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PEN TESTING USING SELECTED AUTOMATED SECURITY TESTING TOOLS FOR MITIGATION OF OWASP TOP-10 2017 VULNERABILITIES

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Abstract
Several millions of transactions take place over the internet on daily basis with web applications at the center stage of these tasks. Disappointingly, web applications do not always function optimally. This is due to vulnerabilities which exist during software development process. These vulnerabilities portends grave dangers to applications and software systems as they are exploited by malicious hackers and other cyber criminals to steal sensitive data and information which could interrupt legitimate activities over the web and shut down the entire system. Software security testing is a priceless aspect of software management technique and security testing of web applications throughout the Systems Development Life Cycle (SDLC) which helps in reducing web applications risk and improve efficiency. Open source automated security testing tools provide a means of assessing and conducting security checks on web applications for the purpose of identifying prevalent vulnerability and mitigating their effects. This article is focused on performing penetration testing on OWASP top-10 2017 web application vulnerabilities using selected security testing tools such as; wapiti, vega, arachni, w3af, sql map, wfuzz, zed attack proxy and grandel-scan. The article examined 15 open source security testing tools and used a test bed and criteria by assigning a scoring matrix with discussions limited to 8 testing tools for the purpose of this experiment. The criteria are reliability/accuracy, ease of use, portability/flexibility, integration, and support/maintenance. Other factors are documentation, usability, installation, interface, maintenance and implemented using Windows, Mac and Linux as operating systems. The test results were justified using webgoat application.
Keywords: OWASP top 10, pen testing, security tools, vulnerability, hackers, web app.

1.0 INTRODUCTION

Human population is dynamically increasing and so are their needs and means of addressing these numerous challenges in society using technology. Robust developments of technologies in the world of software makes it imperative to keep Web Applications secure from threats and make it more users friendly with minimal errors. These rapid advancements in software development has given rise to complex designs and development tools for testing web based applications for optimum performance. Software application security testing is a valuable aspect of software engineering phase that is aimed at engendering high quality applications devoid of bugs or errors that would have ruined the overall objective of the application.

It is imperative that Web-based applications must be safe and secured to avoid failures resulting from vulnerabilities and other forms of threat such as bugs that could lead to crash, hence the need for testing at different layers of the development life cycle. A survey conducted in 2018 by Positive Technologies (ptsecurity.com/ww-en/ analytics/ web-application-attacks-statistics-2017/) on web application for IT, Banks and e-procurement platforms, Government, Healthcare, Education, Energy and Manufacturing reports that vulnerabilities exist which were exploited by hackers and computer criminals. These defects present a list of numerous challenges to the teaming users of web-based applications with consequences of huge financial loss. In addition to financial cost, defects in web applications result in loss of revenue and credibility (Serdar Dogan, 2014). In a recent publication by GEEKFLARE, (2019) (www.geekflare.com/open-source-web-security scanner/) report by Symantec states that "76% of scanned websites had malware and that these websites are vulnerable with critical elements susceptible to major attacks-leading to malware and data breaches". Also, Veracode, (2019) (info.veracode.com/guide-to-application-security-solutions.html) has it in their state of software report that "77% of all applications had at least a vulnerability classified as one of the top 10 web vulnerability types". These vulnerabilities

have caused businesses huge cost at mitigation with severe consequences to customers globally. So this article takes into consideration vulnerabilities experienced during software development using the various processes mentioned above.

2.0 Global impact of web applications vulnerabilities on economy

In 2018, the Global Financial Integrity and World Trade Organization (www.cigionline.org/ Economy- 2019) reported that cyber-attacks each year accounts for 1/3 of the cost of International Crime or those related to counterfeiting and piracy which was estimated at USD1.6 – 2.2 Trillion and USD 1.8 Trillion respectively. Furthermore, according to reports in a publication of the Central European Financial Observer that the global cost of cyber-attack on World Economy is estimated at $600 billion annually (**Sw**iderek, 2018). These figures portend grave danger to the Global Economy due to cyber –attacks hence efforts must be made to secure web applications at different levels of development and monitor performance during implementation. Basically, web application testing tools helps to keep online data and information safe by identifying the security vulnerabilities in your web – based applications. Software security testing tools are used in Software Development Life Cycle (SDLC) to automate certain tasks, improve testing efficienc**y** and identify challenges that would be difficult to find using manual testing approach alone (Veracode, 2019).

The growth of e-commerce sites and rapid increase in business activities (online transactions) carried out over the web makes it imperative that companies must have their web applications tested for efficiency and quality service delivery. Apart from companies and other well established organizations, people also depend on web-based services for their day to day interactions and social engagements. The Web has become a very dangerous place with continuous hacking attacks, security exploits, insiders' threats and other forms of attacks, thereby leaving your company vulnerable. Web –based applications are continuously useful in modern online transactions in society due to its advantageous features. For example, web applications with functional failures for shopping malls, banking, admission system, payroll systems, hospital management system, stock trade, and security and aviation systems will lead to risk by interrupting transactions and threaten human lives with dire financial consequences. According to CREST, that attacks are getting severe over the web and that attackers are getting more sophisticated and this opinion is supported by (Abdul Razzaq, 2013). With the progress of innovation, attackers are finding new strategies for breaking a framework's security tool (Hong, 2003). This has become a source of serious concern to any enterprise that wants to maximize profit and remain in business because it could lead to chaos, loss of reputation, theft of intellectual property, ransom ware, customer and finance loss.

A good web security approach is sacrosanct to keeping hackers and cyber-thieves and other forms of cyber-criminals from accessing valuable information. Ryan Cayubit, (2017) reported that "targeted attacks are so successful on data theft that 25% of all information infringement since 2005 was because of information theft". It is the view of (Thuraisingham, 2005) that data and information have to be protected from unauthorized access as well as from malicious corruption. Data and information is the most valuable asset of any business enterprise or organization and it must be protected from the risk of unauthorized access and use with appropriate authentication and authorization processes. Some prevalent security threats in e-commerce include; hacking, data misuse, phishing attacks, money theft, credit card frauds and unprotected services.

A web application is software application that makes use of web browsers to unveil and execute information in diverse web pages in an HTTP layout in a web server. The aim of web application testing is to execute the application using combinations of input and statements to reveal failures (Giuseppe Di Lvcca, 2006). It suffices to state that no single software testing tool is sufficient to identify all vulnerabilities, different tools must be deployed for testing a web application at various stages of the development life cycle to determine if it is functionally secure. Web application testing tools could be manual, command line driven and automated. Some of these tools can simulate an attack, others scan through an application, while some other tools crawl and perform penetration test on web pages and other web applications. McGraw, (2006), in corroborating the assertion above said that different types of tools and best practices must be applied throughout the development life cycle of a web application. (Elizabeth Fong, 2007) also agree that web application scanners crawl through the

pages of a web application for vulnerabilities by simulating attacks on it.

3.0 Web application security testing tools

Web applications do not always function optimally devoid of design and development fault and bugs. These faults can be exploited by cyber criminals and help them get illegal access to trade secrets of any business. To keep your websites or online data safe, you need to stay one step ahead of hackers. This requires web applications security testing with tools. The focus of security testing is to identify vulnerabilities in a system and determine whether its data and resources are safeguarded from possible intruders and other forms of threats (Strom, 2019). The rapid increases of online transactions have necessitated security testing on web applications to ensure uninterrupted operations and threats from hackers and computer criminals. Web Application Security testing tools involve the use of tools to proactively discover applications vulnerabilities and ensuring the protection of websites against attacks (Andrew Van der Stock, 2017). Some examples of open source security tools for web applications as published by **TESTBYTES** in 2019 are; wapiti, zed attack proxy, vega, w3af, skipfish, ratproxy, sql map, wfuzz, grendel-scan, arachnid, grabbler, acunetix, netsparker, metasploit and burp Suit).

3.1 Experimental design of automated testing tools using scoring matrix and criteria for selecting tools.

numerous tools can be used for extensive testing of web applications Zuokemefa (2019). However, each tool varies significantly from the others due to several metrics such as performance, reliability, and portability of the tool used for testing. Multiple factors determine how accurate test results are gotten and therefore, a model or criteria for using these tools have to be created to ensure the accuracy of test results obtained. Considering the fact that testing activities represent about 30 – 40 % of all activities in the software life cycle (Spillner, 2000), it is important to select the right test tool to get accurate desired results. An efficient way of comparing these tools is by using a scoring matrix. Scoring matrices are used to compare multiple items against factors by matching them up in sequence alignment and assigning numerical values to them. This is done by listing all test tools as row labels on a table and the criteria as the column headings and comparing them against each other. It is scored numerically from 0 (zero) to 5 (five) where zero is the lowest possible score and five represent the highest score achievable. The criteria used for comparing the test tools are as follows; Reliability/Accuracy: This defines the test outcomes in terms of quality and consistency. The more precise and coherent the results, the greater the application's reliability. Moreover, the higher the rate of false positives, the lower the accuracy of the application. Reliability is determined by multiple testing and comparison of the test outcomes of the same web application. If the results are similar, it means the test application is very reliable.

- Ease of use/interface: This is the degree to which an end-user can use software efficiently and effectively. Applications with graphical user interfaces are generally easier to operate than those with command-line interfaces. To guarantee that test tools are used correctly and expected outcomes are obtained, ease of use is very crucial.
- Portability/Flexibility (execution among multiple environments): This describes the ability of an application to work across multiple environments and platforms.
- Integration with other tools: This describes the ability of a web application test tool to extend its primary functionality through the use of add-ons, extensions, frameworks, and API's.
- Support/Maintenance: This criterion describes the amount of support available for a particular web application security audit and vulnerability test tool. The support can either come directly from the developers or from the software's community.

Based on their level of significance, each criterion has been provided a weighted score. Because it is the most significant criteria, the reliability criterion has a weighted value of 5, while the integration with other tools/extensions criterion has a weighted value of 1 as the least significant criteria.

Table 3.1: Description of scoring matrix and criteria for selecting tools

Factors	Reliability /Accuracy (Higher is better)	Ease of use/Interface (Higher is better)	Portability/ Flexibility (Higher is better)	Integration with tools (Higher is better)	Support/Maintenance (Higher is better)	Score
Weights	5	4	3	1	2	
Wapiti	5*5	3*4	5*3	2*1	3*2	60
Zed attack proxy	5*5	5*4	5*3	4*1	3*2	70
Vega	4*5	5*4	5*3	3*1	3*2	64
W3af	4*5	3*4	3*3	4*1	4*2	53
Wfuzz	5*5	3*4	5*3	3*1	2*2	59
SQL Map	5*5	3*4	5*3	2*1	2*2	58
Grendel-Scan	4*5	5*4	5*3	2*1	2*2	61
Arachni	4*5	4*4	5*3	5*1	3*2	62

3.2 Conducting security testing of selected OWASP Top 10 vulnerabilities using automated tools.

Most web application security test tools detect prevalent vulnerabilities; however, when testing for particular vulnerabilities, these test tools generate differing degrees of precision. Some test tools are mainly intended to identify particular vulnerabilities while others lack the features necessary to identify some vulnerability and as such each tool has to be tested against the vulnerabilities of the OWASP Top 10 to know their strengths and constraints. The table below describes the result obtained from test analysis of the OWASP Top 10 against a selected list of tools.

Table 3.2: Showing results of OWASP Top 10 against selected tools.

Vulnerability/Accuracy level	Wapiti	Zed attack proxy	Vega	W3af
A1: Injection	Yes	Yes	Yes	Yes
A2: Broken Authentication and Session Management	No	Yes	Yes	Yes
A3: Sensitive Data Exposure	Yes	Yes	Yes	Yes
A4: XML External Entities (XXE)	Yes	Yes	Yes	Yes
A5: Broken Access Control	Yes	Yes	No	Yes
A6: Security Misconfiguration	No	Yes	No	Yes
A7: Cross-Site Scripting (XSS)	Yes	Yes	Yes	Yes
A8: Insecure Deserialization	Yes	Yes	Yes	Yes
A9: Using Components with Known Vulnerabilities	No	Yes	No	No
A10: Insufficient Logging and Monitoring	No	No	No	No

Table 3.3: Conducting Security testing of selected OWASP Top 10 Vulnerabilities using automated tools

Vulnerability/Accuracy level	Wfuzz	SQLMap	Grendel-Scan	Arachni
A1: Injection	Yes	Yes	Yes	Yes
A2: Broken Authentication and Session Management	No	No	Yes	Yes
A3: Sensitive Data Exposure	Yes	No	Yes	Yes
A4: XML External Entities (XXE)	Yes	No	Yes	No
A5: Broken Access Control	Yes	No	No	No
A6: Security Misconfiguration	No	No	No	No
A7: Cross-Site Scripting (XSS)	Yes	Yes	Yes	Yes
A8: Insecure Deserialization	No	No	No	Yes
A9: Using Components with Known Vulnerabilities	No	No	No	No
A10: Insufficient Logging and Monitoring	No	No	Yes	Yes

Table 3.4. Comparing test tools in terms of documentation, usability, maintenance, installation and interface using scoring matrix.

Test tools	Documentation	Usability	Maintenance	Installation	Interface	Weighted score
Weights	2	5	3	1	4	
Wapiti	2*2	2*5	2*3	3*1	2*4	31
Zed attack proxy	4*2	4*5	5*3	5*1	4*4	64
Vega	4*2	4*5	2*3	4*1	4*4	54
W3af	2*2	3*5	2*3	3*1	4*4	44
Wfuzz	3*2	2*5	2*3	3*1	2*4	33
SQL Map	1*2	2*5	3*3	3*1	2*4	32
Grendel-scan	2*2	3*5	1*3	3*1	3*4	37
Arachni	3*2	4*5	2*3	4*1	4*4	52

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusion

Testing is one of the most important stages of the software development life cycle; this is due to the fact that no software application can be a hundred percent defect-free. Effective vulnerability scans need to be carried out frequently during development and maintenance to detect vulnerabilities and ascertain the level of security risks facing a web application. In this study, multiple open source web application security tools were reviewed and tested to ascertain the best open-source web vulnerability application. From the tests carried out, zed attack proxy (ZAP) web application security scanner was chosen as the best open-source web vulnerability test tool because of its modular design and ease of use, it is highly recommended for students and developers with little or no experience in using automated test tools. It also supports numerous API's, extensions and add-ons which improves its functionality. Zed attack proxy ranks top and can be used for the teaching and learning of web applications security module by students and for conducting penetration testing to mitigate OWASP top-10 vulnerabilities.

4.2 Recommendation

Based on the result obtained from the research study, it is recommended that:

I. regular security test should be carried out on web applications using modern techniques and applications to observe the risks that might be facing a web application.

II. Test results should be explored extensively to check for false positives that might occur during automated tests and vulnerabilities detected should be resolved to prevent malicious agents from carrying out attacks on the web application.

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IMPACT OF CORPORATE ATTRIBUTES ON TIMELINESS OF CORPORATE FINANCIAL REPORTING

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Abstract
This study examined the effect of corporate attributes on timeliness of financial reporting of quoted firms in Nigeria. The objective was to investigate the relationship between corporate attributes and timeliness of financial reporting. Cross sectional data was sourced from financial statement of quoted firms. Number of days was modelled as a function of total assets, age, profitability and number of employees. After cross examination of the validity of the pooled effect, fixed effect and the random effect, the study accepts the fixed effect model. The result showed that profitability and age have positive relationship with timeliness of financial report on financial reports of the selected firms. The panel unit root proved that the variables are stationary at first difference while the causality test showed one unidirectional relationship total assets to timeliness of financial reporting. From the regression summary, the study concludes that corporate attributes have significant relationship with timeliness of financial reports. We recommend that corporate attributes that negatively affect timeliness of financial reporting should be discouraged or properly managed and factors that enhance timeliness of financial reporting should be encouraged
Keyword: Corporate attributes, Timeliness, Business incorporated, cumulative income.

1.0 INTRODUCTION

International Accounting Standards Board (IASB, 2018) states that timeliness of financial reports is the "availability of information needed by decision makers for useful decision making before it loses its capacity to influence decisions." In emerging economies like Nigeria, the provision of timely information in corporate reports assumes greater importance since other non-financial statement sources such as media releases, news conferences and financial analysts' forecasts are not well developed and the regulatory bodies are not as effective as in Western developed countries (Ahmed & Kamarudin, 2016).

In all countries, the production of financial reports is a requirement of the law. Financial reports have information content that has a value to the users of the reports. This value includes the ability to use the reports to predict the performance of the firm. Information in the annual corporate reports can be used to influence the shareholders' and other users' impression of the company performance (Okike, 2014). Timeliness however, is one of the necessary qualitative characteristics of relevant financial information and is thus receiving increased attention from accounting regulators and listing authorities around the world (Abdullah, 2016). There exist extant literatures on the timeliness of financial statements due to the fact that timeliness as an important aspect of financial reporting has been identified by the Accounting Principles Board (APB) in the United States as one of the qualitative attributes of financial reporting (Iyoha, 2019). Timeliness of corporate financial statements as discussed by the Organisation for Economic Cooperation and Development (OECD), under the disclosure and transparency category stated that the corporate governance framework should ensure that timely and accurate disclosure is made on all material matters regarding the corporation, including the financial situation, performance, ownership and governance of the company (OECD, 2004).

In Nigeria, in spite of the existence of the various enactments, there have, however been a number of criticisms from various groups, including the World Bank, concerning perceived inadequacies in the financial reporting outcome of firms in Nigeria (Okike, 2014). For instance, the World Bank, in its Report on the Observance of Standards and Codes (ROSC) conducted in 2004, noted that the accounting and auditing standards in Nigeria suffer from "institutional weaknesses in regulation, compliance and enforcement of standards and codes." And timeliness in financial reporting is one of the requirements to be enforced and complied with by firms in Nigeria. The provision of timely information in corporate report is of great importance since other non-financial report sources such as media releases, news conferences and financial analysts' forecasts are not well developed and the regulatory bodies are not as effective as in the developed countries of the world hence, the heavy reliance on the corporate

financial reports (Abernathy, 2019). The major source of annual financial results of firms is the financial reports. Delays in making public of the financial reports can create information asymmetries and cause users of such information to search for other alternative information. Abdullah (2016) argues that the longer the gap between the year end and the annual corporate report publication, the higher the chances that the information would be linked to some interested investors. The length of the audit has been regarded as the single major determinant of the timeliness of the financial reports. The greater the period between the financial report and the financial year end, the more negative the effect on timeliness of corporate financial information.

Aims and Objectives of the study

The main objective of this study is to empirically investigate the determinants (company attributes) of timeliness of financial reporting in Nigeria. However, the following are the specific objectives of this research work.

i. To investigate the effect of the company's size on the timeliness of financial reporting in Nigeria.
ii. To examine the effects of the size of audit firm on the timeliness of financial reporting in Nigeria

In order to achieve the objectives stated above, the hypotheses hereunder were formulated in null forms:

Ho 1: The size of the company has no impact on financial reporting timeliness in Nigeria.

Ho 2: The size of audit firm has no impact on the timeliness of financial reporting in Nigeria

2.0 LITERATURE REVIEW

This part of the work, takes a review of relevant literatures, looking at the conceptual framework, theoretical framework and empirical review.

2.1 Conceptual Framework

The primary aim of financial reports is to present to stakeholder the information about the company's financial state and performance within the period in which the report covers. It is a medium of communicating various stakeholders and providing information that will enable investors and creditors to make informed decisions. Hassan and Taylor (2018) states that qualitative characteristics are attributes that makes the financial information provided in financial statement useful to users. These attributes include relevance, reliability, comparability and understand ability. However, Abdullah, (2016) stated that financial statement is misleading if it lacks the qualities of accuracy, relevance, comparability and it contains fundamental errors or is prepared with the intention to deceive or confuse users. Since it provides vital information that aid investors and creditors in making informed decision, the timely release of the report is important. Iyoha (2019) believe that the timely release of corporate financial report has long been recognized as one of the qualitative attributes of financial reporting. This attribute suggests that financial statements shall be made available to the public within a reasonable period of time from the close of a company's financial year-end; otherwise the usefulness of the statements would be impaired. In financial institution and capital market where corporate financial information is a primary source of information to creditors and shareholders, timely publication of the information is crucial (Iyoha, 2019). In line with this, Jaggi and Tsui (2019) opine that for investors, timely reporting reduces the uncertainty relating to investment decision and asymmetric dissemination of financial information among stakeholders in the capital market this eliminate the occurrence of leak, rumours and insider trading in capital market (Owusu-Ansah, and Yeoh, 2000).

The qualitative characteristics of financial reporting

According to IASB, the essential principle of assessing the financial reporting quality is related to the faithfulness of the objectives and quality of disclosed information in a company financial reports. These qualitative characteristics enhance the facilitation of assessing the usefulness of financial reports, which will also lead to a high level of quality. To achieve this level, financial reports must be faithfully represented, comparable, verifiable, timely, and understandable. Thus, the emphasis is on having transparent financial reports, and not having misleading financial reports to users; not to mention the importance of preciseness and predictability as indicators of a high financial reporting quality (Okike, 2014). As it is defined in the *Conceptual Framework for Financial Reporting* of the FASB and the IASB, there are agreed upon elements of high quality financial reporting. The qualitative characteristics of financial reporting quality include: relevance, faithful representation, understand ability, comparability, verifiability, and timeliness. They

are divided into fundamental qualitative characteristics and enhancing qualitative characteristics. A theoretical explanation for each of these terms emphasizes their importance as qualitative characteristics, and also indicates what qualities are considered fundamental among different frameworks.

Timeliness of Accounting Information

Timeliness is another enhancing qualitative characteristic. Timeliness illustrates that information must be available to decision makers before losing its powerful and good influences. When assessing the quality of reporting in an annual report, timeliness is evaluated using the period between the year-end and the issuing date of the audit report—the period of days it took for the auditor to sign the report after the financial year-end (Beest, Braam & Boelens, 2019). According to Iyoha, (2019), there are three ways to measure timeliness. The first way is to consider the form in which the news is disclosed. In this respect the different forms of disclosure will include: voluntary disclosure of earnings forecasts by management, voluntary pre-announcement of earnings and mandatory earnings announcement. The first form is considered the timeliest while the last is considered the least timely. The second way to measure timeliness according to Iyoha (2019) is to calculate the number of trading days between the end of the reporting period and the reporting date. This major approach was also used by (Givoly & Palmon 2012). The third method of measuring timeliness is by looking at the company's own disclosure policy and comparing report date to historical dates.

2.2 Theoretical Framework

The attitude towards timely presentation of financial statement could be explained by the stakeholder.

Stakeholder Theory

The stakeholder theory suggests that in the absence of an opportunity to hide bad news, because of the mandatory disclosure requirements, CEOs tend to delay their report when it is bad news. By delaying bad news, managers make sure that the negative effect on the stock price is shifted to a later date. On the other hand, releasing good news early prevents the bad news from counteracting good news (Dogan, Coskun & Orhan, 2007). The authors also argue that delaying bad news basically means preventing the information from reaching the stakeholders and is beneficial until other companies release bad news in the industry. Dogan et al (2007) observed that the shareholders' theory tends to explain well the behaviour of managers. By delaying bad news, managers ensure that the negative effect on the stock price happens later. And conversely releasing good news earlier prevents other resources from counteracting the good news. The argument now is that delaying bad news basically means preventing information from reaching the stakeholders. This theory is relevant to this study because of the timeliness of release of corporate report and its subsequent relevance or effects on the value of the firm. According to Hassan and Zakiah (2014), timeliness is clearly considered as an important qualitative characteristic of financial information. Financial information users need to obtain reliable, relevant and timely information, in order to survive in a highly competitive environment.

2.3 Empirical Review

Timing of the disclosure of financial information is also important for preventing trading activities of insiders, unofficial disclosure of news and market rumours (Ansah, 2020). As compared with developed markets, protective measures and sanctions regarding prevention of trading activities can be inadequate in emerging markets. Companies in emerging markets disclose less information. Consequently, the timing of financial reporting should be expressly designed to minimize such activities, which damage the efficacy of the market in emerging contexts (Leventis & Weetman, 2014).

Newton and Ashton (2019) examined the relationship between audit delay and audit technology. They found that firms using structured audit approaches have greater mean delay than firms using unstructured approaches. Willekens, (2018) examined the relationships between some company attributes and audit delay over six years (1977-1982) for 465 Canadian public companies. They found that the variables (client industry, type of audit opinion, presence of extraordinary items, loss for the year) were significant for at least four of the six years, and three other variables (log of total assets; fiscal-year-end and audit firm) had consistent signs across the six years.

Soltani (2012) examined the timeliness of corporate and audit reports in the French context, using data from French listed companies for each year in the period 1986-1995. He found empirical

evidence of an improvement in timeliness of corporate and audit reporting. His study also showed that the existence of a qualified audit tends to lengthen the delay.

Leventis, Weetman and Caramanis (2015) examined the audit report lag of companies listed on the Athens Stock Exchange at the time of Greece's transition from an emerging market to a newly developed capital market. The study found a statistically significant association between audit report lag and the type of auditor, audit fees, number of remarks in the audit report, the presence of extraordinary items, and an expectation of uncertainty in the audit report. The results suggest that audit report lag is reduced by appointing an international audit firm or paying a premium audit fee.

3.0 METHODOLOGY

The design of this study is directed at analysing the timeliness of corporate financial reporting in relation to firm age, size, audit firm size and industry sector of companies quoted on the NSE. This work adopted the survey research design. This design consists of cross-sectional design and longitudinal research design since the study used selected firms across the Nigeria Stock Exchange spanning ten (10) years, 2012- 2021. The statistical and mathematical tools used include percentages, frequencies, tabulation and descriptive statistics, while multiple regression analysis was used to test the hypothesis generated in this work in introduction section. The multiple regression model is guided by a linear model.

Pooled regression specification

$$TL = \alpha o + \alpha_1 AGE_{1i} + \alpha_2 PAT_{2i} + \alpha 3 NOE_{3\,it} + \alpha_3 TA_{4it\ 6} + \varepsilon 1_{it} \quad \textbf{3.}1$$

Fixed Effect Model Specification

$$TL = \alpha o + \alpha_1\ AGE_{1i} + \alpha_2\ PAT_{2i} + NOE_{3it} + \alpha_3 TA_{4it\ 6} + \varepsilon 1_{it} \quad \sum_{i}^{9} = 1\ \alpha_i\ idum + \varepsilon 1_{it} \quad 3.2$$

Random effect model specification

$$TL = \alpha o + \alpha_1\ AGE_{1i} + \alpha_2\ PAT_{2i} + NOE_{3\,it} + \alpha_3 TA_{4it\ 6} + \varepsilon 1_{it} \quad + \mu i \ + \varepsilon 1_{it} \quad 3.3$$

Where:

TL	=	timeliness of financial reporting
AGE	=	company age
PAT	=	profit after tax
NOE	=	number of employees
TA	=	total assets

The method of data analysis used in this study is the multiple linear regression using ordinary least square method. This approach, which is a quantitative technique, included tables and the test for the hypotheses formulated by using ordinary least square with Econometric View regression analysis at 5% level of significance. In order to circumvent these problems, panel estimation techniques of fixed and random effects were adopted in this study in addition to the traditional pooled regression estimation. Decisions were made between the fixed and random effect models using the Hausman specification test. The panel model for the study is specified based on the modified model of (Menard, 2015).

$$Y_{it} = \beta X'_{it} + \alpha Z_i^{'} + \varepsilon_{it}$$

Where:

Y	=	dependent variable
D	=	independent variable
β_o	=	intercept
β_i	=	coefficient of the explanatory variable
e	=	error term
I	=	cross-sectional variable
T	=	time series variable

Moreover, in order to undertake a statistical evaluation of our analytical model, so as to determine the reliability of the result obtained and the coefficient of correlation (r) of the regression, the coefficient of determination (r^2), the student T-test and F-test were employed.

$$\Delta y_t = \beta_1 + \beta_2 + \delta y_{t-1} + \alpha i \sum_{i-1}^{m} \Delta y_{t-1} + Et$$

Where:

Δy_t = change time t

Δy_{t-1} = the lagged value of the dependent variables

Σ_t = White noise error term

If in the above δ =0, then we conclude that there is a unit root. Otherwise, there is no unit root, meaning that it is stationary. The choice of lag was determined by Akaike information criteria.

