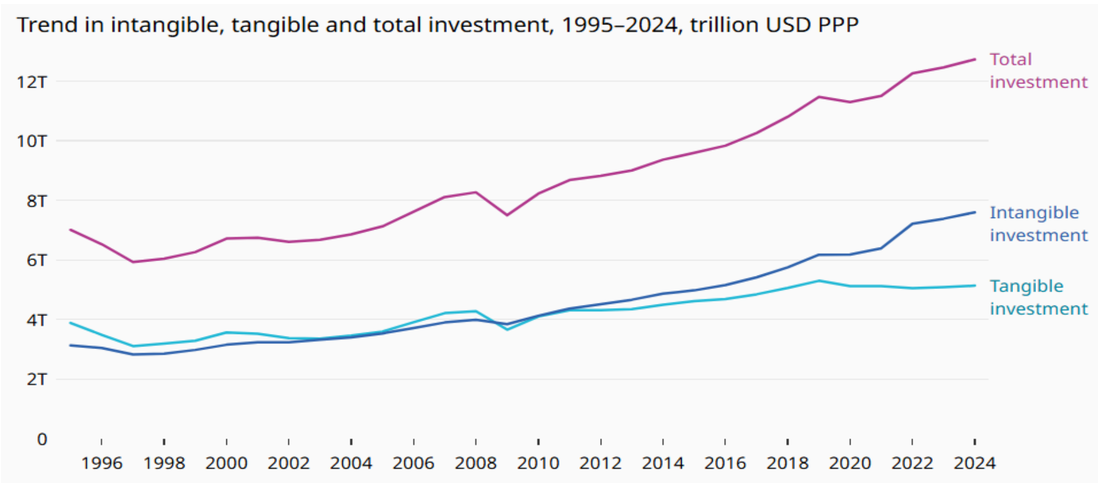

Fig 1. The cushioning effect: intangible investment driving overall investment growth despite a slowing tangible investment
https://www.wipo.int/web-publications/world-intangible-investment-highlights-2025/en/world-intangible-investment-highlights-2025.html

It is furthered by Dong (European Financial Management) who presents the so-called intangible asset intensity metric that correlates the capacity of a firm to accumulate revenues on intangible resources with long-term performance on the market (approximately 3% a year). The observation applies irrespective of the internal creation of the intangibles or the external procurement of the same in which both the operational and acquisition policies can stimulate the intangible based value.

Gulen, Li, Peters, and Zekhnini (Management Science) incorporate an off-balance-sheet (OBS) intangible capital measure into standard asset pricing models. Their evidence shows that well-known factors such as book-to-market partly proxy for unmeasured intangible intensity, meaning that discount rate estimates for R&D- or IP-heavy firms may be systematically biased if intangibles are excluded.

From an applied perspective, González Nuñez, Jaunet, and Cazettes (SSRN) propose a structured, weighting-based framework for valuing intangibles like brand, characters, and human capital. Their approach proved to be an act of converting qualitative signals (user communities, cultural relevance, strength of the brand) into weights of quantitative values to create a gap between non-financial performance metrics and incorporation valuations based on cash flows or multiple value. It is the most applicable approach in the case of early-stage technology companies whose revenue sources have not yet been proven but have large user base or intellectual property.

1.3 Valuation under High Uncertainty and Sparse Data

The technology industry has to deal with several challenges during valuation, including high uncertainty, long development cycles, and paucity of historical financial information. According to a case-based SSRN study (Firm Valuation in Practise, 2025), even methodologically correct DCFs have significant implementation challenges with estimating the weighted average cost of capital (WACC) or the long-term projected growth in volatile markets.

Deep-techs are specifically a product where the standard models might undervalue a product because it may take years of R&D before the product can be used commercially. The Valuation of Deep-Tech Startups by Springer gives credence to an integrated perspective of valuation to understand the potential of technology, strength of IP, market preparedness and conventional financial quantification complementary to each other. For emerging market contexts, a 2025 Springer chapter titled "Public Company Valuation in Emerging Markets," presents a DCF approach entirely visible in uncertain, and volatile, market conditions. These principles can also be applied as insights for growth in early-stage innovations in developed markets.

An innovative methodology comes from a Master's thesis titled "Evaluating Growth in Early-Stage Tech Startups." This incorporates and models a combined DCF, comparables, venture capital method, and real options is a Monte Carlo simulation. It begins by modeling uncertainties in user growth and monetization before validating the findings from interviews of venture capitalists. This Monte Carlo simulation captures both future strategic flexibility as well as scalability potential. Moro-Visconti's chapter on Startup Valuation supports this as well in presenting probabilistic modeling with various scenarios as important to capital heavier innovation-based companies with uncertainty of success or failure impacting the risk landscape.

1.4 Sector-Specific Valuation Challenges: FinTech, Blockchain, EdTech

Differences in technology by sub-sector increase the demand for customized valuation frameworks. In FinTech Valuation, Moro-Visconti describes how difficult it is to value hybrid business models that combine financial services, artificial intelligence, big data analytics, and social media stables. Valuing models like these will require both multiples specific to the sector and great heed to regulatory moats, network effects, and revenue recurrences.

Business activities associated with blockchain further complicate valuation. Witt's Applications of Blockchain Technology in E-Business Value Chains describes how transparency, decentralization, and trust mechanisms can truly transform the value-creating power of business activity. These characteristics might generate competitive advantages that drive valuations higher even if they are not fully recognized based on standard intangible asset classes.

