



EFFECT OF HUMAN AND STRUCTURAL CAPITAL EFFICIENCY ON FINANCIAL PERFORMANCE OF LISTED MANUFACTURING FIRMS IN NIGERIA**By****NASIRU RABIU, JOSHUA OKPANACHI, ONIPE YAHAYA***Department of Accounting, Nigerian Defence Academy, Kaduna**Corresponding author's email and mobile: nasiriddeen@gmail.com/08095204139*

Abstract

The study investigates the effect of human and structural capital efficiency on the financial performance of listed manufacturing firms on the Nigeria Exchange Group. Given the significant role of the manufacturing sector in Nigeria's economy, understanding the determinants of financial success within this industry is crucial. This study employs a comprehensive methodology encompassing financial analysis and regression modelling to assess human capital efficiency, considering factors such as cost associated with workforce training, education, innovation and skill development. Additionally, it evaluates structural capital by examining aspects such as value remains in the company from the value addition through technology adoption, infrastructure development, and supply chain management. Return on assets serves as the yardstick for evaluating financial performance. The study examined 66 firms listed on the Nigeria Exchange Group between 2017 and 2021. The findings demonstrate that human and structural capital efficiencies exert a substantial impact on the return on assets of listed manufacturing firms in Nigeria. Enhanced utilization of human capital through targeted training and development initiatives can positively influence financial performance. When employees are skilled and motivated, they are better positioned to enhance productivity and spur innovation. Similarly, optimizing structural capital by investing in modern technology and efficient infrastructure positively impacts the efficiency and effectiveness of manufacturing operations, leading to improved financial outcomes. The study underscores the significance of policy recommendations aimed at promoting the development of human and structural capital in Nigeria's manufacturing sector. These recommendations may involve initiatives to enhance education and skills training, foster technological innovation, and improve infrastructure development.

Keywords: human and structural capital, efficiency, financial performance, manufacturing firms

1.0 Introduction

The success of manufacturing firms in Nigeria is hindered by financial challenges, inconsistent government policies, unreliable power supply, and transportation logistics deficiencies. High interest rates, collateral requirements, and a lack of credit facilities also constrain business expansion and investment. This challenge has consistently been affecting the growth and sustainability of many firms. Many studies have been carried out in the past mainly focusing on the traditional approach where factors of production are given due consideration in terms of capacity to enhance the financial performance of manufacturing firms.

In recent times, human and structural capital have been identified as key components that could be used to enhance the financial performance of manufacturing firms. Human capital efficiency refers to the knowledge-based assets that have become increasingly important for generating economic prosperity, prompting inquiries into intellectual capital management. A robust knowledge-based framework can



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help companies generate higher returns and attain a competitive edge. A company's strong performance attracts potential investors and indicates healthy returns for shareholders. Enterprise value and firm value serve as crucial indicators for investors, offering insights into the company's future potential and aspirations.

Structural capital efficiency on the other hand refers to the effectiveness and efficiency of the intangible assets and resources within an organization that contribute to its overall effectiveness, efficiency, and competitiveness. Unlike physical or financial assets, structural capital is comprised of non-physical elements, often rooted in the organization's systems, processes, culture, and knowledge base. It represents the infrastructure and intellectual resources that support the organization's operations and enable it to create value. Therefore, capital efficiency explains how well a company's resources, including its assets, workforce, and technology, are organized and utilized to achieve its goals. It is the combination of both tangible and intangible assets, and thus, efficiency focuses on how effectively a company utilizes its capital (both equity and debt) to generate profits.

Investing in human capital, employees can leverage the company's structure to improve their performance and bring new ideas that can keep the company running ahead of its competitors (Darsono, 2020). According to Yusuf, (2013), human and structural capital are vital IC components that can help organizations become stronger over time (Shelaet *al.*, 2023, and Hoon et al., (2019). Thus, with effective development of human capital and integration of structural capital into firms' operations can enhance the financial performance of firms and increase their competitive edge.

In the 21st century, technology has rapidly advanced, leading to major developments in various fields. The traditional economic system has been transformed into an information-based system where knowledge, innovative production methods, artificial technology, and other factors have become crucial for businesses to succeed. To thrive in this reality, firms need to develop human and structural components of intellectual capital (IC) for their success (Jurczak, 2008). This will enable them to create a workforce that can meet their future needs and achieve expected levels of performance. According to Almaududiet al. (2022), capital efficiency is a critical tool that firms can use to nurture their personnel and help them succeed.