4.0 DATA PRESENTATION

Table 4.1 contains the cross-sectional data of the variables from the ten (10) quoted deposit money banks from 2012-2021.

Table 4.1: Choice of the Appropriate Model

Effects Test	Statistic	d.f.	Prob.
Cross-section F	23.166090	(9,84)	0.0000
Cross-section Chi-square	121.020122	9	0.0000
Hausman Test			
Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	11.677200	3	0.0000

Source: Computed from E-view statistical package

Our study used the likelihood ratio test to choose between the pooled effect model and the fixed effects model as shown in Table 4.1 above.

The fixed effects model is better than the pooled effect model, hence the result of the likelihood ratio test was significant (p-value< 0.0000) for the three models. This result means that we reject the Pooled effect model and choose the fixed effects model for this study. To make a choice between the fixed effects model and the random effects model, we utilized the Hausman test as shown in the Table above. The hypotheses of the test are as follows: The fixed effects model is more appropriate than the random effects model. As the result indicated that the results of this test were significant (p-value = 0.0241). Hence, we reject the null hypothesis and conclude that the fixed effects model is the most appropriate of the three models.

Table 4.2: Corporate Attributes and Timeliness of Financial Reporting: Pooled Effect Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NOE	-0.000103	0.000524	-0.195833	0.8452
PAT	4.747556	3.970751	1.195632	0.0000
TA	0.017096	0.013244	1.290851	0.2000
AGE	-0.000830	0.105110	-0.007894	0.9937
C	81.19528	5.211524	15.57995	0.0000
R-squared	0.220428	Mean dependent var		78.91753
Adjusted R-squared	0.011171	S.D. dependent var		23.41726
S.E. of regression	23.54770	Akaike info criterion		9.196296
Sum squared resid	51567.96	Schwarz criterion		9.302470
Log likelihood	-442.0204	Hannan-Quinn criter.		9.239228
F-statistic	0.646462	Durbin-Watson stat		0.682339
Prob(F-statistic)	0.587126			

Source: Extract from E-View 9.0 (2022)

Interpretation of the Result

Table 4.2 above presents the effect of the independent variables on the dependent variables as formulated in a regression model. Evidence from the model shows that the pooled effect can explain 22% and 1.1% variation on the dependent variable while the model is statistically not significant by the value of F-statistics and F-probability. The Durbin Watson statistics is less than 1.00, which means the absence of serial autocorrelation. The effect of the independent variables shows that number of employees and company age have negative relationship with timeliness of financial reporting which is proxied by number of days. However, the t-statistics and the probability proved that from the pooled effect model, all the explanatory variables are statistically not significant except profit after tax of the firms.

Table 4.3: Corporate Attributes and Timeliness of Financial Reporting- The Fixed Effect Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NOE	-0.000601	0.000754	-0.797248	0.4276
PAT	4.747556	3.970751	1.195632	0.0000
TA	-0.004881	0.009815	-0.497347	0.6202
AGE	5.457421	0.216466	2.113131	0.0376
C	62.82663	9.352631	6.717536	0.0000
	Effects Specification			
Cross-section fixed (dummy variables)				
R-squared	0.718682	Mean dependent var		78.91753
Adjusted R-squared	0.678494	S.D. dependent var		23.41726
S.E. of regression	13.27795	Akaike info criterion		8.134233
Sum squared resid	14809.52	Schwarz criterion		8.479297
Log likelihood	-381.5103	Hannan-Quinn criter.		8.273760
F-statistic	17.88287	Durbin-Watson stat		1.609418
Prob(F-statistic)	0.000000			

Source: Extract from E-view 9.0 (2022)

Table 4.3 presents results of the fixed effect model on the effect of corporate characteristics and timeliness of financial reporting of the ten quoted firms' understudy. The fixed effect model indicates that the independent variables can explain 71.8 and 67.8 percent variation on the dependent variable which is timeliness of financial reporting. The F statistics and the F-probability proved that the model is statistically significant. The Durbin Watson statistics justifies the absence of serial autocorrelation in the time series. The fixed effect results showed number of employees and total assets have negative while profit after tax and age of the firms have positive relationship with timeliness of financial reporting of the selected firms. Coefficient of t-statistics and probability showed that profit after tax and company age have significant relationship while number of employees and total assets have no significant relationship with timeliness of financial reporting.

Table 4.4: Corporate Characteristics and Timeliness of Financial Reporting: The Random Effect Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NOE	-0.000552	0.000691	-0.799497	0.4260
TA	-0.005090	0.009602	-0.530051	0.5973
PAT	41.93282	37.73248	1.111319	0.2700
AGE	0.325114	0.184197	1.765034	0.0808
C	68.16512	10.95466	6.222479	0.0000
Cross-section random			23.95109	0.7649
Idiosyncratic random			13.27795	0.2351
	Weighted Statistics			
R-squared	0.440865	Mean dependent var		13.81878
Adjusted R-squared	0.309925	S.D. dependent var		13.24443
S.E. of regression	13.18213	Sum squared resid		16160.48
F-statistic	1.320800	Durbin-Watson stat		1.541329
Prob(F-statistic)	0.272354			

Source: Extract from E-View 9.0 (2022)

However, to further investigate the relationship between corporate characteristics and timeliness of financial reporting, we examined the random effect model. Result from the random effect model revealed that the independent variables can explain 44.0 percent and 30.9 percent variation on the dependent variable. The model is statistically not significant as the F-statistics and the F-probability is less than the critical value of 0.05. The beta coefficient also showed that number of employees and profit after tax has negative relationship with timeliness of financial reporting while total assets and company age have positive relationship with timeliness of financial reporting of the selected quoted firms.

Table 4.5: Granger Causality Test

Null Hypothesis	**Obs**	**F-Statistic**	**Prob.**
NOE does not Granger Cause NOD	80	0.41634	0.6610
NOD does not Granger Cause NOE		0.00904	0.9910
TA does not Granger Cause NOD	74	2.38888	0.0493
NOD does not Granger Cause TA		0.02983	0.9706
AGE does not Granger Cause NOD	80	0.46393	0.6306
NOD does not Granger Cause AGE		1.78250	0.1753

Source: Computed from E-view statistical package

From the causality test presented in the Table 4.5, there is independent relationship from corporate characteristics and timeliness of financial reporting of the selected quoted firms except a unidirectional causality from total asset to timeliness of financial reporting.

Table 4.6: Panel Unit Root Test

Series: D(NOD)

Method	Statistic	Prob.**
ADF - Fisher Chi-square	27.4292	0.1236
ADF - Choi Z-stat	-1.28930	0.0986

Series: D(NOE)

Method	Statistic	Prob.**
ADF - Fisher Chi-square	42.6609	0.0023
ADF - Choi Z-stat	-2.64838	0.0040

Series: D(TA)

Method	Statistic	Prob.**
ADF - Fisher Chi-square	31.6842	0.0240
ADF - Choi Z-stat	-1.22749	0.1098

Age

Method	Statistic	Prob.**
ADF - Fisher Chi-square	9.77806	0.0443
ADF - Choi Z-stat	-1.88529	0.0297

Source: extract from E-view (2022)

The unit root test at first difference shows that all the variables are stationary at first difference; this implies the rejection of null hypothesis of non-stationarity in favour of the alternate for stationarity. The above Table also implies that the variables are co integrated in the order or 1(1).

Table 4.7: Test of Hypotheses

Variables	T-Statistic	P-Value	Observation	Decision
NOE	-0.797248	0.4276	P value > 0.05	Accept H0
TA	1.195632	0.0000	P value< 0.05	Reject H0
PAT	-0.497347	0.6202	P value < 0.05	Reject H0
AGE	2.113131	0.0376	P value < 0.05	Reject H0

Source: Computed from E-view statistical package

Note: Hypotheses tested from the results of the fixed effect model is based on the validity of the model from Hausman test. The Table above summarizes the hypothesis formulated in this study.

5.0 DISCUSSION OF FINDINGS

Discussion of findings in this study is based on the result of the fixed effect model. It is natural to expect that managers would be more willing to report good news (profit) faster than reporting bad news (loss) because of the effect such news could have on the share price and other indicators (Iyoha, 2019). Though in common law countries firms tend to speed the recognition of good news and slow the recognition of bad news in reported earning; while in code law countries firms tend to slow the recognition of good news and speed the recognition of bad news (Bushman & Piotroski, 2016). However, prior research documents the fact that managers are prompt to release good news (profit) faster compared to bad news (loss) (Chambers & Penman, 2018). However, where an auditor believes that a loss is going to increase the likelihood of financial failure or management fraud, and therefore the probability of litigation by the shareholders for failure to take due care and diligence, he would be more cautious in carrying out the audit and thus the financial report would not be timely. Overall, it is expected that companies would be more eager to release 'good news' without delay and be reluctant in releasing 'bad news'. That is, good news (profit) would reduce reporting lag. However, the findings of this study showed that profitability has positive and significant relationship with timeliness of financial reporting of the selected firms, hence this finding confirm the a-priori expectation of the study. The

main objective of this study was to examine the impact of company attributes on the quality of timeliness (reporting lag) of financial reporting in Nigeria. To address this, relevant data were collected and analyzed and from the analysis, and results were obtained and discussed. From the discussion of the results, age was found to be significant in determining timeliness. Company size, such as total assets and number of employees do not appear to have any adverse bearing on financial reporting lag. Most of the findings of this study are contrary to findings of other studies. Overall, three explanatory variables, total assets, age and number of employees did not show predicted signs. However, there is a significant difference in the timeliness of financial reporting among industrial sectors in Nigeria. Base on the cross-sectional time series data, the banking sector was found to be timelier in financial reporting. The results showed that reporting time may be reduced by the existence and enforcement of rules and regulations of regulatory bodies. Therefore, the findings of this study can be used in the debate on the effectiveness or otherwise of regulatory provisions regarding timeliness of financial reporting in Nigeria.

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ELECTRONIC MEDIA AND INDIGENOUS LANGUAGE DEVELOPMENT

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Abstract
The media without doubt is a channel fantasized by children. Children spend so much of their time watching especially their favourite programs such as cartoons, kid's songs and oftentimes educational programs packaged in a play or funny manner. Because of the interest they have in these programs, children often times sing along with the characters in the television program. They also react or reenact the roles played by their favourite characters. This paper was motivated by the observations made over period of time on children between the ages of 1-10 years encountered in various places in Nigeria. The aim of this paper is to explore how the media can be used to develop our indigenous languages. The descriptive research analysis was adopted for this work. The paper asserts that interest and appreciation of the media programs by children can be harnessed to aid in the development of our indigenous languages. It further claims that packaging the sound systems, words and their meanings, parts of the body and types of animals in our indigenous languages in cartoon forms, songs, storytelling forms and other children media related programs will help in inculcating and developing our indigenous languages in children faster and better. It also asserts that children, by reenacting, reacting and reciting the songs, names, sounds, words and simple sentences of the language, they can consciously and/or unconsciously develop acquisition and maintenance of the indigenous language. The paper concludes that the plurality of our indigenous languages Present a major challenge as to which dialect can be used to package the media contents, of such programs. It therefore recommends that all languages should develop a dialect which will be considered as the standard, this will help to solve the ambiguous nature of our indigenous languages while at the same time developing the other dialects alongside.

Key Words: Media, Indigenous Language, Language development, Children

1.0 INTRODUCTION

Apart from seeing the media as information and entertainment tool, it also has the potential to teach and educate individuals. The easiness, with which one can learn from the media, makes it a veritable tool for sociocultural education and mass mobilization. As a heterogeneous medium capable of reaching various persons no matter the social status, educational tutors have seen the need to put in educational and literal materials converted into weekly programs which runs throughout the year in the bid to educate the child on various aspects of learning.

As good as it is, this seems not to have achieved its purpose because children seem to shy away from such programs seeing it as boring and burdensome. This is due to the fact that to the child, such programs do not appeal to their eyes and sense of entertainment. On the other hand, when watching their kiddies programs with lots of visuals pleasing to their eyes, songs and rhymes, favourite characters with lots of fun, children participate fully, singing the songs, naming their characters in the propel manner without missing a sound, segment or structure. Even after watching programs that interest them, Child can recite the names all the characters, say exactly what they said and how they said it. Unconsciously or consciously this aid in the development of the child's language. But the evil is that these programs are mostly packaged in English, thus, developing the child's positive response to English and negative response to the indigenous language.

2.0 LITERATURE REVIEW

2.1 Concept review of Language

Over the years, scholars have differentiated the peculiarities of animal communication with that of humans. While animals use certain shared sounds, humans used a well-developed structure called Language. Studies have shown that only homo-sapiens communicate by using language. This has earned it the precious award of homoloquens, "the speaking one" (Yul-Ifode, 2001). Language in its present state has gone beyond just a state of

passing information to sharing and hiding of emotions, desires, secrets, it is part of the culture. In fact, a surgery on language will reveal the culture of a people. This is because language is not only part of the people, it is the people themselves. Through language one understands the nature of mankind, its abilities and capabilities. Language is an essential commodity, a precious entity and salient authority to humans and humans alone.

These peculiarities of language have made it difficult for a compounded definition which is universally acceptable. No one scholar has claimed to put forward a definition of language that is not one way or the other criticized. Here are some of the definitions of language:
Language is a purely human and non-instinctive method of communicating ideas, emotions and desires by means of voluntarily produced symbols (Sapir 1921:8). It is a system of arbitrary vocal symbols by means of which a social group co-operates (Bloch and Trager, 1942:5). Language is a system of human communication, in speech or writing, by means of a structured arrangement of sounds into morphemes which are in turn arranged to form words, from words larger units such as phrases and sentences are constructed (Yul-Ifode, 2001:2). Language is broadly regarded as a system of communication (Yul-Ifode, 2001:3). It is any system employed in giving, receiving or hiding information. It can be made up of sounds and calls, signals and signs, postures and gestures including silence (Emenanjo in Yul-Ifode, 2001). Language is often described as semiotic system, because it entails the use of certain agreed-upon symbols or signal to convey meaning from one person to another within a given speech community. (Ndimele, 2001:1). Despite the numerous definitions, one agreed concept of language is that "it is a communicative system" (Ndimele 2001, Yul-Ifode 2001). This system is what differentiates it from other animals no matter the status and carriage of such animal. Ndimele (2001:1) states that "Language is essentially a communicative system in the sense that it associates meaning (i.e. the message) with a set of signs (i.e. the sounds or symbols)." With this system (language), man is able to create, recreate, manipulate, deceive, hide, indict, share information of any kind to one another.
One thing that needs to be noted is that language is not static, it has and can be used in various manners; it can be developed to suit different groups and in different circumstances. This is the reason why the language of the Linguists is different from the language of the medical or legal practitioners.

2.2 Brief history of language
Where and how language came from has been a debate amongst Linguists and language interested scholars. Manner theories have been postulated to account for the origin of language. Some which include:
The creationist theory: This theory also known as the divine source theory, claims that language was imbed into man when he was created by a supreme God.

The Bow-Wow theory: This theory claims that language emanated from the echoing of natural sounds which early men heard, thus associated such sounds with the objects thereof.

The interaction theory: which states that language developed as the early man began to interact with each other. They found a way to pass information to each other thereby communicated through language. Sir Richard Paget (1930) cited in Yule (1996) claims that language came into existence through sets of physical gestures which in turn led to the development of sets of oral gestures specifically involving the mouth.

Amongst all these theories which one way or the other seem to account for the origin of language, the creationist or divine source theory stands out vividly. This is because language itself was not once a man's product. That is, it did not originate from man; it was a product of the divine being, God which in creation transferred it to his creature man. Janson (2012:4) captured it this way: "God Himself is a speaker from the beginning. A God without a language would be a fool or an animal. Whoever is superior to man must master man's important faculty." The bible also accounts that God usually come down to communicate with man and that was after He, Himself had spoken the first known utterance ever recorded in history, "Let there be Light" (Genesis 1:3). Beyond communicating with God, man was able to name all the animals. This might also be another cruise of debate as the utterances were not recorded but a proof pointing to the fact that language was created alongside man was recorded when man made its first utterance when he saw his female counterpart, "This is the bone of my bone, the flesh of my flesh. She shall be called woman because she was taken out of man…" (Genesis 2:20). This

could be the reason while Jespersen claims that language emanated from the corridor of romance:
The genesis of language is not to be sought in prosaic, but in the poetic side of life; the source is not gloomy seriousness, but merry play and youthful hilarity. in primitive speech I hear the laughing cries of exaltation when lads and lassies vied with one another to attract the attention of the other sex, when everybody sang his merriest and danced his bravest to lure a pair of eyes to throw admiring glances in his direction. Language was born in the courting days of mankind. (Jespersen, 1921 in Yule, 1996:1)

The babel diversity of language is another instance that proves the fact of a divine source to language. A Claim to which Linguist have one way or the other in the bid to disregard it have validated it. Chomsky's claim of a universal grammar to which all lexicon are embed into a basket representative form to which humans select what suit their communicative pattern. The claim that humans would have been speaking one language if there are no parameters and different lexicons prove to the fact that there was a disordered nature of the lexicon of the human's language system which has led to the diversity witness in the world today. Janson accounts it thus:
All the fundamental features of spoken languages all over the world are the same. Each language has ways of denoting grammatical notions such as person (I, you, he), singular or plural, present or past time, more. Each language also has rules governing how the words are to be combined to form complete utterances. (Janson, 2012:4). Ndimele (oral communication) states that if there is anything like the babel experience, the claim by linguist is that God only changed the lexicon and parameters of the language which yielded the various languages in the world and even more that will emanate in the future. This is because there was only one language spoken during the time of the tower of babel's experience. The language spoken though not known, various suggestions (like Hebrew) have been postulated. Amongst these debates and arguments, all linguists and language interested scholars have agreed that spoken language has been in existence way before written language.

2.3.1 Indigenous Language Development in Children

The word Indigenous connotes own, native, local, home-grown, and original. Simply put, indigenous language means own language, native or local language. By way of definition indigenous language can be defined as the language spoken in a particular locality. It can be described as the language of a homeland spoken by natives of the homeland. It is seen as mother tongue or native language of a people. It is the language which identifies a people in a particular geographical area. As a language of the people, it compounds the entirety of the people, their culture, beliefs and life style. Through the indigenous language, one can identify the particular locality one hails from. It is the language owned and grown by the people from the people to the people. Just like other languages, it has a homeland and all other characteristics of a language whether or not it is only spoken or documented in written and/or other forms of documentation.

The development of Indigenous languages in children does not have any special rendition nor does it require any special skill or techniques. It follows same steps and stages as other languages like English, French and Arabic. Indigenous language enables children to communicate fluently across generations in their families and communities. Lay down the foundation for a coherent and positive cultural identity with links to the land, means by which they are able to speak their heritage language (Battiste, 2000; Norris, 2007, Ball, 2009). Speaking the ancestral language is also seen by some as important to a child's spiritual life (Canadian Heritage, 2005; Kirkness, 2002). But it is unfortunate that most children especially those grown in a multiplicity language environment do not learn their languages as first language. Indigenous children are increasingly less likely to learn their Indigenous language as a first language, if at all (Statistics Canada, 2006 in Ball, 2009): approximately 16% of Indigenous children under the age of 14 years speak an Indigenous language as a first. Often times in Nigeria, English or its contact developed part Pidgin now known as Nigerian Pidgin is the first that children learn.

2.3.2 Language Development in Children

The issue to this menace as mentioned above is not far-fetched. It sometimes results from the inconsistent exposure of indigenous language linguistic lexemes to the child during its language development stages which include:

Pre-grammatical Stage:
The pre-grammatical stage which consists of the cooing, babbling and echolalia stages, is the first

act of a child's language development. Prevalent in this stage is the child act of "crying" and sound play. At this stage all language lexicons exist in the child's mindset including the indigenous language. All of the sounds found in all languages are encompassed in children's first babbling. Gradually, babbling becomes more specific with native language syllables being consistently practiced. Before the end of their first year, children engage in pseudo-language, babbling that mimics the native language in its intonation and form.(Feeney, Christensen, and Moravcik, 2000; Driscoll, Nagel, 2008, http://www.education.com/reference/article/stages-language-development).
The language the child is exposed to at this stage matters a lot. This is because during this stage, the child begins to produce the words he or she hears or had heard during this stage.

Holophrases Stage:
The child starts producing single word or syllables that can stand for a variety of meaningful sentences or phrases in different situations. The child starts developing its own vocabulary especially from those within its immediate environment. This term to mean that the more exposure to indigenous language help the child to develop faster in that area. This helps the child to communicate better with family caregivers of same language.

Two-Word Sentences Stage
Two-word sentences appear between eighteen and twenty months of age and express ideas concerning relationships. The child at this point begins to develop its own grammar. It starts mastering especially the syntactic structure of the language spoken in its environment. At this stage, the child is able to follow the grammatical rules of the indigenous language although could miss it up at times.

Telegraphic Sentences stage
This stage of language witness sentences that are short and simple similar to a telegram. The child is able to produce simple indigenous sentences understandable by his immediate community.

Complete and Competence Stage
As language development proceeds, children join related sentences logically and express ideas concerning time and spatial relationships. They come to understand social expectations for language use and begin to use adult forms of language. Vocabularies expand rapidly, the ability to use words increases, and children intuitively acquire many of the rules of language. By age three children have vocabularies of nearly 1,000 words.

As children become more sophisticated in their language, they overgeneralize rules in ways that are inconsistent with common usage; for example, "I comed home" for "I came home" (sometimes called creative grammar). Correct forms are temporarily replaced as rules are internalized with the child adjusting to meet the standard in the language. With more practice and tutor, the child becomes an expert in the language. According to Ball (2009:1) "Language develops most rapidly from infancy throughout the preschool years". At this stage of a child's linguistic development, it is paramount for the parents and caregiver to communicate more with the indigenous language. Expose the child to words and sentences that are from the language. The child may want to shy away from it but the more exposure he gets, the better he learns to communicate with it. It could delay in most cases, the child may not be able to communicate fluently and he could even make mistakes, but will definitely pick up in later days or years. At this developmental stage, it is the child's best bet of acquiring the indigenous language and this is achievable mostly by more exposure to the language. This does not imply the entirety of difficulties though as there are other challenges that will want to hinder the developmental process of indigenous language process in the child.

2.4. Hindrances to Indigenous Language Development
There are various factors that are at headlock with the development of indigenous language during the child's early stages of language development. These include:

The Child's Linguistic Environment
The child's linguistic environment no doubt plays a major role in the child's language development stages. In fact, without the environment the child will not be able to communicate in anyway. Yes, the child has the "innate knowledge" to capture and produce language notwithstanding, it still relies on stimulus which the environment produces (Chomsky, 1981). The issue relating to the extent of production is not what we are after here. As Chomsky (1981) posits that the child produces more than what he hears, as factual as this is, the most important thing is that without the

environment to stimulate the child's language repertoire, the child will not even have anything to reproduce.

Although as important as the environment is to a child's linguistic development, it can pose a hindrance to indigenous language development. This happens in cases where the child's linguistic environment is multiplicity in nature as observed in urban areas. The child often times is exposed to other languages like English and Nigerian Pidgin at school, market places, amongst its pairs and friends to the indigenous languages which basically he hears at home. Sometimes, even at home which should be the foreground of the indigenous language, the child is hardly exposed to the indigenous language.

The Influence of English Language

The influence of English to our indigenous languages is on a high rate. It is not only a competitor; it seems not to have any outstanding rival. Its influence on our language is over bearing because of it status as the official language to be used in virtually all spheres of endeavor in Nigeria. According to the national language policy contained in sections 55 and 97 of the 1999 constitution as amended states that:

The business of the National Assembly shall be conducted in English and in Hausa, Yoruba, and Igbo when adequate arrangements have been made therefore.

The above by interpretation implies that the business of the Assembly will be conducted sorely with English and if need be as must be agreed, other languages like Hausa, Yoruba or Igbo will be used. This thereby places English as priority over any other language including our indigenous languages. Beyond the fact that it is an official language, it is used in virtually all places where communication exist in Nigeria: schools, markets, churches, media, and so on. According to Dada (2011:77): English is used in all and at all levels of official business: in education, in commerce and industry, in the dispensation of justice, in all government departments and parastatals at the state or federal level. Official records are kept in English and official information is given principally in English. Government activities are published in the gazette and transmitted in the mass media, the press, radio and television in English.

The influence of English is such that even this research work is written in it otherwise none will understand or even want to look at it. With such affluence, it is not miss-normal to state that a greater if not the greatest enemy in the development of indigenous language in children is English. At every given time, the child is exposed outside his first linguistic environment, the family to English linguistic data. In most cases, even in the family, the child is also been exposed to English more than the indigenous language spoken in the family.

Nigerian Pidgin

Nigerian Pidgin came as a contact language with English but over the years it has gathered momentum in the Nigerian Linguistics environment. It has not only developed as a creole but has at its disposal grammatical structures of its own. Pidgin has the largest number of speakers (Dada, 2011; Ayuwo, 2013). It is being understood by greater number of person especially in the grassroots levels who do not understand or speak English (Ayuwo, 2013).

Pidgin is also being used in almost all levels of communication and business. It is even used in the mass media; in fact, a Nigerian radio and television Wazobia FM and Wazobia Max TV respectively uses it for transmission of information and entertainment. Nigerian Pidgin has become a convenient means of lingua franca used to ease communication barriers. As it continuous to have wider spread, it poses a challenge to indigenous language development in children. Children term to pick languages considered to be easier in communication as they grow-a feat which Pidgin presents.

Multiplicity of Dialects

Nigeria no doubt is a multiplicity language nation with various scholars suggesting numbers of languages there exist. While others have suggested 200, 396, 395, 450, and 550 respectively (Bamgbose 1971 in Dada, 2011; Hoffman, 1974, Hansford, 1976, Blench and Dendo, 2003 in Omo-Ojugo, 2004), the recent 2005 ethnological Data listed 521 languages; out of these, 510 are living languages, 2 are second languages without mother tongue speakers and 9 are extinct (Dada, 2011). With such amount of languages existing in Nigeria, one can estimate over a million dialects in existence in Nigeria. This places difficulties in indigenous language development. In Ikwerre for instance where there are about 24 dialects in

existence, the problem of which dialect becomes the choice dialects to be developed as standard is still a bone of contention amongst Ikwerre language scholars with each scholar bidding to develop their various dialects. Presenting this difficulty but relating it to language, the internet journal, Fafunwa foundation asked the following questions:

1. How do people identify the language(s) of the immediate community in plurality settings like urban centres or international communities like universities?
2. Further on the choice of language (dialect), by whom and at what level is this choice one of the three languages (many dialects) to be made? By federal, State or Local Government? By Parents, the school or pupils?

