

# INTEROPERABILITY AND EFFECTIVENESS OF INDUSTRIES IN THE SUB-SAHARAN AFRICA (SSA) EVIDENCE FROM NESTLE NIGERIA PLC.

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## *Abstract:*

*The study was conducted to ascertain the effectiveness of interoperability in manufacturing companies in sub-Saharan Africa. The study used the ex-post facto research design and secondary data on the variables (interoperability, profitability, and liquidity) for 2013 -2018 were obtained from the audited annual report of Nestle Nigeria PLC for the relevant years. Linear regression was used to test the hypothesis at a 5% level of significance and ANOVA was also used to test the significance of the model. The study finds that there is a significant effect of investment in ICT (interoperability) on the bottom-line of Nestle Nigeria thereby having a positive impact on the company's profit, while at the same time, investment in ICT does not have any significant effect on the level of liquidity in Nestle Nigeria. The study therefore concludes and recommended that manufacturing companies should ensure they deliberately set funds aside for continuous investment to improve the level of investment in ICT in their operations.*

*Keywords: interoperability, industrialization, manufacturing, profitability, liquidity.*

## **1. Introduction**

Industrial growth in the sub-Saharan African region has witnessed a tremendous revolution. According to Mendes, Bertella, & Teixeira (2014), developing countries have used import substitution as a development strategy to grow industrialization since the post-war era. They opined that industrialization occurred in Sub-Saharan Africa in two phases: the first stage which is during the colonial era that was inspired by the colonial regime started around within that time frame and lasted till the later part of 1940, while the second stage of industrialization commenced in the late 1950s and witnessed improvement till the late 1960s when import substitution was more widely implemented. Although the African continent started an aggressive industrialization drive in the early 1960s after the independence of many African countries, there is little on the ground to commensurate the effort. As rightly noted by Richard, John & Tape (2018), from 1990 through 1999, there was a growth reduction in structural transformation in Africa rather than increasing, thus, Africa's higher productivity sectors which included manufacturing, failed to generate the required jobs to employ the rapidly growing number of the labor force, thereby decreasing the number of the active workforce eligible for employment in high productivity sectors as well as reducing the aggregate growth of output per worker. Today, industrialization has taken a different dimension with the 4<sup>th</sup> industrial revolution popularly called 'Industry 4.0' or interoperability of

industry taking a central place in how industries are run and set up. Interoperability is the ability of two or more networks, systems, devices, applications, or components to share information between them and to use the information shared for productive capabilities (GridWise Architectural Council, 2009). Interoperability is described in the manufacturing sector as the digital interchange of information and management of data through the Internet of Things (IoT) which has become an important element of the modern factory and Industry 4.0 (Otto Motors, 2017). Since the world is a global village and what happens in one part has a spiral effect on the other, every nation is at the forefront of embracing the interoperability of industries to increase productivity, reduce cost, data creation, and information integration (GridWise Architectural Council, 2009). The objective of this paper is to examine the impact of interoperability on the effectiveness of industries in sub-Saharan (SSA) African. This was achieved by assessing the effect of interoperability (investment in ICT) on the profitability and liquidity of Nestles Nigeria Plc. Nestle Nigeria Plc was adopted because it is a multinational manufacturing company with bases across the Sub-Saharan African region. Also, the company was one of the few that published investment costs in ICT on its financial statement. The paper is divided into 5 sections. Section one is the introduction, section two is the review of related literature, section three is dedicated to the empirical analysis of the variables while section four discusses the findings of the study and section five concludes the study with relevant recommendations.

#### *Hypotheses of the Study*

This study seeks to examine the effect of interoperability (investment in ICT) on the financial performance of Nestle Nigeria. To achieve the objective of this study, the below hypotheses have been postulated as stated in their null form:

- i.  $H_0$ : There is no significant effect of investment in ICT on the profitability of Nestle Nigeria.
- ii.  $H_0$ : There is no significant effect of investment in ICT on the liquidity of Nestle Nigeria.

