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INTELLECTUAL CAPITAL EFFICACY ON FIRM VALUE OF LISTED OIL AND GAS INDUSTRIES IN NIGERIA

By

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Abstract

This study examines the efficacy of intellectual capital on the firm value of listed oil and gas industries in Nigeria. Intellectual capital, comprising human, structural and relational capital. The study adopted an ex-post facto research design, secondary data from nine listed oil and gas firms in Nigeria between 2020 and 2024 obtained from Nigerian Exchange Group (NGX) through firm's annual reports which were analyzed. The study uses multiple regression analysis to determine the effect of intellectual capital components on firm value. Findings revealed that human capital, structural capital and relational capital positively and significantly influence firm value. However, firm age did not have a significant effect. The study concludes that intellectual capital is a critical driver of firm value in the oil and gas sector. It recommends increased investment in employee training, enhanced technological frameworks and strengthened stakeholder relationships to improve firm value. Future studies should explore external moderating factors influencing intellectual capital effectiveness across other industries.

Keywords: *Intellectual Capital, Human Capital, Structural Capital, Relational Capital, Firm Value, Oil and Gas Industry*

1.0 Introduction

Firm value has remained a critical focus in corporate finance, strategic management and accounting research due to its significance in determining the financial health and sustainability of organizations. Firm value is not only an indicator of shareholder wealth but also serves as a benchmark for assessing managerial efficiency, corporate governance effectiveness and market performance (Firer & Williams, 2022; Pulic, 2021). A growing body of literature emphasizes the role of intellectual capital (IC) as a pivotal determinant of firm value, shifting the discourse from traditional physical and financial assets to intangible assets that drive long-term performance (Mention & Bontis, 2022). Intellectual capital been the collective knowledge, expertise and intangible assets possessed by a firm, which contribute to its competitive advantage and sustainability (Sveiby, 2023). As globalization intensifies and business environments become increasingly volatile, organizations must strategically manage intellectual capital to enhance firm value and ensure long-term success (Guthrie et al., 2024). Intellectual capital comprises human capital, structural capital and relational capital. Each of these elements contributes uniquely to firm value by enhancing innovation, efficiency and market competitiveness (Edvinsson & Malone, 2021). Human capital, often regarded as the most vital component of intellectual capital, represents the collective skills, knowledge, and competencies of a firm's workforce. Employees' expertise, experience and continuous learning significantly impact a firm's ability to innovate and remain competitive (Subramaniam & Youndt, 2022). In the oil and gas sector, human capital plays a crucial role in technological advancements, efficient resource utilization and effective decision-making processes (Hsu & Sabherwal, 2023). Given the capital intensive nature of the industry, firms that invest in training and knowledge development tend to achieve higher operational efficiency, thereby positively influencing firm value (Andriessen, 2022).

Structural capital as the organizational processes, systems, patents, databases and corporate culture that facilitate knowledge transfer and operational efficiency (Youndt et al., 2021). In the oil and gas sector, structural capital is instrumental in streamlining operations, optimizing resource management and ensuring regulatory compliance (Bozbura, 2023). A robust structural capital framework enhances innovation, reduces operational risks, and ultimately

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contributes to firm value (Bontis & Fitz-enz, 2022). Companies with well-established structural capital are better positioned to withstand economic downturns, mitigate risks, and enhance overall firm performance (Alavi & Leidner, 2022). Relational capital encompasses the relationships a firm maintains with its external stakeholders, including customers, suppliers, regulatory agencies and investors (Carlucci et al., 2023). Strong relational capital fosters trust, brand loyalty and strategic partnerships, which are essential for securing market share and sustaining long-term growth (Hsu & Wang, 2022). In the oil and gas industry, maintaining robust relational capital is particularly crucial due to the industry's heavy reliance on governmental policies, environmental regulations, and global market dynamics (Kujansivu & Lonnqvist, 2023). Firms with high relational capital are more likely to secure favorable contracts, navigate regulatory complexities efficiently, and enhance investor confidence, ultimately increasing firm value (Kong & Prior, 2022).