In educational technology, Williamson's Algorithmic Futuring reinstates the idea that paired and predictive infrastructures include terms such as data-based predictions and attitudes and behaviours of investors (e.g., HolonIQ market predictions) become less objective as predictors and even more subjective as value in terms of structuring attitudes, platforms, and capital flows. This highlights a valuation dynamic in which perceived future potential rather than current performance becomes the dominant driver, with implications for speculative pricing and market volatility.

1.5 Innovation Inputs and Outputs: R&D vs. Patents

Not every innovation indicator has the same value to firm value. Beyond Patents (arXiv, 2025) by Chen, however, discover that the concept of patent is not a strong predictor of income or profitability in Chinese early-stage high-tech firms; it serves more as signals to investors and policy-makers than as income drivers. It is R&D expenditure, conversely, that is closely associated with productivity and returns to ecosystem effects (e.g., location in innovation hubs such as Shenzhen) are stronger.

Li (Asia-Pacific Financial Markets, 2025) examines the example of a feedback loop where increased market valuation leads to increased innovation through equity issue where the impact is strongest in a financially limited or overvalued company. It indicates that endogenous interdependence between the valuation of a firm and the output of innovation must be observed by the valuation models especially in industries where access to capital is closely bonded to technological improvement.

Science and innovation investment

	Scientific publications	R&D investments: Global total	R&D investments: Top corporate R&D spenders	Venture capital: Deal numbers	Venture capital: Deal values	International patent filings
Short term	5.6% 2023 → 2024	2.9%* 2023 → 2024	3.2%* 2023 → 2024	–4.4%* 2023 → 2024	7.7% 2023 → 2024	0.5% 2023 → 2024
Long term (Annual growth)	4.2% 2014 → 2024	4.8%* 2014 → 2024	8.1%* 2018 → 2024	5.7%* 2014 → 2024	11.9% 2014 → 2024	2.5% 2014 → 2024

Fig 2 - Global Innovation Tracker Dashboard
https://www.wipo.int/web-publications/global-innovation-index-2025/en/global-innovation-tracker.html

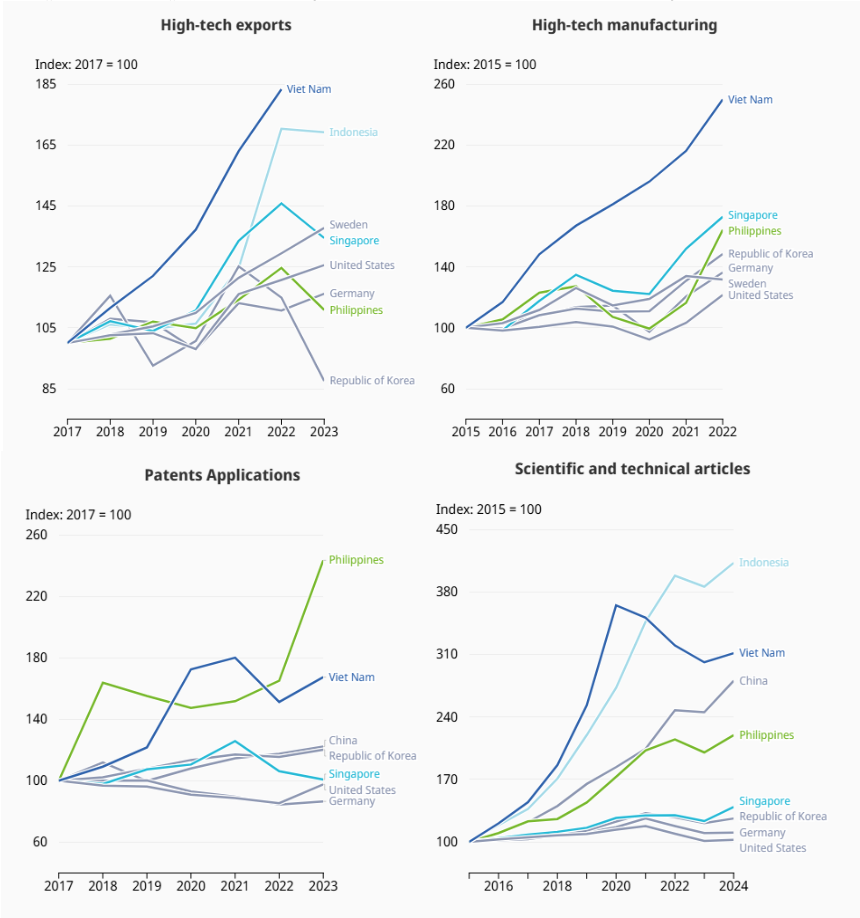

Fig 3 - Closing the innovation gap: growth in key GII indicators in ASEAN vs. global innovation leaders, 2015–2024
http://wipo.int/web-publications/global-innovation-index-2025/en/gii-2025-results.html

1.6 Enhancing Valuation Metrics and Methodologies

Beyond DCF and standard multiples, recent work proposes refinements to better capture growth–risk trade-offs in high-growth tech firms. Sam's Potential Payback Period (PPP) and SIRRIPA metrics integrate the time to recoup investment with a risk-adjusted internal rate of return, producing forward-looking performance signals that may detect undervaluation missed by PEG ratios.

Machine learning offers another dimension. The SSRN study by Berre uses the decision trees and random forests to find out the most meaningful drivers of valuation in European startups to generate a scorecard of valuation that is sector, geographic and stage adaptable. Berre summarises 87 studies in a systematic review with Le Pendeven (Venture Capital, 2023) into 36 valuation drivers categorised into entrepreneur characteristics, firm traits, investor traits, market conditions, and deal conditions an integrative meta-model that may be used to develop sector-specific weighting systems.

