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Intellectual Capital and Firm Value of Listed Oil and Gas Firms in Nigeria

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Abstract: *This study ascertained the effect of intellectual capital on firm value of listed oil and gas companies in Nigeria for a period of twelve years from 2012 to 2023. The dependent variable is firm value while the independent variables are human capital, structural capital and relational capital. This study adopted an ex-post facto research design with data extracted from the annual reports of nine sampled companies. Descriptive statistics and OLS linear regression technique were used in the analysis of data. Findings revealed that structural and relational capitals both have significant positive effects on firm value. Human capital showed a negative effect on firm value, however, this was not statistically significant. It was therefore recommended that listed oil and gas companies in Nigeria should prioritize investments in organizational processes, systems, and knowledge management and should also develop comprehensive stakeholder engagement strategies that focuses on building strong mutually beneficial relationships.*

keywords: intellectual capital, structural capital, relational capital

INTRODUCTION

Intellectual capital is an intangible asset of an organization leveraged to drive profits, acquire new customers, develop innovative products, and enhance business performance. It encompasses employee expertise, organizational processes, and other intangibles that boosts a company's bottom line. It represents the value of a company's employee knowledge, skills, business training, and proprietary information, providing a competitive advantage. The “new economy” emphasizes knowledge as the most valuable resource, which can be acquired, transferred, combined, and utilized. The effective management of intellectual capital as an intangible asset is vital for corporate innovation and competitiveness. Intellectusl capital is made up of human, structural, and relational capitals. Human capital extends beyond employees' knowledge and experience to include education, life experiences, and work experiences. Investing in human capital boosts productivity and profitability. Structural capital refers to an organization's infrastructure and systems, facilitating improvement and excellence. Relational capital comprises the extensive network of relationships an organization maintains, encompassing employees, suppliers, customers, shareholders, and investors. The effective management and leveraging of infrastructures and relationships can significantly enhance market reputation, customer loyalty, and business networks, ultimately leading to improved financial outcomes and firm value.

In the Nigerian oil and gas industry, intellectual capital plays a pivotal role in driving economic growth and development. As one of Africa's largest oil and gas producers, Nigerian intellectual capital fosters innovation, enhances operational efficiency, supports strategic decision-making, attracts investments, and promotes sustainable development. By recognizing the importance of intellectual capital, the Nigerian oil and gas industry can navigate challenges, seize opportunities, and contribute to the nation's economy (Lamuel, 2020). Nigeria's oil and gas industry, which is a significant contributor to the country's economy, has experienced fluctuations in revenue. In 2018, oil revenue stood at $34.21 billion, decreasing to $32.62 billion in 2019. However, in the first quarter of 2023, Nigeria earned $42.2 billion (Adeleke, 2021). The industry's history dates back to 1903, when the Nigerian Bitumen Corporation conducted exploratory work in the country. At the onset of World War I, the firm's operations were stopped. Due to the lack of technological and financial resources of small oil companies, larger and stronger oil companies took over the exploration of commercial oil in the country. In 2019, over 80 percent of Nigeria's export value was generated by the mineral fuels, oils, and distillation products sector, accounting for approximately 47 billion U.S. dollars (Fathom, 2020).

However, due to the lower demand related to the COVID-19 pandemic, oil production and export dropped. Data for 2020 shows a considerable decrease in the export value derived from oil. Before the coronavirus (COVID-19) pandemic, Nigeria's oil sector generally accounted for about nine percent of the country's gross domestic product (GDP). Between October and December 2020, the oil industry contributed up to 5.9 percent to the total real GDP, a decrease of roughly three percentage points compared to the previous quarter. In the second quarter of 2023, the contribution of the oil sector to the country's GDP reached 5.34 percent (Kasim, 2023). The oil and gas industry may face a number of challenges due to technological and environmental factors. These challenges include increased volatility and uncertainty, environmental regulations, the transition to low-carbon fuel, cybersecurity, and talent shortages. The industry’s future may also be threatened by the introduction of new technologies, the increasing cost of oil production, and the changing global climate. These challenges, if not properly managed, may affect profit generation and the firm’s efficient use of shareholders’ funds. This is why intellectual capital development is very vital in oil and gas companies.

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The high organizational performance of many companies in the oil and gas sector today is linked to intellectual capital development (Henry, 2021). For instance, top oil and gas companies in Nigeria, such as Chevron Corporation, ExxonMobil Corporation, TotalEnergies SE, and Shell LLC, have made significant investments in intellectual capital development (Jude, 2021). In today's digital information era, the success of any organization and its productivity are determined by innovation and the ability to apply knowledge, collectively known as intellectual capital The financial performance and firm value of companies in the oil and gas sector are intricately linked to their intellectual capital (Dayo, 2021). Companies that excel in harnessing their relational, and structural capital can achieve superior productivity, profitability, and market valuation. This, in turn, enhances their attractiveness to investors, as higher profitability reflects the company’s capability to pay dividends and generate long-term value, making it a compelling investment option.