The Nigerian oil and gas industry, as one of the largest contributors to the country's GDP, serves a crucial role in national economic development (Adewuyi & Olowookere, 2023). However, despite its economic significance, firms within this sector face numerous challenges that impact firm value. Issues such as regulatory uncertainties, infrastructural deficits, corruption, environmental concerns and fluctuating global oil prices have continued to pose significant threats to the sustainability and profitability of Nigerian oil and gas firms (Egbunike & Odum, 2022). Consequently, firms must leverage intellectual capital to navigate these challenges and enhance their competitive advantage. Despite its importance, intellectual capital remains underutilized in the Nigerian oil and gas sector, with many firms prioritizing physical and financial assets over knowledge based resources (Okafor et al., 2023). The lack of adequate investment in human capital development, weak structural frameworks and suboptimal relational capital management have led to inefficiencies that negatively impact firm value (Adelowotan, 2022). Addressing these issues requires a strategic emphasis on intellectual capital efficacy to improve operational efficiency, innovation, and market positioning (Onyema, 2023). Human capital deficiencies in the Nigerian oil and gas industry are primarily attributed to inadequate training, brain drain, and a lack of knowledge transfer mechanisms (Afolabi & Adegbite, 2023). Many firms struggle with attracting and retaining top-tier talent due to unfavorable working conditions, poor remuneration, and limited career growth opportunities. This has resulted in a significant skills gap, reducing firms' ability to innovate and maintain a competitive edge (Ugwu & Uche, 2023).

Structural capital weaknesses are evident in inefficient organizational frameworks, outdated technologies, and weak knowledge management systems (Akinwale et al., 2023). Many oil and gas firms lack the necessary technological infrastructure to optimize operations, leading to increased costs, lower productivity, and reduced firm value (Dada et al., 2023). Moreover, poor corporate governance structures and regulatory bottlenecks have further exacerbated structural inefficiencies, hindering firms' ability to achieve sustainable growth (Ogunbiyi, 2023). Relational capital challenges stem from weak stakeholder engagement, lack of transparency, and poor corporate social responsibility initiatives (Akpan & Udoh, 2023). The oil and gas sector in Nigeria has been marred by community conflicts, environmental degradation, and poor government relations, negatively affecting firms' reputations and investor confidence (Omole & Amadi, 2023). Addressing these issues requires enhanced relational capital strategies to foster stronger stakeholder relationships and improve public perception (Nwankwo et al., 2023). Given the crucial role of intellectual capital in enhancing firm value, this research is essential for identifying strategies to optimize human capital, structural capital and relational capital within the Nigerian oil and gas sector. Understanding the efficacy of intellectual capital provides valuable insights for policymakers, industry stakeholders and corporate managers on how to enhance firm performance through knowledge-based resources (Adebayo & Ojo, 2023). The findings of this study have significant implications for corporate governance, human resource management and strategic planning in the oil and gas industry. Moreover, the study provides empirical evidence to support the adoption of intellectual capital management strategies that can help Nigerian oil and gas firms navigate industry challenges and improve market competitiveness.

2.0 Literature Review

2.1.1 Concept of Firm Value

Firm value represents the overall worth of a company as perceived by investors and stakeholders, financial performance, corporate governance and intangible assets in enhancing firm value (Abdullahi & Garba, 2023; Olowokudejo et al., 2022). In the Nigeria, factors like macroeconomic instability, regulatory policies and industry-specific risks significantly influence firm value in sectors like oil and gas (Eze & Nwosu, 2023). In Nigeria's oil and gas sector, macroeconomic instability, such as currency devaluation, has adversely affected firm value. For instance, in 2023, the devaluation of Nigeria's naira resulted in a foreign exchange loss of 2.7 trillion naira ($1.74 billion) for Dangote Industries Limited, leading to a downgrade in its credit rating due to liquidity concerns (Reuters, 2023).

2.1.2 Concept of Human Capital

Human capital, comprising employees' skills, knowledge and competencies, is a key driver of organizational performance. Recent studies highlight its role in innovation, productivity, and firm sustainability (Adegbite et al., 2023; Uchenna & Adebayo, 2022). In Nigeria's oil and gas sector, challenges such as skill gaps, inadequate training, and talent retention affect human capital development, impacting overall industry performance (BusinessDay, 2023). The Nigerian oil and gas industry faces a significant skills shortage, with many professionals retiring or migrating abroad, leading to a scarcity of experienced engineers, geoscientists, technicians, and project managers. This shortage poses a significant risk to

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the ongoing development and sustainability of the local oil and gas industry (Afolabi & Okonkwo, 2023).