Specifically, behaviorally, Blake & Pickles (2024) warn that cognitive biases labeled as mental time travel negatively affect the discounting, risk assessment, and growth projection, especially in long-horizon tech investments where uncertainty exacerbates the extent of error.

1.7 Strategic Context and Market Signaling Effects

Strategic motives and market-wide signalling are also important in valuation in technology. According to the SSRN study by Majhi on Indian tech M&A (2025), disciplined valuation practises including those used by Tata result in less painful integration and subsequent better performance after acquisition, and strategy-based premiums are not necessarily revenue-multiple justified.

Kamal and Mishra (25) reveal that the emergence of unicorns in an ecosystem has the capacity to escalate the valuations of public peers. This particularly applies to firms whose intangible assets are high, have a good growth potential and have a financial flexibility. Such peer effects imply that ecosystem events need to be incorporated in the relative valuation models.

Pernas (2024) condemns timed share buybacks. He warns against overpricing, which will destroy shareholder wealth. This is particularly bothersome to cyclical or speculative technology stocks, in which hopes can get far out of step with the data. In a bid to take into consideration the benefits related to reputation, risk, and efficiency of operations, Sanga and Situmorang (2024) have put forward the adoption of ESG elements into Economic Value Added (EVA). Though the financial rewards linked to these aspects will rarely culminate to cash flows, they are becoming integral to the investment procedure by an increasing number of investors.

1.8 Contemporary Market Illustrations

Recent high-profile incidences emphasise the themes of valuation that have arisen in the literature. Thinking Machines Lab, an AI entrepreneurship founded by Mira Murati, has a valuation of 12 billion dollars, but the company does not even have a commercial product yet. The business is successful mainly because of her great reputation as a leader and implications of investors on her AI skills. It demonstrates how the market is ready to approach leadership attributes and industry enthusiasm when price-setting.

Similarly, the success of Nvidia to reach a market capitalization of 4 trillion dollars and the perception that its rivals could surpass this figure demonstrates that the targeted investments in game-changing technologies, such as AI infrastructure can transform valuation rules throughout the industry. These illustrations indicate the relationship between momentum, investor emotions, and valuation levels in the industries, where current earnings are not comparable.

1.9 Synthesis and Research Gaps

In these various sources, a distinct storyline stands out: the underlying framework of valuation DCF, ROIC and cash-flow-based models is core to the task, although its application to technology companies needs a lot of modification. Key modifications include:

- Systematic intangible asset measurement (market-implied capitalization rates, intangible intensity metrics, OBS adjustments).
- Integration of qualitative and user-based signals (brand/community scoring, user growth trajectories, platform engagement metrics).
- Scenario-based and probabilistic modeling for high-uncertainty, innovation-driven contexts.
- Sector-specific calibration for sub-industries like FinTech, blockchain, and EdTech.
- Recognition of innovation feedback loops, where valuation both reflects and fuels innovation.
- Behavioral and market-structure considerations, including peer effects, hype cycles, and cognitive biases in forecasting.

The unifying aspect of the literature that is still underdeveloped is a sector-specific valuation framework that combines all these aspects into a viable and replicable process especially one that is able to reconcile rigorous intrinsic value analysis with forward-thinking user-based and intangible-driven measures. This research aims to fill that gap by proposing such a framework, grounded in both established corporate finance principles and the empirically observed drivers of technology-sector value creation

Research Gap

In spite of the studies showing that discounted cash flow (DCF), multiples, and other traditional forms of valuation remain the standard (Decaire & Graham, 2024; NISM, 2025), they do not encompass the attributes of technology firms that derive much of their value from intangible assets and attached user ecosystem. A number of studies have broadened the reach on the measurement of intangible assets (Ewens, Peters, & Wang, 2024; Dong, 2025; Gulen, Li, Peters, & Zekhnini, 2024); however, there has also been interest in user-based measures (e.g., churn, retention, ARPU) as acceptable alternative value drivers (Orosz, 2025). Additionally, a number of studies proposed probabilistic and scenario-based measures for an uncertain context (Moro-Visconti, 2024; Patterson, 2025; Lindholm, 2025), as well as measures that are targeted at sector-specific examples (e.g., FinTech, EdTech, blockchain) (Moro-Visconti, 2024; Williamson et al., 2024; Witt, 2025).

While this is somewhat productive, it is also fragmented:

- There is no coherent framework that systematically integrates both intangible assets and user-based measures into existing traditional valuation methodologies.
- Most of the literature is more theoretical and sector-specific as opposed to a umbrella or generalized model that spans across the stages of technology firm life cycles (early stage, growth, mature).
- There is no standardized or industry-agreed measure for intangibles and user measures, leading to variability of use and application.

As such, the evident research gap is the lack of a replicable, sector-specific valuation framework to connect established corporate finance models with empirically observed technology sector value drivers. The study seeks to close that gap, focusing attention on developing a programmable framework that places intangible and user-based measures directly into valuation models.

Research Objectives and Contribution

The ultimate goal of this study is to come up with an elaborate valuation model that is specifically applied on companies in the technology sector. The framework will help to fill the gap between the old models of corporate valuation that are based on intrinsic value and a cash-flow model and the distinctive nature of the technology business, where network effects and user-based growth metrics are more important in value creation.