## **2. Literature Review**

### **2.1. Conceptual review**

#### **2.1.1. Industrialization in Africa**

The industrialization journey in Sub-Saharan African occurred in two phases: one being during the colonial era stimulated by the colonial masters which started in the early 1920s and ended in the late 1940s. The second phase of industrialization commenced in the late 1950s and witnessed massive improvement in the 1960s when the continent implemented import substitution (Mendes et al., 2014). The rate of industrialization in the African continent has been slow compared to other continents. Historically all over the world, industry, especially manufacturing, provides the anchor for structural transformation of the economy. This cannot, however, be said about Africa's experience with industrialization as the transformation has been disappointing in the continent. In 2014, the manufacturing sector accounted for about 10% growth in GDP in sub-Saharan Africa (SSA) and had been within this average figure since the 1970s. This is however not surprising as the continent's slow pace of industrialization has made analysts question the sustainability of its growth prospects (Richard et al. 2018). Thus, the question begging for answer is whether Africa will be left behind in the current industrial revolution as it was left behind in the past (Signé & Ndung'u, 2018). This slow growth

in industrialization can be occasioned to a combination of factors. Osunsanmi, Aigbavboa, & Oke (2018) reported that the shortage of adequate investment in research and development by the construction sub-sector of the manufacturing industry is responsible for the lack of innovation and technological progress encountered in the sector. Low awareness of the Internet of things, inadequate bandwidth, and insecurity relating to cyber-attacks as well as the inability to utilize big data and 3D printers are other factors responsible for the slow growth of industrialization in the continent (Dewa, Tendayi, Adams, & Nyanga, 2018). Apart from the listed factors is the issue of poverty that has plagued the continent. Poverty has increased in the continent as approximately 437 million of the world's extreme poor are in sub-Saharan Africa. Also, statistics show that 10 out of the 19 most unequal countries in the world are in SSA. This led the World Bank to forecast that if poverty reduction indices and growth remain sluggish, Africa could be an abode to 90% of the world's poor by 2030 (Chakravorti & Chaturvedi, 2019).

### **2.1.2. Evolution of industrialization in Sub-Saharan Africa**

Industrialization is as old as man and has evolved over the years. It is a term used to describe the economic development experienced by Western Europe and North American countries in the 19th and early 20th centuries (Nzau, 2010). Historically industrialization has passed through three phases (1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> industrial revolution) until recently the current fourth phase (Industry 4.0). Each of these phases has some unique developmental criteria. According to Mendes et al. (2014), the initial phase of industrialization in sub-Saharan Africa was cumbersome and paved with issues of conflict of interests between local and international economic agents. This is because the international agents were dominantly involved in economic activities related to the importation of goods, production, and export of primary commodities to the detriment of the locals or indigenous entrepreneurs who engage in small scale economic activities. Manufacturing in this era (which was largely denominated by colonial rule) was generally been operated at the unskilled and small scale levels. In some colonies, this was complemented by some moderately complex industries whose main products were mainly for export. These industries also produce to meet the demands of local consumption and fast-growing urban population by focusing on food, fiber, and wood processing as well as metal works (Nzau, 2010). Mendes et al. (2014) reported that the early stages of industrialization in the 1920s became possible only because countries such as the Belgian Congo (now Congo Brazzaville), South Rhodesia (now Zimbabwe), and Kenya – which are not fully controlled by the metropolis started to produce local raw materials such as textiles, bottles, cigarette, and soap on a small scale. In the late 1950s and early 1960s, many sub-Saharan African countries started agitating for independence from colonial rule. This era witnessed the second phase of industrialization in the region. Having gotten independence, there was a need to develop the economies of the region and reduce the unfavorable balance of trade deficits. This agitation led to the policy of import substitution that was introduced with the aim that in the long run adverse terms of trade would be reserved by shifting the export focus from primary goods to goods whose prices are higher and have lower elasticity of demand. To achieve this, the ultimate goal of the various governments was to: encourage foreign investment; acquire new technologies from developed economies to diversify the industry, expanding export of local goods and entering the global market where competition for well packaged manufactured goods reign supreme (Mendes et al. 2014). The third state of industrialization in the region was

characterized by various development plans put in place by governments to drive accelerated economic growth through the transformation of industries by aligning with the already established structure set to achieve industrialization (Nzau, 2010).