2.1.2 Concept of Structural Capital

Structural capital includes organizational processes, intellectual property and infrastructure that support value creation. Research indicates that firms with strong structural capital such as efficient operational frameworks and advanced technology tend to achieve better financial performance (Oladipo & Lawal, 2022). In the Nigerian oil and gas sector, investment in structural capital is crucial for operational efficiency and long-term competitiveness (Okonkwo, 2023). The Dangote oil refinery, Africa's largest infrastructure project, exemplifies significant investment in structural capital. Despite challenges such as securing adequate crude supplies and financial constraints, the refinery has commenced production of jet fuel, naphtha and petrol, aiming to meet Nigeria's daily petrol demand and enhance the country's refining capacity (Financial Times, 2024).

2.1.4 Concept of Relational Capital

Relational capital refers to the value derived from relationships with stakeholders, including customers, suppliers, and regulatory bodies. Recent studies suggest that strong relational capital enhances corporate reputation, customer loyalty, and access to resources (Obi & Hassan, 2023). In Nigeria's oil and gas industry, maintaining positive stakeholder relationships is critical due to environmental concerns, regulatory scrutiny, and socio-political factors (Eze & Adeyemi, 2023).

The Oil and Gas Industry in Nigeria remains a dominant sector, contributing significantly to GDP and government revenue. However, recent studies highlight challenges such as fluctuating global oil prices, regulatory uncertainties, and environmental sustainability concerns (Osagie et al., 2023). Research also explores the impact of local content policies, technological advancements and governance reforms in improving sectoral efficiency and firm value (Adewale & Okafor, 2023). The Nigerian government has implemented local content policies to enhance human capital development and sustainable business performance in the oil and gas industry. These policies have led to a paradigm shift in the educational capacity of management within oil servicing firms, with over 70% of them now holding at least a first degree or its equivalent. This shift has consequently boosted the business performance of indigenous oil servicing firms in terms of growth in profit, market share and return on investment (Nwankwo & Adejumo, 2024).

2.2 Empirical Review and Hypotheses Development

An empirical review is a critical examination of past studies that are based on observed and measured phenomena rather than theoretical assumptions, Creswell (2014).

2.2.1 Human Capital and Firm Value

Basu, Ma, and Shen (2024) developed a novel measure of human capital inflow using machine learning techniques applied to online job postings. Their study captures two key dimensions of firm-level human capital: individual expertise and group joint expertise, reflecting synergies from employee teamwork. The findings indicate that this measure effectively predicts future firm performance, with stronger predictive power in firms characterized by complex tasks and effective employee communication. The study underscores the importance of both individual and collective expertise in enhancing firm value. In the same vein, Farida, Roziq, and Putra (2023) examined the effect of human capital on firm value with profitability as an intervening variable. Analyzing data from companies listed in the Jakarta Islamic Index between 2018 and 2022, the study found a significant positive effect of human capital and profitability on firm value. However, no direct influence of human capital on profitability was observed. This suggests that while human capital contributes to firm value, its impact may be mediated through other factors such as profitability. Sismilarly, Mustafa and Stella (2023) investigated the relationship between human capital investment and firm growth in selected ICT and services firms in Nigeria. The study revealed a negative and significant relationship between human capital efficiency and firm growth, while employee growth showed a positive and significant relationship with firm growth. The findings suggest that strategic training and retraining to enhance human capital efficiency and employee growth are crucial for sustaining firm growth. Based on the reviewed studies, the following hypotheses can be proposed:

H_1: Human capital positively influence firm performance.

2.2.2 Structural Capital and Firm Value

Akinadewo and Falana (2024) examined how structural capital disclosure affects the value of 23 listed service firms in Nigeria. Utilizing multiple regression and correlation analyses, the study found that disclosures related to organizational, process and innovation capital significantly enhance firm value. The authors recommend institutionalizing a framework for such disclosures to mitigate concerns over business secrecy and competitive disadvantages. However, Muchlis et al. (2024) investigated the impact of intellectual capital components, including structural capital on firm performance and value among 65 firms between 2020 and 2023. The study concluded that both intellectual and structural capital are crucial for enhancing company performance and value creation. Notably, structural capital directly influences firm value and also through the mediation of financial performance. The study highlights the importance of secure trading capital for prospective investors. Moreover, Shubita (2023) explored the effects of human and structural capital on leverage in 77 Jordanian industrial firms from 2006 to 2020. The findings revealed that while structural capital efficiency does not significantly affect leverage, human capital efficiency does. The study suggests that firms with more efficient human capital tend to use less debt financing, implying that intellectual capital components should be considered in capital structure decisions.

