CLOUD-ENABLED TECHNOLOGIES ON FIRM VALUE: INSIGHTS FROM QUOTED MANUFACTURING COMPANIES IN NIGERIA

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Abstract
Digital penetration has transformed business processes globally, yet empirical evidence from emerging markets remains scanty. This study investigates the impact of cloud-enabled technologies (Industrial Internet of Things, big data analytics, virtual reality, artificial intelligence, and machine learning) on firm value among quoted manufacturing companies in Nigeria. Firm valuewas assessed using the market-to-book value ratio, shareholders' funds, and capital gearing ratio.Panel data from 30 manufacturing companies quoted on the Nigerian Exchange Group, covering 2017-2024, were analyzed using random-effects regression models, with diagnostic tests to ensure robustness. Results revealed that four cloud-enabled technologies significantly influenced firm value, with strong positive coefficients: IIoT ($\beta = 0.903$), BDA ($\beta = 0.811$), AI/ML ($\beta = 0.774$), and VR ($\beta = 0.793$). Specifically, cloud-enabled technologies significantly influenced market-to-book value and shareholders' funds, while capital gearing was linked to IIoT, BDA, and VR, but not by AI/ML. The findings indicate that cloud-enabled technologies are critical success factors enhancing firm value, though adoption remains partial and is limited by infrastructure and organizational challenges. The study concludes that the full integration of IIoT, BDA, AI/ML, and VR can improve shareholders' wealth, refine the capital structure, and boost the market value of quoted manufacturing companies in Nigeria.

Keywords: Artificial intelligence, *capital gearing, Industrial Internet of Things,* machine learning, *market-to-book ratio,* virtual reality.

1.0 Introduction

The fourth industrial revolution has brought in a paradigm shift in manufacturing companies globally, marked by the use of advanced cloud-enabled technologies, redefining how firms create and sustain value. In developed nations, cloud-enabled technologies such as the industrial internet of things, big data analytics, artificial intelligence, machine learning, and virtual reality have been widely used to improve operations. According to Akanbi and Adeoye (2018), efficiency, greater transparency in supply chains, boosted profits, and lower expenses are key outcomes of effective management practices. These innovations have not only improved manufacturing efficiency but also changed how a firm's value is strengthened in both domestic and international markets. (Asley 2020). In response, the manufacturing sector in developed

economies has significantly ramped up its digital transformation initiatives, underscoring the imperative for developing nations to implement broader innovation strategies (KPMG, 2021).

In contrast, quoted manufacturing companies in Nigeria have been slower to adopt these enabled technologies, largely due to infrastructural deficits, a lack of skilled workers, and limited resources. This lag in adoption has led to declining firm value indicators, including persistent falls in stock prices, weakened shareholders' funds, and an increasing capital gearing ratio (Abidde, 2021). From 2019 to 2021, the contribution of manufacturing companies to Nigeria's gross domestic product (GDP) dropped by 13.94%, highlighting the need for technological transformation to regain competitiveness and ensure long-term sustainability (Akenbor & Oghogbemeh, 2021).

Three key indicators define firm value: the market-to-book ratio, shareholders' equity, and the degree of capital gearing. This study aims toconduct an empiricalinvestigation of the connections between the adoption of IIoT, BDA, AI/ML, and VR technologies and these financial metrics. The goal is to determine whether digital transformation can serve as a strategic means to enhance shareholder wealth and organizational resilience among quoted manufacturing companies in Nigeria (Igbinovia & Ogbeide, 2019).

State of the Art

This study, therefore, aims to assess how cloud-enabled technologies affect the value of quoted manufacturing companies in Nigeria and to determine whether implementing these technologies improves financial performance, boosts investor confidence, and increases the overall competitiveness of these firms.

This objective is especially important because it bridges the gap between the theoretical ideals of cloud-enabled technologies and tangible financial outcomes in a developing economy. It also offers insights into how different technologies contribute to firm value in distinct ways, providing evidence-based guidance for managers, policymakers, and investors. Even though there is an increasing body of global research on digital transformation, empirical evidence on the impact of cloud-enabled technologies on firm value in Nigeria remains limited (Akinlade et al., 2026).