### **2.1.3. Interoperability in the Manufacturing Industry**

Interoperability is described as diverse systems, structures, or units within an organization working together to achieve pre-determined objectives or goals. The European Information & Communications Technology Industry Association (EICTA) defined interoperability as “the capability of two or more networks, systems, devices, applications, or components to exchange information between them and to use the information so exchanged” (GridWise Architectural Council, 2009). Also, Meletis (2019) described Interoperability as the capability and the tools needed for the exchange of information and interaction between different information and communications systems and organizational units based on defined models. Interoperability in the manufacturing industry is synonymous with the trending 'industry 4.0' rave across the world. The industry 4.0 concept was developed in Germany as part of the country's strategy to improve its manufacturing industry by increasing integration of the internet and connectivity of humans, machines, and processes into the industrial value chain to increase productivity (Dewa et al., 2018). The manufacturing, automobile, and the banking sector have already embraced the use of digital methods to their operations and this has enhanced their productivity, proficiency, accurateness, and better customer service (Osunsanmi et al., 2018). Interoperability is widely embraced in the developed world but the same cannot be said about adoption in the African continent. Besides the few multinational industries, many indigenous medium and small scale industries cannot afford the cost associated with interoperability. Besides, the cost there is the challenge of insufficient manpower and lack of awareness, inadequate network bandwidth, and insecurity in terms of cyber-attacks from fraudsters (Dewa et al., 2018).

## **2.2. Theoretical Review**

### **2.2.1. Category Theory**

This theory originated from mathematics and computer science discipline. It was propounded by Samuel Eilenberg and Saunders Mac Lane between 1942 & 1945 in their study of algebraic topology to get a better understanding of the processes involved in mathematical structures. Category theory tends to provide an understanding of how units or different components are linked or inter-related to one another. Category theory is a powerful language or framework that allows one to see the general elements of structures of a given kind, and how they are interconnected (Jean-Pierre, 2019).

### **2.2.2. System Theory**

This theory cuts across many disciplines. System theory is based on the assumption that individuals do not function on their own, but rather develop and progress by interacting with their social and natural environment. The theory is derived from the general systems theory that unbundles the parts of a system that interrelate and network to make a complete system (Barbra , 2015). Heylighen & Joslyn (1992) reported that systems theory emphasizes the organization and relationship between the parts that connect them into a complete system and that it also examines the principles associated with all complex systems using a mathematical model to define them into various categories. System theory being a multidisciplinary theory can be applied to solve a wide range of problems. Cristina, Jacqueline, & Francesco (2010) provided some instances of how systems theory

can be applied in management and marketing as well as to the concept of service systems engineering. The authors concentrated on how it can be applied to diverse areas like quality, knowledge, value, environment, complexity, adaptation, and relationships in the field of marketing, management, and engineering.

### **2.2.3. Theoretical Framework**

The theoretical framework adopted in this study is category theory. This is because the theory provides an explanation to the workings of the units and how they are inter-related to one another to make a complete whole in achieving pre-determined objectives.