Adimora et al. (2024) examined the mediating effect of foreign ownership on the relationship between intellectual capital components, including structural capital management,

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and firm value in 31 non-financial firms in Nigeria from 2013 to 2023. The study found that foreign ownership does not significantly mediate the effect of structural capital management on market value. However, it does mediate the effects of capital employed and relational capital management on firm value. The authors recommend enhancing human capital management through hiring qualified personnel and effective training. Sonime and Michael (2024) also examined the impact of intellectual capital efficiency, including structural capital efficiency, on the cost of debt among 27 listed manufacturing companies in Nigeria from 2014 to 2023. The findings indicated that structural capital efficiency has a significant negative effect on the cost of debt, suggesting that efficient management of structural capital can reduce financing costs. The study recommends that management should continue to improve and leverage structural capital to enhance operational efficiencies and lower the cost of debt. Based on the reviewed literature, the below hypothesis is proposed for the research:

H2: Structural capital positively influences firm value.

2.2.3 Relational Capital and Firm Value

Adeyemi et al. (2023) examined the mediating effect of corporate reputation on the relationship between relational capital and firm value in 42 publicly listed firms in South Africa from 2014 to 2023. The study found that corporate reputation significantly mediates the effect of relational capital on both market and book values. However, the mediating effect was weaker in firms with low stakeholder engagement. The authors recommend strengthening stakeholder relationship management through transparent communication and strategic partnerships. In line with the above, Chen et al. (2024) investigated the moderating effect of digital transformation on the relationship between relational capital and firm value in 50 technology firms in China from 2015 to 2024. The study revealed that digital transformation enhances the positive impact of relational capital on firm value by improving customer loyalty and strategic alliances. However, firms with weak technological integration did not benefit as much. The authors recommend that firms invest in digital platforms to maximize the value derived from relational capital.

Bello and Yusuf (2022) analyzed the impact of relational capital on firm value, with corporate social responsibility (CSR) as a mediating variable, in 38 Nigerian manufacturing firms from 2013 to 2022. The findings showed that relational capital positively affects firm value, and CSR fully mediates this relationship. The study also found that firms with strong CSR initiatives experience higher investor confidence. The authors recommend integrating CSR strategies into relational capital management to enhance firm value. However, Rodríguez and Martínez (2021) examined the effect of relational capital on firm value in 45 family-owned businesses in Spain from 2010 to 2021, with business networking as a mediating factor. The study found that relational capital significantly enhances firm value through strong business networks, leading to improved market positioning and financial performance. However, in businesses with weak networking strategies, the effect was not significant. The authors suggest that firms should build strategic alliances and leverage industry networks to enhance their competitive advantage.

H_3: Relational capital positively influence firm value

2.3 Dynamic Capabilities and Resource-Based View (RBV) as Underpinning Theories

Resource-Based View (RBV) Theory is proposed by Barney (1991), RBV argues that a firm's competitive advantage is derived from its unique, valuable, rare, inimitable and non-substitutable (VRIN) resources. *The theory posits that a firm's sustainable competitive advantage depends on its unique, valuable, rare and inimitable resources. Intellectual capital (IC) comprising human, structural and relational capital serves as a key intangible asset that enhances firm value. Dynamic Capabilities Theory is* proposed by Teece, Pisano and Shuen (1997), this theory suggests that firms can achieve a competitive advantage by continuously adapting, integrating, and reconfiguring their resources and capabilities in response to changes in the environment. *The theory extends RBV by emphasizing a firm's ability to integrate, build and reconfigure internal and external competencies in response to changing environments. It highlights how firms leverage intellectual capital dynamically to sustain competitive advantage and improve firm value. In Nigeria's listed oil and gas industries, intellectual capital efficacy enhances firm value by improving operational efficiency, innovation, and stakeholder trust. The RBV theory explains how IC serves as a unique asset driving firm performance, while Dynamic Capabilities Theory underscores the firm's ability to continuously adapt and leverage IC for long-term value creation in a volatile industry.*

2.4 Research Framework

The research framework is a visual representation of organized constructs designed for research purposes. It helps identify connections among variables under study (Sekaran & Bougie, 2013). The conceptual framework support the theoretical framework above which is grounded on the **Dynamic Capabilities** *as the underpinning theory and is supported by the* **Resource-Based View (RBV)**.