Novelty

This research contributes to the literature in several ways. First, it extends global digital transformation studies to an emerging economy, offering insights into how infrastructural and organizational constraints shape adoption outcomes. Second, it integrates multiple cloud-enabled technologies into a single analytical model, providing a more comprehensive understanding of their combined effects on firm value. Third, it employs robust econometric methods to establish statistical relationships, moving beyond descriptive analyses that dominate existing Nigerian studies. Finally, it offers practical recommendations for managers and policymakers, bridging the gap between theoretical ideals and tangible financial outcomes.

Purpose of the Study

In sum, this study responds to the pressing need for empirical evidence on the role of cloud-enabled technologies in enhancing firm value in Nigeria's manufacturing sector. By situating Nigeria within the broader discourse on Industry 4.0, the research underscores the strategic importance of digital transformation for emerging economies seeking to remain competitive for sustainable growth.

Paper Outline

The remainder of this paper is structured as follows:

i. Section 2 Reviews relevant literature on the cloud-enabled technologies and firm value.
ii. Section 3 Outlines the research method, including data sources and
iii. Section 4 presents the empirical findings and analysis.
iv. Section 5 discusses the implications of the results for managers, policymakers, and investors.
v. Section 6 concludes the study with recommendations and directions for future research.

2.0 Literature Review

The fourth industrial revolution has accelerated the adoption of digital technologies across manufacturing industries worldwide. In advanced economies, firms have embraced IIoT, BDA, AI/ML, and VR to enhance operational efficiency, reduce costs, and strengthen competitiveness. Studies from Europe and North America consistently show that digital transformation improves shareholder wealth and firm valuation (Porter & Heppelmann, 2015; Chen et al., 2015; Salemcity et al., 2023). Asian economies, particularly China and South Korea, have integrated IIoT and BDA into smart manufacturing, achieving significant gains in productivity and market value (Lee et al., 2018). These findings highlight the global consensus that cloud-enabled technologies are strategic assets for firms seeking long-term sustainability.

Industrial Internet of Things (IIoT) and Firm Value

The Industrial Internet of Things (IIoT) has become a game-changing technology in the manufacturing sector, facilitating real-time connectivity among machines, processes, and decision-makers. Research in developed countries indicates that adopting IIoT leads to increased operational efficiency, reduced downtime, and improved supply chain visibility, thereby boosting firm value (Porter & Heppelmann, 2015). Research from Asia and Europe indicates that the integration of IIoT is positively associated with market-to-book value ratios and shareholder confidence (Lee et al., 2018). In Nigeria, however, infrastructural issues hinder the adoption of IIoT, yet companies that have embraced it demonstrate productivity and a more robust capital structure (Akinrinade, 2020). This indicates that IIoT has the potential to be a strategic lever for enhancing firm value, provided there is a focus on implementing supportive policies and investing in digital infrastructure.

Big Data Analytics (BDA) and Firm Value.

BDA equips companies with predictive insights and improved decision-making abilities. Studies show that adopting BDA leads to better financial outcomes by facilitating trend analysis, predicting customer behaviour, and optimizing costs (Arnold et al., 2019). Research conducted in manufacturing industries in the United States and China indicates that companies using big data analytics experience higher shareholder returns and greater market value (Chen et al., 2015). In Nigeria, the use of BDA is still in its early stages, but evidence suggests that firms employing analytics in their production and reporting processes experience improved financial transparency and stronger shareholder funds (Mahda et al., 2023). This suggests that BDA plays a key role in the value of firms in emerging markets, especially when combined with favourable regulations.

Artificial Intelligence and Machine Learning (AI/ML) and Firm Value

Artificial intelligence and machine learning(AI/ML) applications are increasing in manufacturing, with processes automated and products being innovated. Previous research

shows that incorporating AI/ML reduces redundancy and improves efficiency, supporting sustainable growth for companies (Jordan & Mitchell, 2015). Empirical evidence from European companies indicates strong positive effects on profitability and shareholder wealth (Oyerogba, 2021). In Nigeria, while the adoption of AI and machine learning remains limited, companies that implement AI-driven automation report improved market-to-book ratios and enhanced competitiveness, although the direct effects on capital gearing are less significant (Moses et al., 2020). Incorporating AI and machine learning into manufacturing operations can increase a firm's value by enabling predictive analytics, optimizing resource allocation, and fostering innovation.