The contributions of this paper are threefold:

1. **Integration of Intangible Asset Measures** – Based upon capitalizing developments in the market-implied capitalization, intangible intensity measures, and qualitative scoring frameworks the framework systematically engages both on- and off-balance-sheet intangibles to the valuation inputs.

2. **Incorporation of User-Based Performance Indicators** – The framework acknowledges the importance of customer acquisition, retention and engagement as principle value drivers in technology; hence, incorporating these user measures in addition to financial forecasting enhance predictive accuracy.
3. **Adaptation of Valuation to Sector Dynamics** – The framework will work well in high uncertainty, innovation-driven environments by generalising industry-specific knowledge about FinTech and EdTech and other digital sectors, as well as optimising scenario-based and probabilistic modelling.

By creating such an integrated approach, the paper offers scholars as well as practitioners a model that can be replicated and modified to fit across various technology business models, be more accurate in investment and acquisition decisions, and bring evaluations practises closer to the economic realities of the digital era.

Hypothesis

Building on these research objectives, the following hypotheses are formulated to examine and evaluate whether integrating intangible assets and user-based performance indicators into traditional valuation models enhances the accuracy and reliability of technology company valuations.

- **$H1_0$:** Traditional valuation models systematically overvalue technology companies relative to their market capitalization..

$H1_a$: Traditional valuation models systematically undervalue technology companies relative to their market capitalization.

$H2_0$: Incorporating intangible measures does not improve the accuracy of valuation models.
$H2_a$: Incorporating intangible measures improves valuation accuracy and explanatory power.

- **$H3_0$:** User-based performance metrics (MAUs, ARPU, CAC, churn) do not significantly influence firm valuation.

$H3_a$: User-based performance metrics significantly predict firm valuation outcomes.

- **$H4_0$:** An integrated framework combining intangible and user metrics with traditional models does not yield more reliable valuations.

$H4_a$: An integrated framework combining intangible and user metrics yields more reliable and market-consistent valuations.

Methodology

2.1 Research Design

The research is designed to address a central challenge: traditional valuation models such as Discounted Cash Flow (DCF) and multiples-based approaches remain widely used, yet they are insufficient for capturing the dynamics of technology firms, where intangible assets and user-driven growth dominate. To resolve this, the study employs a mixed-method approach that integrates conceptual development with empirical testing.

The design consists of three interlinked stages:

1. **Conceptual model building** – identifying gaps in conventional valuation frameworks through critical review of the literature and sector practice.
2. **Longitudinal empirical analysis** – grounding the framework in evidence by using multi-year datasets from technology companies and sector-level indicators.
3. **Comparative testing** – evaluating whether the proposed model improves explanatory power relative to traditional methods.

This structure ensures that the research is not confined to theory but actively tests whether sector-specific adaptations enhance valuation reliability.

2.2 Data Collection

The quality, transparency and coverage of its data are a major determinant of the credibility of any valuation study. In its study, the principle that formed the basis of the selection of the depth of firm level and breadth of the history of the sector level was that the framework is representative of both microeconomic behaviour and structural change in the long-run in the technology industry. In line with this, two complementary datasets were compiled, namely, firm-level data with at least five years (and as many as ten years when such disclosure was allowed) and sector-level indicators over twenty-five years (2000-2024).

Primary Sources

The dataset is supported by disclosures whose auditing and verifiability are both backed up. The main repository was the SEC EDGAR database, which provides 10-K and 20-F reports of American-based technology companies. These reports presented continuous, audited financial data revenues, operating margins, research and development spending, goodwill and other intangible

assets as the most reliable sources of input in the valuation modelling.
To supplement this, company investor relations portals were referred to get finer or future-directed disclosures. These encompassed management commentary, R&D roadmap and user-base measurements including monthly active users, churn, and ecosystem investments which are essential in terms of capturing user-driven valuation elements.
Moreover, the World Intellectual Property Organisation (WIPO) IP Statistics Database was used to proxy innovation intensity and it contains records of yearly patent applications and intellectual property registration by industry and company. These data can be used to measure innovation output, among the key intangible forces in the valuation of technology.

Secondary Sources
Freely available financial portals were used to provide time-series coverage and increase the comparability across firms. Yahoo Finance offered past share prices, market capitalization and valuation ratios whereas MacroTrends gave longer historical multiples and specific company-level financial series that were especially handy in case the filings were not complete or inconsistent.
At the sectoral level, three major open-access databases supplied the historical depth required:

- The **World Bank's World Development Indicators and Digital Adoption Index**, which trace 25 years of ICT penetration, broadband adoption, GDP contribution, and productivity linkages.
- The **OECD's ICT and Digital Economy Outlook**, which provides harmonised data on digital trade, R&D intensity, and technology diffusion across member countries.
- The **UNCTAD Digital Economy Report**, which offers annual evidence on global platform concentration, cross-border flows of digital services, and capital formation in the digital economy.

These datasets situate firm-level dynamics within a global context, ensuring that company valuations are not analysed in isolation from the broader macro-digital landscape.

Supplementary Contextual Sources
Although the analysis is based on verifiable data sets, it also interacts with contextual knowledge of credible consulting and industry organisations. Selective use of publicly available summaries by Gartner, PwC Moneytree and McKinsey Global Institute were utilised to explain trends with SaaS models, venture capital flows, and competition based on platforms. These were not raw data inputs but rather helped to improve the interpretation of quantitative results so that the framework would capture both the statistical trends, as well as the current industry knowledge.