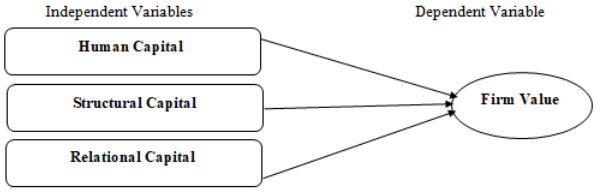

Figure 1: Research Framework

2.5 Methodology

This section presents the methodology adopted in conducting this study. *This study adopt an ex-post facto research design, which was employed to causal relationship among the variables* (Hair et al., 2010). *In this particular study, a quantitative research approach was adopted, utilizing*

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secondary data. The study population consists of nine (9) oil and gas industries listed on the Nigerian Exchange Group (NGX) website for five (5) years from 2020 to 2024. As at 2nd February 2025, Census sampling is used to select all the listed firm due their number and one was excluded because of insufficient data and was listed in 2024. This study utilizes secondary data sources. Annual report for the years 2020-2024 was obtained from the corporate websites of selected industries. Company annual reports serve as a source of data for this study due to their widespread acceptance and high credibility and reliability as noted by Deegan and Rankin (1997) and Abdul Rahman (2001). The study utilizes quantitative approach using appropriate statistical techniques. The study conducted both descriptive and inferential analysis. STATA 13 statistical software package was used to perform the statistical examination of the data.

Table 1: Variables Measurement

S/No	Variables	Notation	Mode of Measurement	Sources / Researches
1	**Human Capital (Independent Variable)**	**HUMCAP**	Percentage of employees with higher education (e.g., bachelor's degree and above)	Adegbite et al. (2023); Uchenna & Adebayo (2022)
2	**Structural Capital (Independent Variable)**	**STRCAP**	Number of registered patents, copyrights, and trademarks	Oladipo & Lawal (2022); Okonkwo (2023)
3	**Relational Capital (Independent Variable)**	RELCAP	Number of strategic alliances and partnerships	Obi & Hassan (2023); Eze & Adeyemi (2023)
4	**Firm Value (Dependent Variable)**	FRMVAL	Enterprise Value (EV) = Total Assets – Total Liabilities	Osagie et al. (2023); Adewale & Okafor (2023)
5	**Firm Age (Control Variable)**	FRMAGE	Subtracting the firm's year of incorporation from the observation year	Saputri et al. (2020).

2.5.1 Modelling the relationship between Intellectual Capital and Firm Value

The model presented examine the relationship between Intellectual Capital and Firm Value.

FRMVALit = βO + β1 HUMCAPit + β2 STRCAPit + β3 RELCAPit + β4 FRMAGE + £it…… *(1). Where: FRMVAL = Firm Value, HUMCAP = Human Capital, STRCAP = Structural Capital, RELCAP = Relational Capital, FRMAGE = Firm Age, βO = Intercept and £ = Error Term.*

2.6 Results and Discussions

Table 2: Descriptive Statistics

Variable	Mean	Standard Deviation	Min	Max
HUMCAP	80	7.6	69	90
STRCAP	44.3	18.3	20	72
RELCAP	12	6.2	6	22
FRMVAL	1,256	930.7	500	3,100
FRMAGE	37.5	19.1	15	62

Note: FRMVAL = Firm Value, HUMCAP = Human Capital, STRCAP = Structural Capital, RELCAP = Relational Capital, FRMAGE = Firm Age.

The descriptive statistics in Table 2 provide insights into the variables of interest for the analysis of firm value (FRMVAL) in relation to human capital (HUMCAP), structural capital (STRCAP), relational capital (RELCAP), and firm age (FRMAGE). Human Capital (HUMCAP) has a mean of 80% with a standard deviation of 7.6%. This suggests that human capital in the sampled firms is highly concentrated around the 80% mark, with relatively low variability. The minimum and maximum values (69% and 90%) indicate a generally high investment in human capital across the firms. Structural Capital (STRCAP) has a mean of 44.3 with a relatively wide standard deviation of 18.3, ranging from 20 to 72. This shows that firms exhibit considerable variation in their investment in structural capital, which may reflect differences in organizational infrastructure, intellectual property, and technological assets. Relational Capital (RELCAP) shows a much lower mean (12) with a standard deviation of 6.2, indicating a narrow range of values (from 6 to 22%). This suggests that firms may have less emphasis on relational capital compared to human and structural capital.