Virtual Reality (VR) and Firm Value

Virtual Reality (VR) applications in manufacturing encompass product design simulation, training, and immersive customer engagement. Studies in advanced economies indicate that adopting VR promotes innovation, lowers prototyping expenses, increases customer satisfaction, and consequently boosts firm value (Chin et al.,2023; Ogungbade & Oyerogba, 2020). Research indicates that the integration of virtual reality (VR) has a beneficial effect on shareholder confidence and market valuation, although its effects on debt-equity structures are varied. In Nigeria, VR adoption is minimal, but firms that are trying out VR for design and training show enhanced innovation capabilities and stronger shareholder funds (Moses et al., 2020). As firms increasingly explore virtual reality applications, their ability to enhance firm value becomes more pronounced.

Firm Value

Firm value is described as a market-based measure rather than one specific to a particular entity. When determining a firm's value, an entity applies the same principles that market participants use to assess the value of an asset or liability under current market conditions, including risk-related assumptions. Consequently, when determining a firm's value, the intention behind holding an asset or settling a liability is irrelevant (Ross, 2012). Shareholder reporting is achieved through firm value accounting, which contrasts with historical cost accounting, providing a more accurate reflection of liabilities and assets at their value to owners in financial reports (Lonkani, 2018). The economic term "firm value" represents the overall worth of a company. A company's valuation at a given time serves as a key measure for industry evaluation at that price. It was a crucial idea for capitalists to assess the industry's assessment of a company interactively (Languju, 2016). It combines the intrinsic value of equity shares and the projected market value of hybrid securities, which are assessed using either the book value or the market value (Ekuobase & Olutayo, 2016). We can also refer to it as the market value of an organization, where the entity's value is extremely important: the higher the firm's value, the greater the returns for shareholders (Brigham, 2016). The stock value of a company is seen in the investor's evaluation of its success, which is known as "firm value." The rising stock price demonstrates investors' confidence in the business and their willingness to spend more in pursuit of a greater return. The firm's assets, including the economic value of its stock and borrowings, constitute its value (Funami & Moghadam, 2015).

Firm value is assessed using three indicators: the market-to-book value ratio (MBV), shareholders' funds (SHF), and the capital-gearing ratio (CGR).

Murphy (2022) claims that net book value is a valuable toolwhen evaluating the potential profitability of a business or making decisions about whether or not to invest in a company and is based solely on the company's financial records, which makes it a more reliable indicator of a company's financial standing and planning purposes. Net book value aids companies to make informed decisions, streamlines asset valuation, establishes financial benchmarks, and assesses a company's financial soundness (Beattie, 2021). Thebook value of a stock represents the theoretical amount of money that would be paid to shareholders if the company were liquidated, its liabilities paid off, and shareholders' equity recorded (Ward, 2020).

The capital-gearing ratio isa significant factor that lenders and investors use to evaluatea company. When a company has a high capital-gearing ratio, it tends to create an unfavorable perception among lenders, whomay assume the company wouldstruggle to repay if business operations deteriorate (Salemcity et al., 2025). Likewise, investors regard the companies in cyclical industries as risky (Ginting & Nausution, 2020). Companies with a high gearing ratio from a stable industry may not pose a serious threat to lenders and investors. Consider the case of the utility sector. Still, a company witha high gearing ratio in a stable industry may not pose a major risk to lenders or investors. Nevertheless, these are monopolies, and their prices are tightly regulated. Consequently, their earnings are highly steady (Brigham & Houston, 2019). Capital Gearing Ratio (CGR)provides investors with insight into the degree to which a company's capital is geared, whether it is low-geared or high-geared. When a firm's capital consists of equity versus debt, it is described as low-geared; when it has less common stock and more interest- or dividend-bearing funds, it is described as highly geared. CR serves as a valuable tool in several areas, including risk and return, cost of capital, growth and expansion, financial flexibility, and stakeholder effects (Handayani & Widyawati, 2020).

Shareholder funds may take a positive or negative value. A positive SF means that a company's total assets exceed its liabilities, whereas a negative SF means its liabilities are greater than its assets. A positive SF position implies that the company has sufficient assets to cover its debts, which could result in a greater amount remaining for shareholders if it were to wind up (Kang & Nanda, 2018). In contrast, a negative SF would leave shareholders with no return once liabilities are cleared with the existing assets. As a result, investors review the balance sheet to determine the level of SF and guide their investment choices. They prefer businesses with positive shareholders' funds, which are generally favoured for low-risk financial dealings. However, SF is often combined with other financial ratios to gauge a company's overall financial soundness. Since SF reflects the owners' investment in the company, it helps compute return on equity (ROE), an essential financial ratio that compares total capital investment to returns earned overa particular period. It serves as a vital indicator of profitability and efficiency (Brigham & Houston, 2019).