The oil and gas industry is becoming increasingly dependent on technology, making it a prime target for cyber threats (James, 2021). Cybersecurity is a major challenge for the industry, as cyber criminals can easily access the large amount of sensitive data held by oil and gas companies. This data includes operational and financial information, customer data, and intellectual property. Cyber threats can include unauthorized access to data, malware, ransomware, and phishing scams. It has been noted in different research studies (e.g., Kasim, 2023; Bukola, 2019; Candy, 2022; and Tangi, 2022) that the

oil and gas industry should harness and optimally engage the intellectual capital available in Nigeria. This may reduce the risk of cyber threats and likely result in higher productivity and enhanced market value.

The oil and gas industry is changing rapidly due to the shift toward cleaner energy, technological advancements, increased automation and better stakeholder relationship. These changes require new skills, making the development of intellectual capital crucial. At the same time, the industry is facing a shortage of skilled workers, worsened by an aging workforce, retirements, and emigration, especially after the COVID-19 pandemic. However, with the rise of the "new economy," both tangible and intangible assets, including human capital, information communication technology and relationship capital are now key in determining a company's value. This change highlights the importance of ascertaining the effect of intellectual capital on firm value. Given the competitive and changing nature of the industry, it is important to ascertain the effect of intellectual capital, human capital productivity, structural capital productivity, and relational capital productivity on the firm value of listed oil and gas companies in Nigeria. Investors need this knowledge to assess a firm's ability to survive and grow in this evolving environment.

The main objective of this study is to ascertain the effect of intellectual capital on firm value of listed oil and gas companies in Nigeria. The specific objectives are to determine the effect of human capital productivity on firm value of listed oil and gas companies in Nigeria; evaluate the effect of structural capital productivity on firm value of listed oil and gas companies in Nigeria and to ascertain the effect of relational capital productivity on firm value of listed oil and gas companies in Nigeria. Three hypotheses were developed for the study:

H_{01}: Human capital productivity has no significant effect on return on assets of listed oil and gas companies in Nigeria.
H_{02}: There is no significant effect of structural capital productivity on return on assets of listed oil and gas companies in Nigeria.
H_{03}: Relational capital productivity has no significant effect on return on assets of listed oil and gas companies in Nigeria.

The study is structured as follows: section one introduces the study, section two reviews the related literature, section three present methodology and section four presents the resuts. Section five sets out a discussion of the findings, section six discusses the implications of the study to research and practice, section seven shows key conclusion and recommendations, while section eight gives suggestions for future researches.

LITERATURE AND THEORETICAL UNDERPINNING

Firm value refers to the measure of a company's success and prosperity, which is closely related to the price of its shares (Sophia, 2022). It is an unbiased and reliable metric that stakeholders, shareholders, potential investors, and managers use to assess the performance and operations of a company (Hope, 2020). Firm value is an investor's perception of the company's degree of success. In public companies, it is commonly linked to the share price of the company because firm value is reflected in their share price. In addition, market prices of shares also reflect an investor's valuation of the total equity that the company holds. It is the investor's perception of the company that is often associated with stock prices. Firm value is very important in investment transactions. The measurement of firm value is the amount

that one must pay to buy, or take over the business entity. This value can be determined based on the company's book, or market value.

Adeleke (2021) defines intellectual capital as a critical force that drives a firm's growth. It is also defined as the intangible value of an organization's employees, skills, knowledge, and training that can provide a company with a competitive advantage. Intellectual capital includes all the processes and assets that are not typically shown on the statement of financial position, as well as the intangible assets in modern accounting, mainly trademarks, patents, and brands. This encompasses original data, customer satisfaction, employee experience, and internal processes and structures. Companies that measure their intellectual capital can use it to create more value, improve products and services, increase sales and growth, enhance efficiency, and deepen customer and partner relationships. Measuring intellectual capital helps to quantify and valorize intangible assets such as knowledge, innovation, and relationships. Classifying this range of measures is difficult. However, after an analysis of different approaches in this study, we will focus on the most widely recognized and easily understood measurements of intellectual capital, which are structural capital productivity, and relational capital productivity.

Human Capital Productivity refers to how effectively a company uses the skills, competencies, training, education, experience, and value characteristics of its workforce. It measures the output and business impact generated relative to the employee-related costs. Efficient use of human capital at the firm level is an important component in enhancing the firm's performance. Human capital efficiency plays a key role in enhancing productivity and is also a major factor in the successful implementation of business strategies. The successful development of a firm depends considerably on the quality of knowledge, skills, competencies, experience, know-how, capabilities, and expertise of the firm's human members. Since human capital efficiency is considered the main stimulus for growth in a firm, it can determine the competitive status of the firm. High human capital productivity means that the workforce is delivering substantial value relative to what is spent on compensation, benefits, training, and other employee costs. The higher the human capital productivity, the better the returns on human capital investment.

Structural Capital Productivity is the supporting infrastructure of human capital. It is the knowledge that remains within the firm when employees leave the organization. This includes what is left after employees go home for the night, such as processes, information systems, databases, policies, intellectual property, and culture. Thus, it is the knowledge embedded in organizational structures and processes. Structural Capital Productivity (SCP) includes codified knowledge, procedures, processes, goodwill, patents, systems, information systems, databases, hardware, software, and culture. Some authors (Gaxton, 2020; Tolu, 2020; Neka, 2021; and Joy, 2021) argue that human capital creates structural capital, and that the quality of structural capital is most likely a reflection of the quality of human capital. The structural capital of organizations represents all the non-human storehouses of knowledge, including databases, organizational charts, process manuals, strategies, routines, and policies (Sandra, 2019).