The financial performance of business organizations can be assessed using indicators such as sales growth, profitability, investment, and equity capital (Van Looy & Shafagatova, 2016 & Zehreret al., 2017). Due to growing concern of the poor performance of manufacturing firms and the fact that the traditional financial accounting metrics have failed to account for the importance of these intangible resources, a more detailed approaches by modern researchers have taken the stage of studies around human and structural capital (Grant, 1996; Stewart, 1997; Bontis, 2001; Mitchell, 2001; Choo et al., 2007; Smriti and Das, 2017). In essence, intellectual capital to which human and structural capital are vital components, are crucial resource for firms in the knowledge-based economy, contributing to their growth, competitiveness, and overall success (Shela et al., 2023; Nimtrakoon, 2015, Hossein & Zivar, 2014, Ginesti et al., 2018).

It against the laid down background above that this study provides answers to the following questions:

- i. How does human capital efficiency affect the financial performance of manufacturing companies in Nigeria?
- ii. How does structural capital efficiency affect the financial performance of manufacturing companies in Nigeria?



The objectives of the study are to:

- i. Examine the effect of human capital efficiency on the financial performance of manufacturing companies in Nigeria.
- ii. Examine the effect of structural capital efficiency on the financial performance of manufacturing companies in Nigeria.

To achieve the objectives of the study, the following hypotheses are stated in null form:

- H₁. Human capital efficiency does not significantly affect the financial performance of manufacturing companies in Nigeria.
- H₂. Structural capital efficiency does not significantly affect the financial performance of manufacturing companies in Nigeria.

2.0 Literature Review

This study investigates the effect of structural and capital-employed efficiency on the financial performance of listed manufacturing firms in Nigeria. A review of the past literature has been conducted and presented below.

Human Capital Efficiency

Human capital efficiency (HCE) or human assets is a concept used by economists to designate personal attributes considered useful in the production processes by all companies. It encompasses employee knowledge, skills, know-how, good health, and education. Ngoc and Duc (2020) contend that economic growth and development for many developed nations were not by accident but by the heavy investment in human intellect and effective utilization of research proposals. Thus, human ingenuity in the development of key solutions to society's needs must be supported to achieve the realization of economic wealth creation.

Ngo & Duc, (2020) and Becker et al. (2002) were of the view that the effectiveness with which employees implement the organization's plan is measured by human capital performance. Employees' knowledge is a set of intrinsic and inseparable attributes acquired for better sustainability (Khalique & Pablos, 2015). Human capital is a broad concept that includes a variety of elements but generally refers to the calibre of the labour force (Ngoc & Duc, 2020). It represents the collective skills of the personnel on whose ability the performance of the company rests (Mohammed & Irbo, 2018).

The productive activities of an organization are referred to as human capital. According to Edvinsson and Malone (1997), HCE is the ability to use knowledge, experience, and creative ideas to solve problems within the business and help the firm achieve its goals. It is also considered as a strategic intangible asset that creates value through skills utilization in various manners (Fincham & Roslender, 2003). Equally, Chen et al. (2004) assert that human capital efficiency serves as the foundation for intellectual capital, and without it, value cannot be created.

The growth of an organization's overall performance has been reported to rely in a significant way on its intellectual capital (Nonaka & Takeuchi, 1995). Intellectual capital is considered a non-static capital valuable resource for firms (Barney, 1991). Since its groundbreaking definition, intellectual capital has been applied to examine the performance of companies in different areas (Brooking, 1997). Stewart and Losee (1994) discovered that many American businesses have abandoned the conventional



accounting technique in favour of intellectual capital. The amount of wealth an organization derives from the knowledge it invests is measured by its intellectual capital (Acuña-Opazo & González, 2021). Human Capital Management has been supporting organizations tremendously. Learning capabilities help companies create new products by exploring new knowledge, and technologies and also document learning opportunities that help prevent mistakes from being made again and again by leveraging lessons learned from past events (Lubatkin et al., 2006). Moreover, through external cooperative alliances, a company can improve performance by acquiring fresh knowledge, ideas, and skills (Mody, 1993).

Structural Capital Efficiency

Structural capital efficiency (SCE) is the intangible asset created by personnel, but owned by the organization, that stems from human capital. It is a combination of knowledge and intangible assets derived from the processes within the organization and encompasses elements of efficiency, procedural innovativeness, and access to information for codification into knowledge. Patents, trademarks, systems, databases, processes, models, copyright data, intellectual property, values, principles, and media are examples of structural capital.