Across global research, IIoT and BDA consistently emerge as the most impactful technologies for boosting economic value, while AI/ML and VR contribute additional advantages in innovation and operational efficiency. Evidence from Nigeria supports these findings, yet it also reveals infrastructural and organizational barriers that hinder full-scale implementation. This literature underscores the strategic significance of cloud-enabled technologies as value drivers for firms, while highlighting the challenges confronting manufacturing companies in developing economies.

Hypothesis Development
Drawing on the literature, this study develops hypotheses linking cloud-enabled technologies to firm value indicators among Nigerian manufacturing companies.

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Drawing on the literature, this study develops hypotheses linking cloud-enabled technologies to firm value indicators among Nigerian manufacturing companies:

i. **H_{01}:** Industrial Internet of Things (IIoT) adoption positively influences firm value (measured by MBV, SHF, and CGR) among quoted manufacturing companies in Nigeria.
ii. **H_{02}:** Big Data Analytics (BDA) adoption positively influences firm value among quoted manufacturing companies in Nigeria.
iii. **H_{03}:** Artificial Intelligence and Machine Learning (AI/ML) adoption positively influence firm value among quoted manufacturing companies in Nigeria.
iv. **H_{04}:** Virtual Reality (VR) adoption positively influences firm value among quoted manufacturing companies in Nigeria.

Since firm-specific variables (e.g., size, age, growth) may moderate these relationships, the study also proposes:

v. **H_{05}:** Firm-specific characteristics moderate the relationship between cloud-enabled technology adoption and firm value.

Theoretical Framework
Cloud-enabled technologies' influence on firm value is explained by these complementary theories, giving a multidimensional view of how adoption drivers, business performance, and market valuation interact.

Signaling Theory (Spence, 1973) argues that firms relay signals to external stakeholders through observable actions and capital investments that narrow information asymmetry and strengthen investor confidence in capital markets. In the context of Nigeria's manufacturing industry, the adoption of advanced technologies such as IIoT, BDA, AI/ML, and VR provides a credible signal of managerial expertise, innovative capability, and a long-range growth mind-set. By investing in these technologies, firms signal their readiness to improve efficiency, enhance production processes, and remain competitive in volatile market conditions. This signalling function is particularly pertinent in Nigeria's manufacturing sector, where investors frequently face uncertainty regarding company performance. Thus, technology adoption can serve as a strategic signal and a potential indicator influencing share prices, market-to-book ratios, and overall firm valuation.

Agency theory (Jensen & Meckling, 1976) highlights the conflict of interest between managers (agents) and shareholders (principals), particularly where information asymmetry exists. Managers may be reluctant to commit resources to long-term technological initiatives due to short-term performance expectations or personal aversion to risk. Nevertheless, when companies implement IIoT, BDA, AI/ML, and VR, it indicates management is aligned with shareholders' goals of maximizing objectives. These technologies enhance transparency, improve reporting reliability, and reduce inefficiencies, thereby mitigating agency costs. For instance, big data analytics strengthens monitoring mechanisms, while AI/ML improves forecasting and decision-making, reducing information gaps between managers and owners. In this sense, adopting

technology both signals managerial competence and helps resolve agency issues by aligning managerial actions with shareholder interests.

Diffusion of Innovation Theory (DOI), developed by Rogers (1962), explains how new ideas and technologies are disseminated across and within firms. It maintains that adoption is influenced by factors perceived as relative advantage, compatibility, complexity, ability to experiment, and observability. Within the Nigerian manufacturing context, these considerations shape how firms evaluate and adopt new technologies that strengthen operational efficiency, enable predictive maintenance, and support product customization. Firms that perceive these technologies as advantageous and compatible with existing operations are more likely to embrace them, thereby improving productivity and ultimately raising firm value.Integrating these theories, the framework argues that cloud-enabled technologies permeate organizational structures (DOI), convey innovation and dependability to the market (signalling theory), and shape managerial actions with shareholder wealth maximization (agency theory).Altogether, these mechanisms account for how technological advancement can greatly boost the economic value of quoted manufacturing companies in Nigeria.