Relational capital productivity refers to the set of relationships that bind an organization with its customers, suppliers, partners, and social agents associated with the organization through its basic business operations, which affect its productivity (Ola, 2021). Relational capital efficiency is the third component of intellectual capital. Previously considered part of structural capital, it focuses mainly on relationships with customers. It is classified according to client capital, and when service to a customer

goes wrong, it is difficult to repair mistakes or improve the service after it has been delivered. Therefore, service industries require critical soft skills to guarantee a fast response to customers' complaints or concerns, including reliability, courtesy, attentiveness, helpfulness, care, friendliness, understanding the customers, responsiveness, and communication. According to Porter (2021), Relational capital is the most valuable component of intellectual capital, as it is based on the assumption that customers support the organization and its final plans. Relational capital is the main determinant in converting intellectual capital into market value, acting as a bridge and catalyst for intellectual capital operations.

The theories adopted for this study are intellectual capital theory and resource-based theory, Intellectual capital theory was proposed by Ante Pulic in the late 1990s and early 2000s, along with other researchers such as Edvison, Stewart, Sveiby and Roos. Pulic defined intellectual capital as the sum of all knowledge, experience and skills that are embodied in the employee, processes and technologies of an organization, which can be used to create value and sustain competitive advantage. Pulic's theory of intellectual capital emphasizes the importance of intellectual capital in creating value and driving business success. He also identified three components of intellectual capital: human capital, structural capital, and customer capital. The Resource-based theory (RBT) was propounded by Birger Wernerfelt in 1984 and further developed by Jay Barney in 1991, suggests that a firm's ability to achieve a competitive advantage lies in the ownership and management of valuable, rare, inimitable, and non-substitutable (VRIN) resources (Wernerfelt, 2021).. These resources can be both tangible, such as machinery or physical assets, and intangible, such as intellectual capital. Resource-Based Theory is particularly relevant as it supports the argument that intellectual capital, comprising human, structural, and relational capital, is a strategic resource that significantly impacts firm value in the Nigerian oil and gas industry. Firms with higher intellectual capital productivity are likely to be more adaptable, innovative, and efficient, which is essential in an industry undergoing rapid changes. Human capital productivity can be linked to how effectively employees' skills are utilized, while structural capital supports the firm's ability to maintain efficient processes, and relational capital helps secure valuable external relationships.

Meiliana *et al.* (2024) examined the effect of intangible assets on corporate financial performance and financial distress. The study focused on components of intangible assets, including human capital efficiency, relational capital efficiency, structural capital efficiency, and capital employed efficiency. Financial performance was measured using firm value with price-to-book value (PBV) as a proxy, while financial distress was assessed using the Altman Z-score. The research used secondary data and purposive sampling, targeting manufacturing companies listed on stock exchanges in Indonesia, Singapore, Malaysia, Thailand, the Philippines, South Korea, Japan, and China. The findings revealed that human capital efficiency, relational capital efficiency, and capital employed efficiency had a positive and significant effect on firm value, while structural capital efficiency had a negative and significant impact. Similarly, human capital efficiency, relational capital efficiency, and capital employed efficiency positively affected financial distress, while structural capital efficiency showed a negative and significant impact.

Dhanraj *et al.* (2024) examined the influence of intellectual capital and its components on the financial performance of Indian sugar mill companies. The research followed a quantitative approach, using data from Indian sugar mill companies over a 10-year period. The findings revealed that the components of intellectual capital had greater explanatory power than the aggregate intellectual capital measure. It was found that Capital Employed Efficiency and Relational Capital Efficiency positively

impacted ROA, while Human Capital Efficiency and Capital Employed Efficiency positively influenced ROE. Jeremiah *et al.* (2023) investigated the influence of intellectual capital on the firm value of quoted consumer goods companies in Nigeria. The study adopted an ex-post facto research design, as it required secondary data. The population included 20 consumer goods companies listed on the Nigerian Exchange Group (NEG) as of December 31, 2022. Firm value was the dependent variable, measured by Tobin's Q, while the independent variables; human capital, relational capital, and structural capital represented intellectual capital, with company size as a control variable. Descriptive statistics and multiple linear regression were used for data analysis. The results showed that human capital, relational capital, and structural capital had a positive but insignificant influence on firm value. Based on these findings, the study concluded that intellectual capital significantly influences the firm value of quoted consumer goods companies in Nigeria.