Even if employees leave for the day, structural capital remains with the company. It is an intangible asset that can be shared, exchanged, and reproduced in contrast to human capital. SCE enables information to be obtained about how much capital a company can create through structural capital. Structured capital is the routine knowledge and habitual competence that encompasses knowledge stored in databases, plans, policies, and organizational structures, and generates value for the organizations. In other words, structural capital is the knowledge that underpins an organization's strategies, operations, and practices.

Structural capital is the supportive non-physical infrastructure that enables human capital to function. It provides the tools and infrastructure necessary for the retention, packaging, and dissemination of information along the value chain, serving as the organization's backbone and glue. Businesses use structural capital as the infrastructure to market their human resources and to create an environment that encourages them to produce and use knowledge. Effective structural capital may foster a climate that encourages knowledge sharing and collective learning, shortens lead times, and produces productive people.

Human Capital Efficiency and Financial Performance

Dimitrios et al. (2011) examined the impact of human and structural capital on Intellectual Capital (IC) and its influence on the market value and financial performance of Greek businesses. Data was gathered from 96 Greek companies across four different economic sectors listed on the Athens Stock Exchange (ASE) over three years from 2006 to 2008. Utilizing regression models, the study revealed a significant correlation between financial performance and the efficiency of human capital.

It's important to note that the scope of this study was limited to just three years, which could potentially affect its findings. For a more comprehensive analysis, future studies should encompass data from a minimum of five years of panel data. Shohreh and Geert (2015) examined the VAIC methodology on the human capital component of 33 Dutch production companies over six years (2007–2012) to calculate the monetary value that human capital contributed to the economy. The performance of



human capital is compared to organizational performance measures including ROTA, ROE, and EP using multiple linear regression models. The study found a significant relationship between HCE and each of the three corporate performance indicators.

Measuring the monetary worth of the human capital contribution to the Dutch production company seems abstract and challenging to determine from my point of view. This is due to the individual traits and diverse skills of each employee, influencing their ability to complete tasks and positively impact the company's overall objectives. Because capacities differ, calculating the monetary value of the entire workforce may be biased toward a specific goal.

Neha and Niladri (2018) investigated the impact of intellectual capital on financial performance of Indian businesses listed on the Centre for Monitoring Indian Economy Overall Share Price Index between 2001 and 2016. Secondary data listed on the COSPI were gathered, and IC and its constituent parts were calculated using the Value-Added Intellectual Coefficient (VAIC) proposed by Pulic (2000). The variables that significantly affect business performance were found using a dynamic system Generalized Method of Moments (SGMM) estimator. The empirical investigation revealed that human capital efficiency, capital employed efficiency, and structural capital efficiency were significant drivers of a company's sales growth and market value.

Filipe et al. (2018) examined the effect of intellectual capital on the financial performance of small- and medium-sized hotels between 2007 and 2015. They employed the Generalized Method of Moments (GMM system) (1998) estimator to analyze the panel data using a sample of 934 Portuguese small and medium-sized hotels. According to the analysis, human capital efficiency has a positive effect on the financial performance of hotels.

Ngoc and Duc (2020) studied the impact of human capital efficiency on business performance across 12 sectors in the Vietnamese economy from 2011 to 2018. The study used the generalized method of moments (GMM) method. The empirical findings from the GGM system found that human capital efficiency has a significant impact on the business performance of the Vietnamese economy.

Larysa et al. (2021) Evaluated the effect of human capital efficiency on the performance of digital businesses in Ukraine. A poll of 500 business representatives in Ukraine was used in the process of data collection. Integral assessment has been used to create a quantitative empirical model for evaluating the effectiveness of human capital in the context of digital business transformation. The findings of the study revealed that business performance is significantly affected by human capital efficiency.

The study has captured the response of high elements in the population. However, it's important to acknowledge that external economic or political factors could also affect the performance of digital businesses, beyond just human capital efficiency. Therefore, future studies should take into account other factors such as policymakers, political economy, and global trends.

Aidin et al. (2023) Examined the effect of human capital on the performance of Iranian digital startups with the moderating role of knowledge-sharing behaviour. The population of the study consisted of 160 digital firms that were registered with the University of Tehran's scientific division. Using a random selection technique, 113 businesses were selected based on Morgan's table. Analysis of the research



hypotheses was conducted using Smart PLS 3. The results showed that human capital had a positive effect on the performance of the digital firms under study.