### **2.3. Empirical Review**

Interoperability in the manufacturing industry is an emerging concept that has gradually gained attention all over the world. In trying to provide clarity to the meaning of interoperability, Diallo et al. (2011) seek to provide clarity on the meaning of interoperability, how it works, and tried to develop a model for a formal theory of interoperability. They recognized the required and adequate conditions that could make a system to be interoperable and established how current methodologies are semantically equivalent by recommending a set of objectives that a formal theory of interoperability should meet to be useful. Michael et al., (2004) conducted a study using survey and interview instruments to ascertain and evaluate the efficiency losses that occurred in the U.S capital facilities industry as a result of inadequate interoperability of resources. The study discovers that \$15.8 billion in interoperability costs were calculated for the U.S. capital facilities supply chain in 2002 and that this annual cost projection relates to between 0.86 and 1.24 percent of yearly receipts for engineers, fabricators, suppliers, architects, engineers and general contractors. On the other hand, in a study to ascertain how interoperability has been implemented in the finance, travel, health industries and a sector of the food industry (fresh produce), Bhatt et al., (2017) discovered that the existence of common protocols and standards are pre-requisites for the implementation and operation of interoperability initiatives. The resulting perceptions were cascaded into a series of guidelines for allowing interoperability in any industry. Interoperability is not confined only to the manufacturing industry. It is applied in every work of life where individual units need to be interrelated to one another to achieve predetermined objectives. Izunildo & Antonio (2018) in their study to examine the influence of business interoperability on the performance of complex cooperative supply chain networks, proposed an agent-based model to mimic the interactions among similarly networked companies and analyzed how business interoperability affects their interdependence and performance. To achieve interoperability in the manufacturing industry, it requires a lot of preparedness and investment. Thus, Dewa et al., (2018) in their study to ascertain the preparedness of South African companies to implement Industry 4.0 discovered that there is a lack of awareness concerning the concept both in academia and in industries. They, therefore, recommended that there is a great need to enlighten the society on the concept of Industry 4.0 and formulate the much-required policies and strategies which are relevant to the South African environment.

However, Signe & Johnson (2018) worked on the evolution and prospects of manufacturing and industrialization in Africa and discovers that it eventually offers business leaders an overview of Africa's biggest projections in the manufacturing sector thereby offering interesting trends, focus, projections, and strategies for productive investment in the continent by 2030. This provides officials with prospects to attract private investors, grow manufacturing and industrial development, and

contribute to economic growth and poverty reduction thereby enabling the achievement of the Sustainable Development Goals and the African Union's inclusive Agenda. They concluded that while policy solutions are likely to differ from one country to the other, manufacturing and industrial development will be central to Africa's ability to meet its development goals.

### 3. Methodology

The quantitative research method was used for this study while the ex-post facto/after-the-fact research design was deployed in this study. This is a case study with focus on Nestle Nigeria Plc. Secondary data on the variables (interoperability, profitability, and liquidity) for 2013 -2018 were obtained from the audited annual report of Nestle Nigeria PLC for those years. Simple linear regression was used in testing the effect of the independent variable on the dependent variables while the hypotheses were tested at 5% level of significance. Analysis of Variance (ANOVA) was used to test the significance of the model. The linear regression model was used to determine the relationship and also the degree of association between the independent variable (interoperability identified as IT cost) and the dependent variables (profitability and liquidity). This is represented as:

$$Y=f(X)$$

Financial Performance = f (Interoperability).

Mathematically, this can be written as shown below:

$$PBT = \beta_0 + \beta_{Inter} + e \dots \dots \dots i$$

$$CCE = \beta_0 + \beta_{Inter} + e \dots \dots \dots ii$$

Where

PBT = Profit Before Tax (Proxy for profitability/ Dependent Variable)

CCE = Cash & Cash Equivalent (Proxy for liquidity/ Dependent Variable)

$\beta_0$  = Intercept where the independent variable is zero

$\beta_{Inter}$  = Investment in ICT (proxy for interoperability Independent Variable)

e = error term

#### Decision rule:

If the computed coefficient is lower than the significant level of 5%, we reject ( $H_0$ ) and retain ( $H_1$ ). But if the computed coefficient is greater than the significant level of 5%, we accept ( $H_0$ ) and reject ( $H_1$ ).

### 4. Data Analysis and Discussion of Findings

The extracted data is presented below in a tabular form for ease in understanding the trend of the data over the six years under review.