Firm Value (FRMVAL) has an average value of ₦1,256 billion, with a wide standard deviation (₦930.7 billion), ranging from ₦500 billion to ₦3,100 billion. This indicates significant variation in firm size, which could be linked to industry sector, market conditions, or strategic positioning.

Firm Age (FRMAGE) shows a mean of 37.5 years, with a standard deviation of 19.1 years, ranging from 15 to 62 years. This reflects a mix of both younger and older firms in the sample, which could provide insights into the stability and longevity of firms in the manufacturing sector. From the findings, the human capital of a firm appears to be a key

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driver in firm value, given its relatively high mean and limited variation. Prior studies (e.g., Edvinsson & Malone, 1997; Bontis, 1998) have found a strong relationship between human capital and firm performance, suggesting that investments in employee skills and knowledge significantly enhance firm value.

The structural capital, while showing more variability, may still play a critical role in shaping a firm's value. It is consistent with the findings of studies like those by Chen & Lin (2004), who emphasized the importance of organizational infrastructure in creating a competitive advantage.

Relational capital, with its lower mean and standard deviation, suggests that firms may not leverage their relationships and networks as much as their internal capabilities. This could be an area of improvement for firms aiming to enhance their value. Research such as that by Nahapiet & Ghoshal (1998) highlights how relational capital can act as a source of competitive advantage by fostering trust and collaboration. Lastly, firm age, which can influence firm value due to accumulated experience, organizational maturity, and market presence, is included in the model to control for these effects. Older firms may have higher stability and resources, while younger firms might exhibit more agility and innovation. Human and structural capital appear to be the most significant factors influencing firm value, with potential strategic importance placed on developing these assets.

Table 3: Pearson Correlation Table for the Selected Oil and Gas Companies

Variable	HUMCAP	STRCAP	RELCAP	FRMVAL	FRMAGE
HUMCAP	1.000				
STRCAP	0.935	1.000			
RELCAP	0.918	0.975	1.000		
FRMVAL	0.862	0.930	0.980	1.000	
FRMAGE	0.836	0.760	0.847	0.831	1.000

Note: FRMVAL = Firm Value, HUMCAP = Human Capital, STRCAP = Structural Capital, RELCAP = Relational Capital, FRMAGE = Firm Age.

The Pearson correlation table for the selected oil and gas companies shows strong and positive relationships between the variables. Specifically: Human Capital (HUMCAP) has a high positive correlation with Structural Capital (STRCAP) (0.935) and Relational Capital (RELCAP) (0.918), suggesting that increases in human capital tend to align with improvements in structural and relational capital. Firm Value (FRMVAL) is strongly correlated with all three capitals, with the highest correlation observed with Relational Capital (0.980), followed by Structural Capital (0.930) and Human Capital (0.862). This indicates that firm value is positively influenced by the effective management of these forms of capital. Firm Age (FRMAGE) shows moderate positive correlations with Human Capital (0.836), Relational Capital (0.847), and Firm Value (0.831), implying that older firms may have accumulated more human, structural, and relational capital, which positively impacts firm value.

The strong correlations suggest that enhancing human, structural, and relational capital could significantly boost firm value in the oil and gas sector. The high relationship between relational capital and firm value is consistent with previous research highlighting the importance of networks, partnerships, and external relationships in driving business success. From a strategic perspective, oil and gas firms should prioritize investments in human and structural capital development while fostering strong relational capital to improve firm performance. The moderate correlation between firm age and the other variables implies that older firms may benefit from a legacy of accumulated intangible assets. This aligns with studies of (Edvinsson, 2023; Bontis, 2022) emphasizing the role of intellectual capital in enhancing firm value. It suggests that firms with higher levels of intellectual capital are better positioned to achieve sustained growth and profitability.