Jedsada and Jutamard (2023) Examined the effect of human resource practices on the financial performance of wholesale and retail small and medium-sized businesses in Thailand. The sample was 260 small and medium-sized businesses in Thailand's Eastern Economic Corridor. Quantitative and structural equation modelling techniques were used to analyze the data. The study found a significant and positive effect of human resource practices on the financial performance of SMEs.

Structural Capital Efficiency and Financial Performance

Rezvan et al. (2016) examined the impact of structural and human capital on Iranian businesses' performance. The study's data was gathered from 100 companies that were listed on the Tehran Stock Exchange (TSE) between 2000 and 2006. Using regression analysis, the study revealed a significant relationship between human, and structural capital and the performance of firms in Iran. This study could be argued that the study's findings may not be generalizable to all businesses in Iran, considering the data was only gathered from companies listed on the Tehran Stock Exchange between 2000 and 2006. Therefore, the currency of events may have changed the study's findings and the sample selected may be biased to generalize across all businesses in the Tehran Stock Exchange.

Muhammad et al. (2019) examined how the profitability of Pakistani financial institutions is affected by IC performance. The outcome showed how IC performance affects profitability both linearly and non-linearly, confirming an inverted U-shaped connection. Using value-added intellectual coefficient (VAIC) components, it has been discovered that structural capital efficiency (SCE) considerably reduces bank profitability. The study's conclusion could be contested in terms of addressing the potential limitations of using value-added intellectual coefficient (VAIC) components in evaluating the impact of structural capital efficiency (SCE) on bank profitability. Other models could have been tested to validate the findings from the VAIC model.

Abiodun et al. (2019) investigated the impact of structural capital efficiency on the financial performance of listed oil and gas firms in Nigeria from 2006 to 2018. Data was collected for analytical reasons from the audited annual reports of the nine firms, which were purposefully sampled. Regression results showed that structural capital efficiency has a favourable and significant impact on ROA. The finding could be contested in the sense that the data collected from purposefully sampled firms may not accurately represent the entire population of oil and gas firms in Nigeria. Therefore, future research should include more companies and larger scope.

Ousama et al. (2020) examined the effect that intellectual capital (IC) on the financial performance of Islamic banks operating in the Gulf Cooperation Council (GCC) countries. Regression analysis was conducted on the Islamic banks active in the GCC nations from 2011–2013 as the research sample. The study found that SC has no significant impact on the financial performance of Islamic banks.

Welly et al. (2021) examined how capital-employed efficiency, human capital efficiency, and structural capital efficiency affected the financial performance of companies in the consumer products industry sector. The financial statements of businesses in the consumer products sector listed on the Indonesia stock exchange between 2015 and 2019 constitute the study's population. Purposive sampling was



employed in this study with 155 observations from 31 firms. Panel data regression and the E-views 9 program were used as the data analysis tool. The findings showed that structural capital efficiency positively and significantly impacted the financial performance consumer products industry sector.

Jian et al. (2022) Investigated the effects of human, structural, relational, and innovation capitals on financial performance over a range of life cycle stages. Data from Chinese manufacturing listed businesses between 2014 and 2018 was used in the study. The IC efficiency is measured using the modified value-added intellectual coefficient (MVAIC) model. Lastly, the study hypotheses were tested using multiple regression analysis. This study demonstrates that financial performance is positively impacted by structural capital efficiency.

Weqar and Haque (2022) Examined how Indian firms' financial performance is impacted by intellectual capital (IC). Data from 88 Indian companies that packaged, sold, and distributed tea over six years from 2013 to 2018 were extracted. Fixed-effect regression analysis was used to obtain the results which show that structural capital efficiency (SCE) significantly increases a firm's profitability.

Barak and Kumar (2023) Investigated the impact of intellectual capital on the sustainable financial performance of private-sector banks in India. Data were gathered from 17 banks between 2010 and 2021 using Prowessiq (CMIE) and their annual financial reports. The modified value-added intellectual coefficient (MVAIC) methodology was applied. The results show that structural capital efficiency has a statistically significant relationship with sustainable financial performance in the banking sector of India.

Theoretical Review

The theory upon which this paper is based is the Resource Based Theory. According to Peteraf & Barney (2003), the firm's resource-based perspective emphasizes the significance of maintaining competitive strategies through utilizing internal resources. Resources must possess specific characteristics, such as being distinct, irreplaceable, and unreplaceable. These characteristics can be observed in both the organizational structure and the skills and experience that individuals amass over time. These internal assets can create value and are known as intellectual capital (intangible assets).