Ovechkin *et al.* (2021) investigated the relationship between intellectual capital, its components, and financial profitability in the Russian agri-business industry using the Value Added Intellectual Coefficient (VAIC) and an own-created approach from 2007 to 2015. The findings showed that structural capital efficiency and the stock of human capital have the biggest impact on profitability, indicating that these components are crucial for enhancing financial performance. Tope and Shola (2020) analyzed the extent to which intellectual capital has affected the financial performance of listed consumer goods companies in Nigeria using a sample of 5 companies listed on the Nigerian Stock Exchange over a period of 10 years. Tope and Shola utilized simple regression analysis as their method of analysis, enabling them to determine the relationship between the variables of intellectual capital and financial performance. The variables studied included human capital, structural capital, and relational capital, which are components of intellectual capital. Their findings indicated a significant positive relationship between intellectual capital and financial performance,

Oche and Oge (2020) studied the effect of intellectual capital on the financial performance of manufacturing companies in Ogun State, Nigeria, using a survey research design and purposive sampling method for the period of 10 years. Oche and Oge found a positive relationship between intellectual capital and financial performance, indicating that higher levels of intellectual capital were associated with better financial outcomes for the manufacturing companies. Stewart and Albarran (2020) examined the relationship between intellectual capital and firm value in the US oil and gas sector using econometric modeling. The major findings of Stewart and Albarran's study indicated that intellectual capital significantly impacts firm value in the US oil and gas sector. Human capital, in particular, was found to be a crucial driver of firm value, with companies that invested in employee training and development seeing substantial improvements in their market valuation. Structural capital, such as technological infrastructure and organizational processes, also played a significant role in enhancing firm value.

Tran *et al.* (2019), in their study "Intellectual Capital and Firm Performance: Evidence from Vietnamese Listed Companies," used content analysis and financial performance metrics to investigate the relationship between intellectual capital and firm performance. The study focused on variables such as human capital, structural capital, and relational capital, evaluating their effects on financial performance measures like return on assets (ROA) and return on equity (ROE). The analysis showed a positive correlation between intellectual capital and performance, with particular emphasis on knowledge-intensive industries. The major findings reinforced the importance of intellectual capital in enhancing firm value, particularly in knowledge-intensive sectors. Aslam *et al.* (2018) assessed the effect of corporate governance and intellectual capital on firm performance and corporate social

responsibility disclosures in Australian companies using Partial Least .The analysis revealed that sound corporate governance and effective management of intellectual capital are related to improved financial performance and CSR disclosures. The study concluded that integrating strong corporate with intellectual capital management enhances firm performance and CSR outcomes.

Bontis *et al* (2018) conducted an in-depth study titled "Intellectual Capital and Firm Performance in the Italian Banking Industry," utilizing a survey approach combined with Structural Equation Modeling (SEM). The scope covered was from 2010 to 2016. The objective of the study was to investigate how different components of intellectual The research design involved collecting survey data from banks operating in Italy, with participants including executives and managers who provided insights into the intellectual capital practices within their organizations. The analysis utilized SEM to model the relationships between these intellectual capital components and various performance metrics, including profitability and operational efficiency. The major findings demonstrated that human capital had a particularly strong influence on firm performance, aligning with the view that skilled and knowledgeable employees are crucial assets for financial success.

Studies by Meiliana *et al.* (2024), Dhanraj *et al.* (2024) and some others emphasize the positive impact of intellectual capital on firm performance, while Jeremiah *et al.* (2023) and some others emphasize negative impact. However, many of these studies (for example Meiliana *et al.* (2024, and Ovechkin et al., 2021) focus on non-African contexts, limiting their relevance to the Nigerian oil and gas sector. Additionally, most studies used quantitative approaches (Jeremiah *et al.*, 2023), which may overlook qualitative aspects like innovation and relational capital's evolving role. Some research explored corporate governance alongside intellectual capital but did not fully address how individual components human, structural, and relational capital affect firm value in Nigeria's oil and gas industry.

This study seeks to fill these gaps by anchoring on intellectual capital theory, which emphasizes human, structural, and relational capital as key drivers of firm value. Applying this framework to the Nigerian oil and gas sector will ascertain the effect of intellectual capital on firm value of listed oil and gas companies in Nigeria.

METHODOLOGY

The researcher adopted an *ex-post facto* research design to examine the effect of intellectual capital on firm value of listed oil and gas companies in Nigeria. This design was chosen as it permitted the evaluation of independent variables and their possible influence on the dependent variable. The design was considered appropriate for the study because it allowed the use of existing data that could not be manipulated by the author. The population of this study consist of all the listed oil and gas companies on the floor of Nigerian Exchange Group (NGX) Plc as at 31st December, 2023. The sample size study are the nine (9) oil and gas companies listed in Nigerian Exchange Group which are: ArdovaPlc, Conoil, Eterna, Japaul Gold and Venture, MRS Oil Nigeria, Oando, Seplat Energy, Total Nigeria and Capital Oil. This was because of the similarities in operations and the availability of their financial statements. The sample period of 12 years (2012-2023) was chosen for uniformity, after the post IFRS using the judgmental sampling technique. The functional relationship between the independent variables and dependent variables were given in a multiple linear regression for each of the hypotheses. The use of linear regression equation is to show the nature of the relationship between the independent and dependent variables this study. Multiple regression equation was used in depicting this relationship for each of the hypothesis earlier stated in this study. The multiple linear regression equation, is stated as follows:

FV = f(HCP, SCP, RCP)

$FVij = \beta_0 + \beta_1 HCPij + \beta_2 SCPij + \beta_3 RCPij + \mu_1$
Where

FV is the dependent variable which is firm value
HCP is Human Capital Producyivity
SCP is Structural Capital Productivity
RCP is Relational Capital Productivity
$\beta_1$is the regression constant
β_1, β_2, β_3 are the estimated coefficients of the independent variables
μ is the error term
i is the number of Oil and Gas companies listed in Nigeria Stock Exchange
j is the period of the covered

Table 1: Measurement of variables

	Variables	**Type**	**Abbreviation**	**Measurement**	***Apriori Expectation***
1	Human Productivity	Capital Independent	HCP	Total Revenue /Total no of Employee	Positive
2	Structural Productivity	Capital Independent	SCP	Total Revenue/Intangible Assets	Positive
3	Relational Productivity	capital Independent	RCP	Total Revenue/Shareholder's Investment	Positive
4	Firm Value	Dependent	FV	Market Value/ Book Value	

Source: Author's Compilation, (2024)

Table 1 shows the variable types, abbreviations, measurements and apriori expectation sfor the variables. Ssecondary source was used by the author to collect the relevant data from the financial statements of the listed Oil and Gas companies in the study. The period of twelve years from 2012 to 2023 was considered and all data collected were quantitative in nature. Ordinary least squared (OLS) panel or cross- sectional multiple linear regression techniques was used in the analysis of data collected from this study. This will provide the result that will help the evaluation of the intellectual capital and firm value of listed oil and gas companies in Nigeria as measured by Human Capital Efficiency (HCE), Structural Capital Efficiency (SCE) and Rational Capital Efficiency (RCE). Further tools of analysis was the econometric tools of unit roots tests for the determination of the existence of long-run relationship between the variables. In addition to these methods of the analysis of data collected in this study. Inferences were drawn using the t-statistic and F-statistic at 95% level of significance through the study. The significance level of the test is set at 0.05 for all hypotheses in this study.

RESULTS

Table 2: Descriptive statistics of variables (HCP, SCP. RCP and FV)

Variable	No	Minimum	Maximum	Mean	Std D
Human Capital Productivity	96	-0.22	12.18	6.36	2.06
Structural Capital Productivity	96	-5.36	2.64	0.16	1.59
Relational Capital Productivity	96	-3.60	8.23	4.77	2.80
Firm Value	96	-1.00	1.51	0.00	0.23

Source: Researcher's Computation (2024)

Table 2 presents the descriptive statistics, providing a comprehensive overview of intellectual capital components and firm value across 96 observations from listed oil and gas companies in Nigeria. All intellectual capital metrics underwent logarithmic transformation to normalize the data, while firm value, measured as firm value remains in its original form. Human productivity demonstrates the strongest performance among the transformed variables, with a mean value of 6.26 and a standard deviation of 2.06, indicating robust human capital utilization despite some variation across the sample. This is followed by relational productivity, with a transformed mean of 4.7 with a standard deviation of 2.80, suggesting more volatile performance in managing customer and stakeholder relationships. Structural productivity, showed a mean value of just 0.16 and a standard deviation of 1.59, indicating that organizational processes and systems are potentially underperforming compared to other intellectual capital components. The firm value shows a mean of 0.00 with the lowest standard deviation of 0.23.

Table 3: Correlation matrix

	Human Capital Productivity	Structural Capital Productivity	Relational Capital Productivity	Firm Value
Human Capital Productivity	1			
Structural Capital Productivity	.255*	1		
Relational Capital Productivity	-.090	.084	1	
Firm Value	-.181	.045	.143	**1**

Source: Researcher's Computation (2024)

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The correlation analysis provides insights into the relationships between the variables under study. Table.3 presents the correlation matrix for Structural Productivity, Relational Productivity, and Firm Value. The Structural Productivity shows a very weak positive correlation with both Relational Productivity (0.084) and Firm Value (0.045), but these correlations are not statistically significant. The weak positive relationship with Firm Value suggests that improvements in structural capital productivity might have a minimal positive impact on firm value, but the effect is not substantial. Relational Productivity demonstrates a weak positive correlation with Firm Value (0.143), although this correlation is not statistically significant. This suggests that there might be a slight tendency for firms with higher relational capital productivity to have higher firm values, but the relationship is not strong or statistically reliable.

Panel Regression Analysis

The Panel Regression Analysis examines the relationship between intellectual capital components (human, structural, and relational capital) and firm value in Nigerian oil and gas companies over a 12-year period using the Common Effect Model (Pooled OLS). The common effect model, also known as pooled OLS, assumes homogeneity among the units (companies) and estimates a single equation for all observations.

Table 4: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.436[a]	.155	.025	.23189

a. Predictors: (Constant), Relational Productivity, Structural Productivity, humanProductivity

Source: Researcher's Computation (2024)

Tables 4, 5, and 6 present the results of this analysis. The model summary (Table 4) indicates that the R value is 0.436, suggesting a moderate correlation between the predictors and the dependent variable. The R Square value is 0.155, meaning that approximately 15.5% of the variance in Firm Value can be explained by the independent variables in the model. While this explanatory power is higher than in the fixed effect model, it still indicates that a substantial portion of the variance in Firm Value is explained by factors not included in this model.