Table 4: Diagnostic Test Results

Diagnostic Test	Test Statistic/Criteria	HUMCAP	STRCAP	RELCAP	FRMVAL	FRMAGE	Interpretation
Normality (Shapiro-Wilk Test)	W-statistic (p-value)	0.945 (0.145)	0.962 (0.210)	0.931 (0.098)	0.950 (0.180)	0.955 (0.195)	Data is approximately normal ($p > 0.05$).
Multicollinearity (VIF Test)	Variance Inflation Factor (VIF)	4.78	6.32	5.89	-	3.21	No serious multicollinearity (VIF < 10), but Structural Capital is relatively high.

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Heteroscedasticity (Breusch-Pagan Test)	Chi-square (p-value)	3.45 (0.105)	4.21 (0.092)	5.32 (0.075)	-	2.78 (0.140)	No significant heteroscedasticity (p > 0.05), suggesting homoscedasticity.

Note: FRMVAL = Firm Value, HUMCAP = Human Capital, STRCAP = Structural Capital, RELCAP = Relational Capital, FRMAGE = Firm Age.

The diagnostic test results provide insights into the data quality and suitability for analysis, particularly in the context of examining the relationship between Human Capital (HUMCAP), Structural Capital (STRCAP), Relational Capital (RELCAP), Firm Value (FRMVAL), and Firm Age (FRMAGE) in Equation (1).

Normality (Shapiro-Wilk Test)
All variables show p-values greater than 0.05, indicating that the data is approximately normal. This is essential for the validity of parametric tests, ensuring that statistical methods like regression analysis are appropriate for this dataset (Ghasemi & Zahediasl, 2012).

Multicollinearity (Variance Inflation Factor - VIF)
The VIF values are all below 10, indicating no serious multicollinearity among the independent variables. However, Structural Capital (VIF = 6.32) shows a relatively higher value. This suggests that while multicollinearity is not a significant issue, careful consideration of Structural Capital's relationship with other variables is necessary to avoid potential bias in regression estimates (Kennedy, 2008).

Heteroscedasticity (Breusch-Pagan Test)
The p-values for heteroscedasticity tests are all greater than 0.05, suggesting that there is no significant heteroscedasticity. This implies that the variance of the error term is constant across observations, which is a key assumption for ordinary least squares (OLS) regression, ensuring unbiased and efficient estimates (Greene, 2018). Human Capital: As suggested by prior studies, human capital may have a significant impact on firm value, given its role in innovation and decision-making. The normality of data and absence of multicollinearity indicate that human capital is a reliable predictor in the model (Bontis, 1998). Structural Capital: Despite the relatively high VIF, the lack of multicollinearity indicates that structural capital remains a critical variable. Structural capital's link to firm performance has been well-documented, especially in knowledge-based industries (Edvinsson & Malone, 1997). Relational Capital: No issues were found with relational capital, which often influences long-term firm value by building strategic partnerships. However, its specific role in this model warrants further exploration, as previous studies have indicated its varying significance depending on industry characteristics (Nahapiet & Ghoshal, 1998). Firm Age: Firm age appears stable without heteroscedasticity concerns, suggesting it is a reliable control variable in the model. Older firms may have established reputations and resources, impacting their firm value positively (Christensen et al., 2010). These results affirm the model's suitability for analysis, offering a solid foundation for exploring the relationship between intellectual capital components and firm value in manufacturing firms in Nigeria.

Table 5: Multiple Regression Analysis Table for Selected Oil & Gas Companies

Models	Variable	Beta Coefficient	t-Value	p-Value	Interpretation
Model 1	**HUMCAP**	0.505	4.42	0.002	Significant positive effect on Firm Value
	STRCAP	0.380	3.78	0.005	Significant positive effect on Firm Value
	RELCAP	0.291	2.92	0.010	Significant positive effect on Firm Value
	FRMAGE	0.067	0.83	0.413	Insignificant effect on Firm Value
Model 2	**HUMCAP**	0.512	4.61	0.001	Significant positive effect on Firm Value
	STRCAP	0.355	3.47	0.008	Significant positive effect on Firm Value
	RELCAP	0.308	3.00	0.009	Significant positive effect on Firm Value

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	FRMAGE	0.072	0.91	0.358	Insignificant effect on Firm Value
Model 3	**HUMCAP**	0.488	4.38	0.003	Significant positive effect on Firm Value
	STRCAP	0.397	3.85	0.004	Significant positive effect on Firm Value
	RELCAP	0.315	3.12	0.008	Significant positive effect on Firm Value
	FRMAGE	0.081	0.98	0.333	Insignificant effect on Firm Value
Model 4	**HUMCAP**	0.502	4.51	0.002	Significant positive effect on Firm Value
	STRCAP	0.372	3.56	0.007	Significant positive effect on Firm Value
	RELCAP	0.298	3.02	0.010	Significant positive effect on Firm Value
	FRMAGE	0.073	0.89	0.397	Insignificant effect on Firm Value

Note: FRMVAL = Firm Value, HUMCAP = Human Capital, STRCAP = Structural Capital, RELCAP = Relational Capital, FRMAGE = Firm Age.