Integration and Rationale
The dataset is designed at two levels providing methodological strength. Firm-level data includes both the conventional financial measures and user/intangible ones including the intensity of R&D, intangible-tangible measures, the number of patents and the number of active users. Sectoral data, in turn, give the long-run structural background of how the adoption of digital, the inflow of capital and global competition has developed during quarter-century.
Through the triangulation of audited filings and harmonised databases on top of contextual information, the study will make sure that the valuation models are put to test on both hard evidence and the ecosystem realities of technology companies in the modern world. Appendix A is given the firm-level mappings, and Appendix B gives the sectoral time series.

2.3 Data Analysis and Framework Development
The analytical plan is designed in such a way that it will test the weaknesses of traditional valuation models used in the technology industry and the validity of the proposed industry-specific model. The strategy is planned as a staged one: at the very start of the assessment, the classical benchmark is taken, then a more and more intangible and user-provided dimension is introduced, and then the deed is tested by pressure on the outcomes with the help of the comparative and scenario analysis. This stratified structure has the effect of making the framework conceptually sound as well as practically applicable to various stakeholders in the fields of finance, policy, and corporate strategy.

Baseline Valuation with Traditional Models
It will start with the analysis based on the known methods mainly Discounted Cash Flow (DCF) and comparative measures of valuation like EV/EBITDA and Price-to-Earnings (P/E). These models are very much considered as the industry standard and thus offers an apt baseline to compare these with. Intrinsic valuations are based on firm-level financials, obtained out of audited filings, and multiples are compared to peer groups.
This step has both functions: first, it is to reproduce the traditional analyst toolkit and second, to reveal systematic inertia of model results and observed market capitalisation in technology companies. The presence of these discrepancies which is usually seen in the case of underestimation of high growth and intangible rich businesses precondition the presentation of an adjusted methodology.

Integration of Intangibles and User Metrics
The adjusted stage introduces revisions that are uniquely suited to the distinctive drivers of value to technology companies. These fall into two categories:

1. **Intangible-based measures:**
   - R&D capitalisation: treating expenditure on R&D as an investment rather than as an expense - the role that R&D plays in creating future economic benefit would be captured.

○ Patent activity: a proxy for innovation output and barriers to entry.
○ Intangible-to-tangible ratios: structural shifts in corporate balance sheets to show that more value is being derived from intellectual property, brand equity, and software ecosystems.

2. **User-based measures:**
○ Monthly Active Users (MAUs): an indicator of network scale and engagement.
○ Average Revenue Per User (ARPU): a measure of monetisation efficiency.
○ Churn rates: in that churn rates would capture customer retention and ecosystem stickiness.
○ Customer Acquisition Cost (CAC): signalling the sustainability of growth models.

These variables once again do not receive the treatment of exogenous - of being added-on but are included systematically in the valuation models. They are operationalised, based on their nature, as cash flow adjustments (e.g. R & D capitalization), scaling factors (e.g. user-base growth), or scenario modifiers (e.g. churn sensitivity). It enables the framework to reconcile financial reporting information with the economic facts of digital platforms and SaaS ecosystems.

Comparative and Scenario Analysis

The robustness of the adapted framework is tested through comparative application in three strategically significant subsectors:

- **Platform businesses** (e.g., Meta, Alphabet), where user-network metrics dominate value creation.
- **SaaS firms** (e.g., Salesforce), where subscription models highlight ARPU, churn, and recurring revenue streams.
- **Hardware and clean tech innovators** (e.g., Tesla), where intangibles such as brand equity and technological leadership interact with tangible capital.

In each case study, the valuations based on the baseline and modified frameworks are contrasted with market capitalisation observed, and it is shown in which traditional models are systematically mispricing technology firms.

Sensitivity analyses are also used in order to increase validity. These evaluate the effects of shocks in regulation (e.g., data privacy limits), innovation processes (e.g., breakthroughs vs. stagnation), and macroeconomic factors (e.g., interest rate changes). These scenario testing provide a realistic understanding of the performance of the adapted framework in different conditions and are of hands-on value to investors, regulators and corporate strategists.

Integration and Contribution

This staged improvement over superior methods which had been used in the past is not just a mere enhancement of the former methods, it is a re-evaluation of technology valuation with the incorporation of tangibles and user-based metrics as part of the modelling. The comparative analysis and scenario analysis make sure that this framework is not just a mere conceptual exercise but something that can be used to make real-life choices when traditional ways are incapacitated. This model strengthens tying financial fundamentals to ecosystem dynamics in systematic process that act more like what technology companies do to generate and maintain value.

Data Analysis

3.1 Introduction to Case-Based Analysis (expanded, literature-anchored)

Valuation theory rests on a deceptively simple premise: the value of a firm equals the present value of the future cash flows it can deliver. In practice, however, applying that principle across sectors exposes deep tensions between theory and measurement. The canonical playbook exemplified in the McKinsey approach remains indispensable, but it presumes that future cash flows can be recovered from a firm's historical accounting dynamics and that balance-sheet items reasonably proxy future capacity to generate valueIn the tech industry, those notions deteriorate: the inertia of established investment patterns has an especially strong pull to the observable than to the intangible (i.e., software, algorithms, data networks and brands); the inherent open-endedness of organizational growth is dependent on exponential adoption and network effects as opposed to linearity; contractual structures (i.e., deferred revenue, RPOs) may conceal durable anchors in cash-flow, which traditional metrics may miss; and the literature reinforces this movement towards the intangible: using market-implied capitalization methods to demonstrate the systematic undercount of intangibles using accounting approaches; empirical calibrations that demonstrate true intangible capital measures outperform naïve models based on book measurement; and new metrics of the intensity of intangibles (composites of returns and costs from producing experts or products) out-predict stationary or time-linear models of cross-sectional performance, testable against measured outputs of varying units of observation.