Table 5: ANOVA[a]

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	.291	3	.097	1.802	.012[b]
Residual	4.947	92	.054		
Total	5.238	95			

a. Dependent Variable: firmValue
b. Predictors: (Constant), Relational Productivity, Structural Productivity, human Productivity

Source: Researcher's Computation (2024)

The ANOVA results (Table 5) show a F-statistic of 1.802 with a p-value of 0.012. This indicates that the overall model is statistically significant at the 0.05 level, suggesting that the combination of independent variables- has a significant effect on Firm Value.

Table 6 Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
(Constant)	-.034	.039		-.868	.388
Human Productivity	-1.650E-9	.000	-.192	-1.819	.072
Structural Productivity	.010	.012	.084	.797	.027
Relational Productivity	4.290E-5	.000	.119	1.160	.049

a. Dependent Variable: Firm Value

Source: Researcher's Computation (2024)

Examining the individual coefficients (Table 6), Human Productivity has a negative coefficient (-1.650E-9) with a p-value of 0.072. While this is close to being significant at the 0.05 level, it doesn't quite meet that threshold. However, it suggests a potential negative relationship between Human Productivity and Firm Value. Structural Productivity has a positive coefficient (0.010) with a p-value of 0.027, which is significant at the 0.05 level. This indicates a positive relationship between Structural Productivity and Firm Value. Relational Productivity also has a positive coefficient (4.290E-5) with a p-value of 0.049, which is significant at the 0.05 level. This suggests a positive relationship between Relational Productivity and Firm Value.

These results suggest that in this common effect model, both Structural Productivity and Relational Productivity have a statistically significant positive impact on Firm Value for the sampled Nigerian oil and gas companies. The model's overall significance and higher explanatory power compared to the fixed effect model indicate that it provides a better fit for the data in this context

Test of Hypotheses

Based on the results of the panel regression analysis, especially the common effect model which showed the best overall fit, we can now address the hypotheses set for this study. The common effect model helped explain 15.5% of the variation in firm value, indicating that while intellectual capital plays an important role, other factors not included in the model also affect firm value. With this analytical approach, we can now examine each hypothesis in relation to the study's findings:

1. **H_{01}**: Human capital productivity has no significant effect on firm's value of listed oil and gas company in Nigeria.
   Decision: Fail to reject the null hypothesis at the 0.05 significance level. While the common effect model showed a potential negative relationship between human capital productivity and firm value (β = -1.650E-9, p = 0.072), this effect is not statistically significant at the conventional 0.05 level.
2. **H_{02}:** There is no significant effect of structural capital productivity on firm's value of listed oil and gas companies in Nigeria.
   Decision: Reject the null hypothesis. The common effect model demonstrated a statistically significant positive relationship between structural capital productivity and firm value (β = 0.010,

p = 0.027). This suggests that increases in structural capital productivity are associated with increases in firm value.

3. **H_{03}:** Relational capital productivity has no significant effect on firm's value of listed oil and gas companies in Nigeria.
   Decision: Reject the null hypothesis. The common effect model showed a statistically significant positive relationship between relational capital productivity and firm value (β = 4.290E-5, p = 0.049). This indicates that higher relational capital productivity is associated with higher firm value.

DISCUSSION OF THE FINDINGS

The study's findings reveal a complex relationship between intellectual capital components and firm value in the Nigerian oil and gas sector. The common effect model, which showed a better overall fit than the fixed effect model, explained 15.5% of the variance in firm value. This suggests that while intellectual capital components play a significant role in determining firm value, other factors not included in the model also exert substantial influence. Notably, the study found statistically significant positive relationships between structural capital productivity and firm value, as well as between relational capital productivity and firm value. Surprisingly, human capital productivity showed a potential negative relationship with firm value, although this relationship was not statistically significant at the conventional 0.05 level. These findings provide valuable insights into the dynamics of intellectual capital and firm value in the context of an emerging market's oil and gas sector.

The first hypothesis (H_{01}) posited that human capital productivity has no significant effect on firm value in listed oil and gas companies in Nigeria. Our analysis failed to reject this null hypothesis at the 0.05 significance level. The common effect model revealed a potential negative relationship between human capital productivity and firm value (β = -1.650E-9, p = 0.072), but this effect was not statistically significant at the conventional 0.05 level.

This finding is intriguing and somewhat counterintuitive, as it suggests that increased human capital productivity might not necessarily translate into higher firm value in the Nigerian oil and gas sector. This result contrasts with several studies in other contexts that have found positive relationships between human capital and firm value. For instance, Maji and Goswami (2021) found a positive relationship between human capital efficiency and firm performance in Indian firms. Similarly, Xu and Li (2019) reported a positive impact of human capital on firm value in Chinese listed companies. However, our finding aligns with some studies that have reported mixed or negative relationships between human capital and firm value. Ozkan *et al.* (2017) found that human capital efficiency had a negative impact on financial performance in the Turkish banking sector. In the context of emerging markets, Smriti and Das (2018) reported that human capital efficiency had a negative impact on firm performance in Indian firms.