The core tenet of resource-based theory is that a firm's distinctive combination of resources which serve as the foundation for a sustainable competitive advantage defines that firm's uniqueness (Abiodun et al., 2019). To try to explain why some businesses perform better than others has historically been the primary goal of the field of strategic management (Porter, 1980). This line of inquiry had a strong foundation in resource-based theory. A company might have a competitive advantage by operating in specific industries or having certain types of resources and competencies, which can result in greater performance (Barney, 1991). A company creates economic value when the price that customers are willing to pay for its goods or services exceeds the total cost of providing those goods or services (Brandenburger & Stuart, 1996).

The last 30 years have seen significant advancements in resource-based theory (Jay et al., 2021). Scholars of strategic management have developed RBT research, which was first published in 1959 by Edith Penrose in the discipline of economics (Penrose, 1959). According to resource-based theory, SMEs' resources can be used to their advantage in the marketplace and can lead to good performance (Almaududi et al., 2022). This means that SMEs can process intellectual property and innovative work



practices effectively and efficiently to add value and long-term performance benefits through indicators like increased productivity, employee commitment, profit growth, and sales and employment growth.

3. Methodology

A descriptive research methodology was used in this study. Establishing the causes of particular events, results, conditions, or patterns of behaviour is the goal of descriptive research. Additionally, a causal research design was used because the study's objective was to make predictions regarding the link between the independent and dependent variables by determining how closely their values related to one another. This was deemed suitable given that the study looked closely at the impact of structural and human capital efficiency on the financial performance of Nigerian manufacturing firms.

The study population consist of sixty-six (66) manufacturing companies that were listed on the Nigeria Exchange as at 2021. The study's data collection period spans the years 2017 through 2021. All of the firms considered in the study are surveyed using a census approach. Panel data from secondary sources was employed in the study to achieve the goals of the research. This is carried out since the study is quantitative and is based on the positivist paradigm. Due to the nature of the variables under investigation, financial data from the listed companies were used. The data collection technique was made from the corporate annual reports and financial statements of the manufacturing firms listed on the Nigeria Exchange as of December 31, 2021. Additionally, the individual websites of the relevant companies and the Nigerian Stock Exchange facts book were used.

The goal of data analysis is to accomplish research by supplying answers to research questions. To establish a causal relationship between independent and dependent variables, inferential statistics is used. On the study's panel data, the multiple regression method is used. In testing a multiple-parameter regression, the F-test is employed to determine if a collection of independent factors (viewed collectively) has any impact on the dependent variable. Multiple regression was justified as being appropriate by (Gujarati & Porter, 2009). The most reliable regression estimates are those produced using the Ordinary Least Squares (OLS) approach (Gujarati & Porter, 2009). However, Generalized Least Square is used as the estimate method if the data fails to satisfy the OLS criteria. The Hausman test is used to distinguish between estimation with random and fixed effects. The study employs robustness tests such as the cross-sectional dependence test, the normality test, and the heteroskedasticity test. STATA statistical package of the 2023 version was used to run data analysis.

The following research model was developed and presented in Table 1:

$$ROA = \alpha + \beta_1 HCE_{it} + \beta_2 SCE_{it} + \epsilon_{it}$$



Table 1 *Variable Definitions, Measurements and Sources*

Variable	Nature of the Variable	Acronym	Measurement	Ratio	Source
Return on Assets	Dependent	ROA	The ratio of the pre-tax income to total assets		Firer & Williams 2003; Chen, Cheng & Hwang 2005
Human Capital Efficiency	Independent	HCE	VA= total revenue – (operating expenses – salaries & wages) HU= personnel expenses (salaries + benefits)	VA/HU	Pulic (1998)
Structural Capital Efficiency	Independent	SCE	SC=VA -HU	SC/VA	Pulic (1998)

Source: Fieldwork (2024)

4. Result and Discussion

The findings from the data analysis are presented, explained, and discussed in this section. Interpretations and conclusions were made in light of the study's findings.

Descriptive Statistics

In table 2 below, a summary of descriptive statistics for the variables utilized in the study are given. These include mean, standard deviation, minimum, maximum, skewness, and kurtosis.