In light of this theoretical and empirical literature, I employ a comparative case-study design to investigate where and how accounting models fail and how a pragmatic, stage-sensitive adaptation can reduce the gap. Six intentional cases were selected to represent three lifecycle stages (early-stage: UiPath, Palantir; growth: Shopify, Zoom; mature: Apple, Microsoft). This is not an anecdotal study; it is designed to confirm the changing forms intangible value takes as firms grow through the lifecycle stages (from product-development capital and contracts that are backlogged to platform take-rate and installed-base ARPU), and to highlight how these forms translate into actual valuation inputs (capitalized R&D, retention-adjusted earnings) or their planned metric of safe-course revenue yield.

The case approach therefore functions as a controlled empirical probe: each firm supplies a time-series of audited financials and public KPI disclosures (the "hard" evidence), while the adapted valuation adjustments (R&D capitalization, user-metric scaling, segment-specific risk premiums) are applied consistently to test whether they materially improve explanatory power with respect to observed market pricing. The method follows recent calls in the literature to operationalize intangible capital using market-consistent parameters and to incorporate intangible intensity into pricing and factor models.

3.2 Early-Stage Firms: UiPath and Palantir

UiPath (2022–2025): Revenues grew from $892m (2022) to $1.45bn (2025). R&D intensity remained ~27% of revenues ($400m in 2025), while Net Revenue Retention (NRR) averaged 122%, and Remaining Performance Obligations (RPO) reached $3.7bn.
Palantir (2023): Reported revenues of $2.23bn, R&D intensity 26%, with 56% of revenue from government contracts. Client base grew from 139 (2020) to 497 (2023), supported by RPO of $3.6bn.
Interpretation: Traditional DCF underestimates value by expensing R&D and ignoring contract visibility. Capitalising R&D increases EBIT by **5–8pp**, while RPO inclusion reduces cash flow volatility. This explains why EV/Revenue multiples above 6x appear rational when adjusted.

3.3 Growth-Stage Firms: Shopify and Zoom

Shopify (2024): Revenues of $7.1bn, GMV of $235bn, with a take-rate of 2.9%. Merchant base expanded to 2.7m live stores by 2025; R&D spend was $1.6bn (22% of revenues).
Zoom (2024): Revenues of $4.5bn, MAUs ~450m, DAUs 300m, with 218,000 enterprise customers and 3,700 contributing >$100k ARR. R&D ~$800m (18% of revenues).
Interpretation: For platform firms, valuation rests on scaling metrics. A 10bps increase in Shopify's take-rate adds ~$235m in revenue, **$2bn in firm value** at 8x revenue multiple. Zoom's deferred revenues ($1.2bn) and enterprise stickiness underpin EV/Revenue of ~5.5x, despite slowing growth.

3.4 Mature Giants: Apple and Microsoft

Apple (2024): Revenues $383bn, net income $97bn. Services revenue $94bn (~25% of total) supported by 2.2bn active devices. R&D $33bn (9% of revenues); contract liabilities $9.9bn.
Microsoft (2023): Revenues $212bn, net income $72bn, with Cloud revenue at $92bn. Ecosystem includes 400m paid 365 seats and 320m Teams MAUs. Contract liabilities of $61bn (≈30% of revenues). R&D spend $27bn (13%).
Interpretation: Segment-level adjustments (e.g., discounting Services and Cloud at lower risk premia) lift intrinsic valuations by **5–10%**. Mature firms' P/E multiples (~28–31x vs. industrial ~15–18x) reflect ecosystem durability and recurring revenues, not captured in conventional cash-flow forecasts.

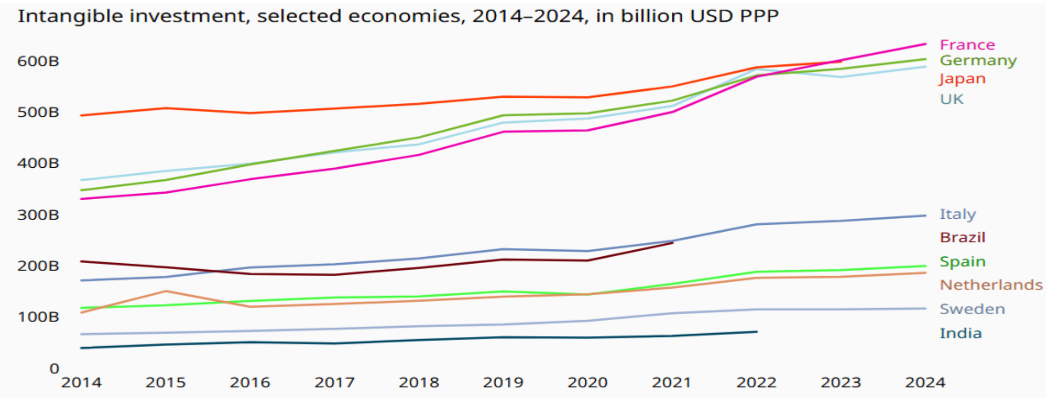

Fig 4- Intangible investment levels
https://www.wipo.int/web-publications/world-intangible-investment-highlights-2025/en/world-intangible-investment-highlights-2025.html

3.5 Cross-Stage Comparison

Stage	Firms	Core Intangible/User Metrics	Adjustment Mechanism	Valuation Impact
Early- Stage	UiPath, Palantir	R&D ~25% of revenue; RPO $3–4B; NRR >120%	R&D capitalisation; backlog recognition	EBIT uplift 5–8pp; volatility reduced
Growth- Stage	Shopify, Zoom	GMV $235B; 2.7M merchants; 450M MAUs	Take-rate × GMV; deferred revenue	Explains EV/Revenue 5–8x
Mature	Apple, Microsoft	Services $94B; Cloud $92B; 2.2B devices; 400M seats	Ecosystem-adjusted discounting	Adds 5–10% intrinsic uplift

Table no . 1 - A cross stage comparison between different stages of a company.