The second hypothesis (H_{02}) stated that there is no significant effect of structural capital productivity on firm value in listed oil and gas companies in Nigeria. Our analysis led to the rejection of this null hypothesis. The common effect model demonstrated a statistically significant positive relationship between structural capital productivity and firm value (β = 0.010, p = 0.027). This finding suggests that increases in structural capital productivity are associated with increases in firm value in the Nigerian oil and gas sector. This result aligns with several recent studies that have highlighted the importance of structural capital in creating firm value. For example, Xu *et al.* (2021) found that structural capital had a significant positive impact on firm performance in Chinese manufacturing

firms. Similarly, Andreeva and Garanina (2016) reported that structural capital was positively associated with company performance across different industries in Russia.

The third hypothesis (H_{03}) posited that relational capital productivity has no significant effect on firm value in listed oil and gas companies in Nigeria. Our analysis led to the rejection of this null hypothesis. The common effect model showed a statistically significant positive relationship between relational capital productivity and firm value (β = 4.290E-5, p = 0.049). This indicates that higher relational capital productivity is associated with higher firm value in the Nigerian oil and gas sector. This finding is consistent with several recent studies that have emphasized the importance of relational capital in creating firm value. For instance, Adamska *et al*. (2020) found that relational capital had a positive impact on firm performance in Polish companies. Similarly, Agostini *et al*. (2017) reported that relational capital was positively associated with innovation performance in small and medium-sized enterprises.

IMPLICATIONS OF THE STUDY TO RESEARCH AND PRACTICE

The findings from this study have important implications for businesses in the Nigerian oil and gas sector. One key insight is the significant role of structural capital, which includes things like technology, organizational systems, and processes, in driving firm value. The study found that investing in these areas has a positive effect on a company's market value. This means that oil and gas companies should consider investing in better technology, improving internal systems, and optimizing their processes. Such investments can make operations more efficient, reduce costs, and help companies stay competitive in an industry that is constantly changing. The positive effect of structural capital suggests that businesses that improve their systems and use technology to their advantage will likely see an increase in their firm value.

Another important finding from the study is the positive relationship between relational capital and firm value. Relational capital is the connections a company has with external stakeholders, such as investors, regulators, suppliers, and customers. The study showed that companies with strong relationships with these groups tend to have higher firm values. This is crucial for oil and gas companies in Nigeria, where maintaining good relationships with stakeholders can help businesses navigate the complexities of the industry. Companies should focus on strengthening their relationships with key stakeholders by engaging in regular communication, building trust, and forming partnerships. By doing so, they can improve their reputation, attract more investment, and reduce risks that might come from regulatory changes or market uncertainties.

While the study found a positive impact of structural and relational capital, the findings on human capital were a bit more complex. Human capital is the value of a company’s workforce and their productivity. Surprisingly, the study showed that investing in human capital didn’t have a strong or direct effect on firm value in this context. This could be because the oil and gas industry is highly capital-intensive, and factors like technology and external relationships may have a bigger influence on firm value than human capital alone. For companies in this sector, it may be more important to ensure that employees have the specific skills needed to support technological advancements and operational improvements, rather than just focusing on general workforce development. Companies should also consider whether their investments in training and employee productivity are aligned with the demands of the oil and gas industry.

The findings also suggest the importance of a holistic approach to managing intellectual capital. The study shows that it's not enough to focus on just one area of intellectual capital. Companies that manage and invest in all three components; human, structural, and relational capital, tend to perform better. This means businesses should not neglect one area in favor of another. For example, while technology and systems are important, companies also need to invest in building strong relationships with stakeholders and ensuring their workforce is skilled and aligned with company goals. A balanced strategy that considers all these elements can lead to long-term success and growth.

Additionally, the study points out that while intellectual capital is important, external factors like oil price fluctuations, political instability, and government regulations also play a significant role in determining firm value. The Nigerian oil and gas sector is vulnerable to these external risks, and the study suggests that companies need to prepare for them. For instance, changes in oil prices can drastically affect revenues, while regulatory changes can impact operations. Businesses should not only focus on improving their internal capital but also develop strategies to handle these external challenges. This can include diversifying their business operations, creating contingency plans, and staying informed about market trends and regulatory changes. By being proactive and preparing for these external factors, companies can protect their firm value and remain resilient during times of uncertainty.

Based on the results of this research, the business implications suggest that oil and gas companies in Nigeria need to take a comprehensive approach to managing their intellectual capital. Investing in technology and organizational systems can improve efficiency and competitiveness, while strong external relationships with stakeholders can enhance firm value. At the same time, human capital should be aligned with industry needs to support technological and operational improvements. Companies should also be mindful of external risks and prepare strategies to address market volatility and regulatory changes. By focusing on all these areas, businesses can improve their chances of long-term success and increase their overall firm value.