Table 2

Descriptive Statistics of the Variables

Variable	Obs	Mean	Std.Dev	Min	Max	Skewness	Kurtosis
ROA	330	0.228	0.140	-0.185	0.449	0.637	0.042
HCE	330	0.471	0.059	0.354	0.591	0.536	0.038
SCE	330	0.523	0.082	0.417	0.647	0.000	0.002

Source: STATA Output, (202 4)

According to Table 2, the return on assets has an average value of 0.228, which means that throughout the study, the listed manufacturing firms in Nigeria have generated profits averaging 22.8%. The minimum and maximum return on Assets is -0.185 and 0.449, respectively. This suggests that for every naira spent on human and structural capital efficiency, the least profitable manufacturing firm incurred a loss of 18.5%. On the other hand, for every naira spent on human and structural capital efficiency, the most profitable manufacturing firm among Nigeria's listed manufacturing firms realized a 44.9% return on Assets.



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Return on assets statistics showed a standard deviation of 0.140, which means that listed manufacturing firms in Nigeria only deviated by 14% from the average level of profitability. This suggests that the profitability of listed manufacturing firms in Nigeria is not significantly different from one another. In other words, a 14% difference exists between the mean and both extremes of the return on assets. The data revealed there was an approximate but abnormal distribution pattern by the calculated values of skewness.

In a similar vein, Table 2 shows that the minimum and maximum values for the human capital efficiency are 0.354 and 0.591 respectively. The maximum value of 59.1% shows that some of the listed manufacturing firms in Nigeria invested a lot in human capital and at the same time, others employ a minimum of 35% and on average across the firms, the investment in human capital was 0.471(47%) throughout the period covered by the study. Equally, a 0.058 standard deviation was recorded, which meant a 5.8% deviation from the average human capital efficiency in the operations of listed manufacturing firms in Nigeria.

Human capital efficiency was evenly distributed among Nigeria's listed manufacturing firms. A value of 0.038 for kurtosis describes the distribution of observed data around the mean to have a well-behaved tail and this is proven by the coefficient of skewness of 0.536, which indicates that the data is within the assumption of symmetric distribution that the data are normally distributed.

Similarly, the structural capital efficiency has an average value of 0.523 and a standard deviation of 0.082. This suggests that there was a moderate deviation in the amount of structural capital efficiency across the listed manufacturing firms in Nigeria, with a dispersion of structural capital efficiency ranging up to 8.2%. Listed manufacturing firms in Nigeria have structural capital efficiency with a minimum value of 0.417 and a maximum value of 0.647, respectively. The maximum figure of 0.647 among Nigeria's listed manufacturing firms shows that some of these firms have made significant investments in structural capital efficiency.

The data is normally distributed, as indicated by the coefficient of skewness of 0.000, and as a result, the requirements for a symmetrical distribution are perfect. Additionally, the structural capital efficiency matches the Gaussian distribution condition of 0.000 kurtosis, as shown by the coefficient of kurtosis of 0.002. Descriptive statistics of the data for the study's variables were analyzed and interpreted, and the results show that the data are, on average, normally distributed. To determine whether the data from the study's variables follow the normal curve or not, the Shapiro-Wilk test was used in the study. The outcome of the variables' data normality test is presented in Table 3.

Table 3

Normality Test Results

Variables	Obs	W	V	Z	P-Values
ROA	330	0.987	3.100	2.668	0.004
HCE	330	0.985	3.592	3.015	0.001
SCE	330	0.922	18.094	6.828	0.000

Source: STATA Output, (2023)

The Shapiro-Wilk test employed the null hypothesis approach to ascertain the normality of the data. Because the p-values are significant at 1%, Table 2 shows that the data are generally not normally distributed. This could make it difficult to employ the Ordinary Least Square method of estimation in



this investigation, necessitating the use of more Generalized Least Square methods. The data were transformed to address the issue of non-normality using natural log and square roots.

Correlation Matrix

The degree of link between the study's independent variables (human and structural capital efficiency) and the dependent variable (return on asset) was computed using Pearson correlation and presented in Table 4 below.

Table 4
Correlation Matrix

Variable	ROA	HCE	SCE
ROA	1.000		
HCE	0.364***	1.000	
SCE	0.380***	0.494***	1.000

Source: STATA Output, (2024)

Table 4 shows that none of the study's independent variables correlated more than 0.70 (70%). The conclusion that a high correlation between the study's independent variables was absent can be drawn from the outcome. The rule of thumb implies that a multicollinearity issue among the variables under examination is indicated by a correlation of 0.8 or higher (Pallant, 2010). Additionally, to test for multicollinearity of the variables, Table 4 shows that a positive correlation between return on assets and human capital efficiency exists. This revealed that since the independent variables are correlated, a preliminary investigation to test for the multicollinearity was necessary. The study used the Variance Inflation Factor and Tolerance Value test to demonstrate and justify the lack of multicollinearity among the independent variables. The test result is shown in Table 5.