By extension, the Linguists or Language Scholars?

As existing in Ikwerre, it is not farfetched with other languages with numerous dialects as Ikwerre. As it stands now, only Hausa, Yoruba and Igbo have grown to standardize a particular dialect even with so many dialects. Such feat has aided these languages to be able to achieve the exploit to which they enjoy.

Migration

Migration, the movement from one place to the other due to economic or comfort reason can hinder the indigenous language development in children. Often times these migrations are from the villages where these children should have learnt the indigenous languages to the urban cities where they are exposed to other languages. It could also occur as a result of sending the child to boarding schools during those early stages of language development.

The Family

The family can also be a tool to hinder indigenous language development in children. The family of course is the first linguistic environment of the child. Where the family hardly speaks the language as a means of communication, it becomes difficult for the child. The bilingual nature of the family can also pose a great challenge. This is a situation where the father is from a different linguistic terrain from the mother. At such situation, English or Pidgin becomes the means of communication.

The Media

"Radio, television (TV), movies, video games, cell phones, and computer networks have assumed central roles in our children's daily lives. The media has demonstrated potentially profound effects, both positive and negative, on children's cognitive, social, and behavioral development" (RAY and JAT, 2010:561). The above assertion summarizes the grip to which the media hold on children as they transcend into adults. It is proven that children spend more time on TV watching their favourite programs. Homes that have DSTV dishes do not help in reducing the time they spend watching cartoon and kiddies channels. As good and entertaining this may be, it is not helpful in the development of indigenous language in the child. The channels are all programmed using moistly English. The cartoon characters are named with English names, sing English songs and communicate in English. While no doubt it develops the child's English capabilities, it acts as danger to indigenous language development.

3.1 Media as a Tool to Indigenous Language Development

The media are seen as channels to which a large audience is reached. Channels through which a particular programme aired reach several persons simultaneously. Hasan (2013) refers the Media as any kind of format used to convey information. The media is divided into print and electronic media. This paper's attention is on the electronic media especially television which appeals more to the senses of the children especially that of the ears and the eyes. Television since its invention has been a veritable tool in information dissemination, entertainment and education. With its audio-visual combination, it captures the attention of viewers better than any other media. "The attraction of the visuality of the medium makes people glued to TV sets for hours" (Hasan, 2013:112). It captures our imagination that of children inclusive and is the most complete and dramatic mass media. This attribute helps it to ensure that children spend more time on it than any other.

4.1 Findings of Observation on Language Development

While there have been other effective roles of the media through television, the development of a child's indigenous language has not been studied by scholars. This to some might look absurd since television is not static in nature. A careful study of some children in Port Harcourt Metropolis reveals that television is a very good tool in a child's

language development. The participatory observation reveals that children not only watch but participate by acting, reacting, singing, and playing along with their favourite characters. They even after the programmes could name their characters, still sing these songs and even in most cases say exactly what they heard in the programme. The observation further reveals that the more children are exposed to these programs, the more they begin to pronounce correctly, consciously or unconsciously, the accurate words used. While this was majorly English programs, the observation reveals that children could also sing and respond to other languages if exposed to it.

This came to life when at the sound of a particular movie advert in ZeeWorld, an Indian Channel shown in Nigeria through DSTV dish, some of the children observed where able to sing along in Indian language used and were able to pronounce correctly the names of some of the actors and actresses in the movie. These they did consciously without missing a word or misplacing one for another. This shows that children are receptive to media content. Employing that attribute in children can facilitate the development of indigenous languages in the children.

4.2 Indigenous Programming

The media should create programs that are more local content than foreign. Creating programs with the characters that can appeal to children's imagination using the indigenous languages. Cartoon programs and all various kinds of kiddies programming on TVs should be produced with the indigenous languages. It is a fact that the multiplicity of the indigenous languages or dialects could create a difficulty but the media could dedicate a particular period to show a programme appealing to the children in various languages as obtained in the society where it is located. By this cautious act, the children will be able to watch, act, react, sing and play along with their various characters, actors or actresses in the programme or programs. With this continuous act, the child's repertoire towards language is developed. Notwithstanding though, the media still has some shortcomings since it is a transcending medium. This way, the media will be able to force the caregiver or parents in not only monitoring the child's indigenous language development, they will assist the child in cases where he pronounces a word wrongly. This will give the child the confidence to develop faster and better in the language.

5.1 Conclusion

The paper presents that a child's indigenous language development is not sorely on the family and environment but the media inclusive. The media has a great effect on children. Keeping them entertained, informed and educated as such can also aid in the child's language development especially the indigenous language. Various kiddies show on our television sets have been anchored and packaged with and/or in English, thus, becoming a catalyst to killing indigenous language development. A change to this menace makes the media a positive agent to a child's indigenous language development. By restructuring its programs for children to suit the indigenous language, that is, using indigenous languages in packaging kiddies programs and with content airing, the child with its receptiveness will tend to play along with the characters, speak the language they speak and thus its language been developed.

Through the media, right pronunciations can be learnt; right structure and meaning too can be taught with the caregiver becoming more of a secondary agent. The paper recommends that more programs for kids using the indigenous languages should be produced as there are only few, if not none in existence. It also recommends that the government should create free to air television stations sorely for children and such stations should package children related programs in the indigenous languages. The paper encourages community television stations but should include kids programming too. That way, the indigenous language of that community will be used which will aid in the child's indigenous language development. As a matter of urgency, languages where there are clashes of dialect, the paper recommends that linguistic and language scholars should harmonized to standardize a particular dialect for easy communication while in same vein developing the other dialects. If this is done, it will facilitate the development of the indigenous language through the media which will concentrate their programs on the use of agreed standardized dialect. While this yet to be, the media should focus in encouraging and package programs meant for kids using the indigenous language in its environment in Port Harcourt Metropolis and other urban or local areas.

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THE IMPACT OF GREEN COMPUTING FOR A SUSTAINABLE ENVIRONMENT IN NIGERIA

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Abstract
With growing awareness about the environmental impact of computing, green computing is gaining increasing importance. With rising energy consumption, global warming, and e-waste, the idea of green computing is widely taken into consideration by both government agencies and private organizations, as their contribution to sustainable development. Green computing refers to the practice of environmentally responsible and efficient use of computing resources while maintaining economic viability and improving their performance in an eco-friendly way. The aim of this paper is to examine the impact of green computing on the Nigerian environment and to suggest applicable strategies for sustainable environment. The method adopted for this study is desktop survey of literatures. Survey results indicate that Nigeria has a large population and is facing a number of environmental issues including climate change and air pollution. Findings show that green computing is an emerging technology that has the potential to reduce the environmental impact of computing by making it more energy efficient and reducing the amount of waste generated. The impact of green computing in Nigeria can be significant, given the country's environmental challenges and the increasing adoption of technology. One of the major environmental challenges in Nigeria is electronic waste (e-waste) generated from the disposal of computers, mobile phones, and other electronic devices. Green computing can help reduce e-waste in Nigeria by promoting the practice of reuse and recycling of electronic devices. One key benefit that green computing offers to Nigeria is the potential to cut down on energy consumption and greenhouse gas emissions. The paper recommends that adoption of green computing as an adaptation strategy to combat climate change

Keywords: Green Computing, Information Technology, Sustainable Environment, e-waste recycling

1.0 INTRODUCTION

1.1 Background of the study

Green computing," or green IT," is the practice of environmentally sustainable computing or information technology. It originated from IBM's mainframe operating systems in the 1960s and was commercialized for x86-compatible computers and other computer systems. In 1992, when the EPA created its Energy Star program. The program was launched to reduce the use of hazardous materials, maximize energy efficiency, increase recyclability and biodegradability, and reduce the environmental impact of IT operations. The idea behind green computing is to minimize the negative impact of electronic waste and reduce the energy consumption of electronic devices.

In early 2000s, there was a growing concern of the environmental impact of electronics industry, which was producing a large amount of electronic waste. This led to the development of e-waste recycling programs and the establishment of standards for the recycling of electronic devices. In the mid-2000s, there was a growing focus on energy efficiency in electronic devices. This led to the development of more energy-efficient processors, graphics cards, and other components. Energy-efficient devices consume less power and produce less heat, which can reduce the need for cooling systems and other energy-intensive components.

In the late 2000s and early 2010s, there was a growing interest in cloud computing and virtualization. Cloud computing allows multiple users to access and use computing resources over the internet, which can reduce the need for physical hardware and reduce energy consumption. Virtualization allows multiple operating systems and applications to run on a single physical server, which can reduce the need for physical servers and reduce energy consumption.

In recent years, there has been a growing focus on the circular economy in the electronics industry. The circular economy is an economic system that aims to keep resources in use for as long as possible, extract the maximum value from them, and then recover and regenerate products and materials at the end of their service life. This approach can help reduce electronic waste and promote the use of more sustainable materials.

Green computing has come a long way since its inception in the 1990s. Today, there are many initiatives and standards in place to promote energy efficiency, reduce electronic waste, and promote sustainable computing practices.

In the early 2000s, there was a growing concern in Nigeria about the environmental impact of electronic waste. This led to the establishment of e-waste recycling programs and standards for the recycling of electronic devices.

As Nigeria faces growing environmental and social challenges related to the use of electronic devices and the generation of electronic waste. This paper is therefore aimed at exploring the potential of green computing as a strategy for the sustainable management of electronic waste and adaptation to climate change.

2.0 LITERATURE REVIEW

2.1 Concept of green IT/Computing

Green computing refers to environmentally sustainable computing. Dr. San Murugesan a Senior Consultant defines the field of green computing as "the study and practice of designing, manufacturing, using, and disposing of computers, servers, and associated subsystems, such as monitors, printers, storage devices, and networking and communications systems efficiently and effectively with minimal or no impact on the environment."

The goals of green computing are similar to green chemistry; reduce the use of hazardous materials, maximize energy efficiency during the product's lifetime, and promote the recyclability or biodegradability of defunct products and factory waste. Research continues into key areas such as making the use of computers as energy-efficient as possible, and designing algorithms and systems for efficiency-related computer technologies.

One of the highly cited work that consolidated the concept of Green IT is (Murugesan 2008). The author has proposed four domains of Green IT which are green use, green design, green manufacturing and green disposal of IT Systems.

Green use focuses on reducing the energy consumption associated with the computer and other information systems and use them in an environmentally sound manner. Green disposal is all about repairing and recycling computers and electronic equipment that might be old or unwanted. Green design concern about designing energy efficient equipment, computers, servers and cooling equipment. Green manufacturing is trying to find out the way of manufacturing electronic machineries, computers and other associate subsystems with minimal impact on environment or even having no impact on environment (Murugesan 2008). According to Murugesan (2008), green IT can be recognized as a synonym to environmentally sound Information Technology. Information Technology is essentially the design, implementation and management of computers that comprises both individuals and industry level. Green IT includes multiple aspects like environmental sustainability, energy efficiency economics, cost of disposal/recycling etc. The green technological innovation is the key to the sustainable development.

In response to these challenges, the term "green information technology" (IT)' has been coined with reference to initiatives that are focused on reshaping IT into environmentally friendly forms (Chetty et al. 2009; Chetty et al. 2008; Huang 2009; Melville 2010). Green IT promotes the design, manufacture, and management of IT equipment and services that consume minimal energy throughout the entire lifecycle of IT products (Murugesan 2008). Therefore, it can be argued that "green IT refers to the use of IT resources in an energy-efficient and cost-effective manner (Nishant et al. 2012).

Green IT can be considered an optimal use of information and communication technology to manage enterprise activities in an environmentally sustainable manner, including its products, services, and resources throughout their life cycle. Eastwood (2009) gives an ample definition of "green IT": "Green IT is a collection of strategic and tactical initiatives that directly reduce the carbon footprint of an organization's computing operation". The primary goal behind the green IT strategy is to reduce energy consumption, maintain operating costs, and manage the continuously increasing requirements for performance and capacity of resources. Trimi and Park (2013) argue that green IT aims to save energy and reduce carbon emissions in order to create an environmentally-friendly IT itself, which is 'greening the IT', as well as using IT to reduce environmental impacts across the economy, which is 'greening by IT'. Nanath and Pillai (2012b) also agree with the statement, as they claim that there

are direct and indirect effects of green IT. The direct effect occurs by reducing the environmental impact of computers and IT. Indirect by using IT to support the business initiatives promoting sustainability. However, it is worth mentioning that there are two sides of Green IT. Firstly, IT can be the cause of environmental problems, and alternatively IT/IS can be used to solve environmental issues (Nanath and Pillai 2012b).

To discuss Green IS, Butler (2011) claims that through Green IS can guide organizations to handle toxic and hazardous materials and e-waste, design products in green manner, re-design business processes to be more environmentally friendly, and most importantly manage energy consuming facilities. According to Molla (2008) Green IT is a nascent field and there are few academic researches on the topic. Jenkin et al. (2011) also agreed with this opinion. Scholars have suggested that practitioners have begun the journey of focusing on "Green IT" and there is little research in this field (Jenkin et al. 2011; Molla 2009).

2.2 Environmental impact of Information and Communication Technology in Nigeria.

We live in an era of Information Technology (IT) where computers, data centers, servers, internet and other machineries play an important role in the industrial sector. IT assists organizations to be smart, increase profitability and operate efficiently and effectively to help sustain in the competitive global market. However, the high usage of technology results in several issues, such as extreme power consumption. Technology has undoubtedly translated into a medium for destruction of our environment. (Tanya, 2022). Technology has expanded the carbon footprint that has a detrimental effect on the environment (Forrest et al. 2008;). These issues induce a demand for environmental sustainability concerns owing to global societal concerns about energy usage, climate change, and the consequences there of. These concerns are very germane to the IT sectors as high the usage of technology does contribute to the increase of greenhouse gas emissions (Ruth 2009).

Computing in Nigeria is observed to have developed over the years. An upsurge in IT utilization occurred around the early 2000s when global satellite for mobile communication (GSM) phones were introduced to the Nigerian populace. Subsequently, utilizations of IT products and services have increased with the increase in IT innovations. However, an ugly dimension is the importation of outdated or out-of-trend environmentally unfriendly computing products into the country. Malakata asserted that West Africa (of which Nigeria is a part) has become a landing point for old computers, mobile devices and components and that Ghana, Benin, Ivory Coast, Nigeria and Liberia are said to be among the hardest-hit countries in this e-waste menace. To keep up with developments in the IT world, Nigerians, especially the youths embrace novel technologies that are made available to them. However, due to their low purchasing power these youths usually buy devices that may not be considered to be of measurable global standard. Furthermore, out-of-life or unused electronic devices are observed not to be usually retrieved for re-use or recycle in the country. The implication of this trend is the increasing amount of e-waste generated in the country annually.

2.3 Green computing Policy Implementation in Different Countries

Green computing policies have been implemented in many countries around the world to promote the sustainable use of computing resources and reduce the environmental impact of information and communication technology (ICT) systems. Here are some examples of green computing policy implementation in different countries:

I. **United States**: The United States has implemented a number of policies aimed at promoting green computing, including the Energy Star program, which provides energy efficiency guidelines for electronic products, and the Federal Computer Acquisition Regulation (FAR), which requires federal agencies to consider environmental factors when purchasing IT products.

II. **European Union**: The European Union has implemented a number of policies aimed at promoting sustainable ICT, including the EU Code of Conduct for Data Centers, which sets standards for energy efficiency and environmental sustainability in data Centers, and the EU Green Public Procurement (GPP) directive, which requires public sector organizations to consider environmental factors when purchasing IT products.

III. **Japan: Japan** has also implemented a number of policies aimed at promoting green computing, including the Green IT

Action Plan, which sets targets for reducing the environmental impact of ICT systems, and the Japan Green Information Technology Promotion Council, which promotes the adoption of green ICT practices.

IV. **China**: China has equally implemented a number of policies aimed at promoting sustainable ICT, including the Green ICT Development Plan, which sets targets for reducing the environmental impact of ICT systems, and the China National Green Informationization Development Strategy, which promotes the adoption of green ICT practices.

V. **India**: India has implemented a number of policies aimed at promoting sustainable ICT, including the National Policy on Electronics, which sets targets for reducing the environmental impact of ICT systems, and the National Green Tribunal, which provides a forum for addressing environmental issues related to ICT systems.

VI. Green computing policies have been implemented in many other countries around the world to promote sustainable ICT practices and reduce the environmental impact of computing systems. These policies take a range of forms, including regulations, standards, and incentives, and can help to promote the adoption of sustainable ICT practices and technologies.

3.0 APPLICABLE STRATEGIES FOR PROMOTING GREEN COMPUTING

3.1 key points about IT in Nigeria

Information technology (IT) has played a significant role in the development of Nigeria's economy and society. Here are some key points about IT in Nigeria: The IT industry in Nigeria has grown rapidly in recent years, driven by the increasing demand for technology services and products. Nigeria has a large and skilled workforce, which has helped to attract foreign investment and spur the growth of the IT industry. Nigeria government is also encouraging partnerships between local and foreign ICT companies to diversify the economy. Despite challenges, many tech start-ups are emerging, and companies are focusing on supporting young talent in the tech space. The Nigeria Startup Act, 2022 provides a legal and institutional framework for startups in Nigeria, addressing issues of capital, regulations, infrastructure, and talent. The Act establishes the National Council for Digital Innovation and Entrepreneurship, responsible for setting policy guidelines, monitoring program implementation, and providing support for postgraduate research in science, technology, and innovation. Key provisions include reforming legal and regulatory bottlenecks that have held back startups and establishing a Startup Support and Engagement Portal to provide access to funding programs, government contracts, and training programs.

Moreover, in partnership with other countries, Nigeria is facilitating the growth of tech startups through various initiatives. One of such program was designed to support 50 tech startups in two pilot countries, Nigeria and Kenya. Overall, IT has played a significant role in the development of Nigeria's economy and society. While there are still many challenges facing the industry, there is also significant potential for growth and innovation in the years ahead.

3.2 Key Strategies for promoting Green Computing in Nigeria

Green computing is becoming increasingly important in Nigeria as the country faces growing environmental and social challenges related to the use of electronic devices and the generation of electronic waste. Here are some strategies that can be used to promote green computing in Nigeria.

1. **Establish e-waste recycling programs**: One important strategy for promoting green computing in Nigeria is to establish e-waste recycling programs. This can be achieved by promoting the responsible disposal of electronic devices and the collection and recycling of electronic waste. (Ojo, et al., 2019; Abdullah, et al. 2020) have also advocated for this
2. **Encourage the use of energy-efficient technologies**: One of the most effective ways to promote green computing in Nigeria is to encourage the use of energy-efficient technologies. This can be achieved by promoting the use of energy-efficient processors, graphics cards, and other components, as well as by encouraging the adoption of energy-efficient power management practices.
3. **Promote the use of open-source software**: Open-source software is often more energy-efficient and

environmentally friendly than proprietary software, as it requires fewer resources to operate. Promoting the use of open-source software in Nigeria can help to reduce the environmental impact of computing.

4. **Encourage the adoption of cloud computing:** Cloud computing can be a more sustainable and energy-efficient option than traditional computing, as it allows for the efficient use of computing resources. Encouraging the adoption of cloud computing in Nigeria can help to promote green computing practices.
5. **Green disposal**: Re-purposing an existing computer or appropriately disposing of, or recycling, developing end of life for unwanted electronic equipment measures during and after the sale to ensure that their products are sold and then collected, deposited or recycled so as to reduce their impact on the environment.
6. **Green design:** Designing energy-efficient computers, servers, printers, projectors and other digital devices
7. **Green manufacturing:** Minimizing waste during the manufacturing of computers and other subsystems to reduce the environmental impact of these activities Government regulatory authorities should also actively work to promote green computing concepts by introducing several voluntary programs and regulations for their enforcement. At a macro level, as the Eco trends are sweeping across the globe.

The European Union, for example, has established guidelines for a computers' end of life (EOL) making manufacturers responsible for the implementation of e European Union, during and after the sale to ensure that their products are sold and then collected, deposited or recycled so as to reduce their impact on the environment. Europe's strong stance on the environment has strong support from its newest member states in Eastern and Central Europe. These transitioning economies are in the process of transferring legislation and incorporating EU policies. Nigeria has developed a National Strategy for Sustainable Development for 2013–2020–2030, which sets out the following priorities: climate change and clean energy; sustainable consumption and waste management; and conservation and management of natural resources. However, there is still a gap between legislation and practice. Particularly in the reduction of electronic waste, Nigeria still needs to set up the infrastructure to facilitate these directives that closely mirror those established by the EU.

However, according to the Environmental Performance Index 2022, Nigeria is ranked 168 out of 180 countries. The country scored 28.32 out of 100 on 'environment and sustainability' and is also ranked 41st out of 46 countries in sub-Saharan Africa. Nigeria is among the poorest-performing nations in the world on environmental health, struggling to protect its population from environmental risks such as poor air quality, sanitation and drinking water, heavy metals, and waste management. Additionally, Nigeria is the 53rd most climate-vulnerable country globally but is the sixth least-ready country in the world to adapt to climate change (Amara, 2014). Promoting green computing in Nigeria will require a combination of policy, technical, and behavioral approaches. By adopting these strategies, Nigeria can reduce the environmental impact of computing and promote sustainable development.

Potential Impact of Green Computing in Nigeria

Nigeria ranks poorly in the Environmental Performance Index due to serious environmental health risks caused by pollution. Therefore, the implementation of green computing practices should be done with caution to avoid potential negative impacts. Nevertheless, the positive effects of green computing far outweigh the negative impacts. The Nigerian government has recognized the importance of promoting startups through the Nigeria Startup Act, which could help drive innovation and adoption of green computing practices. It is essential for Nigerian governments and private organizations to continue implementing green computing policies to promote sustainability and reduce the environmental impact of their operations.

However, Green computing has the potential to have a significant impact in Nigeria in a number of ways. Some of the potential impacts of green computing in Nigeria include:

1. **Energy savings**: Green computing practices, such as the use of energy-efficient technologies and the implementation of power management strategies, can help to reduce energy consumption and save costs associated with energy use.

2. **Reduced carbon emissions**: Green computing can help to reduce the carbon emissions associated with ICT systems, which can contribute to reducing greenhouse gas emissions and mitigating the impacts of climate change.
3. **Improved air quality**: The use of energy-efficient technologies and the implementation of power management strategies can help to reduce air pollution associated with the use of ICT systems.
4. **Job creation**: The implementation of green computing practices can create new jobs in areas such as energy efficiency engineering, sustainable ICT design, and green IT consulting.
5. **Improved sustainability**: green computing practices can help to improve the sustainability of ICT systems and contribute to the development of a more sustainable economy.

Benefits of Green IT/Computing

To sum up: "manufacturing and purchasing of energy efficient IT infrastructure, the efficient operation and utilization of computing devices as well as its proper disposal i.e., green manufacturing, use and disposal are the efforts that lead to economic and ecological benefits" (Gupta, 2013, p. 4). Two major benefits of Green IT implementation have been identified that are related to operating cost and the environment. In discussing green computing benefits, Brooks et al. (2012) has said that "here are two major categories of benefits: environmental benefits and cost reduction benefits." Murugesan (2008) has identified the three drivers of Green IT as economical, regulatory and ethical. Bose and Luo (2011) also say "the three primary drivers of Green IT initiatives according to the literature are: (1) reducing costs due to budget cuts, (2) reducing consumption due to resource restrictions, and (3) complying with the local law." Therefore, it is evident that green computing aims at cost reduction as well as environmental protection.

Green Benefits of Computer Recycling

Info-Tech Research Group (2009) has described the green benefits of computer recycling as follows

I. E-recycling development program safe the environment from polluting the landfill with e-waste.
II. Through recycling program, thee-waste is decreased
III. Recycling of old computers also benefits in term of storage space because companies running out of space to keep old computers
IV. Through proper recycling, companies get back to customer with the good reputation that they are not ending the end-of-life in land fill

Challenges Facing Green Computing Implementation in Nigeria

Green computing is becoming increasingly important in Nigeria, but there are a number of challenges that need to be addressed in order to effectively implement green computing practices. Some of the challenges facing green computing implementation in Nigeria include:

1. **Lack of awareness**: Many people in Nigeria are not aware of the benefits of green computing or the steps that can be taken to reduce the environmental impact of ICT systems.
2. **Limited resources**: Green computing practices often require investment in new technologies and infrastructure, which can be a challenge in Nigeria due to limited financial resources.
3. **Inadequate policies** and regulations: While there are some policies and regulations in place to promote sustainable ICT practices in Nigeria, they are often not effectively enforced, which can hinder the implementation of green computing.
4. **Limited access to electricity**: Many people in Nigeria do not have access to reliable electricity, which can make it difficult to implement energy-efficient technologies and implement power management strategies.
5. **Lack of skills and expertise**: There is a shortage of skilled professionals in areas such as energy efficiency engineering and sustainable ICT design, which can make it difficult to effectively implement green computing practices in Nigeria.

Overall, the challenges facing green computing implementation in Nigeria are significant, but addressing these challenges is essential for promoting sustainable development and reducing the environmental impact of ICT systems in the country.

Possible Solutions and Initiatives That Can Be Undertaken by Stakeholders in The Sector

There are several possible solutions and initiatives that can be undertaken by stakeholders in the ICT sector to promote sustainable development and reduce the environmental impact of ICT systems in Nigeria. Some of these solutions and initiatives include:

1. **Increase awareness**: Stakeholders in the ICT sector can increase awareness of the benefits of green computing and the steps that can be taken to reduce the environmental impact of ICT systems. This can be done through education and training programs, public awareness campaigns, and other initiatives.
2. **Implement green ICT policies and regulations**: The government can implement policies and regulations that promote sustainable ICT practices, such as energy efficiency standards, waste reduction requirements, and sustainable procurement policies.
3. **Promote the use of renewable energy**: Stakeholders in the ICT sector can promote the use of renewable energy sources, such as solar and wind power, to power ICT systems. This can be done through incentives and subsidies for renewable energy technologies, and through partnerships with renewable energy companies.
4. **Implement energy-efficient technologies**: Stakeholders in the ICT sector can implement energy-efficient technologies, such as servers, data centers, and network devices, to reduce energy consumption and costs associated with ICT systems.
5. **Implement power management strategies**: Stakeholders in the ICT sector can implement power management strategies, such as turning off equipment when not in use, to reduce energy consumption and costs associated with ICT systems.
6. **Promote the use of sustainable ICT products**: Stakeholders in the ICT sector can promote the use of sustainable ICT products, such as those made from recycled materials or with reduced environmental impact, to reduce the environmental impact of ICT systems.

There are a number of possible solutions and initiatives that can be undertaken by stakeholders in the ICT sector to promote sustainable development and reduce the environmental impact of ICT systems in Nigeria.