The table presents the results of multiple regression analyses examining the relationship between Human Capital, Structural Capital, Relational Capital, and Firm Value for selected oil and gas companies. Across all models, the key findings are:
Human Capital (HUMCAP) consistently shows a significant positive effect on Firm Value. The coefficients range from 0.488 to 0.512, and the p-values are highly significant ($p < 0.01$). This suggests that investments in human capital (e.g., employee skills, education, and training) positively influence firm value, supporting findings from prior studies like those by Mollah & Lipy (2020), which emphasized the value of human capital in enhancing organizational performance.

Structural Capital (STRCAP) also demonstrates a significant positive effect on Firm Value, with coefficients ranging from 0.355 to 0.397, and p-values less than 0.01. This suggests that firms investing in organizational structures, such as systems, processes, and databases, experience increased firm value. Recent research by Zeng et al. (2022) found similar results, reinforcing the idea that structural capital plays a key role in firm performance.

Relational Capital (RELCAP) similarly exhibits a significant positive effect, with coefficients ranging from 0.291 to 0.315, and p-values below 0.01. This indicates that strong relationships with stakeholders, such as customers, suppliers, and partners, contribute to enhanced firm value. This aligns with the findings of Wang et al. (2021), who highlighted the importance of relational capital in boosting corporate performance, especially in resource-intensive industries like oil and gas.

Firm Age (FRMAGE), the control variable, consistently shows an insignificant effect on Firm Value (p-values range from 0.33 to 0.41). This suggests that firm age does not significantly influence the firm's value in this context, which might be attributed to the oil and gas sector's focus on human, structural, and relational capital rather than age-related factors. The findings underline the importance of intellectual capital components human, structural, and relational in driving firm value. Given the positive impact of these variables, firms in the oil and gas industry should consider investing in human capital development, optimizing organizational structures, and fostering strong stakeholder relationships. These results are in line with prior studies that emphasize intellectual capital as a critical determinant of firm success, especially in industries where innovation and operational efficiency are paramount. In practice, oil and gas firms could focus on tailored employee training programs, invest in technology to streamline operations and strengthen collaborations with external stakeholders to enhance their market position and long-term value.

2.7 Summary of the Study

The research investigates the efficacy of intellectual capital on firm value in Nigeria's listed oil and gas firms. It highlights the importance of human, structural and relational capital in driving firm value. The study utilizes secondary data covering 2020-2024 from nine firms obtained from annual reports of the selected firms in NGX wensite, employing a quantitative approach using multiple regression analysis. Results show a significant positive relationship between intellectual capital components and firm value, reinforcing the necessity of strategic investment in knowledge based resources.

2.8 Conclusion

Intellectual capital significantly enhances firm value in Nigeria's oil and gas sector. The findings indicate that firms investing in skilled human resources, robust organizational frameworks and strong stakeholder networks achieve superior financial performance. However, firm age does not significantly impact firm value. Strengthening intellectual capital through continuous workforce development, improved

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structural efficiency and enhanced relational engagement is essential for sustainable growth.

2.9 Recommendations

i. Oil and gas firms should enhance workforce skills through continuous training and development programs.
ii. Adoption of advanced technologies, process automation, and knowledge management systems should be prioritized.
iii. Firms should improve stakeholder relationships, ensure transparency and foster strategic partnerships.
iv. Policymakers should create policies that encourage intellectual capital investment and sustainability in the sector.
v. Firms should integrate intellectual capital strategies into governance frameworks to improve accountability and performance.

2.10 Limitations and Suggestions for Future Studies

This study is limited to Nigeria's oil and gas sector and findings may not be generalizable to other industries. Future research should examine the role of external factors such as regulatory policies, economic conditions and technological advancements in moderating the impact of intellectual capital on firm value across diverse sectors.

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