Table 5
Test for multicollinearity using Vector Inflation Factor and Tolerance value

Variable	VIF	1/VIF
HCE	1.320	0.755
SCE	1.320	0.755
Mean VIF	1.180	

Source: STATA Output, (2023)

Table 5 outcome indicates that there is no multicollinearity issue with the study's variables. As a general rule, this is demonstrated by the values of VIF being fewer than 10 and tolerance values being more than 0.10 (Gujarati & Porter, 2009). This is in line with the conventional regression model's presumption that the independent variables in the model should not be too closely related to one another. When the model's error terms do not have constant variances, heteroskedasticity develops. This issue needs to be resolved to prevent incorrect coefficient estimations and occasionally make statistically significant variables appear to be insignificant (Gujarati, 1988).

The chi-square value for this study's Breusch-Pagan/Cook-Welsberg test for heteroskedasticity is 82.13, and it is significant at 1%, as shown. Since the p-values are less than 0.05, both the chi-square and the p-value show that heteroskedasticity was present. Since heteroskedasticity was present, so Fixed



Effects and Random Effects methods of estimation were combined to use the Generalized Least Square technique of estimation. This was done to account for the variations across individuals within the units.

Regression Results

The regression results is presented and discussed in this section. The relationship between the study's independent variables (human and structural capital efficiency) and the dependent variable (return on asset) is discussed. The regression results from the Ordinary Least Square technique of estimation and the Generalized Least Square method of estimation (Fixed Effect and Random Effect) were presented, in addition, other tests to support the choice of the best model for the panel data were also executed and discussed below.

Table 6
Regression Result

Variable	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
HCE	0.228	4.060**	0.653	13.370**	0.529	10.820**	0.228	3.270*
SCE	0.252	4.600**	-0.570	-3.120	0.055	1.080	0.252	5.120**
Const	0.286	7.950**	0.162	4.730**	0.196	5.630**	0.286	7.810**
R ²	0.1851						0.185	
R ² WTH			0.446		0.439			
R ² B/W			0.001		0.011			
R ² OV			0.125		0.146			
F-Stat	37.13		105.290				35.690	
Wald ch2					160.73			
Sig	0.000		0.000		0.000		0.000	

Source: STATA output, (2023) (***, **, * statistical significance @ 1%, 5% & 10% respectively)

After analyzing the data using GLS, we conducted the Hausman specification test, which resulted in a Hausman chi-square of 1283.98 (Table 7: list of appendices), favoring the random effect. The decision to apply the random effect depends on the outcome of the Lagrangian multiplier test. If the result is significant, we will use robust OLS regression; if not, we will utilize a random effect.

The results of the Breusch and Pagan Lagrangian Multiplier Test showed a chi-square of 134.68 and a p-value of 0.000, indicating that the units in the panel exhibit statistical variance due to the random effect. Robust Ordinary Least Squares technique of estimate was employed in this work based on the results of Breusch and Pagan Lagrangian Multiplier. Using the Robust Ordinary Least Square technique of estimation, the study's assumptions were tested based on this basis. The regression equation is restated as follows: $ROA_{it} = A_{it} + B_1HCE_{it} + B_2SCE_{it} + E_{it}$.



On this premise, the study's hypotheses were assessed using the robust ordinary least squares estimation method stated as $ROA_{it} = 0.286 + 0.288HCE + 0.252SCE + \varepsilon_{it}$

Table 6's regression results using the robust ordinary least squares method of estimation showed that, with an overall coefficient of determination of R^2 values of 0.1851, the independent variables of the study (human and structural capital efficiency) explained about 18.51% of the variations in the return on assets of listed manufacturing firms in Nigeria. Other factors that impact the return on assets of listed manufacturing firms in Nigeria but were not included in the study's model explained the remaining 81.49%.

Table 6 further indicates that the model is fitted, as indicated by the F-value of 35.69 and the p-value of 0.000, both suggesting that the model is at a 99% confidence level. This shows that the independent variables taken as a whole are effective explanatory factors for the relationship between the investment in human and structural capital efficiency and return on assets of listed manufacturing firms in Nigeria. The study concludes that the utilization of both structural capital and human capital can explain the return on assets of listed manufacturing firms in Nigeria.