Conclusion

In conclusion, the impact of green computing in Nigeria can be significant in promoting sustainable practices in the use and disposal of electronic devices, reducing energy consumption and greenhouse gas emissions, and promoting the adoption of renewable energy sources. Government regulation, no matter how well-intentioned is only a fraction of an overall green computing philosophy. Everybody within the information technology atmosphere in Nigeria is a stakeholder in the IT eco-sustainability project. It is concluded that green computing has the potential to significantly contribute to the advancement of environmental sustainability in Nigeria. The challenges faced by the country are significant, but with the adoption of the all-inclusive strategies outlined in this paper, which if carried out is expected to improve green computing practice in Nigeria. We must therefore, individually and collectively take up the responsibility in ensuring a greener environment for ourselves and the succeeding generations. Furthermore, it is important that the identified gaps in the literature can encourage and contribute to perform new work.

Finally, capacity-building initiatives are needed to equip citizens with the necessary skills to promote and use green computing technologies.

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AN EVALUATION OF THE ENVIRONMENTAL REMEDIATION FUND UNDER THE PETROLEUM INDUSTRY ACT 2021

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Abstract
Globally, one fundamental effect of petroleum operations is its negative impacts on the environment. The environment and its potentials to sustain life are continually depleted, degraded or destroyed, hence the imperative for remediation of the environment exposed to such devastating consequences. Factually, different remediation efforts in Nigeria to properly safeguard the environment and protect human health, for one reason or the other, have not yielded the desired results, over the years. Consequently, one latest effort in Nigeria, which is aimed at alleviating the problem of environmental pollution and degradation, is the provision of what is called the Environmental Remediation Fund (ERF) under the Petroleum Industry Act 2021. This paper evaluated the content, scope and modalities for the application of the ERF. The finding of the study shows that, though the law on this issue is of good intention and that sufficient provision is made for contribution to the fund and how same can be deployed. However, insufficient attention is given to the issue of remediation monitoring, either before, during and after the implementation process in a holistic format. The study advocates for a more comprehensive legal framework that would involve stakeholders from both the ministries of Environment and Petroleum Resources to ensure proper implementation of the relevant laws.

Keywords: Petroleum Operations; Environmental protection; Remediation Fund; Petroleum Industry Act; Nigeria.

1.0 INTRODUCTION

It is true that petroleum has been the most important energy resource and a raw material of the chemical industry since the 1950s.[1] Nevertheless, oil spills during Petroleum exploration and exploitation, transportation, and refining, undoubtedly, have the propensity to cause some fundamental problems to the environment,[2] hence the imperative for a comprehensive environmental remediation. Environmental remediation refers to the systematic mechanisms for reducing pollution exposure, for example, from contaminated soil, groundwater or surface water. The purpose is more than just eliminating pollution sources; it is about protecting people and the environment against potential harmful effects from exposure to petroleum industry pollution in Nigeria.[3] Therefore, international best practice requires that environmental remediation goes along side with petroleum activities.

The Niger Delta, where the bulk of Nigerian petroleum is being mined, has suffered a great deal of environmental pollution and degradation since 1956 when Petroleum was discovered in commercial quantities at Oloibiri. It has been reported that it may take more than 200 years to properly remediate the environmental pollution that Petroleum activities have caused in the Niger Delta region in Nigeria.[4] On 16th August 2021 when former President Muhammadu Buhari assented to the Petroleum Industry Act (PIA), the Act came with a new innovation called the Environmental Remediation Fund (ERF). The ERF is aimed at taking care of the issue of environmental remediation as far as the Petroleum Industry is concerned in Nigeria. This paper carried out a textual evaluation of this Fund as provided under the PIA and the relevant

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1https://pei.org/wiki_pei/petroleum/#:~:text=Due%20to%20its%20high%20energy,energy%20since%20the%20mid%2D1950s. (<accessed on 20 February 2023>).

2Visit:https://www.google.com/url?sa=t&source=web&rct=j&opi=89978449&url=https://wwf.panda.org/discover/knowledge_hub/teacher_resources/webfieldtrips/climate_change/petroleum/%23:~:text%3DAs%2520a%2520fossil%2520fuel%252C%2520its,role%2520in%2520moderating%2520global%2520temperatures.&ved=2ahUKEwj24ObohIqAAxXtSUEAHZ84DhcQFnoECA8QBQ&usg=AOvVaw29inTjeeEb9c1QOx6ZlS79 (<accessed on 23rd February 2023>).

3 https://www.aziza.com.ng/environmental-remediation/)

4ibid.

regulations made pursuant to the PIA in that behalf.

1. Objectives of the study

This study acknowledges the all-pervasive importance of the oil and gas industry in the Nigerian economy and its overall impacts on the environment. Therefore, this research is an anatomy of the law relating to environmental remediation in the oil and gas industry in Nigeria. Thus, the study is aimed at carrying out a textual evaluation of the current legal regime with respect to environmental remediation in the petroleum sector in Nigeria, with particular reference to the environmental remediation fund established under the PIA 2021 and other relevant regulations made pursuant to the PIA. This is with a view to determining the adequacy or otherwise of the regulatory provisions needed to combat the subsisting issues of negative environmental impacts arising from petroleum operations in Nigeria and to proffer some solutions where some gaps or loopholes are detected in the existing legal framework.

2.0 METHODOLOGY OF THE STUDY

Legal research involves the systematic examination of problems relating to law within an appropriate methodological framework.[5]There are essentially two major legal research approaches with respect to legal research methodology, namely doctrinal research and non-doctrinal research. A doctrinal research refers to a research that has been carried out on a legal proposition or propositions by way of analysing the existing statutory provisions and cases by applying the reasoning power.[6] Thus, "doctrinal legal research endeavours to develop theories, and non-doctrinal legal research endeavours to see as to whether the theories, the doctrines, that we have assumed are appropriate to apply in society at a given time, are still valid and relevant."[7] Doctrinal research is normally a two part process which involves locating the sources of the law and then interpreting and analysing the text. It is the doctrinal method that is being employed in this study.

2.1 Legal framework

The current legal framework for environmental remediation in Nigeria is centered on the Petroleum Industry Act 2021; the Upstream Environmental Remediation Fund Regulations (UERFRs) 2022[8] and the Midstream and Downstream Environmental Remediation Fund Regulations (MDERFR) 2023. While the Nigerian Midstream and Downstream Petroleum Regulatory Authority (the "Authority") released the MDERFR 2023 and had it gazzetted on 19th June 2023, the UERFR was released by the Nigerian Upstream Petroleum Regulatory Commission (NUPRC). These Regulations apply to the environmental remediation fund established under section 103 of the PIA.[9]

2.2 Nature of the obligation to remediate: Environmental Management Plan (EMP)

Under the current Petroleum legal regime in Nigeria, an environmental management plan (EMP) is required for both upstream and midstream petroleum operations in the country.[10] However, in terms of administrative control, while the NUPRC ("the Commission") is statutorily charged with the regulation of upstream petroleum operations, including remediation activities in the sector, the NMDPRA, otherwise simply referred to as the Authority, on the other hand, is saddled with the responsibility to regulate downstream and midstream petroleum operations in Nigeria, including remediation operations in this sector. Specifically, section 102 (1) of the PIA stipulates that every licensee or leasee who engages in upstream and midstream petroleum operations shall within one year of the effective date[11]; or six months after the grant of the applicable licence or lessee, submit for approval an EMP in respect of projects which require environmental impact assessment to the Commission or Authority, as the case may be.[12] The said EMP shall be in accordance with the provisions of the relevant

5 A. Kharel, 2018. 'Doctrinal Legal Research', (*Research Gate*, January 2018 DOI: 10.2139/ssrn.3130525), (https://www.researchgate.net/publication/323762486, accessed on 25 July 2019)

6 S.R. Myneni, 2006. *Legal Research Methodology*. India: Allahabad Law Agency, referred to in fn. 14 above.

7 K. Vibhute& F. Aynalem, 2009. 'Legal Research Methods', *Teaching Material*, Justice and Legal System Research Institute, Ethiopia, 70 (2009).

8 It is still a Draft.

9 Reg.1(1) of the UERFRs.

10 s.102 (1) of the PIA.

11 s.102 (1) (a) ibid.

12 s.102 (1) (b) ibid.

regulations made under the PIA.[13] Accordingly, the two key regulations in that behalf are considered in this paper, that is, the Upstream Environmental Remediation Fund Regulations (UERFRs) and the Midstream and Downstream Environmental Remediation Fund Regulation 2023 (MDERFR). They are part and parcel of the legal framework for remediation activities in the Petroleum industry, in addition to the PIA.

2.3 Conditions for the approval of an EMP.

The Commission or Authority, as the case may be, shall approve the EMP upon the satisfaction of two conditions, that is, where - (a) it complies with subsection (2) of section 102 to the effect that it (EMP) is in accordance with the regulations made pursuant to the PIA; and (b) the applicant has the capacity or has provided for the capacity to rehabilitate and manage negative impacts on the environment.[14] The Commission or Authority, as the case may be, shall in considering the worthiness of the EMP, take into account the policy thrust of the Government regarding environmental protection and management practices.[15] However, the Commission or Authority, as the case may be, may request for additional information from the licensee or lessee and may direct that the EMP be adjusted in a manner the Commission or Authority may require.[16] The Commission or Authority, as the case may be, may after its approval of an EMP and after engagement with the operator of a licence or lease, call for an amendment of the EMP.[17] For instance, the PIA expressly stipulates that chemicals shall not be utilised for upstream petroleum operations, except the Commission grants an applicable permit and approval.[18]

One key function or requirement of the EMP, as hinted above, is to enable the applicant show that he has the capacity to rehabilitate and manage negative impacts on the environment. This invariably means that the primary duty of rehabilitating the negative impacts[19] of petroleum activities on the environment is solely imposed on the licensee or lessor, as the case may be.[20] This responsibility is to be discharged by way of the application of the remediation fund.

3.0 CATEGORISATION OF AREAS FOR PETROLEUM OPERATIONS

According to section 318 of the PIA, "petroleum operations" means upstream, midstream and downstream petroleum operations. For instance, for purposes of the UERFRs 2022, upstream petroleum operations under each licence or a lease, shall fall under one of the following categories of areas where operations are located[21] —

(a) *Onshore High-Risk Area*:

These are areas which include any of the following: (i) mangrove areas; (ii) wetland and swamp areas; (iii) a zone of 500 metres along any river and lake; (iv) such other areas as the Ministry of Environment may determine as high-risk.[22]

(b) *Shallow Water High-Risk Areas:*

These are areas described as being: (i) a zone of 10 km seawards of a high-water mark; (ii) such other shallow water areas as the Ministry of Environment may determine as high risk.[23]

(c) *Other Onshore Area*, being the part of Nigeria that is defined as onshore and frontier acreages in the PIA, other than Onshore High-Risk Areas.

(d) *Other Shallow Water Area*, being the part of Nigeria that is defined as shallow water in the PIA, other than Shallow Water High-Risk Areas.

(e) *Deep Water Area*, being the part of Nigeria that is defined as deep offshore in the PIA. That is to say, “deep offshore” means any area within the territorial waters, continental shelf or exclusive economic zone offshore of Nigeria having a water depth in excess of 200 meters.[24]

It is worthy of note that the category, under which a petroleum prospecting licence or a lease shall fall under pursuant to the above subsection (2) of this section, shall be confirmed in a written notice by the Commission prior to the first payment of the financial contribution. Where:

(a) all or part of a petroleum prospecting licence or lease is situated in an area that is considered an Onshore High-Risk Area, the entire licence or lease shall be

13 s.102 (2) ibid.
14 s.102 (3) ibid.
15 s.102 (4) ibid.
16 s.102 (5) ibid.
17 s.102 (6) ibid.
18 s.102 (7) ibid.
19 Note that whilst the entitlement of the Authority to the Fund upon a licensee’s default is well pronounced, the specific meaning of “negative environmental impacts” (which will serve as a qualifying reference for a licensee default) was not provided in the Regulation. The Authority may consider providing a definition, or a guide for determining what constitutes “negative environmental impacts” for regulatory precision.
20 Reg. 2(2) of the MDERFR 2023.
21 Reg. 3 (2) of the UERFRs.
22 Reg. 3 (1) (a) ibid.
23s. 318 of the PIA
24Ibid.

considered as being located in an Onshore High-Risk Area,

(b) all or part of a petroleum prospecting licence or lease is situated in a shallow water area that is considered a Shallow Water High Risk Area, the entire licence or lease shall be considered as being located in a Shallow Water High-Risk Area,

(c) all or part of a petroleum prospecting licence or lease is situated onshore and part in shallow water, the entire licence or lease shall be considered onshore, and

(d) all or part of a petroleum prospecting licence or lease is situated in shallow water and part in deep offshore, the entire licence or lease shall be considered shallow water.

4.0 ESTABLISHMENT AND ADMINISTRATION OF THE FUND

The PIA introduced the Environmental Remediation Fund (ERF) in Upstream and mid/downstream sectors to be wholly financed by the operators respectively.[25]

A. Upstream Petroleum Operations

The ERF which is established for the upstream petroleum operations under licences and leases, is administered by the Commission under the PIA, 2021. It is known as the Upstream Environmental Remediation Fund (UERF), in these Regulations.[26] The said Fund is a special account under relevant provisions of the Finance Management Act established for the Commission to be administered, in the case of upstream petroleum operations, by the Commission pursuant to the UERFRs. The Commission shall be responsible to manage the funds of the Fund in accordance with the applicable laws.[27]

B. Midstream and Downstream Operations

In respect of midstream and downstream Petroleum operations, there exists the Midstream and Downstream Regulation which also derives its life from section 103(1)[28] of the PIA.[29] The Regulation provides for the administration of the Environmental Remediation Fund established for midstream and downstream petroleum operations carried out under licences, permits and authorisations administered by the Nigerian Midstream and Downstream Petroleum Regulatory Authority (NMDPRA), herein under simply referred to as the Authority. Financial contributions to the Fund shall be made by licensees conducting midstream and downstream petroleum operations. The Authority is mandated to administer and manage the Fund in accordance with the Regulation.[30]

It is important to note that there are two separate funds and that in respect of midstream and downstream petroleum operations, the Environmental Remediation Fund (ERF) is known as the Midstream and Downstream Environmental Remediation Fund (MDERF). As hinted above, this Fund is aimed at addressing the negative impact of hydrocarbon exploration on the environment. That is, the Fund would be utilised to manage the environmental impact of midstream and downstream petroleum industry operations, as well as for the rehabilitation of impacted areas.

In the 2023 regulations guiding its establishment, as required by the PIA, the NMDPRA, referred simply in this discourse as the Authority, disclosed that the fund is established for midstream and downstream petroleum operations carried out under licences, permits and authorisations administered by it. The Authority is also the administrator and manager of the fund and the fund shall be financed from financial contributions from operators in the Nigerian midstream and downstream oil sectors.

3.1 Utilisation of the Fund

The main purpose of the Fund is to provide a source of funding for the rehabilitation or management of negative environmental impacts from petroleum operations, which shall include upstream and downstream/midstream petroleum operations that meet the requisite conditions of the PIA, 2021.[31] The Fund shall be utilised solely for the management of environmental impact and the rehabilitation of negative environmental impacts caused by petroleum operations or activities. The

25 Ibid.
26 Reg.1 (2) of the UERFRs.
27 Reg.1 (3), ibid.
28 This section empowers the Authority to establish a fund for remediation purposes as a condition for the grant of a licence.
29 Pursuant to the Authority's powers under section 103(1) of the PIA.
30 Reg. 1(3) of the MDERFR 2023.
31 Reg. 2 (1) of the UERFRs.

funding shall only be used where a licencee fails to rehabilitate or manage, or is unable to undertake rehabilitation or management of any negative impact on the environment[32], and the Commission or Authority, as the case may be, has failed to enforce under the law that such rehabilitation or management of negative environmental impacts is fulfilled by such licensee or lessee.[33] If, for instance the Commission or Authority makes a decision to apply the Fund, the procurement of any goods, works or services required to rehabilitate or manage the negative environmental impact shall be subject to the laws and regulations applicable to public procurement.[34] If the Commission makes a decision to apply the Fund to rehabilitate or manage the negative environmental impact relating to a particular licence or a lease, it should provide a written notice to the holder of such licence or a lease that they have defaulted to fulfill their obligation.[35]

Again, it is important to state that in applying the Fund, great attention should be given to prudence and accountability. Thus, in order to avoid misapplication of scarce resources, the procurement of any goods, works or services must be subject to competitive bidding principles under the Public Procurement Act.[36]At least, this is expected to engender regulatory discipline and curtail imprudence.

3.2 Procedure for utilising the Fund

In the event the Commission or the Authority, as the case may be, determines to utilise the Fund following default by a licensee, the Commission or Authority, as the case may be, shall provide a written notice of default to the defaulting licensee.[37] It is not clear if the default notice envisaged in the Midstream and Downstream Environmental Remediation Fund Regulation (MDERFR) 2023 will include a cure period for the licensee to remedy its default. The determination of the licensee's default therefore seems final without an opportunity to remediate or explain the reason for the default. To avoid such ambiguity, it is expected that the gazzetted Regulation will specify a licensee cure period before the Authority deploys the Fund for remediation activities.

Another bone of contention is the issue of using the Fund for past adverse environmental impacts resulting from the licensee's activities. The MDERFR 2023 is silent on the applicability of the Fund to such environmental impacts. However, under the PIA, every licensee is obligated to submit, within one year of the effective date ((i.e., 16 August, 2021) of the PIA or six months after the grant of a licence, its environmental management plan (EMP) to the Commission or Authority, as the case may be, for approval.[38] It is expected that at the EMP approval stage, considerations about remediation of previous environmental impacts by a licencee or utilisation of the Fund for such remediation will be addressed by the Commission or Authority, as the case may be. It would also be appropriate for this to be included in any final version of the regulation for reasons of administrative clarity.

Although, the MDERFR 2023 clarifies the licensee's obligation to eliminate or control adverse environmental impacts of petroleum activities, it does not clarify what constitutes a licensee's failure to eliminate or control adverse environmental impacts of petroleum activities or not. In order to provide clarity, failure by a licensee to undertake remediation activities in accordance with its approved EMP may be considered by the Authority as a definitive trigger of rehabilitation default by a licensee. However, amongst others, the MDERFR 2023 characterizes the use of unapproved products or technologies for remediation, failure of a licensee to adequately remediate impacted sites or update the Authority on the status of impacted sites, as remediation defaults.

4.3 Financial contribution for remediation of environmental damage

According to section103 (1) of the PIA, as a condition for the grant of a licence or lease and prior to the approval of the EMP by the Commission or Authority, a licensee or lessee shall pay a prescribed financial contribution to an environmental remediation fund (ERF) established by the Commission or Authority, as the case may be, for the rehabilitation or management of negative environmental impacts with respect to the licence or lease. In determining

32 Reg. 2(1) of the MDERFR 2023.
33 Reg. 2 (2) of the UERFRs.
34 Reg. 2 (3), ibid.
35 Reg. 2 (4), ibid.
36 Reg. 2(4) of the MDERFR 2023.
37 Reg. 2(3) ibid.; see also Reg. 2 (4) of the UERFRs.
38 s.102 (1) of the PIA.

the amount of the financial contribution the Commission or Authority, as the case may be, shall take into consideration the size of the operations and the level of environmental risk that may exist.[39] The financial contribution to an ERF as stated above shall be subject to audit by the licensee or lessee, in accordance with guidelines that the Commission or Authority may, as the case may be, issue.[40]

Where a licensee or lessee fails to rehabilitate or manage or is unable to undertake the rehabilitation or management of any negative impact on the environment, the Commission or Authority, as the case may be, may, upon written notice to the holder, apply the fund under section 102 (1) of the PIA to rehabilitate or manage the negative environmental impact.[41]

A licensee or lessee shall, pursuant to 102 sub (1) and (2) of PIA section assess its environmental liability annually and increase its financial contribution to the satisfaction of the Commission or Authority, as the case may be.[42] However, where the Commission or Authority, as the case may be, is not satisfied with the assessment and financial contribution in question, the Commission or Authority, as the case may be, may appoint an independent assessor to conduct the assessment and determine the financial contribution.[43]

The PIA also makes provision for what is known as '*allowable deductions'*. Thus, in computing the adjusted profit of a company in upstream petroleum operations related to crude oil for any accounting period, there shall be deducted expenses wholly, reasonably, exclusively and necessarily incurred during that period for the following, including but without otherwise expanding or limiting the generality of ... 'any amount contributed to any fund, scheme or arrangement approved by the Commission pursuant to the establishment of Host, Environmental Remediation Fund and other similar contributions.'[44]

4.4 Financial Contributions to the Fund

The Fund shall be funded by the financial contributions for remediation of environmental damage levied on licensees of petroleum prospecting licenses and lessees under section 103 of the Petroleum Industry Act, 2021 and under these Regulations.[45] The MDERFR 2023 obligates prospective licensees to pay the initial financial contribution prior to the grant of the licence, which will apply to the first year in which the licence is granted by the Authority.[46]The MDERFR 2023 further provides that the financial contribution of a licensee will not be refunded, offset or credited against any liability due from the licensee, except in the event of an overpayment.[47] However, it is not clear whether a prospective licensee will be eligible for a refund in the event that the licence was not granted by the Authority. The Authority may consider clarifying this ambiguity in the next turn of the Regulation. Perhaps, the Authority may consider extending the grounds for a refund to accommodate this.

4.5 Procedure for Payment and Quantum of the financial contribution

Both the Upstream Environmental Remediation Fund Regulations (UERFRs) 2022 and the Midstream and Downstream Environmental Remediation Fund Regulation (MDERFR) 2023 make provision for the procedure for payment of financial contributions as well as the quantum required thereto. Both the regulations stipulate that the financial contribution shall be paid in United States dollars each licensee., though subject to audit by the licensee or lessee, in accordance with guidelines that the Commission or Authority, as the case may be, may issue.[48] However, for production delivered for local refining, the MDERFR allows Naira contributions, converted at the Central Bank of Nigeria applicable exchange rate on the day of payment.[49]

As for upstream petroleum operations, the financial contribution shall be paid each year with respect to each petroleum prospecting licence or a lease, including for the year in which a petroleum prospecting licence or a lease have been granted.[50] As for midstream and downstream operations, the

39s.103 (2), ibid.
40 s. 103 (3), ibid.
41s. 103 (4), Ibid.
42s.103 (5), ibid.
43s.103 (6), ibid.
44s. 263 (1), ibid.

45 Reg. 1 (5) of the UERFRs.
46 Reg. 4(1) of the MDERFR 2023
47Reg. 4 (4), Ibid.
48 Reg. 8 (1) of the UERFRs.
49 Reg. 3(6).*Ibid.*
50 Reg. 3 (1)*Ibid.*

financial contribution shall be paid on or before 31st December of every calendar year for each licence, permit and authorisation including for the year in which a licence, permit and authorisation has been granted.[51]

4.5.1 When and how shall payments be made?

There is an initial financial contribution and an annual financial contribution to be paid. The initial financial contribution shall be paid by the prospective licensee or lessee prior to the granting of the licence or lease and shall apply to the first year in which a licence or a lease is granted. The initial financial contribution shall consist solely of what is called the Fixed Contribution provided for in Regulation 3(4) of the UERFRs for upstream operations.[52] Subsequently, the annual financial contribution for any succeeding year shall be paid by the licensee or lessee prior to each anniversary of the effective date of the licence or lease. Such annual financial contribution shall consist of the Fixed Contribution plus the capital and production related components of the contribution related to the estimated capital expenditures and production for the year prior to the succeeding year pursuant to regulation 3(4) of these Regulations.[53] Where the period of a licence or lease terminates prior to the anniversary of the effective date of such a licence or lease, the applicable financial contribution shall be paid prior to the termination of the licence or lease,.[54] Subject to the provisions of Regulation 5(1) of these UERFRs, the financial contribution paid by a licensee or lessee under these Regulations shall not be refunded, credited or otherwise offset against any liability due from a licensee or a lessee, unless an over-payment is made due to an error in which case a refund shall be made to the extent of such overpayment.[55]

4.5.2 Quantum and Formula for determining the yearly Financial Contribution

Specifically, and with respect to midstream and downstream operations, the MDERFR 2023 provides the formula for determining the yearly contributions of the companies. By the Regulation, monetary contribution to the Fund must be paid on or before 31st December of every calendar year for each licence, permit and authorization including the year such licence, permit and authorization was granted by the Authority.[56] For the purpose of determining the financial contribution, the Regulation provides a specific formula[57], represented below:

Financial contribution for a year = Fixed Contribution + (Midstream and Downstream Capital Expenditure x CER[58]) + (CL[59] x CLR[60]) + (CG[61] x CGR[62]), where CER is the rate applicable to the capital expenditure, and CL is the average daily capacity of facilities under a licence during a year for which the financial contribution is payable, in barrels per day.

Furthermore, CLR is the rate in US dollar per barrel per day for average daily capacity for liquid hydrocarbons (CL); while CG is the average daily capacity of facilities under a licence during a year for which the financial contribution is payable, in thousand cubic feet (Mcf) per day; and CGR is the rate in US dollar per Mcf per day for average daily capacity for gaseous hydrocarbons (CG).

For purposes of determining the annual Fixed Contribution of a licensee, the petroleum operations under each licence will be classified under one of the following categories such as

51 Reg. 3 (1) of the MDERFR 2023.
52 Reg. 4 (1) of the UERFRs.
53 Reg. 4 (2) ibid.
54Reg. 4 (3) ibid.
55Reg. 4 (4) ibid.
56 Reg. 3(1) of the MDERFR 2023
57 Reg. 3(4)(a) *ibid.*
58 This is the rate applicable to the capital expenditure, as determined in accordance with Table 1 of the Schedule to the MDERFR 2023.
59 This is the average daily capacity of facilities under a licence during a year for which the financial contribution is payable, in barrels per day.
60 This is the rate in US$ per bbl/day for average daily capacity for liquid hydrocarbons (CL), as determined in accordance with Table 1 of the Schedule to the MDERFR 2023
.61 This is the average daily capacity of facilities under a licence during a year for which the financial contribution is payable, in thousand cubic feet (Mcf) per day.
62 This is the rate in US$ per Mcf/day for average daily capacity for gaseous hydrocarbons (CG), as determined in accordance with Table 1 of the Schedule to the MDERFR 2023.

Onshore High-Risk[63], Shallow Water High-Risk[64], Other Onshore Areas[65], Other Shallow Water Areas[66] and Deep Water Areas.[67] The Regulation further grants the Authority the power to also categorise operations under a petroleum prospecting licence or petroleum mining lease for the purpose of determining their yearly Fixed Contribution.[68] However, this power is ultra vires as it eats into the regulatory purview of the Upstream Petroleum Regulatory Commission (the "Commission"), which has been exclusively empowered by the PIA[69] to regulate utilisation of relevant remediation fund in upstream petroleum operations.[70] Therefore, we recommend that this ultra vires provision be expunged subsequently from the Regulation to avoid a regulatory clash between the Authority and the Commission. Further, in determining the Midstream and Downstream Capital Expenditure component, the MDERFR excludes contributions to any decommissioning and abandonment fund.[71]

On the CL and CGR components, the Regulation provides that the average daily capacity of a facility for purposes of determining the CL and CGR inputs is the name plate capacity (which may be adjusted following additional investment by a licensee or an abandonment event). Determining financial contributions using name plate capacities may not be practical, given that licensees may not fully utilise the name plate capacities of their facilities during a relevant year. The Authority may consider benchmarking the CL and CGR capacities against the average daily capacity utilized by a licensee in the relevant year of assessment.