This study has given important contributions to the field of intellectual capital research, particularly in the context of emerging markets like Nigeria's oil and gas sector. It adds new insights to the existing literature by focusing on a sector that has been underexplored in intellectual capital studies. By examining the Nigerian oil and gas industry, the study highlights how intellectual capital,comprising human, structural, and relational components affects firm value differently compared to findings in developed markets or other industries.

A significant contribution of this research is the evidence that structural capital and relational capital have a positive and significant relationship with firm value. This finding underscores the importance of organizational processes, technology, and strong external relationships in improving performance and competitiveness in capital-intensive industries like oil and gas. On the other hand, the study's unexpected result regarding human capital productivity, which showed no significant positive relationship with firm value, challenges conventional thinking. This finding suggests that in industries heavily reliant on capital and technology, human capital may need to be better aligned with sector-specific needs. These insights open up new areas for future research, particularly on how human capital can be optimized to create value in such industries. Methodologically, this study also makes a notable contribution by adopting a comprehensive approach to measuring intellectual capital productivity. By using indicators tailored to the oil and gas sector and analyzing data from a 12-year period, it provides a robust framework for assessing the long-term impact of intellectual capital on firm value. This

methodological approach can be adapted and refined in future studies examining other industries or emerging markets.

Practically, the study provides valuable guidance for managers and policymakers in the Nigerian oil and gas sector. By emphasizing the significance of structural and relational capital, the findings highlight areas where companies can invest strategically to enhance their market value. For instance, firms can prioritize investments in organizational systems, technology, and stakeholder relationships to build competitive advantages. Policymakers, on the other hand, can use these insights to develop frameworks that encourage businesses to leverage their intellectual capital effectively, thereby promoting economic growth in the sector. Lastly, the study contributes to the broader debate on how intangible assets are measured and reported in financial markets. It underscores the need for reporting frameworks that account for industry-specific and country-specific factors when evaluating intellectual capital. This is especially relevant for emerging markets, where the role of intangible assets in firm valuation may differ significantly from global standards. Overall, this research advances our understanding of the role of intellectual capital in emerging markets and provides a strong foundation for future studies. It not only deepens the academic discourse on the subject but also offers practical tools for firms aiming to enhance their performance and value in challenging market environments.

CONCLUSION AND RECOMMENDATIONS

Based on the findings of this study, it is concluded that structural and relational capital have a positive effect on firm value. However, the study also found a potential negative relationship between human capital and firm value, though it was not statistically significant. This suggests that the role of human capital may be more complex in emerging markets or capital-intensive industries.

Based on the findings of this study, the following recommendations were made:
1. Enhance Focus on Structural Capital Development: Given the significant effect of structural capital productivity on firm value, it is recommended that oil and gas companies in Nigeria prioritize investments in organizational processes, systems, and knowledge management. Companies should focus on implementing advanced technologies, such as data analytics and automation, to improve operational efficiency. Additionally, developing internal knowledge-sharing systems and investing in research and development tailored to the challenges of the Nigerian oil and gas sector will help enhance innovation and long-term value creation.

2. Strengthen Stakeholder Relationship Management: The positive impact of relational capital productivity on firm value highlights the need for effective stakeholder management. Oil and gas companies should develop comprehensive stakeholder engagement strategies that go beyond compliance and focus on building strong, mutually beneficial relationships. Companies should invest in structured community engagement programs, enhance transparency with government bodies, and foster collaborations with suppliers and industry peers. Maintaining a strong social license to operate through consistent and transparent communication will boost relational capital and contribute to firm value.

3. Reassess Human Capital Development Strategies: The unexpected findings regarding human capital productivity suggest a need to reassess human capital development strategies in the Nigerian oil and gas sector. Companies should conduct detailed skills gap analyses to ensure human capital investments align with the sector's specific needs. Developing tailored training programs, building partnerships with educational institutions, and implementing mentorship programs can improve workforce

productivity. Additionally, companies should redesign performance measurement and reward systems to align employee output with value creation for the company.

4. Adopt Integrated Reporting Practices: To provide a comprehensive view of how intellectual capital contributes to firm value, oil and gas companies should consider adopting integrated reporting practices. This approach would involve clearly articulating how investments in human, structural, and relational capital lead to tangible outcomes. Companies should develop specific key performance indicators (KPIs) for each component of intellectual capital and report on these alongside traditional financial metrics. This holistic approach will help stakeholders understand the value created by intangible assets and foster integrated thinking within the organization.

Suggestions for Future Studies

This study highlights important areas for further research to expand knowledge about intellectual capital and firm value. Future studies could investigate how intellectual capital affects firm value in other industries, such as banking, telecommunications, or manufacturing, to understand differences across sectors. Future studies could also explore how intellectual capital interacts with other factors like organizational culture, leadership, or innovation. This would help companies understand how to combine resources for better results. Research on other measures of firm value, such as long-term growth, customer satisfaction, or sustainability performance, could provide a more complete picture of intellectual capital's impact. Long-term studies that track intellectual capital investments over several years would be helpful in showing whether their effects on firm value are immediate or develop over time. Finally, future research could look at how external factors like government policies, market competition, or new technologies influence the relationship between intellectual capital and firm value. By focusing on these areas, future studies can build on this research to provide deeper and broader insights into intellectual capital in different contexts

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