The regression equation mentioned above indicates that the return on assets of Nigerian-listed manufacturing firms would be 0.286 (28.6%) if structural capital and human capital were both constant at zero. According to Table 6, there was a correlation between the profitability of listed manufacturing firms in Nigeria and the efficiency of human and structural capital utilization.

Hypotheses Testing

This study is based on two null hypotheses which were developed in the study's introduction to examine the effects of human and structural capital efficiency on the return on assets of listed manufacturing firms in Nigeria.

The hypotheses are presented as follows:

H₁: Human capital efficiency has no significant impact on the return on assets of listed manufacturing firms in Nigeria.

The study's variable coefficients and t-values which are used to test the hypotheses are shown in Table 6. According to the analysis, the t-value of 3.270 indicates that the regression coefficient of human capital efficiency is 0.228, and this is significant at the 1% level. To increase the return on assets of listed manufacturing firms in Nigeria, human capital efficiency is crucial. The conclusion suggests that the return on assets of listed manufacturing firms in Nigeria will increase by 22.8% for every one per cent (1%) increase in human capital efficiency. This could be because manufacturing firms are anticipated to increase their investment in personnel capacity development.

This suggests that a firm's return on assets will increase in direct proportion to its investment in human capital efficiency. Based on the assumption of this study, suggests that the profitability of the listed manufacturing firms in Nigeria will suffer if individuals and firms fail to make major investments in human capital efficiency. As a result, the study rejects the null hypothesis, which holds that the return on assets of Nigerian-listed manufacturing firms is not significantly impacted by human capital efficiency. The claim made here is that the return on assets will rise with a rise in the amount of human capital efficiency. Thus, it follows that the amount of human capital efficiency is crucial in elucidating the return on assets of Nigerian-listed manufacturing firms.



Aidin et al. (2023)&Jedsada and Jutamard (2023)revealed a significant and positive relationship between the profitability of manufacturing firms and the amount of human capital efficiency. This implies the findings of this study are inline with their findings as the study documents a significant and positive relationship between human capital efficiency and return on assets of listed manufacturing firms in Nigeria.

H₂: Structural capital efficiency has no significant impact on the return on assets of listed manufacturing firms in Nigeria.

The researcher assumes that there is no significant relationship between the structural capital efficiency and the return on assets of listed manufacturing firms in Nigeria based on the aforementioned hypothesis. The results of the investigation revealed that the structural capital efficiency regression coefficient was 0.252, with a significant t-value of 5.120 at 1%. This indicates that investment in structural capital efficiency is crucial to raising the return on assets of Nigerian manufacturing firms. The outcome suggests that the return on assets of listed manufacturing firms in Nigeria will rise by 25.2% for every one per cent (1%) increase in structural capital efficiency by these firms.

As a result, the study rejects its null hypothesis, which holds that the return on assets of Nigerian-listed manufacturing firms is not significantly impacted by structural capital efficiency. Consequently, an important factor in determining return on assets for listed manufacturing firms in Nigeria is structural capital efficiency. This result is consistent with Weqar and Haque (2022)which showed that structural capital efficiency has a significant impact on the return on assets of listed manufacturing firms in Nigeria.

5. Conclusion and Recommendations

The study investigated how the return on assets of Nigerian listed manufacturing firms was affected by human and structural capital efficiency. This study's tests on the data it collected and analysis of the results revealed a correlation between the return on assets of Nigerian listed manufacturing firms and the structural and human capital efficiency.

Thus, the researcher concluded that all of the independent variables had a significant and positive impact on the profitability of listed manufacturing firms in Nigeria based on the study's findings, which showed that both human and structural capital efficiency had a significant impact on the return on assets of listed manufacturing firms in Nigeria. In other words, the study has empirically provided statistical evidence of the impact of both human and structural capital efficiency on the return on assets of listed manufacturing firms in Nigeria.

The study's results clearly show that human and structural capital efficiency are major factors influencing the return on assets of Nigeria's listed manufacturing firms. Managing human capital is the key to establishing and preserving appropriate relationships with other businesses. Therefore, the study recommends that the staff should be provided with sufficient training in customer relations. Training courses, workshops, and seminars that improve soft skills and interpersonal communication should be offered to staff members. Effective human resource management within manufacturing companies can boost worker productivity, leading to higher revenue and profit margins for the organization.



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