Concerning financial contributions for the remediation of upstream petroleum operations, the UERFRs provide that the following formula shall be used to determine the annual financial contribution —

63 Operations in mangrove areas; wetland and swamp areas; a zone of 500 meters along any river and lake; and such other areas as the Authority may determine as high-risk. Regulation 3(2)(a)(i)-(iv). For operations in these areas, the licensee will be required to pay US$40 per day under the Fixed Contribution component of its yearly financial contribution to the Fund. See Schedule 1 to the Regulation.

64 Operations in a zone if 10km seawards of a high-water mark; and such other areas as the Authority may determine as high-risk. Regulation 3(2)(b)(i)-(ii). For operations in these areas, the licensee will be required to pay US$24 per day under the Fixed Contribution component of its yearly financial contribution to the Fund. See Schedule 1 to the Regulation.

65 Operations in the parts of Nigeria defined as onshore and frontier acreages under the PIA, other than Onshore High-Risk Areas. Regulation 3(2)(c). For operations in these areas, the licensee will be required to pay US$32 per day under the Fixed Contribution component of its yearly financial contribution to the Fund. See Schedule 1 to the Regulation.

66 Operations in the parts of Nigeria defined as shallow water under the PIA, other than Shallow High-Risk Areas. Regulation 3(2)(d). For operations in these areas, the licensee will be required to pay US$16 per day under the Fixed Contribution component of its yearly financial contribution to the Fund. See Schedule 1 to the Regulation.

67 Operations in the parts of Nigeria defined as deep offshore in the PIA. Regulation 3(2)(e). For operations in these areas, the licensee will be required to pay US$8 per day under the Fixed Contribution component of its yearly financial contribution to the Fund. See Schedule 1 to the MDERFR 2023.

68 Reg. 3(3)(a).

69 s. 103(1) PIA.

70 Upstream petroleum operations include the exploration, development and winning or obtaining of petroleum by or on behalf of a company in Nigeria for commercial purposes, including all activities upstream of the measurement points, related to the winning of petroleum through wells or mining from petroleum reservoirs such as: drilling, fracking, completing, treatment and operation of wells producing petroleum; construction and operation of gathering lines and manifolds for crude oil, natural gas and water; construction and operation of high and low pressure separators; construction and operation of facilities to treat crude oil and natural gas; flaring of natural gas; compression and reinjection of natural gas in reservoirs; construction and operation of facilities for the production of electricity or heat from natural gas or other fuels as energy source for the winning of petroleum; construction and operation of fixed or floating platforms or other vessels required for the winning of petroleum; metering of petroleum at the measurement points prior to transportation; sale and marketing of crude oil, natural gas or condensates or any of them at the measurement points; and such other activities which by regulation are considered upstream petroleum operations, provided however that, where field facilities or fixed or floating platforms or vessels provide for fully integrated upstream and midstream petroleum operations, the Commission may consider the entire operations as upstream petroleum operations. Section 318 PIA.

71 Reg. 3(4)(a)-(b).

Financial contribution for a year = Fixed Contribution + (Upstream Capital Expenditure x UCER) + (VL x LR) + (VG x GR) where — Fixed Contribution is the fixed contribution in US$ per year, as determined in accordance with Table 1 of the Schedule to these Regulations; In this formula, Upstream Capital Expenditure is the expenditure relating to a licence or a lease, characterised as expenditure of capital nature under the Companies Income Tax Act, incurred during a year for which the financial contribution is payable. UCER is the rate applicable to the capital expenditure, as determined in accordance with Table 1 of the Schedule to the UERFRs. VL is the volume of crude oil, condensates, and separately produced natural gas liquids, in barrels, produced from a licence or a lease during a year for which the financial contribution is payable. LR is the rate in US$ per barrel, applicable to the production of liquids(VL), as determined in accordance with Table 1 of the Schedule to these Regulations.

VG is the volume of natural gas, including any natural gas liquids contained in the raw gas, expressed in million British Thermal Units (MMBtu), produced from a licence or a lease during a year for which the financial contribution is payable. GR is the rate in US$ per MMBtu, applicable to natural gas production(VG), as determined in accordance with Table 1 of the Schedule to these Regulations.

For purposes of determining the financial contribution, the volume of crude oil, condensates, separately produced natural gas liquids, and natural gas, produced from a licence or a lease during a year for which the financial contribution is payable, shall be the production subject to royalty under the PIA 2021 and the Petroleum Royalty Regulations, 2022. It is germane to state that in determining the financial contribution, the Upstream Capital Expenditure shall also include expenditure relating to midstream operations, where a licence or a lease meets the condition of section 8(g) of the Petroleum Industry Act, 2021. However, in determining the financial contribution for upstream operations, the Upstream Capital Expenditure shall not include exploration and appraisal expenditure, and contributions to a decommissioning and abandonment fund. This is similar to the provisions under the MDERFR 2023.

4.6 Adjustment of the financial contribution

Where the Commission or Authority, as the case may be, is not satisfied with the assessment of the financial contribution determined under Regulation 3, the Commission may appoint an independent assessor to conduct the assessment and determine the financial contribution. The remuneration of the assessor and other costs associated with such assessment shall be borne by the Commission.[72] The Commission shall exercise the right pursuant to subsection (1) of this section, if the Commission reasonably believes that the financial contribution determined under regulation 3 does not reflect the size of the operations and the level of environmental risk that may exist from the petroleum operations under a respective licence or a lease.[73] An independent assessor to be appointed by the Commission under subsection (1) of this section shall be competent and have expertise and experience in environmental matters, natural resource planning and management, management of petroleum operations, and environmental rehabilitation practices.[74]

The Commission must give the licensee or the lessee a written notice within [thirty] days after receiving the application for a licence or a lease, that the financial contribution requires an adjustment and that an assessment has been initiated.[75] An assessment shall be completed and the Commission shall notify the licensee or the lessee in writing about the adjusted financial contribution, within [sixty] days from the written notice issued to a licensee or lessee under subsection (4) of this section.[76] Where the Commission does not notify the licensee or the lessee within the timeline prescribed in subsection (5) of this section the financial contributions shall be deemed approved and should be calculated under section 3.[77]

The Commission shall initiate the process identified in subsection (1) of this section where the Commission has evidence that the allocation to environmental categories pursuant to section 3(2) of these Regulations is in error or that capital

72 Reg. 6 (1) of the UERFRs.
73 Reg. 6 (2), ibid.
74 Reg. 6 (3), ibid.
75 Reg. 6 (4), ibid.
76 Reg. 6 (5), ibid.
77 Reg. 6 (6), ibid.

expenditures or production or both are under-estimated.[78]

4.7 Re-assessment of the Quantum of the Financial Contribution

The Authority is empowered by the Regulation to appoint an independent assessor to conduct an assessment and determine the financial contribution of licensees where, amongst others, the financial contribution does not reflect the size of operations and level of environmental risk; the capital expenditures and/or production are under-estimated; or for any other reasons.[79] The inclusion of "for any other reasons" (i.e., an omnibus clause) in the assessment metrics allocates wide discretional powers to the Authority in re-assessing financial contributions made by licensees. To limit discretional re-assessment, the Authority may consider providing an exhaustive list of circumstances for re-assessment of a licensee's financial contribution.

4.8 ANNUAL REPORTS AND DISCLOSURES

There are provisions for making annual reports and disclosures under both regulations. For instance, concerning upstream operations, the licensee or lessee shall submit the calculation of the annual financial contribution in the form prescribed by the Commission not later than thirty days (30) days after the payment due date and where actual capital expenditures or actual production or both are different from the estimated expenditures or production or both the required adjustment shall be made.[80]

Therefore, the UERFRs prescribe that the Commission shall keep proper accounts and records in relation to the Fund and shall prepare and publish in respect of each financial year a statement of Fund's accounts.[81] The annual statement required in this respect shall be published not later than 180 days after the end of a relevant financial year.[82] The Commission shall publish the said annual statement in a public domain, and keep it available to the public on the website of the Commission.[83]

Similarly, as for the fund for the remediation of midstream and downstream activities, the MDERFR 2023 also requires the Authority to maintain proper accounts and records relating to the Fund. The Authority is equally required to publish[84] annually, a statement of the Fund's account not later than 180 days after the end of the financial year.

From the foregoing, the question of what constitutes "end of a financial year" may arise, given that financial year of each company holding a licence may vary. For precision and regulatory accountability, a definite financial period to benchmark the Commission's or the two bodies.

4.9 Penalties for remediation default

The consequences of a remediation default include fines, the cancellation, suspension or termination of the relevant licence.[85] There is no clarity with respect to the sequence by which the Authority will exercise its discretion to cancel, suspend or terminate a licence following a remediation default. It will be expected that upon a remediation default (particularly where the Authority will apply its discretion of cancellation, suspension or termination) a licencee's licence should first be suspended before cancellation or termination; such that where a licencee eventually carries out the required remediation activity, its licence may be restored. Outright cancellation or termination of a licence following a remediation default may foreclose an easy window of reinstatement of such licence. Therefore, the option of cancellation or termination should be reserved for where a licencee ultimately fails to remediate the impacted environment after a determinable period of suspension.

78 Reg. 6 (7), ibid.
79 Reg. 6(1) of the MDERFR 2023.
80 Reg. 5 (1) of the UERFRs.
81 Reg. 7 (1), ibid.
82 Reg. 7 (2), ibid.
83 Reg. 7 (3), ibid.
84 Available at the Authority's website, accessible to the public.
85 Reg. 29 of the MDERFR 2023

5.0 CONCLUSION AND RECOMMENDATIONS

In this paper, we have made a textual evaluation of the key provisions of the two Regulations on environmental remediation in Nigeria vis-à-vis the PIA and the potential impacts on petroleum operations. Certainly, the extant Regulations are signposts of the commendable efforts by both the Commission and the Authority to specifically codify the modalities for utilising the Environmental Remediation Fund.

Though, the current legal framework does not seem to be comprehensive enough to deal with the challenges of remediation holistically, since no enough attention is given to the issue of pre-remediation or post-remediation monitoring, it is nevertheless, a step in the right direction and, thus, hoped that if the current legal regime is properly implemented, the two regulations, which are greatly identical, will promote a culture of operational prudence, maintenance, rehabilitation and remediation of the negative environmental impacts in states where upstream and/or midstream and downstream petroleum operations are undertaken. A more comprehensive legislative framework is equally recommended for a holistic management of the issues at stake.

IMPACT OF KNOWLEDGE MANAGEMENT ON ORGANIZATIONAL PERFORMANCE

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Abstract
Knowledge is very important to the success of any human endeavor. This includes business organization. The aim of this paper is to provide a review of the impact of knowledge management on organization performance. Relevant literature were identified and analyzed. A research model concerning relations between knowledge management processes (creation, storage, transfer and application) and organizational performance and relations between knowledge infrastructure elements (technology, organizational culture, and organizational structure) and organizational performance were reviewed. Findings of the study reveal that there is positive impact of knowledge management practices and knowledge infrastructure elements on organizational performance. Impact of knowledge management on organizational performance is confirmed by several studies year by year. A study of relation between knowledge management and more specific performance indicators (financial and non-financial) as well as strength of relation still remains a challenge and subject of future researches. Based on the findings of the study, the researcher recommends that those organizations that crave to remain competitive in business should embed knowledge identification into their knowledge management strategy.

Keywords: **knowledge management, knowledge infrastructure elements, organizational performance**

1.0 INTRODUCTION

The advancement of technology and the rebirth of new inventions have kept most organizations in the race to remain competitive in the business. In recent years knowledge management is emerging in business world not only as important aspect of doing business but also as a strategic resource that increases potential in organizations to achieve competitive advantage. Successful managers realized that their company value is becoming more and more dependent on the ability of the company to effectively manage knowledge. Competitive market requires never ending process of developing company strategies and operations as well as adapting to market changes while seeking the goal of company long term success and increase in shareholder's value. Knowledge management is becoming an important factor in company success as any other, including capital, property or brand. Therefore, managerial focus is shifting towards effective management of company resources, especially knowledge and related processes of creation, codification, transfer and usage of knowledge.

Knowledge management consists of "leveraging on intellectual asset to enhance organizational performance (Stankosky, 2008). Knowledge sharing throughout the organization enhances existing organizational business processes, introduces more efficient and effective business processes and removes redundant processes (Bhojaraju, 2005). Knowledge management as emphasized by Kolam (2004) in Bhojaraju (2005) helps an organization to gain insight and understanding from its own experience. Knowledge management is an audit of "intellectual assets" that highlights unique resources, critical functions and potential bottlenecks, which hinder knowledge flow to the point of use. It protects intellectual assets from decay, seeks opportunities to enhance decisions, services and products through adding intelligence, increasing value and providing flexibility (Bhojaraju, 2005).

Knowledge management complements and enhances other organizational initiatives such as; total quality management (TQM), business process re-engineering (BPR) and organizational learning as well as providing a new and urgent focus to sustain competitive position (Bhojaraju, 2005). As organizations are viewing importance of knowledge management as generator of their success, questions of linkage between knowledge management and organizational performance are emerging among practitioners and academia. Studies have shown that organizational performance is more complex than was initially believed and goes beyond traditional financial measures only.

Studies have also shown that financial measures of organizational performance are not sufficient in modern economy and other measures must also be

used to see the wider perspective of company performance. In this paper systematic literature review have been made on relevant literature on selected topical studies in recent years. The goal of systematic review is to find out how the authors approached on the conduct of their research, which criteria they used, what are the finding of research and which knowledge management elements and performance indicators they used when examining relationships between them.

2.0 LITERATURE REVIEW

2.1 Conceptual review

Knowledge Management

Knowledge management can be defined in different ways as there is no one that can cover all aspects of it. Knowledge management can be viewed as identifying and leveraging the collective knowledge in an organization to help organization compete (von Krogh, 1998). Chawla and Joshi (2010) define knowledge management as identification and analysis of available and required knowledge in order to achieve organizational objectives. Knowledge management aims to exploit an organization's information for greater productivity, new value and increased competitiveness, and also to encourage the exchange of tacit knowledge (Davies, 2000). As there is divers' definition of knowledge management and so are also several categorizations of knowledge management practices. For the purpose of this paper we will use Alavi's and Leidner (2001) definition of four knowledge management processes:

Knowledge creation

Knowledge creation can be described as developing new or replacing existing content. Using Nonaka's model (1994) knowledge creation is viewed as continual interplay between tacit and explicit dimensions of knowledge and a growing spiral flow as knowledge moves through individual, group and organizational levels. By that, four modes of knowledge creation have been identified: socialization, externalization, internalization and combination.

Knowledge storage / retrieval

Organizational knowledge storage includes knowledge residing in various component forms, including written documentation, structured information stored in electronic databases, codified human knowledge stored in expert systems, documented organizational procedures and processes and tacit knowledge acquired by individuals and networks of individuals.

Knowledge transfer

Considering the distributed nature of organizational cognition, an important process of knowledge management in organizational settings is the transfer of knowledge to locations where it is needed and can be used.

Knowledge application

Bhatt (in Mills & Smith, 2011) stated that: ''knowledge application means making knowledge more active and relevant for the firm in creating value. For organizations to create value they need to apply knowledge to their products and services by various means such as repackaging available knowledge, training and motivating its people to think creatively, and utilizing people's understanding of the company's processes, products and services (Mills & Smith, 2011). Gold et al.'s (2001) dissected knowledge infrastructure element into three components which include technology, organizational culture and organizational structure.

a) Technology

The technology element of knowledge infrastructure comprises the information technology (IT) systems that enable the integration of information and knowledge in the organization as well as the creation, transfer, storage and safe-keeping of the firm's knowledge resource.

b) Organizational culture

In the context of knowledge management organizational culture is considered a complex collection of values, beliefs, behaviours and symbols that influences knowledge management in organizations.

c) Organizational structure

Organizational structure comprises the organizational hierarchy, rules and regulations, and reporting relationships and is considered a means of co-ordination and control whereby organizational actors can be directed towards organizational effectiveness.

Organizational Performance

Increasing organizational performance is a goal every organization is pursuing. Organizational performance can be most simply defined as company performance compared to goals and objective. Measuring organizational performance

was in the past limited more or less to financial measures in the form of revenue, profit, net operating income, Return on Assets (ROA), Return on Equity (ROE), Return on Sales (ROS) and others, mostly revenue and profit related measures. Although very practical and useful, traditional financial measures cannot create advantages for the organization in an intense competitive environment (Wu & Liu, 2010). New organizational concepts demanded additional measurement information in order for managers to make proper decisions and for shareholders to properly evaluate company performance. New financial and especially non-financial information in measuring performance became more or equally important and provided added value to stakeholders. By incorporating non-financial information in performance criteria as well; this information can reflect intellectual capital and social responsibility as well as promotion of organizational knowledge level (Wu & Liu, 2010). New measurement concepts and models of organizational performance emerged into business world like EVA (Economic Value Added), MVA (Market Value Added), integral measurement concepts like BSC (Balance Score Card) that contain financial perspective, customer's perspective, internal process perspective, learning and growth perspective and other models that contain perspectives like human resource, output, stakeholders satisfaction, strategy and process alignment, operational performance, value creation, corporate vision, organizational growth, competitive advantage etc. Review of available literature reveal seven performance measures. Researchers used different performance indicators to conduct their research: These include

- Financial performance
- Innovation performance
- Growth performance
- Operational performance
- Competitive advantage
- Value creation
- General and Integral performance measurements

2.2 Theoretical Framework

The relevant theory that helps significantly towards realizing the important role of knowledge management is the knowledge-based theory developed by Grant (1996). He argues that the source of competitive advantage in dynamic business environment is not the knowledge that is repository to the organization, because the value of such knowledge erodes quickly due to obsolesce and imitation. Rather, sustained competitive advantage is determined by non-proprietary knowledge in the form of tacit individual knowledge. Tacit knowledge can form the basis of competitive advantage because it is both unique and relatively immobile. Yet, because that knowledge is possessed by individuals and not the organization, a crucial element of competitive advantage is the ability to integrate the specialized and tacit knowledge of individuals. The main idea of the knowledge-based theory of the firm is that organizations exist in the way that they do because of their ability to manage knowledge more efficiently than is possible under other types of organizational structures. In other words, organizations are social entities that use and store internal knowledge, competencies and capabilities that are vital for the firm's survival, growth and success (Hakanson, 2010). The theory assumes that organizations are all heterogeneous knowledge-bearing entities that apply knowledge to the production of their goods and services (Foss, 1996). Firms are able to organize the way they do because they are depositories of productive knowledge.

2.3 Empirical review of related Studies

A number of studies have been carried out to explore the effect of knowledge management on the performance of organizations. Rhodes et al. (2008) examined the relationship of organizational learning, social capital and the effectiveness of knowledge transfer and perceived organizational performance. Their study results indicated that the elements of knowledge transfer (absorption capacity, learning intention) is positively correlated to innovation process and financial performance. Study of innovation performance improvements through proactive management of knowledge assets was performed by Inkinen et al. (2015). The researchers provided empirical evidence of how various knowledge management practices influence innovation performance. Strategic knowledge management, knowledge-based compensation and technology were recognized as influential factor on innovation performance, while impact from some other knowledge management practices was not confirmed. Another study of relationship among knowledge processes, organizational trust and innovativeness was conducted on sample of Polish companies by Sankowska (2013). The study revealed that organizational trust and innovativeness are correlated through knowledge

management processes as mediator. Trust engages more effective knowledge managing processes that impact process of innovation in firms.

Andreeva and Kianto (2012) researched relation between knowledge management activities and organizational outcomes in the form of firm competitiveness and economic performance. Result of the study revealed that activities inside of knowledge management area such as information technologies and human resource management have positive effect on competitive advantage. On the other hand, information technologies improve financial performance only when supported by human resource management which on its own has positive impact on financial performance. Abubakar et al. (2016) study examined relationship between knowledge management practices and growth performance in construction industry. Growth performance measurement was undertaken through company turnover and employment growth. The results show that knowledge creation, storage, transfer and application have a significant relationship with growth performance. On the four processes knowledge transfer has strongest impact on growth performance.

Akhavan at al. (2014) explored the relationship between ethics, knowledge creation and organizational performance. Organizational performance was determined in the study in three dimensions: output, adaptability and human resources. While ethics was positively correlated with both knowledge creation and organizational performance, there were no significant relationship between knowledge creation processes and organizational performance. Another result of that research was that there is a positive correlation between ethics and dimension of human resources which indicates that human resources management as one of the enablers of knowledge management has positive impact on organizational performance. In study on identification if integration between knowledge strategy and knowledge management processes leads to organizational creativity, Shahzad et al. (2016) discovered that knowledge creation process impacts organizational performance which is defined in a model that includes successfulness, market share, growth, profitability and innovativeness.

Mills and Smith (2011) evaluate in their study impact of specific knowledge management resources (Knowledge management enablers and processes) on organizational performance. The result showed that some of the knowledge management processes and enablers (knowledge application and organizational structure) were directly related to organizational performance, while others, though important preconditions for knowledge management are not directly related. The influence of intellectual capital (knowledge management as moderator) on organizational performance was examined by Ling (2013). The study supported hypothesis that all three types of intellectual capital (human capital, structural capital, relational capital) have direct positive impacts on a firm's global initiatives (global agility and global innovation). As a result, intellectual capital enhances not only a firm's financial performance but also its global initiatives.

Study of Tseng (2016) explored influence of knowledge management capability and customer knowledge gaps on corporate performance. Knowledge management capability can be described as ability of a firm to utilize existing knowledge and generate new one and can be viewed in form of knowledge management processes and also knowledge infrastructure elements. Results showed positive impact of knowledge management capability on corporate performance. Palacios-Marques et al. (2013) study analyzed the effect of several managerial elements and information technology on knowledge transfer and subsequently on firm performance. Results showed that mangers can improve knowledge transfer and by that positively influence the creation of superior firm performance. The influence of knowledge loos and knowledge retention on absorptive capacity and performance was studied by Lin et al. (2016). Study supported positive effect of knowledge loss (as opposed to knowledge retention) on the decrease of performance by management information system departments in companies.

Noruzy et al. (2013) conducted a study about the relationship between transformational leadership, organizational learning, knowledge management, organizational innovation and organizational performance. The result indicated that Organizational performance was impacted directly and indirectly through different factors. Knowledge management has indirect impact on organizational performance through organizational innovation. Evaluations of impacts

of knowledge management on the organizational success were conducted by Kim (2014). Level of knowledge management was measured in knowledge implementation index and level of organizational success was measured in project performance data (cost, quality, safety, and schedule). Generally positive relationships were found which validate impacts of knowledge management on organizational success. Study of Chuang et al. (2013) examined relationship between knowledge management with information technology support on firm performance. Study first revealed that organizational culture and structure together with incentives facilitate use of knowledge based technology which has positive impact on firm performance.

Rašula et al. (2012) conducted a study on impact of knowledge management practices measured through information technology, organization and knowledge on organizational performance. The Study showed positive effect on organizational performance. Additionally, the study also revealed that knowledge management heavily relies on technology although many organizations experienced difficulties in its effective use. Effect of knowledge management programs on value creation in Icelandic firms was analyzed by the study of Edvardsson & Oskarsonn (2011). Knowledge management was described as organizational culture and/or structure that contribute to value creation in form of intangible assets in firms like customer capital, innovation and human capital. Findings of the study shows that there was a positive correlation however, number of respondents was low, hence finding need to be interpreted with some caution. Similar research was conducted by Schiuma et al. (2012) with analyses on correlation between knowledge management processes and value creation. Results of the study indicated that knowledge management processes impacts positively on value creation through impacting organizational processes by aligning knowledge management processes with organizational structure.

Tan & Wong (2015) examined the effect of knowledge management on manufacturing performance which was defined as production and operational performance measured as quality, time, cost, flexibility and customer satisfaction. Result showed that knowledge management processes and factors have significant and direct effects on manufacturing performance. On research of relationship between knowledge transfer and product development inside organization Kumar and Ganesh (2011) discovered significant influence of knowledge transfer processes on the efficiency of product development.

3.0 CONCLUSION AND RECOMMENDATIONS

3.1 Conclusion

With knowledge management being fully recognized in business and academic world, studies about its relevance has become regular phenomenon. The number of studies examining impact of knowledge management on organizational performance has been increasing in recent years. Many researchers were trying to examine the relation and its strength between knowledge management and various performance indicators. Knowledge management was most often studied through knowledge management processes and knowledge infrastructure elements which both together form concept of knowledge management capabilities in organization. On the other hand, organizational performance was measured or presented in many different perspective ranging from financial to non-financial and to combination of many performance indicators. In majority of studies, researchers used general concept of organizational performance that indicated organizational performance through several perspectives using different kind of performance indicators.

Relation between concept of knowledge management capabilities, consisting of knowledge management processes, knowledge infrastructure and organizational performance, was confirmed in majority of studies to at least some degree. Linkage can be direct or indirect with former being more often. Strength and direction of impact on organizational performance was sometimes not clearly visible or examined in studies and performance indicators were defined too general. Consequently, conclusions in studies were presented rather generally focusing more on existence of relations between researched variables. Nevertheless, impact on knowledge management was confirmed in recent studies and thus research of strength of relation between knowledge management and more specific organizational performance indicators, financial and non-financial indicators, could be interesting topic for future empirical researches.

3.2 Recommendations

Organizations are often faced with the challenge of remaining competitive in a dynamic business environment, and also sustaining its comparative advantage which they hold over their competitors. Knowledge is the key resource needed if an organization intends to operate at a level that is equal to no other. However, an effective knowledge management system cannot be practiced if organizations do not identify what knowledge that exists within their organization and where the knowledge resides. It is also important to note that it is only when organizations have identified the relevant knowledge, will they then talk about the acquisition of the identified relevant knowledge.

Based on the findings, the following are recommended;

I. Organizations who crave to remain competitive in business should embed knowledge identification into their knowledge management strategy. It is believed that organizations do practice knowledge identification, but it is not done as extensively as it should be. An effective system should be put in place to ensure that relevant knowledge that will boost performance is identified.

II. Organizations should also note that knowledge acquisition is not merely the acquisition of more knowledge; instead organizations will benefit from orchestrating and mindfully managing knowledge acquisition activities in order to tap different kinds of knowledge.

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THE RELATIONSHIP BETWEEN KNOWLEDGE APPLICATION AND INNOVATIVE PERFORMANCE

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ABSTRACT
This paper examined the relationship between knowledge application and innovative performance. The purpose of this paper was to determine the relationship existing between knowledge application and innovative performance from scholarly studies. The methodology adopted for this study was a survey of literatures. Based on the survey of literature, the results of the study show that knowledge application is strongly related to innovative performance of organizations. The study therefore concludes that knowledge application is an indispensable strategic tool for achieving innovative performance. Therefore, the study recommends that firms should give serious attention to improving their knowledge application mechanism to enhance their innovative performance so as to remain competitive in the market place.
Key words: knowledge application, innovative performance, problem solving,

1.0 INTRODUCTION
The need for firms to reposition and innovate for effective performance is more manifest now than before. As the business world has become a global village, the importance of business performance has stimulated the interest of stakeholders like business strategists, product designers, facility managers and workplace consultants. The trend of globalization does not only provide opportunities for firms to bring products and services to wider market, but also increases the intensity of competition. To survive in such an extremely competitive environment, organizations tend to utilize their knowledge resources effectively for creating competitive advantage and developing a greater ability to act and adapt (Handzic et al 2008). Treating knowledge as significant organizational resources, studies in the area of knowledge management (Km) have grown dramatically over the last decade (Hislop et al 2000, Feng et al 2004). Knowledge application has become the focal point for discussions on mechanisms to facilitate firms acquiring greater competitive edge in the emerging global information economy.