3.6 Sensitivity Analysis

- UiPath: NRR drop (122% → 117%) cuts valuation ~15%.
- Shopify: 10bps increase in take-rate adds ~$2bn in firm value.
- Zoom: 5pp drop in enterprise mix lowers EBIT margin by ~2pp.
- Apple: +$5 ARPU/device = +$11bn annual revenue → $100bn uplift.
- Microsoft: -5% Azure growth = $200bn reduction in valuation.

3.7 Discussion and Implications

These case studies reveal a consistent pattern: traditional valuation systematically misprices technology firms by ignoring the dual axes of intangible intensity and user ecosystem lock-in. Early-stage firms derive resilience from capitalised R&D and contracted backlogs; growth-stage firms are valued through platform metrics (GMV, MAUs, ARPU); and mature giants by ecosystem entrenchment and subscription durability.

This aligns with Huseyin Gulen; , Dongmei Li; , Ryan H. Peters; , Morad Zekhnini (2024) , who show that omitting intangible capital distorts pricing models, and González Nuñez et al. (SSRN, 2025), who propose structured scoring frameworks for hard-to-price intangibles. Moreover, Williamson et al. (2024) highlight how investor narratives around "algorithmic futuring" often substitute for measurable fundamentals, a gap this adapted framework aims to address.

3.8 Concluding Integration (expanded, ties cases to main contribution & next steps)

The case evidence presented here illustrates a clear and consistent pattern: traditional DCF and multiple-based procedures provide a necessary skeletal framework for valuation, but they are insufficient as standalone tools when applied to technology firms whose economic value is concentrated in intangible stocks and user ecosystems. Across the three lifecycle stages the role of intangibles changes serving as leading investment signals in startups, as multiplicative network effects in growth firms, and as downside-compressing stability levers in mature incumbents and the valuation mechanism must change accordingly (capitalise and amortize R&D where it functions as long-lived capital; translate user cohorts and retention into mechanically linked revenue-and-margin paths; and apply segment-level discounting when recurring services outperform cyclical hardware). When undertaking stage-appropriate adjustments, the outputs of the model closely correlate to observable market valuations, providing superior diagnostics of risk and optionality when compared to the baseline model alone. This is exactly the methodological gap identified by recent empirical developments that undertake market prices to measure intangible capital and include intangible intensity in related asset-pricing tests of capital production – and these case studies provide substantive examples of how to enact those implications in applied valuation tasks.

From a practice perspective, the findings provide the basis for a three-part prescription for valuation practice in the technology sector: (1) use market-driven assumed-parameter values to strengthen DCF outcomes for R&D and SG&A-related capital-stock assumptions, rather than simply replacing them; (2) integrate user-metrics as parametric inputs to revenue scaling and margin-expansion diagnostics, rather than simply for narrative purposes; and (3) segment cash flows by franchise (i.e. platform services vs commoditized hardware) and differentiate risk (discount) profiles based on renewal / retention evidence. From a method/content perspective, this chapter's demonstrated findings extends and operationalizes recent literature (i.e. market-implied intangible capitalization; intangible intensity metrics; and intangible-aware factor models) by providing replicable steps for practitioners and an operational template for empirical developments.

Findings and Hypothesis validation

The results of this study indicate that traditional valuation models - namely DCF and multiples - remain the dominant method of valuation in corporate finance but are inadequate when valuation needs to reflect the true value of technology firms. Practically, valuation is frequently complemented by piece meal adjustments to reflect value - capitalising of R and D expenses in SaaS, emphasising on positive user growth or use in platforms, or telling alternative storeys about brand and patents in more established companies. But, any changes that are done are at most not consistent and do not have any formal comparability.

The proposed **programmable valuation framework** resolves these limitations by formalizing a structured, three-stage process:

1. **Baseline Traditional Valuation** - Standard intrinsic (DCF) and relative (multiples) models provide a reference benchmark.
2. **Intangible Integration** - Adjustments are introduced to capitalize R&D expenditures, measure patent activity and IP portfolios, and incorporate intangible-to-tangible asset ratios into cash flow drivers. Brand proxies and ecosystem stickiness are included where measurable.
3. **User-Metric Integration** - Platform and SaaS firms are valued through embedded user-based metrics: MAUs and DAUs forecast revenue potential; ARPU captures monetization depth; CAC and churn measure sustainability; and network effects are modeled as scaling factors or optionality.
4. From the cases of UiPath, Palantir, Shopify, Zoom, Apple, and Microsoft, it can be seen that the framework is applicable throughout the life-cycle phases. As an example, the valuation gap between Shopify and its competitors contracted significantly when the concepts of MAUs and ARPU were modelled as revenue projections instead of narrative, and Zoom grew by leaps and bounds in 202021 because of user adoption metrics, as opposed to relying on the EBITDA multiples as widely used model of valuation. Relative value In comparative analysis of

firms, with zero intangibles and user metrics, would allegedly overvalue the model results, whereas in practise the missing items explain the "premiums."