Empirical Review

Yong Lee, Mengjie Lee, Yujiao Hu, Qingmin Jia, Yuao Yao, Chenyi Wang, Xiaomao Zhou, Renchao Xie & F. Richard Yu (2024) examined industrial Internet of Things intelligence empowering smart manufacturing: a literature review. A quantitative survey and econometric modeling were used in a multi-country sample for their study. They found that firms implementing IIoT and AI/ML achieved substantial improvements in operational efficiency, which translated into higher market-to-book ratios and stronger shareholder return.

Similarly, Porter & Heppelmann (2023) studied digital integration involving the Internet of Things, virtual reality, and smart, connected products. Using a conceptual framework and industry case studies to illustrate how IIoT and virtual reality integration reshape supply chains, reduce expenses, signal innovation, and boost firm value. A qualitative case study analysis of manufacturing firms adopting IIoT and virtual reality to examine strategic implications.

Oyerogba, Anjorin, Alamu, and Shangodare (2024) explored the effects of adopting modern manufacturing technologies on the listed manufacturing companies in Nigeria. A mixed-methods approach combining survey research and an ex post facto design. The targeted population comprised 78 listed manufacturing companies on the Nigerian Exchange Group; 39 were proportionately sampled, and 390 respondents were purposively selected. The analysis was conducted using descriptive statistics and random-effects regression on panel data from 2014 to 2021. Their findings confirmed that adoption levels remain limited among Nigerian manufacturing companies, while those that adopted IIoT, BDA, AI/ML, and VR experienced better performance in terms of firm value. They further concluded that infrastructural advancement, workforce competence, and organizational commitment were critical determinants of adoption.

The study (Balogun, 2025) investigated technology innovation and transformation in Nigeria's manufacturing sector, using Dangote Cement and Nestlé as case studies. He adopted a sector-level qualitative and quantitative approach, combining case study analysis with secondary data. The research looked at large firms such as Dangote Cement and Nestle Nigeria, as well as SMEs

like Reel Fruits, to assess the use of IoT, AI, robotics, and blockchain in manufacturing. He found that IoT-enabled predictive maintenance and AI-based supply chain platforms reduced operational costs by 15-30%, thereby boosting profitability and firm value. However, he identified ongoing obstacles, including an inconsistent electricity supply, high financing costs with loan rates of 18-30%, and skill shortages, all of which restrict expansion. His policy recommendation included a $500 million Tech Innovation Fund to support SMEs in embracing advanced technologies.

Gap in Literature

Most studies have concentrated on the adoption of digital technologies in developed economies, where support systems, financing, and technical expertise are generally more available. By contrast, research in Nigeria has typically examined technology adoption in isolation without integrating the industrial internet of things, big data analytics, artificial intelligence, machine learning, and virtual reality into one coherent analytical model. Furthermore, many studies tend to focus on descriptive analyses of technology use rather than relating adoption to tangible firm value measures such as the market-to-book ratio, shareholders' equity, and capital gearing.

Moreover, while technologies like IIoT, BDA, AI/ML, and VR have been widely associated with boosting efficiency and competitiveness globally, few Nigerian studies have rigorously tested their direct statistical influence on firm value using robust econometric models. Likewise, the role of firm-specific variables such as firm size, age, and growth in moderating the relationship between technology adoption and firm value remains underexplored. Addressing these gaps would help build a more comprehensive understanding of how cloud-enabled manufacturing technologies influence firm value in developing economies. Studies from advanced economies (Veinampy, 2013; Esoswo, 2011) suggest these factors strongly influence technological capability, yet such relationships remain underexplored in Nigeria.

3.0 Methodology

This study used a mixed-methods research approach, including an online survey and an ex post facto design, to assess how cloud-enabled technologies influence the firm value of quoted manufacturing companies in Nigeria. The rationale for this approach was to capture both the measurable financial impact of cloud-enabled technologies and the contextual realities of their adoption in Nigeria's manufacturing sector. Quantitative analysis was conducted using panel data regression models, while qualitative data were obtained through structured surveys of managers, accountants, and IT specialists. This triangulation enhances the robustness of findings by integrating objective financial indicators with practitioner perspectives.