Business organizations are operating in an ever increasing knowledge-based economy, where firms have to increase customers' satisfaction and retention levels, lower employees' turnovers rates and operating expenses, maximize profits and strive to gain sustainable competitive advantages. In order words, Knowledge caters to the critical issues of organizational adaptation, survival and competence in the face of increasing discontinuous environmental changes. Knowledge application is the ability needed to perform specific tasks. It is practical, and often relate to mechanical, information technology, mathematical, or scientific tasks. The focal point of knowledge management is knowledge application (KA) because it makes knowledge more active and relevant for the creation of firm value (Bhatt, 2001; Choi, Lee, & Yoo, 2010). Because of the tacit nature and stickiness of knowledge, it is argued that the value of knowledge is derived from its application. When organizations correctly apply relevant knowledge, they reduce the likelihood of making mistakes, reduce redundancy, increase efficiency and continuously translate their organizational expertise into embodied products (Chen & Huang, 2009). Continuous innovative activity is the key source of long-term firm success (Rosenbusch, Brinckmann, and Bausch, 2011). It has therefore become the continuous claim of contemporary scholars that firms which fail to engage in innovation are putting themselves at great risk (Kotler, 2003). In another view, it has been noted that due to the heightened level of competition and shortened product life cycle, firm's ability to innovate may be more important than ever in allowing firms to improve performance and maintain competitive advantage (Artz, Norman, Hatfield, and Cardinal, 2010). Therefore it is generally expected that all firms should innovate regardless of their size or sector in order to compete and survive in the market (Elci and Karatyh, 2009). In recent times, all industries from manufacturing to service have felt the need to

gradually introduce new organizational concepts, exposing themselves to a plethora of changes in order to meet the growing challenges posed by markets and new competitors. Innovation performance has come to be seen as one of the key antidotes to the plenitude of problems confronting today's organizations as a result of environmental dynamism.

2.0 LITERATURE REVIEW

2.1 Conceptual Review

Concept of knowledge Application

Knowledge application refers to an organization's timely response to technological change by utilizing the knowledge and technology generated into new products and processes. The knowledge management processes in the literature mentioned as the Knowledge application is defined here as observable organizational activities that are related to knowledge management. It is an interrelated set of various business processes developed in an organization to create, store, transfer, and apply the knowledge. In knowledge application, the first stage is knowledge acquisition, knowledge creation, knowledge storage, knowledge distribution, knowledge use, and knowledge maintaining (Patrick & Choi, 2009). Therefore, we can infer that this process is mainly and axial processes in knowledge management that improves the performance and competitive advantage in organizations.

Alavi and Leidner (1999) defined knowledge application as a systematic and organizationally specified process for acquiring, organizing and communicating both tacit and explicit knowledge for employees so that other employees may make use of it to be more effective and productive at work. Duffy (1999) described knowledge management as a process capitalizing on organizational intellect and experience to drive innovations.

According to Dayon and Evans (2006) emphasizes that the activities of knowledge application include knowledge capture, documentation, retrieval and reuse, creation, transfer and sharing of knowledge assets integrated in its operational and business processes. In essence, the processes of technical knowledge application and practice involve the systematic organization, planning, scheduling, monitoring and deployment of people, processes, technology and environment, with appropriate targets and feedback mechanisms to facilitate the 'retention, sharing, identification, acquisition, utilization of knowledge and new ideas in order to achieve strategic aims.

Through knowledge application, organizations can speed up their new product development process and the processing of administrative and technology systems. Knowledge application (KA) responds to the different types of knowledge that is available within an organization, and it applies knowledge that has been created and shared. This point out that KA is more important than other processes such as created knowledge or shared knowledge because knowledge is of no importance until it is applied.

Dimensions of knowledge Application

a) Decision making

Decision making is the process of making choices by identifying a decision, gathering information, and assessing alternative resolutions. Using a step-by-step decision-making process can help you make more deliberate, thoughtful decisions by organizing relevant information and defining alternatives.

Decision making is defined as a process of making a choice from a number of alternatives to achieve a desired result (Eisenfuhr, 2011). Stoner, Freeman, and Gilbert (1995:239) defined decision making as a process of identifying and selecting a course of action to deal with a specific problem or take advantage of an opportunity. According to Hellriegel, Jackson and Slocum (2005), decision making include the following; problem identification, information gathering, developing alternatives, analyzing alternative and identifying decision criteria.

b) Problem solving

Problem solving consists of using generic or adhoc methods in an orderly manner to find solutions to difficulties. Some of the problem-solving techniques developed and used in philosophy, medicine, societies, mathematics, engineering, computer science, and artificial intelligence in general are related to mental problem-solving techniques studied in psychology and cognitive sciences.

Problem-solving enables us to identify and exploit opportunities in the environment and exert (some

level of) control over the future. Problem solving skills and the problem-solving process are a critical part of daily life both as individuals and organizations.

The term problem solving has a slightly different meaning depending on the discipline. For instance, it is a mental process in psychology and a computerized process in computer science. There are two different types of problems: ill-defined and well-defined; different approaches are used for each. Well-defined problems have specific end goals and clearly expected solutions, while ill-defined problems do not. Well-defined problems allow for more initial planning than ill-defined problems (Tidd, & Bessant, 2009). Solving problems sometimes involves dealing with pragmatics, the way that context contributes to meaning, and semantics, the interpretation of the problem. The ability to understand what the end goal of the problem is, and what rules could be applied represents the key to solving the problem. Sometimes the problem requires abstract thinking or coming up with a creative solution.

Concept of Innovation Performance

The spirit of innovation is essential for keeping an organization vital and in maintaining a competitive advantage. Innovation is the activity of creating new ideas and converting them into useful applications- specifically new goods and services. Hence innovation performance can be understood as the ability to transform innovation inputs into outputs, and thus the ability to transform innovation capability and effort into market implementation. The result of innovative performance is innovation market success.

Innovation performance estimation has always been a thing of great interest to both researchers and organizational leadership teams (Jenatabadi, 2015). This is probably because the potential success or failure of any business is largely dependent on its organizational performance (Randeree & Al Youha, 2009). Moreover, it has continued to be pervasively used in management and allied fields as the ultimate evaluative criterion by most investigators and strategists (March & Sutton, 1997; Richard, Devinney, Yip & Johnson, 2009). According to Randeree and Al Youha (2009), organizational or business performance is generally regarded as an organization's ability to realize its objective via effective implementation of corporate strategies. Almatrooshi, Singh and Farouk (2016) posited that this ability to effectively implement corporate strategies is largely dependent on the skill set possessed by its leaders. The only way to ascertain this is the measurement of performance at a given time; thereby underscoring the importance of performance. In other words, measuring organizational performance enables practitioners and researchers to assess the activities of managers and their firms; so as to know their standing in comparison to competing firms as well as their evolution and performance over a given period (Richard et al 2009). According to Richard et al, measuring firms' performance cuts across three outcome areas - financial indicators (which include profits, return on investment, return on assets, etc.); market standing (such as sales, market share, etc.); and shareholder return (e.g. total shareholder return, economic value added, etc.). Some experts prefer measuring performance based on a single factor; while others prefer the multiple factor approach (Hahn, 2007).

Measures of Innovation Performance

a) Product / Service Innovation

A Product service innovation is the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses. Many companies have redefined their service businesses explicitly in terms of "product".

Product innovation is defined as the development of new products, changes in design of established products, or use of new materials or components in the manufacture of established products. Numerous examples of product innovation include introducing new products, enhanced quality and improving its overall performance. Product innovation, alongside cost-cutting innovation and process innovation are three different classifications of innovation which aim to develop a organization's production methods (Sundbo, 1997).

Product innovation can be divided into two categories of innovation: radical innovation which aims at developing a new product, and incremental innovation which aims at improving existing products. Advantages of product innovation include: Growth, expansion and gaining a competitive advantage: A business that is

capable of differentiating their product from other businesses in the same industry to large extent will be able to reap profits. This can be applied to how smaller businesses can use product innovation to better differentiate their product from others.

b) **Process/technology innovation**

Process/technology innovation is the application or introduction of a new technology or method for doing something that helps an organization remain competitive and meet customer demands. Process innovation also typically impacts a broader portion of an organization than do incremental improvements. Process/technology innovation is a new or significantly improved way of doing things in a business that typically increases production levels and decreases costs. Process innovation might come in the form of new processes or techniques, new equipment, or software.

c) People innovation

People innovation is a business approach opposite of a task-driven mentality. It is investing in people as an innovative business approach that can reap rewards for both employees and companies. By focusing on treating employees right and valuing the qualities of fairness, respect, dignity and support, companies are able to build relationships with employees and create a culture of trust. Gronen (2002) stated that knowledge application has been identified as a key success factor in most industries.

2.2 Theoretical framework

The underlying theories for this work are the Theories of Product Innovation.

Theories of product innovation

Popular theories of product innovation - what causes it and how it is achieved - include Outcome-Driven Innovation and "Jobs to be Done" (JTBD). JTBD Theory is used extensively as part of a methodical approach to product innovation, postulating that users "hire" a product to do a "job" and that innovation can be achieved by providing a better way of getting a particular job done.

Used as a framework, JTBD is very similar to outcome-driven innovation, focusing on the functional, emotional, and *social* 'jobs' that users want to perform. However, this is one of two main interpretations of the theory known as "Jobs-as-action (Butter, 1986)." The second interpretation is known as "Jobs-as-progress" and focuses on what the user wants to be, stating that the jobs a product user wants to do are secondary to (and a result of) the person they want to be.

3.0 RELATIONSHIP BETWEEN KNOWLEDGE APPLICATION AND INNOVATIVE PERFORMANCE

Mardani et al. (2018) posits that knowledge management activities have direct impact on innovation and organizational performance, and indirectly through an increase in innovation capability. This study reveals that knowledge creation, integration, and application facilitate innovation and performance.

Darroch (2005) asserts that firms with the capacity to manage knowledge will utilize resources more efficiently, thus will be more innovative and perform better. This study identifies knowledge diffusion, generation, storage and application as the core knowledge management practices that can enhance firm innovation.

Xu Jiang, Yuan li (2009): conducted an empirical investigation of Knowledge management and innovative performance'. The findings of the study indicate that knowledge application, knowledge sharing, knowledge creation and their interaction significantly contribute to firms' innovative performance. The finding of the study clearly indicate that knowledge application is positively related to innovative performance.

Raymond Van Wijk et al (2012): "How firms shape knowledge to explore and exploit: A study of knowledge flows, knowledge stocks and innovative performance across units". This study was carried out on branches of a large European financial services firm. The findings shows that horizontal knowledge flows develop units' breath of knowledge stocks, which in turn positively relates to exploratory innovations. The findings also confirmed that level of knowledge application contributed also to exploitative innovation. This study result also shows that knowledge application related to innovative performance.

Lionel Nesta, Pier Paolo Saviotti (2005): "Coherence of the knowledge base and the firm's innovative performance: Evidence from the U.S. Pharmaceutical Industry". This study was conducted on U.S. Pharmaceutical firms. The study used a count data regression models which

show a strong positive relationship between coherence and knowledge base and the firms' innovative performance.

Helenia Garriga, Georg Von Knogh, Sabastian Spaeth (2013). "How constraints and knowledge impact open innovation". This study was conducted on Swiss-based firms. This study was conducted to examine how both constraints on the application of firms' resources and the abundance of external knowledge have a direct impact on innovative performance. The result of the study shows that constraints decrease and external knowledge increases innovative performance.

4.0 CONCLUSION AND RECOMMENDATIONS

4.1 Conclusion

These study is a conceptual review of the relationship between knowledge application and innovative performance in organizations. The findings of the study from the reviewed literature clearly indicate a strong relationship between knowledge application and innovative performance of firms. Knowledge application is one of the most important practices in the organization that brings about innovative performance.

Innovation brings potential changes in most business operations. In today's economy, innovation has been pointed out to be the main catalyst to the firm's growth. Innovation is the platform that can completely and robustly turn around any organization. In order to make the innovation successful and have better organizational performance, it is important for firms to focus on knowledge application practices. Continuous overlooking of knowledge application issues creates barriers for innovation. Knowledge management practices provide a guide on how firms can enhance innovation performance.

The study therefore conclude that knowledge application greatly influence innovative performance of organizations. Firms that apply the explicit and tacit knowledge can improve their innovative effectiveness.

4.2 Recommendations

Based on the findings and conclusion of the study, it is recommended that:

I. Firms should improve their knowledge application practices in order to enhance their innovative performance.
II. Organizations should employ knowledge application techniques to stand a better chance of promoting innovation through knowledge transfer and continuous learning.
III. Firms should improve individual competence to enhance the creative abilities of the workers. Building a strong knowledge base will assist firms to improve innovative performance.

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EVALUATION OF THE EFFECTIVENESS OF SELECTED EIA REPORTS ON PROJECTS IN BAYELSA STATE

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Abstract
Environmental Impact Assessment (EIA) is an environmental management tool that has been established globally to manage and control the impact of development activities on the environment and human health. However, in Nigeria observations have revealed that over time organizations have seen EIA as a mere project approval requirement and therefore reducing EIA studies to just literature review process and thereby relegating the real essence of EIA to the background. The aim of this research is to assess the quality of EIA reports on some projects in Bayelsa and determine the effectiveness of the process and practice. The EU Guideline on EIA review was adopted to evaluate the selected EIA reports with view to determining the effectiveness of EIA process and practice in Nigeria. The two EIA reports reviewed are report on Emette field further Development and EIA report on the drilling of additional wells at Ogboinbiri field in OML 63 both project located in Bayelsa State. Each of the reports have seven components which include; Project description, consideration of alternatives, description of baseline environment, description of the project likely significant effect on environment and human health, description of mitigation measures, non-technical summary and quality of presentation. Results of overall evaluation of the various components of each EIA reports show that EIA report on Emette field further development has 76.75% effectiveness while report on Ogboinbiri field in OML 63 has 81.71% overall effectiveness. It is concluded that EIA process on the two projects are adequately efficient. The researchers recommend that independent assessment of EIA process and practice in the Bayelsa state and the nation should be regularly undertaken to promote sustainable development.

Keywords. Environmental impact assessment, effectiveness, projects, process and practice.

1.0 INTRODUCTION

1.1Background of the study

Human activities on the planet earth are propelled and directed by the endless desires for a comfortable living. These endless desires have driven humans to deploy scientific, technological and industrial capabilities to explore, exploit and process natural resources to satisfy human needs. The increasing population of humans on the surface of the earth, couple with massive industrialization and development has tremendously increased the volume of human activities on earth with associated fall out of some negative consequences on the environment in which human live and operate.

The national geography (www.Education. national geography) reported that humans, impact on the physical environment in many ways. These include pressure from over population, pollution, burning of fossil fuels and deforestation of natural vegetation beyond natural revegetation ability. These impacts in turn have triggered climate change, soil erosion, poor air quality and drinkable water. All these ultimately affect human behaviour and health. Population connection (2023) reported that population growth contributes to emissions that cause global warming. Human activities have an adverse effect on the environment by polluting the water we drink, the air we breathe and the soil in which plants grow (Loannis., Elisavet., Agathangelos and Eugenia, 2020). Air pollution causes long term health effects such as respiratory, cardiovascular, mental and perineal disorders (USGCRP, 2009). This leads to children death or chronic disease in adults (Kelishadi R and Poursafa P, 2010). The problem of air pollution is even more serious in developing countries due overpopulation and uncontrolled urbanization with industrialization (Manucci and Franchini, 2017).

Environmental Impact Assessment (EIA) is an environmental management tool that has been established to manage and control the impact of development activities on the environment. The birth of EIA can be traced back to the 1970s. The first national environmental policy act (1969) was established in 1969 by the United States of

America. This is considered the beginning of EIA. EIA was initially practiced by developed countries but gradually it was introduced in developing countries including Nigeria. In Nigeria, EIA was introduced in 1992 following the dumping of toxic was in Koko in the then Bendel State by an Italian company.

The key objectives of EIA are: identifying, predicting and evaluating economic, environmental and social impacts of development on the environment, providing information on the environmental consequences for decision making and promoting environmentally sound and suitable development by identifying appropriate alternatives and mitigation measures. Although EIA is established by Law in Nigeria and is made mandatory for any proposed project that is likely to significantly affect the environment. Though it is aimed at promoting sustainable development many project proponents see it as a regulatory requirement for project approval. Egbo and Allison-Kulo, (2023) reported that there have been several complaints that EIA practices has been reduced to mere literature review process to secure project approval in Nigeria. (Nwoko, 2013) reported respondents' response on EIA report quality revealed that EIA report quality is highly dependent on the competence and experience of the developer as they are the ones who hire the consultant. (Aifeseni et al., 2014) employed checklist EIA review system to review 19 EIA reports on Oil and Gas projects in Nigeria and reported that results confirmed that Nigeria EIA process is in line with best practices. However, Nwoko (2013) reported that EIA reports in Nigeria need improvement by seeking international functioning and training.

A study by Agaja (2013) revealed that out of 53 developmental projects EIA reports in Abuja submitted to the Federal Ministry of Environment (FMEnv), 54% of the reports had low public participation, 15% had medium public participation while 31% had a high public participation. Public participation is a key factor that help to strengthen EIA process, hence if public participation is low, then it will lack the necessary input of stakeholders that will help the EIA process to achieve set objectives. The aim of this research is to assess the quality EIA reports on some projects in Bayelsa and determine the effectiveness of the process and practice.

2.0 MATERIALS AND METHODS

2.1Area of the study.

Bayelsa State is geographically located within Latitude 4°15′ North and latitude 5°23′ south and longitude 05°22′ West and 06°45′ East. Bayelsa is a state is situated in southern Nigeria, with Yenagoa as its capital. It is bordered on the west by Rivers State, on the East and South by the Atlantic Ocean and on the North by Delta State. The state has a population of 1,703,358 and occupies an area of 10,773 square kilometers. It has eight Local Government areas. These include; Nembe, Brass, Ogbia, Emeyal, Yenagoa, Southern Ijaw, Kolokuma/Opokuma, Sagbama and Ekeremor. Some major cities include Amassoma, Brass, Ekeremor, Kaiama, Nembe, Odi, Ogbia, Oporoma, Otuoke and Sagbama.

2.2 Materials

The materials used for the critical review of the quality of the EIA reports produced by some oil and gas industries in Rivers State in the course of this project include:

- The report of the Environmental Impact Assessment (EIA) of Emette Field Further Development Project proposed by Nigeria Agip Oil Company.
- The report of the Environmental Impact Assessment (EIA) of the drilling additional wells at Ogboinbiri field in OML 63, project proposed by Nigeria Agip Oil Company.
- EIA procedural guidelines of the Federal Republic of Nigeria (1992)
- Guidance on EIA & EIS Review by the European union (2001)

2.3 Methods

The methodology adopted in conducting the review of the effectiveness of the selected EIA studies is desktop research based on the (EU) EIA review checklist as a model alongside with the EIA studies procedural guidelines developed by Federal Environmental Protection Agency Now Federal Ministry of Environment (FMEnv), of the Federal Republic of Nigeria. Review according to the EU guidance, is the process of establishing whether the environmental information submitted by a developer (proponent) to a competent authority (Regulator), is adequate to inform the decision on development consent. The EU EIA review model was adopted for this review because it is consistent with the Nigeria EIA procedural

guidelines; it covers every component and segments of the Nigeria EIA guidelines. The questions raised in the checklist are so numerous, encompassing and investigative that hardly any salient point in EIA study is not touched. Above all, this EU guidance is used by most competent authorities, developers, EIA practitioners' academics and organizations in EU member states, other developed and developing Nations.

A total of one hundred and forty-four (144) EIA relevant questions are raised in the review checklist. These questions are divided into seven segments representing the legal requirement of EIA components. These include:

- 50 questions for Project description
- 5 questions for consideration of project alternatives
- 22 questions for description of Environmental baseline condition
- 38 questions for description of likely significant effects of project
- 10 questions for description of Mitigation
- 7 questions for Executive summary
- 12 questions for quality of Reporting, including a supplementary section for overall EIA appraisal by Grading and comments.

2.4 Data analysis

The results obtained from the assessment were analyzed using the formula below.

$$\%\text{Adequacy of EIA report component} = \frac{\textit{Number of yes answers}}{\textit{Total number of question in each section of EIA report}} \quad \textbf{Eqn 1}$$

$$\text{Overall \% Effectiveness of EIA Study} = \frac{\textit{Sum of sections \% adequacy}}{\textit{Total number EIA Sections}} \quad \textbf{Eqn 2}$$

In order to determine the adequacy of each of the Environmental Impact Assessment report as an effective tool for decision making, each EIA section was evaluated using equation (1) above. The percentage adequacy of all the components of each EIA report is illustrated on a pie charts and tables as shown below.

3.0 RESULTS AND DISCUSSION

3.1Results

Assessment of the report of the Environmental Impact Assessment (EIA) of Emette Field Further Development Project proposed by Nigeria Agip Oil Company was conducted. Result of the assessment of the quality of the EIA process and report on Emette Field Further Development Project is presented in Fig 3.1.

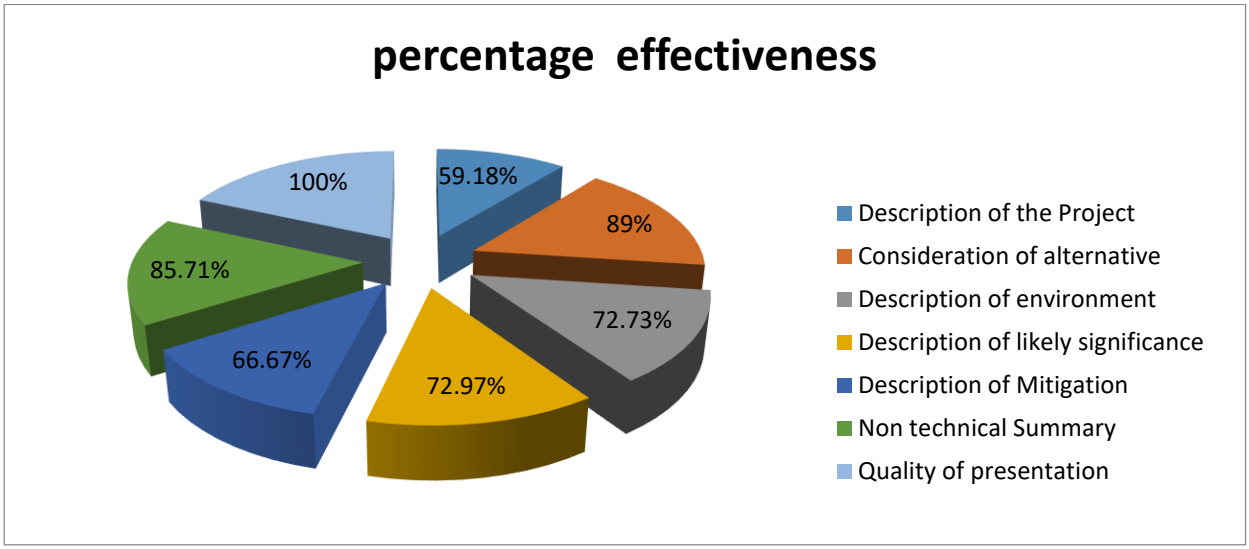


Fig 3.1: Result of the assessment of the quality of the EIA process and report on Emette Field Further Development Project (Overall effectiveness 76.75%)

Assessment of the report of the Environmental Impact Assessment (EIA) of the drilling additional wells at Ogboinbiri field in OML 63, project proposed by Nigeria Agip Oil Company was conducted. Result of the assessment of the EIA process and quality of the report is presented in Fig 3.2

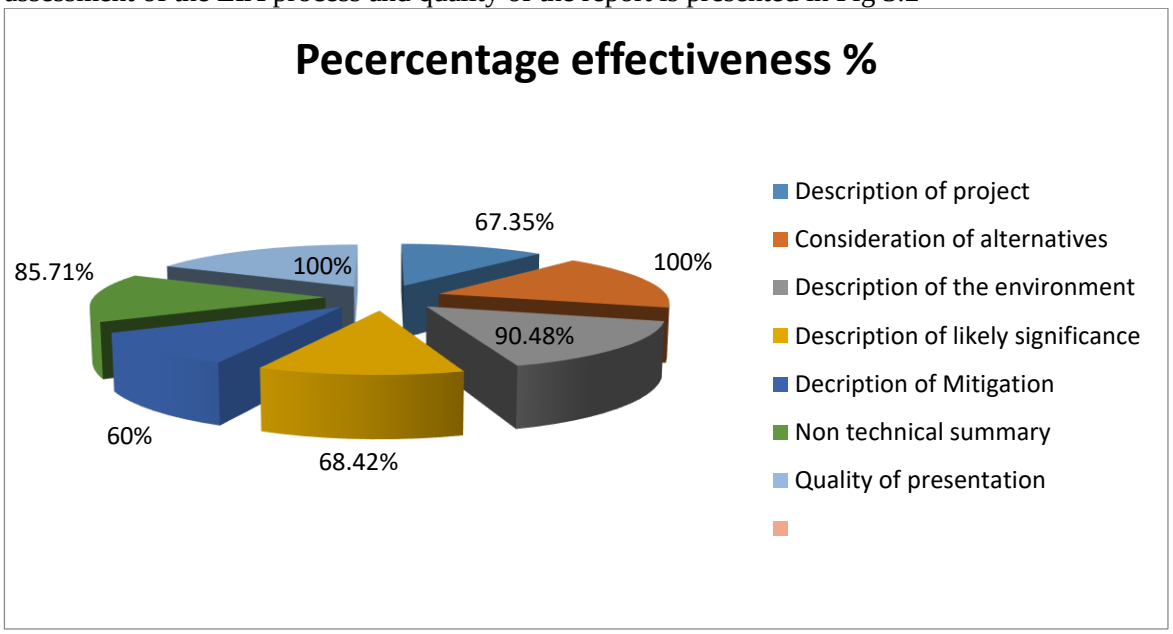


Fig 3.2: Result of the assessment of the EIA process and quality of the report on the drilling of additional wells at Ogboinbiri field in OML 63 (Overall effectiveness 81.71%)

3.2 Discussion

Environmental Impact Assessment (EIA) is recognized worldwide as an effective tool to support environmentally conscious decision making (Caucasus Environmental NGO Network, 2004). This study undertook the assessment of the effectiveness of EIA practice in Bayelsa State and compare with international best practice by reviewing the quality of EIA reports on two selected projects embarked upon in Bayelsa State. These include; assessment of the report of the Environmental Impact Assessment (EIA) of Emette Field Further Development Project proposed by Nigeria Agip Oil Company. The Project involve the site preparation for the actual drilling of an exploratory well Emette – C and associated activities, construction of a 13km flow line from the well head to Obama flow station as well as the drilling of development wells based on the results of seismic prognosis. Result of the assessment of the quality of the EIA process and report on Emette Field Further Development Project is presented in Fig 3.1. The result show description of the project score 59.18% effectiveness, consideration of alternatives has 89%, description of environmental baseline has 72.73%, description of likely significant impact of the project activities on the environment is rated 72.97%, description of mitigation measures 66.67% and non-technical summary 85.71% overall percentage effectiveness is rated 76.75%. The second assessment is on the report of the Environmental Impact Assessment (EIA) of the drilling additional wells at Ogboinbiri field in OML 63, project proposed by Nigeria Agip Oil Company. The Ogboinbiri field in OML 63 covers an area of about 22.80km^2 in Southern Ijaw local Government Area of Bayelsa State of Nigeria. The proposed project involve the development of drilling of Ogboinbiri deep A, B,C,D,E and F oil wells as well as the laying of flow lines to connect the wells to a gathering facility. Result of the assessment of the EIA process and quality of the report is presented in Fig 3.2. The result indicate that description of the project is 67.35% effectives**,** consideration of alternatives is 100% is effective, description of environmental baseline is 90.48%, description of likely significant impact of the project activities on the environment is 68.42% effective, description of mitigation measures is 60% effective and non-technical summary is 85.71%. While the entire EIA report has overall effectiveness of 81.71%.