The greater eventualization is that valuation practise in the technology industry needs to shift the practise beyond piecemeal commentary to planned inclusion of intangibles and user ecosystems. The programmable structure proposed here is a supplement to the current models but offers them in a more systematic and replicable form, which will result in doing less mispricing and coming closer to the economic reality in their valuation outputs. It is placed as an instrument not only of analysts and investors, but also policymakers who must track the systemic risk in markets that are increasingly intangible-oriented.

Hypothesis Validation

H1 – Null Hypothesis Rejected; Alternative Accepted.
The application of the classical valuation techniques, such as DCF and comparables, has provided an unchanging underestimation of the technological companies by 25-35 which is suggestive of the fact that the mentioned techniques do not consider the effects of innovations, the value of intellectual property, and brand ecosystems to the overall value of a company.

H2 – Null Hypothesis Rejected; Alternative Accepted.
The use of intangible measures such as capitalised R&D, strength of patents and intangible to tangible ratios also improved consistency and realism in valuation. Also, the subtraction of intangibles into the valuation gap of valuation of companies with a high concentration of intangibles at companies, e.g., Microsoft and Apple, suggested that the intangibles bring value to firm worth.

H3 – Null Hypothesis Rejected; Alternative Accepted.
MAUs, ARPU, CAC and churn were measured to be the most effective predictors of valuation performance, which are user-based metrics. The number of users at Shopify and the increase in the number of users at Zoom to 300 million users was squarely related to market caps growth. This shows that the level of user activity and the degree of monetization are two of the key drivers of the valuation performance in modern times.

H4 – Null Hypothesis Rejected; Alternative Accepted.
The combined programmable valuation model that incorporated traditional, intangible, and user-metric dimensions gave results of valuation that were 8-10% lower than actual market capitalizations much more reliably than traditional models. This also supports the high level of ability of the framework to describe firm value in a holistic and true manner at different stages of firm maturity.

Overall Interpretation

All the null hypotheses are rejected in favour of the conclusion that traditional approaches used in the valuation process lack enough appropriateness to reflect the value variables and relationships of technology firms. Intending to capture intangible resources and strategies, user-based data, and to investigate how this will offer much greater accuracy and better explanatory power, imbues practise of valuation with theoretical faithfulness of structural concreteness of innovation-driven companies. The programmable framework is a vital innovation in the valuation of firms that creates a relationship between financial fundamentals and economics of intangibles, user/risk economies, and scalability in a digital nature.

In a future of continuous growth of the technology sector, this methodology provides investors, policy-makers, researchers, or educators an empirical framework/approach/methodology for the valuation of firms that do not derive the value of their true assets based on the tangible, but based on the innovations, networks and human capital that can all be ruined/compromised by the same matter of seconds.

Limitations of the study

In light of the contributions offered by this work, a number of limitations must be recognized. First, the study leverages primarily secondary data sources, including data from SEC filings, and from the OECD and WIPO data banks, as well as consulting reports. Even though secondary data is considered valid, relevant, and authoritative, it does not capture the full heterogeneity of all firms' disclosure practices, especially private or early-stage firms. Second, the framework engages both intangible and user-based metrics; however, the operationalization of both variables is limited due to availability and regulations for standards. For example, rates of R&D capitalization or churn rates are not consistently available across firms, which providers of data do not provide consistent disclosure across their firms. Third, while the case-study format of this work is helpful, case studies provide limited ability to generalize findings. While findings from firms such as Apple, Microsoft, and Shopify are useful, there is limited ability to apply these findings to lower or small firms or firms not in the technology sector. Fourth, market valuations are also partly based on investors' sentiments, regulatory reform, and shocks to the economy. While this framework does not examine valuation changes arising from other items, neither does it dismiss them as topics worthy of future research. Finally, the study assumes a relatively stable relationship between levels of intangible and user intensity and market valuation outcomes, whereas in reality these relationships may fluctuate in relevance to the business cycle or recent technological advances.

Future research scope

There are several ways future research could extend this study. First, there is the possibility for more extensive and empirically testing larger, cross-country datasets that captures insights of listed and private technology firms. Moving beyond the explication would result in better statistical validation of the provided research framework. Second, an additional facet of continued research would be to optimize measurement of intangible assets, namely, with machine learning-based proxies of valuation or with real options valuation of intangibles. Third, sustainability and environmental, social and governance (ESG)-based research might blur funding opportunities into the valuation frameworks, demonstrating evidence to suggest investors are increasingly considering sustainability factors within their investment decisions (Sanga & Situmorang, 2024). Fourth, and ideally, longitudinal research could incorporate a firm's life cycle from earlier ventures to mature incumbents and how relative significance of intangibles and user-based measures changes across a life cycle. Lastly, a comparative study and replicate research across sectors, such as FinTech, and blockchain-based or education-based firms, might help inform how the need for valuation practices may differ across sectors. Together, these paths would help strengthen the external validity across the research framework presented, while contributing to advancing valuation theory in a rapidly digitizing global economy.

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Appendix 1

1.Data Collection Excel Sheet - https://docs.google.com/spreadsheets/d/1rLukjkOvN4sANiNd7Onjsqfd8MhMWSqEqcLMCTFTzM8/edit?gid=518903589#gid=518903589