Population and sampling

The study population included 60 quoted manufacturing companies listed on the Nigerian Exchange Group (NGX). To ensure representativeness across subsectors, a proportionate sampling technique was employed, resulting in a final sample of 30 companies. From these companies, 240 respondents were selected specifically, including production managers, accountants, and IT specialists who were directly involved in adopting and reporting on the technologies used. This dual-level sampling enabled triangulation between firm-level financial data and individual perceptions of technology adoption.

Table 1:
Survey Response Rate

Section	Retrieved	Percentage
Production Managers	75	31.25
Accountants	60	25.0
IT Specialists	105	43.75
Total	240	

Source: Authors' Computation, 2025.

Data Collection

Primary data were gathered through an online survey administered to a stratified sample of quoted manufacturing companies on the Nigerian Exchange Group, conducted between March and September 2025. The questionnaire was aimed at understanding perceptions related to the factors driving adoption and usage of IIoT, BDA, AI/ML, and VR, and the organization's preparedness for digital transformation. Secondary data were extracted from the audited financial statements of the sampled companies and the NGX fact books over an eight-year period. These data are provided in assessing various factors related to the firm's value. The combination of survey and archival data ensured both subjective and objective dimensions of technology adoption were captured.

Model Specification

The firm's value was determined using the market-to-book value ratio, shareholders' funds, and the capital-gearing ratio. The independent variables considered were IIoT, BDA, AI/ML, and VR adoption, while the control variables included firm size, growth rate, and age. Thefunctional form of the model is expressed as follows:

$$Fvit = \beta\alpha + \beta 1IIoTit + \beta 2BDAit + \frac{\beta 3AI}{MLit} + \beta 4VRit + \beta 5FSit + \beta 6FGit + \beta 7FAit + \epsilon i$$

Equation 1

Where:
FV – Firm value
IIoT – Industrial Internet of Things
BDA – Big Data Analytics
AL/ML – Artificial intelligence/machine learning
VR – Virtual Reality
FS – Firm Size
FG – Firm Growth
FA – Firm Age

The study employed panel regression analysis to examine how cloud-enabled technologies affect a firm's value. Specifically, random-effects regression models were used for analyzing the panel data.

4.0 Result and Discussion

Regression Results

Table 2:

Random Effects Regression Results for Market-To-Book Value Ratio (MBV).

Variable	Coefficient (β)	Standard Error	Wald x^2	P-value	Interpretation
IIoT	0.903	0.112	56.93	< 0.01	Strong positive effect
BDA	0.811	0.098	56.93	< 0.01	Significant positive effect
AI/ML	0.774	0.105	56.93	< 0.01	Positive, significant
VR	0.793	0.110	56.93	< 0.01	Positive, significant
FS	0.215	0.080	12.45	< 0.05	Larger firms gain a greater advantage.
FG	0.187	0.075	10.22	< 0.05	Growth facilitates adoption
FA	-0.102	0.070	8.11	< 0.10	Older firms are unadaptable.

Source: Authors' Computation, 2025.

Interpretation: Cloud-enabled technologies significantly improved MBV, with IIoT showing the strongest effect. Larger and growing firms benefited more, while older firms struggled to adapt. This aligns with global findings where IIoT adoption signals innovation and boosts investor confidence (Lee et al., 2018)

Table 3:

Random Effects Regression Results for Shareholders' Funds (SHF).

Variable	Coefficient (β)	Standard Error	Wald x^2	P-value	Interpretation
IIoT	0.845	0.120	47.35	<0.01	Profoundly beneficial impact.
BDA	0.802	0.115	47.35	< 0.01	Significant positive effect
AI/ML	0.765	0.118	47.35	< 0.01	Positive, significant
VR	0.781	0.122	47.35	< 0.01	Positive, significant
FS	0.198	0.085	9.87	< 0.05	Larger firms show improved equity
FG	0.176	0.078	9.12	< 0.05	Growth amplified shareholders' value
FA	-0.095	0.072	7.02	< 0.10	Older firms show weaker equity gains.

Source: Authors' Computation, 2025.

Interpretation: IoT and BDA again emerged as the strongest drivers of shareholder funds. AI/ML and VR also contributed positively, though to a lesser extent. Bigger and growing firms demonstrated stronger equity positions, consistent with agency theory, which suggests that technology adoption reduces information asymmetry and strengthens shareholder trust.

Table 4:
Random Effects Regression Results for Capital Gearing Ratio (CGR).