The international best practices of EIA are anchored on key operation principles. The two reports were also evaluated on the basis of the

basic operating principles. The operating principle activities include Screening: The screening operating principles provision is to determine whether or not a propose project should be subjected to EIA and, if so at what level of details. The two reports indicate that there was screening by the regulator (FMEnv) in all the two EIAs.
The second operating principle is scoping. This operating principle activities makes provision to identify the issues of impacts that are likely to be important and establish terms of reference for EIA. The reports indicate that there was scoping. The host communities of projects and other stakeholders are supposed to be involved in scoping exercise. However, there is no indication of the involvement of people of host communities in the scoping exercise in the two EIAs. The next operating principle activity is examination of alternatives. This provides for evaluation of various project options include location to establish the preferred or most environmentally sound option for achieving the objectives of a proposal. The two reports indicate that Project options were considered and the preferred alternatives were chosen.

Impact analysis. This principle provides for the identification and prediction of the likely environmental, social and related effects of the proposed project during EIA study. The two reports show that there was impact analysis on the basis of environmental and socioeconomic impact during the study. Mitigation and impact management. This operation principle provides for establishment of the measures that are necessary to avoid, minimize or offset predicted adverse impact and, where appropriate, to incorporate these into an environmental management plan or system. There is impact mitigation and management plan in the reports.

Evaluation of significance. This principle for the determination of the importance of acceptability of residual impacts that cannot be mitigated. There is evaluation of potential significance environmental impact in the two EIA reports. Preparation of environmental impact statement (EIS) or report. This principle provides for the documentation of the impacts of the proposal, the significance of effects, and the concerns of the interested public and the communities affected by the proposed project. There is a documented report of the two EIAs. Review of the EIS. This operating principle of EIA provides for the determination whether report meets its terms of reference, provides a satisfactory assessment of the proposal (s) and contains the information required for decision making. There is an indication that review of studies were carried out. Decision making. This is provided to approve or reject the proposal and to establish the terms and conditions for implementation. Decisions for the implementation of the projects were taken in all the two EIA studies. Follow up: The operating principle provides for follow up of project implementation to ensure compliance with the terms and conditions of approval, to monitor the impacts of development and the effectiveness of mitigation measures, and where required, to undertake environmental audit and process evaluation to strength future EIA applications and mitigation measures and to optimize environmental management. Onuora and Nnubia (2021) reported that the basic challenge of the Federal Ministry of Environment which is the responsible party in Nigeria is how to translate the laudable provisions of the Environmental Impact Assessment Act into an effective tool for managing or protecting the environment. The report further stated that Environmental Impact Assessment is hardly undertaken prior to the approval of any project and the key defaulters are the various levels of government in Nigeria. Vincent D. (Choji., *et al*., 2022 conducted an evaluation of the quality of environmental impact assessment reports in the mobile telecommunications infrastructure sector in plateau state and reported that the quality of the reports were grossly inferior and unsatisfactory in many key areas. Charles and Leonard (2019) Conducted a study on the effectiveness and relevance of environmental impact assessment in the sustainability of the built environment in Nigeria: perception of three communities in Anambra State and reported that public awareness on EIA as instrument of environmental sustainability and governance as well as mitigation measures was poor.

4.0 CONCLUSION AND RECOMMENDATIONS

4.1 Conclusion

Environmental impact assessment (EIA) is a multidisciplinary study usually undertaken by a project proponent via a consultant to determine the potential and significant impact a proposed project may have on the environment, socioeconomic and health of the life of the people of the host

community (s), stakeholders so that findings of the study can be taken into consideration in decision making. EIA reports contains information that would aid environmental decision making. It contains findings on the biophysical, social and health impacts of a proposed developmental project together with positive and negative impacts (Okowa., Arokoyo and Lawal, 2021). However, quite often, decisions on projects are taken even before undertaken EIA study. This practice therefore reduces the EIA process to a mere literature review exercise.in this study a comprehensive evaluation of the different components of two EIA reports on selected Oil and Gas projects in Bayelsa State was undertaken to determine the effectiveness of EIA practice in the state. The two reports scored overall effectiveness of 76.75%. and 81.71% respectively. Is therefore concluded that EIA reports quality shows that EIA process on the two projects adequately effective.

4.2 Recommendations

The researchers recommend that independent assessment of EIA process and practice in the state and the nation should be regularly undertaken to strengthen environmental control.

Government should regularly train the staff of the ministry of environment to update their knowledge as well as improve their capabilities and competence so that they can carry out their duty effectively and efficiently.

Public participation and involvement in EIA process should be improved upon and should transparent.

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COMPUTER NETWORK DESIGN FOR NIGERIAN UNIVERSITIES

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ABSTRACT

Computer Networks are integral parts of everyday social and professional life, in the 21st century and it has a lot of positive impact on society at large. With increasing dependence on and usage of information and communication Technology (ICT) in tertiary institutions worldwide, it has become very imperative for computer systems been used in Nigeria Universities to be linked together to enhanced interconnectivity and access to information. The Objective of this project is to design a suitable network system for Nigerian universities. The target is to design a network with high-quality security and low cost, in such a way that the network devices of the university will meet standards associated with universities in developed countries. The developed system is an integration of network systems configured with IP addresses to all the devices incorporated. The network consists of routers, switches, backups, firewalls, and servers. The incorporation of the firewall device helps to prevent any unfavourable data from entering the network. All devices in the network are secured by passwords and these passwords are encrypted to be more secured. Additionally, each computer in the network is secured by antivirus programs and a backup system. The servers used for this network design are DHCP servers and DNS servers. The Nigeria university communities stand to benefit from the project as the project will enhance education, interconnectivity and information accessibility in Nigerian universities. Conclusively, the general productivity, development and stability of any University, depend so much on the Network Infrastructure as the backbone of its operations, therefore this project will be a veritable tool for the smooth educational operation of Bayelsa Medical University.

Keywords: Computer, network, design Nigeria and universities.

1. 0 INTRODUCTION

University Campus Networks play a pivotal role in the learning, management, research and other day-to-day activities of Universities. in today's Nigerian Universities where there is development in infrastructure, student increasing population, computer network plays vital role as backbone to enhance and sustain Administration, Collaborative and Digital educational system, as well as communication, access to resources and research platforms. The university communities need the computer Network to deliver quality and secure resource utilization; hence the need for a University Campus-wide Network can never be overemphasized. The increasing demand for high performance network has challenged network researchers to design network architectures that can deliver high quality service to end users (Sarkar., Bymer and Al Qirim, 2005; Magus,2011).

A Network is a combination of devices, Computers, phones, sensors and any other equipment, interlinked together to function, share Information and resources, communicate and collaborate and store Information. Ramaya (2023) defined computer network as a system that connects two or more computing devices to transmit and share information. Computer networking is the practice of transporting and exchanging data between nodes over a shared medium in an information system (Scarpati, 2023). Computer network node is any physical device within a network of other tools that is able to send, receive or forward information (Tim, 2021). A University Campus Network Infrastructure is a combination of devices within a University campus environment, for Administration, Teaching, Learning and Communication.

The functionality of a University Network Infrastructure is to serve a variety of purposes such as sharing University resources. Most often, the software resources like the University portal, Electronic Library, Human Resource System and Educational Platforms are stored in a centralised location and members of staff and student within and outside the campus environment might at some point in time require to use these resources. The ability of members of the university to

optimally utilize such resources depends on the kind of network infrastructure and policies that are inherent in the University.

Students sometimes would want to access library resources or might have to submit assignments on the learning platforms, and staff of the different departments would also want to carry out the specific task from outside their office locations, all of these are factors that must be considered in the planning of a University computer network system. Computer networking in tertiary institutions provides students with access to educational resources as well as enable staff to share information effectively, thereby increasing their productivity, efficiency, reduce cost, enhance flexibility. Many institutions in Nigeria, like the Bayelsa Medical University, are looking for solutions to integrate networks with security, backup, and other elements found in a developed country's university network. The objective of this project was to offer a local area network design suited for universities in Nigeria in Bayelsa Medical University.

2.0. EQUIPMENT AND DESIGN SELECTION

2.1 Network Topology

Network topology defines the structure of the network of how all the components are interconnected to each other (ww.javapoint.com). There are different network topologies for computer networking. A network topology determines how hosts are connected to a computer network. It characterizes how the personal computer (PCs) and other hosts are organized, and linked to each other. Available network topologies include Point-to-Point, Bus, Star, Ring, and Mesh topology. Each type has a different set of advantages and disadvantages. However, for this project, the star network topology was selected because it is best suited for the purpose of the project.

Star Topology

The star topology is generally used for all networks whereby each device or computer is connected to a central hub by a direct line. The centre hub can be a switch, router, or server. Each computer connects directly to the centre device such as the hub, router, and server. A star topology is designed with each node connected directly to a central network hub, switch, or concentrator. It is easy to add and remove a computer from the network without affecting the network. It is easy to replace, install or remove hosts or other devices. A problem in the network can be easily detected, t is easier to modify or add a new computer without disturbing the rest of the network by simply running a new line from the computer to the central location and plugging it to the hub. Furthermore, the cost of this network topology is less. The star topology network connection was used for this design because each computer is independent of other computers in the network, and it is less expensive than mesh and ring topology and easy to install.

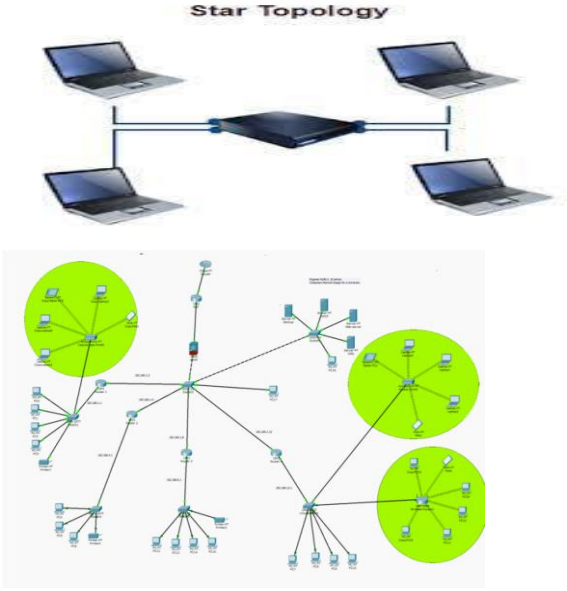


Fig 2.1: Star topology

Figure 2.1: The access point is star topology

2.2 Choice of network connection

Wireless

There are different methods of equipment connection for computer networking. However, for this project, the wireless connection is adopted. Wireless is used to depict media communications in which electromagnetic waves transfer the signal over part or most of the transmission path, so there is less need for a cable. There are many advantages of wireless transmission when compared to wire. The advantages of wireless connection include easy network installation, increase accessibility, wide reach, flexibility, efficiency and cost effectiveness (Prasanna, 2023). The wireless that is used in this network design is (802.11). The 802.11 is an advanced group of details for WLANs developed by a group in the Institute of Electrical and Electronics Engineers (IEEE). Mobility is less limited and can provide wide coverage over a long

distance. Thus, making use of wireless is of great benefit to users of this network design. All Wi-Fi devices are secured by a password. The password prevents unauthorized users to connect to the Wi-Fi network. This is because the network could easily be hacked when it is open to all users, especially unauthorized users who can overcrowd the network, making it work very slowly. Also, a limited number of IP addresses that are reserved for the real users of the network can be taken by unauthorized users. To connect the wireless, Cisco access point is used, and at least one access point is installed in each building. The number of access point Installations depends on the size of the building.

Connection Setup

The obvious way, given the constraints, to connect devices is for all computers to be connected to switches, and then switches must be connected to the routers. After that, all routers connect to the last switch to link with the edge switch, in which various servers, such as the DHCP server and DNS server, are connected. The last switch is also connected to a firewall device. The firewall device links to the NAT router and then to the external networks or internet. The Fig 2.3 below shows the connection setup of all devices.



Fig 2.3: Integration network system

Devices Used

The devices used, in this project are routers, switches, servers, etc. All were chosen from the Cisco Company. This is because the quality of Cisco devices is much better than other devices. According to the Cisco website, With Cisco network systems, intelligent network services, such as quality of service (QoS) and encryption, are consistently supported and preserved across the entire network, enabling the security, and high-quality service delivery regardless of whether the user is at the main campus or in a satellite campus. The number of hosts used is 5075 for the network and is distributed among various sections in the university.

2.3 Features of the Network Infrastructure

Infrastructure

Infrastructure powers all functions on the network. Network infrastructure is the backbone that connects people and business to each other (Ron, 2022). The network infrastructure includes all base devices in the network. When all base devices are protected, the network system will be secured. This is because the data passing from the outside of the local network must pass through those devices into the local network. The devices used for infrastructure in this network design are a virtual switch, backup systems, firewalls, and DNS.

Virtual switch

A virtual switch accomplishes more than simply forward information bundles. It keenly coordinates the correspondence on a network by checking information parcels before moving them to a destination.

Backup

Backup creates duplicates, and this is a greater degree of protection. It is through creating backup copies saved both in the same workplace or another location, updated on a regular basis, that ensure the least amount of losses in the case of the original data loss. Backup helps to reduce human error (www.nordic.backup).

Firewall

The firewall prevents external users from gaining access to the network resources and local data and thereby securing the network and its resources from external threats.

Domain Name System (DNS)

Domain Name System (DNS) device directs local and Internet movement to the proper target by performing real-time look-ups of Internet addresses with different DNS servers situated on the Internet. Prior to a local computer to sending a DNS server.

Encryption Passwords

Encryption Passwords**.** Each host must have its own password for authentication control. Encryption of Passwords is the only authorization process to gain access to the information in the network. The password must be different from one device to another, depending on the user of the device.

Individual Hosts

The number of attacks worldwide has risen in recent times due to the constant development of sophisticated software. Each person or host must have his/her security to protect their data from hackers. Every host must secure their data from attack and protect their information from being stolen. A professor preparing questions for an exam to administer to his students should be able to ensure the exam remains confidential on the network under consideration. If the exam questions are not private, all students will see the exam questions. This will cause a serious academic integrity problem. So, each professor must secure their data. Also, students must secure their grades and assignments from other students. Security is very important in preventing others from seeing their personal information. There is much software to secure each host device, such as antiviruses, update and patching tools, basic support and server room.

Antivirus:

Antivirus is dedicated computer software's that help in detecting cyber threats such as malicious, spywares and phishing program in the system (intellipaat, 2023). The antivirus prevents viruses from been active in computers in the network to make the network become fully protected from threats.

Switches

Switches are devices used on the network to transmit and receive data from one device to another or many devices, depending on the message intended. A switch provides the full bandwidth of the network to each port, thereby reducing collisions on the network. Switches also perform functions from the Data Link Layer (Layer 2 on the OSI [Open Systems Interconnection] Model

Routers

A router is a networking device that forwards data packets between computer networks. The router chooses the best path to transfer data packets to their destination in the most efficient manner. Think of a router as a traffic cop at a busy intersection. This traffic cop determines which vehicles get through, which vehicles are not permitted on the path and the destination that the vehicles may take. Since the network must connect many computers to many switches, the router is an important component of the network. The router will control switches in a hyper-star topology.

NAT System

NAT stands for Network Address Translation. It is a software tool that translates numerous private IP addresses from the LAN to one public IP address that is required for access to the Internetwork (Internet or WAN: Wide Area Network). NAT devices are used to connect an isolated address realm with private unregistered addresses to an external realm with globally unique registered addresses.

Wireless Access Point

An access point is a wireless service device used for networks. Wireless access point service plays a significant role in this design and is very important for educational institutions. The Access point devices connect to the router directly. Each access point device is placed in an area to distribute the internet for that particular area.

Servers

The term server refers to a device or a computer program that supports other devices or programs called clients. This is known as the client-server model; one server can support many clients and give different functionalities or characteristics to different clients. The few servers used in this project are the DHCP and DNS servers. The Domain Name System (DNS) is a server service that maps a domain name to IP addresses. The DNS server translates a domain name to the IP address. IP address contains 32 bits. Since people cannot easily memorise all numbers of IP addresses, it is easier for them to memorize the domain names of IP addresses. The DNS server is connected to the switch and then to the router. The IP address for the DNS server is static, and the IP

address used is 199.8.8.8. The configuration of the DNS server is shown in the Fig 2.4 below.

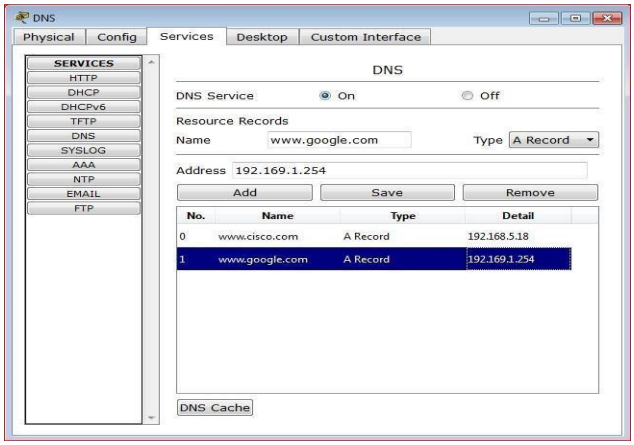


Figure 2.4: DNA configuration

Server Room

Server Room is a room where all major devices (servers, routers, firewall, DNS… etc...) are securely placed. All the devices are placed in a standard way in a rack in the server room. Only authorized personnel who have permission to maintain, install, protect, secure, design, and monitor network devices are allowed into the server room.

Update and Patching Tools

All devices in the network are programmed by software such as the operating system (OS). Over time, this software loses some characteristics which make it vulnerable to attacks. Sometimes, companies make software for devices. Then, that company might want to develop that software or test it to see if there are some problems with that software. If there is any problem with the software, the company will publish a new or higher version of the software, usually with a patch to fix the old problems to make it more secure. The important thing that companies focus on is security when updating the software to a new version. All devices in the network need a software update for the security of the network devices and data.

2.4 Basic Support

All universities have specialised technicians for managing the network devices. The Bayelsa Medical University must have specialised technicians for managing the network devices. These specialists must have skills in networking. If they do not have experience, it will affect the whole network system. For example, when a device such as a router does not work or breaks down, and if a person does not have enough experience to fix that problem, it may affect the whole network. So, network technicians must take networking courses to gain enough experience on how to fix the problem of the network system.

3. 0 IMPLEMENTATION

The first step is to configure all the personal computers. Each personal computer must be connected to a switch. Each computer needs a unique Internet Protocol (IP)
address.

3.1 Expectations and ongoing Challenges, Options, and Possible Future Evolution

An operating network will face challenges over its lifespan. One big challenge this design will face is economic problems. This is because a key requirement has been cost on making reduction suitable for Bayelsa Medical University. As a result, robust materials and fewer numbers of complex devices, such as servers, will be used. If there are improvements in the economy in the future, the network materials and the number of devices used will be upgraded or extended. For example, in the future, more servers can be added to the already existing three servers as a form of system-wide upgrade.

Furthermore, more than one backup device can be added to save the network's data. Accordingly, it is necessary to include room for future development plans. For instance, this project's network design has an extra number of IP addresses for the future. The network needs 5075 hosts while it has 8190 hosts. In the future, the Bayelsa Medical University can connect 3115 additional hosts, which can be included without exhausting available IP addresses.

3.2 Scenarios and Issued to be should be considered for the optimal functioning of the network

Quality of Devices

The quality of the network device is vital for the network. When the device has good quality, the number of issues in the network will be reduced. Cisco Company is known for their good quality network devices. According to the Cisco website, "With Cisco network systems, intelligent network services, such as quality of service (QoS) and

encryption, are consistently supported and preserved across the entire network, enabling the same secure, high-quality service delivery regardless of whether the user is at headquarters or in a local branch." As a result, all devices used for this research are Cisco devices, such as routers, switches, access points, services, and firewalls. One reason for patronising Cisco devices is the high protection service that its devices provide, which will be highly relevant to important information of the University. It is important for a network to continue working all the time and should never stop for any reason. A network failure can disrupt academic activities. All staff, professors, and students need the network most of the time. For example, suppose a network stops for any reason. In that case, the students cannot submit their assignments, exams can be halted, and every other student's academic activities that use the network will be stopped. Also, professors will not be able to attend online class sessions until the network starts working again. Cisco devices are very strong at withstanding such network failures. Therefore, using Cisco devices will minimise possible network failures for this project's implementation.

Backup

As a form of best practice, organisations and companies always place Backup server offsite. A backup system is a mechanism for storing data in the network, allowing storage and recovery if needed. Network backup is an integral part of the backup and recovery process in an IT environment (Rouse, 1014). The data in the backup are updated periodically depending on how the backup schedule is configured. The data stored in this platform are very important and must be protected from any loss. To protect these data, more than one backup server is strongly preferred, and the location of the backup server must be far away from the location of the original data. However, the cost will be high when the backup device is placed in another location. If a budget allows, more than one backup server device and the backup server will be placed in other continents, separate from the location of the local area. As an extreme example, if the local area network is in the Asian continent, the backup device can be placed in another continent, such as the North or South American continent or the Australian continent. This is because if natural disasters such as earthquakes, floods, hurricanes, volcanoes, etc., occur in the location of the local network, the backup data will not be affected since its location is far away from the disaster.

Evolution/ Optional Additions

Budget plays a significant role in the design of the network in terms of quality, device selection, and network security. The budget for this network design is limited. When the budget is limited for designing the network, the designer must utilise specific devices that the available budget can afford. Therefore, if the budget is high, devices that could be used include optical fibres, firewalls, backup devices, two networks for security and many servers.

Optical Fiber

Optical fibre cable is a medium for transferring information. Fiber-optic communication is a method of transmitting information from one place to another by sending pulses of infrared or visible radiation through an optical fiber (Macintosh, 2014 and www.thefoa.org). This cable is more expensive than other cable types, less noisy than twisted pair cable, faster, and mostly used for long-distance transmissions. However, "from around 2005, the development of the continuous extrusion techniques began in earnest, and by 2008 40-Gb transmission was developed. This was the world's fastest transmission speed, surpassing the GI type silica optical fibre. These results were achieved through joint research with Asahi Glass.

4.0 CONCLUSION AND RECOMMENDATIONS

4.1 Conclusion

All networks need many servers to do their work. For this research, the use of servers was minimized because of cost, hence only few but very important servers such as DNS and DHCP were used in the project. These servers help the network to perform their functions smoothly. This Research has proven that a standard network system can be designed with less cost. We used the cheapest devices in designing the network, the security of this network turned out to be very strong. This is because the firewall and backup devices used in this network are of good quality. This design allows for future expansion, as universities can connect 3115 additional hosts, allowing for per-host costs, like cabling. The additional hosts can be included without exhausting the available IP address. Also, if there are high budgets, they can develop the network system to become more

powerful and have a high level of security, and many servers can be added to the network.

4.2 Recommendation

The design allows for future expansion therefore the researcher recommends that the University management should work toward expanding the network as the university community expand.

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DIGITAL LEADERSHIP AND ORGANIZATIONAL RESILIENCE OF MANUFACTURING FIRMS IN SOUTH-SOUTH OF NIGERIA

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ABSTRACT
The study examined the relationship between digital leadership and organizational resilience of manufacturing firms in South-South of Nigeria. The study adopted a cross sectional survey research design. The population of the study covers 48 manufacturing firms in South-South of Nigeria. The unit of analysis was 240 respondents consisting of general managers, production managers, marketing managers, financial managers and human resource managers in the 48 manufacturing firms. A total of 240 (100%) copies of the questionnaire were distributed to the respondents and 178 copies representing 74.2% were retrieved. Bivariate data analyses were conducted to test the research hypotheses by Spearman's rank correlation via (SPSS Version 23.0). Correlation analysis result show that strategic vision and organizational resilience correlates at r = 0.882) when the P-value is .000 < 0.01. This indicates a very strong and positive relationship. Hence the null hypothesis was rejected and accepted the alternative hypothesis. Technological expertise and organizational resilience correlates at (0.836) when the P-value is .000 < 0.01. This indicates a moderate and positive relationship. Hence, the study rejected the null hypothesis and accepted the alternative hypothesis. The result also indicates that data-driven decision making and organizational resilience correlates at (0.753) when the P-value is .000 < 0.01. This indicates a moderate and positive relationship. Thus, null hypothesis was also rejected and the alternative hypothesis accepted. Based on the results obtained, it is concluded that digital leadership has a significant positive relationship with organizational resilience. It is therefore recommended that manufacturing firms in South-South Nigeria should invest in digital technological infrastructure to enable the adoption of new technologies and support effective communication and collaboration.

Keywords: Digital Leadership, organizational resilience, manufacturing firm and strategic vision.

1.0 INTRODUCTION

In this modern business world, organizational resilience has become essential for organizations to thrive in a rapidly changing and uncertain environment. Organizational resilience is the ability of an organization to adapt, withstand, and recover from disruptions, challenges, and unexpected events. Organizational resilience enables organizations to adapt to changing circumstances and emerging threats, helping them to remain relevant and competitive in the marketplace (Hamel & Välikangas, 2003). Resilient organizations are better equipped to identify and mitigate risks, reducing the likelihood and impact of disruptive events (Reeves & Deimler, 2018). Organizational resilience ensures business continuity, enabling organizations to maintain operations and serve their customers even during times of crisis or disruption (Nagpal, 2018). Resilient organizations are able to embrace change and uncertainty, fostering a culture of innovation and growth (Weick & Sutcliffe, 2001). Resilient organizations prioritize employee well-being, creating a supportive and empowering workplace culture that promotes health, safety, and work-life balance (Cameron & Caza, 2004). Therefore, organizational resilience is a critical capability for organizations seeking to thrive in today's fast-paced and uncertain environment. By building a culture of resilience and investing in the right people, processes, and technologies, organizations can enhance their ability to adapt to change, mitigate risks, and drive innovation and growth.

Although several studies have examined some factors that improves resilience of organizations such as leadership and culture (Coutu, 2002). Resilient organizations have strong and adaptive leadership that fosters a culture of innovation, agility, and risk-taking (Coutu, 2002): Diversity and inclusivity (Holt & Marques, 2012). Resilient organizations value and leverage diversity in their workforce, including diversity in gender, ethnicity, culture, and skills.