Variable	Coefficients (β)	Standard Error	Wald x^2	P-value	Interpretation
IIoT	0.612	0.130	32.10	<0.05	Deleveraging
BDA	0.589	0.125	32.10	<0.05	Significant effect
AI/ML	0.210	0.140	32.10	N.S	Not significant
VR	0.498	0.128	32.10	< 0.05	The dampenedpositive effect
FS	0.175	0.082	8.76	< 0.05.	Larger firms optimized debt utilization.
FG	0.162	0.077	8.01	< 0.05	Growth reduction gear.
FA	-0.088	0.069	6.45	< 0.10	Historic firms are unproductive.

Source: Authors' Computation, 2025.

Interpretation: IIoT and BDA significantly reduced gearing ratios, indicating improved debt-equity balance. Virtual Reality has a moderate effect, while AI/ML has no significant effect, reflecting its high implementation costs and limited influence on capital structure. These findings diverge from European studies, where AI/ML adoption improved gearing by optimizing resource allocation (Jordan & Mitchell, 2015).

Findings

This studyindicates that the industrial internet of things and big data analytics consistently have the most significant positive impact on MBV, SHF, and CGR, thereby reaffirming their role in predictive maintenance, supply chain optimization, and data-driven decision-making. Artificial intelligence and machine learning play a crucial role in MBV and SHF, but they do not influence the capital-gearing ratio, and theirconsiderable implementation costs and skill requirements restrict their impact on the debt-equity balance. Virtual reality has a moderate yet noteworthy impact, especiallyin enhancing shareholders' confidence and mitigating gearing risks.The benefits of adopting technology increase with a firm's size and growth, whereas the firm's age negatively influences this relationship, suggesting that older firms may be less flexible in adapting to technological advancements.

Comparison with Global Studies

i. ASIA: Studies in China and South Korea confirm that IIoT and BDA significantly enhance firm value (Lee et al., 2018). Nigerian results mirror these findings, though adoption is constrained by infrastructure.
ii. Europe: AI/ML adoption in Europe improved profitability and capital structure (Jordan & Mitechell, 2015). Nigerian firms show similar benefits for MBV and ShF but not CGR, reflecting contextual barriers.
iii. Africa: Limited studies exist, but evidence from South Africa suggests that digital transformation enhances competitiveness and shareholder confidence (Balogun, 2025). Nigerian results extend this evidence, highlighting the role of firm characteristics in shaping outcomes.

5.0 Conclusion and Recommendation

This research concludes that cloud-enabled technologies, the Industrial Internet of Things (IIoT), Big Data Analytics (BDA), Artificial Intelligence and Machine Learning (AI/ML), and Virtual Reality (VR) immenselyimprove economic value among quoted manufacturing companies in Nigeria. The regression analysis indicated that IIoT and BDA wield the strongest positive influence on market-to-book value and shareholders' funds, while VR contributes moderately, and AI/ML has a minimal effect on capital gearing. The advantages of firm size and firm growth amplify these benefits, while firm age tends to hinder the capacity for adoption. Additionally, the findings affirm that integrating technologyserves not only to improve operational efficiency but also as a determining factor in financial performance and shareholder value.

It is recommended that the management of quoted firms treat the full adoption of IIoT and BDA as core strategic assets, while phasing in AI/ML and VR to reduce cost and expertise constraints. In addition, policymakers should provide enabling infrastructure, reduce financing costs, and establish targeted incentives to accelerate digital transformation with capacity-building programs, which are essential to address skill shortages and ensure sustainable adoption. This study demonstrates that empirical evidence connecting cloud-enabled technologies to firm value in Nigeria addresses a key gap in the literature. Incorporating firm size, firm growth, and firm age into the analysis deepens understanding of how company characteristics shape technology-value relationships.

Further studies should broaden their scope to include small and medium-sized enterprises (SMEs), insurance companies, and the banking industry, which face distinct adoption challenges. Comparative studies across sectors and regions in Africa would provide richer insights into contextual distinctions. Moreover, longitudinal studies may be explored to analyze the changing effects of technology adoption over time, specifically with respect to competitiveness, sustainability, and investor confidence, and the African Continental Free Trade Area (AfCFTA). In addition, earlier studies mainly used simple regression, paired-samples t-tests, or multiple OLS regressions for data analysis. This study applied panel regression analysis to measure the impact of cloud-enabled technologies on firm value, with firm size, growth, and age as moderating factors.

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