Although scholars have put in efforts to examine the range of factors that improves organizational resilience, however, the concept of digital leadership has not been studied as a widely studied as empirical research in literature. Digital

leadership refers to the ability of individuals or organizations to leverage digital technologies to achieve their goals and objectives. It involves the use of technology to enhance decision-making, communication, collaboration, innovation, and performance among others. Digital leaders must possess a combination of technical, strategic, and interpersonal skills to effectively navigate the complex and rapidly changing digital landscape. One important aspect of digital leadership is the ability to set a strategic vision. Digital leaders must have a clear strategic vision for how technology can be leveraged to achieve organizational goals and drive innovation. Technological expertise: Digital leaders should have a strong understanding of the latest technologies and digital tools, as well as the ability to evaluate their potential impact on the organization. Data-driven decision making: Digital leaders must be able to collect, analyze, and interpret data to inform decision-making and drive business outcomes.

According to a study by Deloitte, "leaders who harness the power of data and analytics are more likely to succeed in today's digital economy" (Deloitte, 2019). Digital leaders must be able to collect, analyze, and interpret data to make informed decisions and drive business outcomes. Despite these range of factors that improves organizational resilience, the concept of digital leadership has not been thoroughly studied to gain a wider recognition in literature through empirical research. This show that studies that examined the relationship between digital leadership and organizational resilience is still at low level in literature. Hence, to bridge this gap, the present study examined the relationship between digital leadership and organizational resilience in manufacturing firms in South-South of Nigeria.

1.1 Statement of the Problem

The problem addressed in the study of digital leadership and organizational resilience of manufacturing firms in South-South Nigeria is the lack of understanding and adoption of digital technologies and strategies, as well as the limited focus on organizational resilience in the face of unexpected disruptions, such as economic downturns, natural disasters, and pandemics. Manufacturing firms in southern Nigeria face unique challenges in terms of accessing and implementing digital technologies due to limited infrastructure and resources. As a result, many firms may struggle to keep pace with digital transformation trends and fail to develop the necessary competencies to adapt to changing business environments. In addition, the study highlights the need for manufacturing firms in South-South Nigeria to prioritize organizational resilience as a means of maintaining operational continuity and achieving long-term success. This requires a comprehensive approach to risk management, including the development of contingency plans, the identification of key risks, and the implementation of measures to mitigate those risks.

Overall, the problem addressed in the study is the lack of understanding and adoption of digital technologies and strategies, as well as the limited focus on organizational resilience, which can leave manufacturing firms in South-South Nigeria vulnerable to unexpected disruptions and hinder their ability to achieve long-term success.

1.2 Aim and Objectives of the Study

The aim of the stud is to examine the relationship between digital leadership and organizational resilience of manufacturing firms in South-South of Nigeria.

The objectives of study are to:

i. Examine the relationship between strategic vision and organizational resilience of manufacturing firms in South-South of Nigeria
ii. Examine the relationship between technological expertise and organizational resilience of manufacturing firms in South-South of Nigeria
iii. Examine the relationship between data-driven decision making organizational resilience of manufacturing firms in South-South of Nigeria.

Research Questions

i. What is the relationship between strategic vision and organizational resilience of manufacturing firms in South-South of Nigeria?
ii. How does technological expertise relate to organizational resilience of manufacturing firms in South-South of Nigeria?
iii. What is the relationship between data-driven decision-making organizational

resilience of manufacturing firms in South-South of Nigeria?

Research Hypotheses

HO₁: There is no significant relationship between strategic vision and organizational resilience of manufacturing firms in South-South of Nigeria

HO₁: There is no significant relationship between technological expertise and organizational resilience of manufacturing firms in South-South of Nigeria

HO₁: There is no significant relationship between data-driven decision-making and organizational resilience of manufacturing firms in South-South of Nigeria.

Scope of the Study

Content scope: The content scope of the study is the theoretical domain of digital leadership and they are examined using their theoretical components which include strategic vision, technological expertise, informed decision-making for the predictor variable and organizational resilience as the criterion variables.

Geographical scope: The study was conducted among manufacturing firms in South-South of Nigeria.

Unit of analysis: The study unit is at the organisational (macro) level as the study only examined the management team of the firms investigated.

Significance of the Study

The study of digital leadership and organizational resilience is significant for several reasons: Increasing importance of digital transformation: In today's rapidly evolving business landscape, digital transformation is no longer an option but a necessity. Organizations need to adopt new digital technologies to remain competitive and relevant in the market. Understanding how digital leadership can foster organizational resilience is critical for the success of such transformation efforts.

Growing complexity and uncertainty: The business environment is becoming increasingly complex and uncertain. Disruptive technologies, changing customer preferences, and geopolitical risks can all have a significant impact on organizations.

2.0 REVIEW OF RELATED LITERATURE

2.1 Conceptual Review

As a study, it's important to first identify and then explain the core components of the study variables and then link them with organizational resilience The diagram below depicts the independent and dependent variables in the conceptual framework for the study.

Conceptual Framework

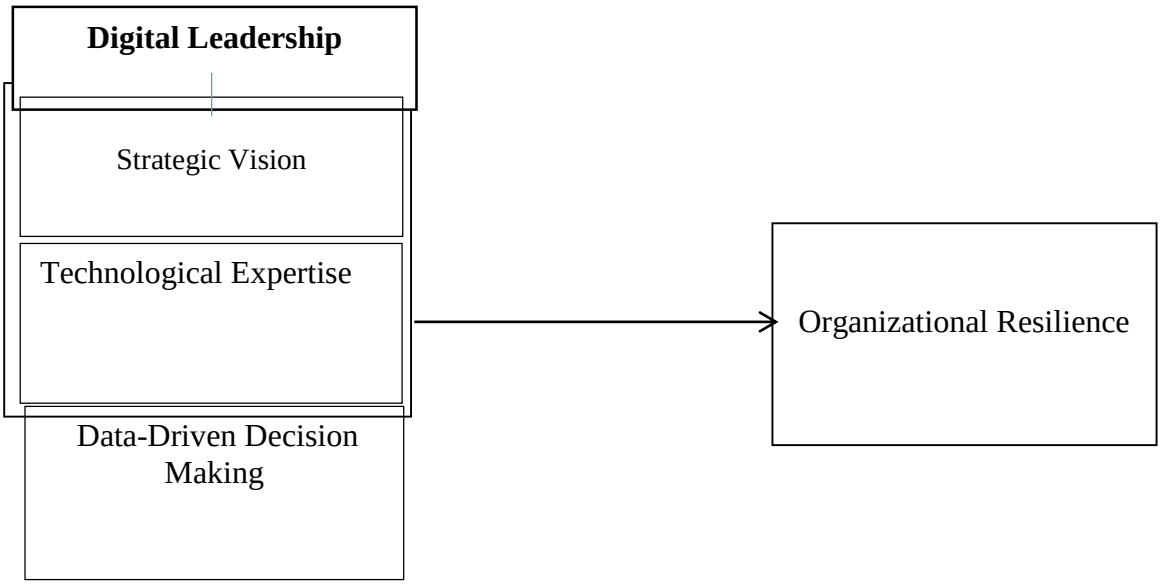


Figure 1. Conceptual framework on digital leadership and organizational resilience
Source: Research Survey (2023).

Concept of Digital Leadership

Digital leadership refers to the ability of individuals or organizations to leverage digital technologies to achieve their goals and objectives. It involves the use of technology to enhance decision-making, communication, collaboration, innovation, and performance. "leaders who harness the power of data and analytics are more likely to succeed in today's digital economy" (Deloitte, 2019).

Another key characteristic of digital leadership is the ability to foster a culture of innovation and experimentation. In a digital environment, organizations must be able to adapt quickly to changing circumstances and opportunities. Leaders who encourage experimentation, collaboration, and risk-taking are more likely to be successful in this environment.

Finally, digital leaders must be able to communicate effectively in a digital context. This includes the ability to use a variety of digital communication tools and platforms to engage with stakeholders, build relationships, and influence others. Digital leaders excel at communicating the vision, values, and culture of the organization in a way that inspires and motivates others" (MIT Sloan Management Review, 2020). Thus, digital leadership is a critical skill set for individuals and organizations in today's digital economy.

Strategic Vision

Digital leaders must have a clear strategic vision for how technology can be leveraged to achieve organizational goals and drive innovation. Strategic vision refers to an organization's long-term goals and aspirations, which guide its decision-making and actions. It is a critical component of effective leadership, as it provides direction and purpose for the organization.

According to Hamel and Prahalad (1996), a strategic vision should be "an imaginative conception of what a firm could be or what it could achieve." They argue that a strategic vision should be future-oriented, challenging, and provide a sense of purpose and direction for the organization. A well-crafted strategic vision can also be a source of competitive advantage, as it can differentiate the organization from its competitors

Technological Expertise

Digital leaders should have a strong understanding of the latest technologies and digital tools, as well as the ability to evaluate their potential impact on the organization. Technological expertise refers to the knowledge and skills required to effectively leverage technology in the workplace. It includes an understanding of how technology works, the ability to troubleshoot technical issues, and the ability to identify and implement new technologies that can improve organizational performance.

Technological expertise is a crucial component of organizational performance in today's digital age. Employees who possess the necessary technological expertise can help businesses leverage technology to improve productivity, reduce costs, and stay competitive. Research has shown that there is a strong relationship between technological expertise and organizational performance.

Data-Driven Decision Making

Digital leaders must be able to collect, analyze, and interpret data to inform decision-making and drive business outcomes. Data-driven decision-making is the process of making decisions based on data analysis rather than intuition or guesswork. In today's data-rich environment, businesses are increasingly relying on data-driven decision-making to gain insights into their operations and make more informed decisions. The concept of data-driven decision-making is widely recognized as a critical component of organizational success. One of the main benefits of data-driven decision-making is the ability to make more informed decisions. By analysing data, businesses can gain insights into their operations and identify areas for improvement. Research has shown that organizations that adopt data-driven decision-making tend to outperform their peers. McKinsey & Company (2018) found that companies that use data analytics to make decisions tend to have higher levels of productivity and profitability than companies that do not.

A study by Li et al. (2021) found that data-driven decision-making can improve an organization's agility. A Similar study by Berman and Thelen (2020) found that organizations that use data analytics to monitor their supply chains are better able to respond to disruptions and minimize their impact. A study by Hu and Ye (2018) found that

data-driven decision-making can help organizations identify new market trends and customer preferences, which can be leveraged to create new products and services.

Concept of Organizational Resilience

A diverse workforce can bring different perspectives, ideas, and solutions to the table, helping the organization navigate complex challenges (Holt & Marques, 2012). Resilient organizations engage in strategic planning and risk management activities to identify potential threats and develop proactive mitigation strategies. This includes scenario planning, risk assessment, and contingency planning (Bhamra et al., 2011). Resilient organizations prioritize the well-being of their employees and provide them with support during times of stress or crisis. This includes mental health support, flexible work arrangements, and employee assistance programs (La-Montagne et al., 2007).

Organizational resilience is the ability of an organization to adapt to unexpected changes, disruptions, or crises while continuing to function effectively. In today's rapidly changing business environment, organizational resilience is a critical component of success. The concept of organizational resilience is widely recognized as essential for organizations to thrive in the face of uncertainty. One of the key elements of organizational resilience is the ability to anticipate and prepare for potential disruptions. By identifying potential risks and developing plans to mitigate them, organizations can reduce the impact of unexpected events. For example, a company might develop a business continuity plan to ensure that critical operations can continue in the event of a natural disaster or cyber-attack.

Another element of organizational resilience is the ability to respond effectively to disruptions when they occur. This might involve quickly adapting to new circumstances or implementing contingency plans to minimize the impact of disruptions. For example, during the COVID-19 pandemic, many organizations quickly shifted to remote work to maintain operations while minimizing the risk of infection. Research has shown that organizations that are more resilient tend to outperform their peers. For example, a study by the Boston Consulting Group (2020) found that companies with high levels of organizational resilience had higher levels of revenue growth and profitability than companies with lower levels of resilience. To develop organizational resilience, businesses must adopt a proactive approach to risk management and develop a culture of resilience. This might involve investing in risk assessment tools, training employees on crisis management techniques, and creating a culture of openness and transparency that encourages communication and collaboration. Another study by Linnenluecke and Griffiths (2010) found that companies with a strong commitment to sustainability were more resilient and better able to manage environmental risks. The authors argue that this resilience translated into improved financial performance as sustainable companies were better able to adapt to changing environmental conditions and regulatory requirements. To achieve organizational resilience and improve performance, businesses must adopt a proactive approach to risk management and develop a culture of resilience.

2.2 Theoretical Review

There are several theories that help explain the relationship between digital leadership and organizational resilience. In this study, four theories were used. These are Transformational, Leadership theory, transformational leadership theory, resource-based theory, dynamic capability theory and social learning theory. Transformational leaders inspire and motivate their followers to achieve their full potential and drive innovation within the organization. This theory suggests that leaders who can effectively communicate a vision for digital transformation and encourage employee buy-in can help develop a culture of innovation and increase organizational resilience (Bass, 1985).

Resource-Based Theory

Resource-based theory suggests that organizations can gain a competitive advantage by leveraging unique resources and capabilities. In the context of digital leadership and organizational resilience, this theory suggests that organizations can develop resilience by investing in technology, data-driven decision-making, and technological expertise, which can provide unique resources and capabilities that competitors may not possess. (Barney, 1991)

Dynamic Capability Theory

Dynamic capability theory suggests that organizations must be able to adapt to change in order to remain competitive. This theory suggests that leaders who can develop a culture of innovation and agility, invest in technology, and develop the necessary skills and knowledge to effectively use technology can build dynamic capabilities that allow them to adapt to unexpected changes and disruptions (Teece et al., 1997).

Social Learning Theory

Social learning theory suggests that individuals learn from observing others and through social interactions. In the context of digital leadership and organizational resilience, this theory suggests that leaders can develop organizational resilience by creating a culture of knowledge sharing and collaboration, which can facilitate the development of technological expertise and data-driven decision-making skills (Bandura, 1977). Overall, these theories provide insights into the mechanisms through which digital leadership and organizational resilience can be developed and sustained, ultimately leading to improved organizational performance.

2.3 Empirical review

Few studies have found that digital leadership can contribute to organizational resilience by enhancing the organization's agility, adaptability, and innovation capabilities. For instance, a Li et al. (2021) reported that digital leadership practices such as data-driven decision-making, agile methodologies, and open innovation can improve an organization's ability to respond to disruptions and uncertainties. Similarly, a study by Karimi et al. (2021) found that digital leadership can improve an organization's ability to adapt to changes in the business environment, such as shifts in customer preferences or technological advancements.

Moreover, digital leadership can also help organizations build resilience by enabling them to leverage digital technologies to create new business models, products, and services. For example, a study by Aral et al. (2019) found that digital leadership practices such as leveraging social media and big data analytics can help organizations create new value propositions and revenue streams. Thus, digital leadership can contribute to organizational resilience by enhancing an organization's agility, adaptability, and innovation capabilities. By leveraging digital tools and technologies, digital leaders can help their organizations build resilience in the face of uncertainty and change. Digital leadership and organizational resilience are closely intertwined, as the ability to leverage technology and digital tools is essential for organizations to adapt to and thrive in rapidly changing environments. Digital leadership can help organizations develop the agility and flexibility needed to withstand disruptions while also driving innovation and growth.

In addition, digital leadership can help organizations build robust digital infrastructure and systems, which can enhance their ability to respond to disruptions. For example, cloud computing, data analytics, and artificial intelligence can help organizations identify emerging risks and opportunities while also enabling remote work and collaboration. Overall, digital leadership is essential for building organizational resilience in a rapidly changing digital landscape. Leaders who embrace technology and digital tools can develop the agility, flexibility, and innovation needed to thrive in a world of constant disruption.

Summary and Gap in Review of Related Literature

While there is existing literature on the relationship between digital leadership and organizational resilience, there are still gaps that need to be addressed. One notable gap is the lack of empirical research on the specific digital leadership practices that contribute to organizational resilience. Although there is some evidence to suggest that digital leadership can enhance an organization's ability to adapt and innovate, there is limited research on the specific digital leadership practices that contribute to resilience.

Another gap in the literature is the lack of research on how digital leadership can contribute to resilience in different types of organizations, such as small and medium-sized enterprises (SMEs) or non-profit organizations. Most of the existing research has focused on large, established organizations, and it is unclear whether the relationship between digital leadership and resilience holds for other types of organizations.

3.0 METHOD

A cross sectional research design can be defined as a snapshot of a population in a given period of time. Hence, in this study, the cross sectional research design was adopted because it guides the study to collect data at the particular time of the research and analyze it to generate findings.

3.1 Population of the Study

A research population is the entire group of events, people or things of interest that the researcher intends to examine. The available record indicated that there are 167 manufacturing firms in South-South of Nigeria (Manufacturing Association of Nigerian, South-South Zone, 2022). However, the actual functional firms in operations during the time of this study were 62 firms. Due to difficulty in reaching all the 62 operating firms, the study examined 80% of these firms which amount to 48 firms as accessible population of manufacturing firms for this study. Therefore, the population of forty-eight (48) manufacturing companies in South-South of Nigeria was chosen using a census sampling method.

3.2 Sample/Sampling Technique

The forty-eight (48) manufacturing firms serve as the population of the study since the population size was not large. In this situation, the researcher studied 48 manufacturing firms for this study. The unit of analysis was the macro levels therefore only those who occupied the organizational level were examined. These were the top managers, production managers, product development managers, marking managers and financial managers resulting in a total number of 240 respondents. This study used structured copies of the questionnaire to elicit primary data from the respondents for the study, while the secondary data was sourced from journal papers, newspapers, textbooks, published government records, and websites.

3.3 Instrumentation/Measurement

The data for this research were collected from both primary and secondary sources. The primary data was collected mainly through a structured questionnaire. The questionnaire was divided into two parts. The first part covered the demographic representation of the various respondents while the second part covered the respondents' ideas and opinions relating to the studied variables. The 240 copies of the questionnaires were personally administered to respondent by the researcher.

3.4 Measurement

The predictor variable (digital leadership) has three dimensions, which include strategic vision, technological expertise and data driven decision making. While organizational resilience was the dependent variable. Each of these variables was measured on a Likert scale ranging from strongly agreeing to strongly disagreeing. Where 1 means strongly disagree, 2 means disagree; 3 means undecided; 4 means agree and 5 means strongly agree.

3.5 Validity of Instrument

Validity is the extents to which a particular research instrument measure what it is actually intend to measure (Baridam. 2001). In this study, steps were taken to ensure the validity of the measuring instrument. The validity of the instrument in this study was ascertained using the content validity. This was done by subjecting the instrument to experts who carefully examined the content for suitability for data collection. The Cronbach Alpha coefficient, which is the most generally used internal consistency indicator, was employed to verify the instrument's dependability. When it comes to internal consistency, however, most experts agree that a minimum of 0.70 was required (Nunnally, 1978). This was accomplished by loading all variables into version 23.0 of the Statistical Package for Social Sciences (SPSS), a statistical data programming tool designed to handle sophisticated analysis. The following results were obtained. All 43 items met the benchmark score of 0.7 or higher, which Cronbach (1951) recommended as the research instrument's reliability level. The study claims that the research tool utilized in this study was accurate and measured the variables it was intended to. The outcome displays a Cronbach alpha of 0.7 or higher, was sufficient for all of the items under examination.

3.6 Administration of Instrument

The research instrument was split into two components, A and B. Section 'A' contained demographic data, whilst Section 'B' contained data on the research variables. The researcher personally distributed the questionnaire to the respondents and was assisted by two under-graduate students so that they can learn in

preparation for their final year project requirement. Detailed instructions for filling out the questionnaire were provided, and the questionnaire was returned promptly. The use of a questionnaire to collect data was advantageous since it allowed respondents to consider the questions before responding.

3.7 Data Analysis and Results

The association between digital leadership and organizational resilience was tested using Pearson Product Moment Correlation Coefficient. All of these were conducted using statistical package for social sciences.

Questionnaire Distribution and Retrieval

A total of 240 (100%) copies of the questionnaire were distributed to the respondents based on Table 4.1. Out of this total, 178(74.2%) copies were recovered, meaning 62(25.8%) of the total copies of the questionnaire were left unanswered. The researcher next went on to assess copies of the questionnaire that had been returned.

Table3.1: Descriptive Analysis of the Study Variables

Descriptive Statistics

	Mean	Std. Deviation	N
Strategic vision	3.4070	1.66188	178
Technological expertise	3.0814	1.70959	178
Data-driven decision making	3.3721	1.78916	178
Organizational resilience	3.5349	1.74017	178

Source: Research Survey (2023)

3.8 Test of Hypotheses (Bivariate Data Analyses)

Bivariate data analyses focus on test of hypotheses. The variables in this study were tested using Spearman's Rank Order Correlation Coefficient statistical tool to ascertain their relationship. Two variables at a time were tested and their correlation results were presented in tabular form through SPSS application.

Table3. 2: Correlations

		Strategic vision	Technological expertise	Data-driven decision making	Organizational resilience
Strategic vision	Pearson Correlation	1	.836**	.753**	.882**
	Sig. (2-tailed)		.000	.000	.000
	N	178	178	178	178
Technological expertise	Pearson Correlation	.836**	1	.728**	.803**
	Sig. (2-tailed)	.000		.000	.000
	N	178	178	178	178
Data-driven decision making	Pearson Correlation	.753**	.728**	1	.871**
	Sig. (2-tailed)	.000	.000		.000
	N	178	178	178	178
Organizational resilience	Pearson Correlation	.882**	.803**	.871**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	178	178	178	178

**. Correlation is significant at the 0.01 level (2-tailed).

Source: Research Survey (2023)

4.0 RESULTS AND DISCUSSION

4.1 Results

From Table3.1, it shows that strategic vision and organizational resilience correlates at r = 0.882) when the P-value is .000 < 0.01. This indicates a very strong and positive relationship. Therefore, the study rejected the null hypothesis and accepted the alternative hypothesis. Also, from Table 3.2, it shows that Technological expertise and organizational resilience correlates at (0.836) when the P-value is .000 < 0.01. This indicates a moderate and positive relationship. Hence, the study rejected the null hypothesis and accepted the alternative hypothesis. Finally, from Table 3.2, it shows that Data-driven decision making and organizational resilience correlates at (.753) when the P-value is .000 < 0.01. This indicates a moderate and positive relationship. Thus, the study rejected the null hypothesis and accepted the alternative hypothesis.

4.2 Discussion of Findings

Digital leadership and organizational resilience are closely linked, as effective digital leadership can help organizations build resilience in the face of uncertainty and change. Digital leadership involves using technology and digital tools to lead and manage organizations in a way that maximizes their effectiveness and success. It involves leveraging technology to improve communication, collaboration, decision-making, and innovation within organizations (Li et al., 2021). On the other hand, organizational resilience refers to an organization's ability to adapt and thrive in the face of challenges, disruptions, and unexpected events (Coutu, 2002). It involves having the capacity to absorb shocks, recover quickly, and learn from experiences.

One study by Deloitte (2017) found that companies with strong technological expertise were more likely to outperform their peers. The study found that companies with high levels of digital maturity (a measure of technological expertise) had higher levels of revenue growth, profitability, and market valuation than companies with lower levels of digital maturity.

Another study by McKinsey & Company (2018) found that companies that invest in building technological expertise among their employees are more likely to succeed in the digital age. The study found that companies that prioritized building technological expertise among their employees had higher levels of innovation, productivity, and revenue growth. One reason why technological expertise is so important to organizational performance is that it enables businesses to take advantage of new technologies and innovations. By having employees who understand how to use new technologies, businesses can more quickly and effectively implement new systems and processes that improve operations.

According to a study by The Economist Intelligence Unit (2019), technological expertise is one of the key skills that will be required for the future workforce. The study found that 70% of executives surveyed believe that their organization's success over the next five years will depend on their ability to attract and retain employees with technological expertise. In order to develop technological expertise, employees need to be provided with training and development opportunities. This can include formal training programs, on-the-job learning, and access to resources such as online courses and tutorials. Employers can also encourage the development of technological expertise by providing opportunities for employees to work on cross-functional teams, attend industry conferences, and participate in hackathons and other innovation-focused events.
According to a study by Deloitte, "digital leaders are better equipped to respond to market changes and disruptive technologies and to leverage these disruptions to their advantage" (Deloitte, 2019). This is because digital leaders have the ability to quickly identify opportunities and threats, develop and implement agile strategies, and build and maintain strong relationships with stakeholders. Digital leadership can also help organizations build a culture of resilience. Leaders who embrace technology and digital tools can encourage experimentation, collaboration, and innovation, which can help organizations adapt and innovate in response to changing circumstances. This can create a culture of continuous improvement and learning, which is essential for building resilience. Li et al. (2021) found that digital leadership practices such as data-driven decision-making, agile methodologies, and open innovation can improve an organization's ability to respond to disruptions and uncertainties. Similarly, a study by Karimi et al. (2021) found that digital leadership can improve an organization's ability to adapt to changes in the business environment, such as

shifts in customer preferences or technological advancements.

Moreover, digital leadership can also help organizations build resilience by enabling them to leverage digital technologies to create new business models, products, and services. For example, a study by Aral et al. (2019) found that digital leadership practices such as leveraging social media and big data analytics can help organizations create new value propositions and revenue streams

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The study of digital leadership and organizational resilience highlights the importance of adapting to the rapidly changing technological landscape in order to remain competitive and successful in today's business world. Leaders who embrace digital transformation and incorporate it into their organizational strategies are better equipped to weather unexpected disruptions and market shifts. Effective digital leaders prioritize collaboration, innovation, and agility in their decision-making processes. They also prioritize the development of digital competencies throughout the organization, ensuring that all employees have the skills and tools necessary to effectively navigate digital transformation. In addition, the study highlights the importance of organizational resilience in the face of challenges such as cyber-attacks, natural disasters, and pandemics. Resilient organizations are able to quickly adapt to changing circumstances and maintain operational continuity, even in the face of significant disruptions. Overall, the study emphasizes the critical role that digital leadership and organizational resilience play in achieving long-term success in today's rapidly evolving business environment. Organizations that prioritize these areas are better positioned to thrive in the face of uncertainty and emerge stronger from unexpected challenges.

5.2 Recommendations

Based on the study of digital leadership and organizational resilience in manufacturing firms in South-South Nigeria, the following recommendations can be made:

1. Manufacturing firms in South-South Nigeria should develop a clear strategic vision that outlines their long-term goals and objectives. This vision should be communicated effectively to all employees and stakeholders, and should guide all decision-making processes.
2. Manufacturing firms in South-South Nigeria should invest in technological infrastructure, such as high-speed internet, to enable the adoption of new technologies and support effective communication and collaboration.
3. Manufacturing firms should develop data-driven decision-making processes to ensure that decisions are based on objective and accurate information. This includes establishing clear criteria for decision-making, ensuring data accuracy and reliability, and using data to inform decision-making at all levels of the organization.
4. Manufacturing firms should foster a culture of resilience by encouraging employees to embrace change and adapt to unexpected disruptions. This includes promoting open communication, encouraging innovation, and empowering employees to take ownership of their work.

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