**Table 1**

**Extracted data of variables 2013 to 2018**

	2013	2014	2015	2016	2017	2018
	₦	₦	₦	₦	₦	₦
IT Equipment Investment	973,570	1,072,264	1,008,394	1,113,753	1,192,957	1,400,878
Profit Before Tax (PBT)	26,047,590	24,445,978	29,322,477	21,548,408	46,828,682	59,750,846
Cash & Cash Equivalent Balance	13,716,503	2,466,899	12,624,502	51,196,570	11,424,767	14,368,358

*Source: Nestle Nigeria Audited Annual Report*

Table 1. Shows the trend of investment in ICT which moves upward over the years, Trend in profitability shows an up and down movement which is also noticed in the data for liquidity also for the period (2013 – 2018) under review.

**Test of Hypotheses**

*Hypothesis One*

H<sub>0</sub>: There is no significant effect of investment in ICT on the profitability of Nestle Nigeria.

**Table 2**

**Model Summary**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.879 <sup>a</sup>	.773	.716	8106555.559

*a. Predictors: (Constant), IT Equipment*

Table 2. shows that there is a high relationship between investment in ICT and profitability which is shown as 87.9%. Also, investment in ICT has a strong effect on the profitability of Nestle Nigeria which is shown as 71.6%.

**Table 3**

**ANOVA**

Model	Sum of Squares	df	Mean Square	F	Sig.
1 Regression	893665207689545.500	1	893665207689545.500	13.599	.021 <sup>b</sup>
Residual	262864972129811.530	4	65716243032452.880		
Total	1156530179819357.000	5			

*a. Dependent Variable: Profit Before Tax*

*b. Predictors: (Constant), IT Equipment*

Table 3, shows that the computed value is 0.021 which is lower than the p-value set for this study at 0.05. This, therefore, means that we are to reject the null hypothesis which states that there is no significant effect of investment in ICT on the profitability of Nestle Nigeria. And accept the alternate hypothesis which states that there is a significant effect of investment in ICT on the Profitability of Nestle Nigeria.

**Table 4**

**Coefficients**

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
1 (Constant)	-62540655.391	26564579.270		-2.354	.078
IT Equipment	86.247	23.388	.879	3.688	.021

*a. Dependent Variable: Profit Before Tax*

Table 4, shows the numbers used to represent the model which was used to test the hypothesis. From the information in the model, the intercept is represented by a negative integer.

*Hypothesis Two*

H<sub>0</sub>: There is no significant effect of investment in ICT on the liquidity of Nestle Nigeria.

**Table 5**

**Model Summary**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.021 <sup>a</sup>	.000	-.249	19009930.448

*a. Predictors: (Constant), IT Equipment*

Table 5, shows that there is a low relationship between investment in ICT and the level of liquidity in Nestles Nigeria which is shown as 21%. Also, it shows that investment in ICT has a weak negative effect on the liquidity of Nestle Nigeria.

**Table 6**

**ANOVA**

Model	Sum of Squares	df	Mean Square	F	Sig.
1 Regression	638073459615.801	1	638073459615.801	.002	.968 <sup>b</sup>
Residual	1445509822538150.000	4	361377455634537.700		
Total	1446147895997766.000	5			

*a. Dependent Variable: Cash & Cash Equivalent*

*b. Predictors: (Constant), IT Equipment*

Table 6, shows that the computed value is 0.968 which is higher than the p-value set for this study at 0.05. This, therefore, means that we are to retain the null hypothesis which states that there is no significant effect of investment in ICT on the liquidity of Nestle Nigeria.



**Table 7**

<b>Coefficients</b>						
Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	
	B	Std. Error	Beta			
1	(Constant)	15035734.451	62294127.342		.241	.821
	IT Equipment	2.305	54.845	.021	.042	.968

*a. Dependent Variable: Cash & Cash Equivalent*

Table 7, it shows the numbers used to represent the model which was used to test the hypothesis. From the information in the model, Both the intercept and the Investment in ICT integers are positive.

**Discussion and Policy Implication of Findings**

Based on the result of the data analysis carried out in this study, it shows that there is a significant effect of investment in ICT on the bottom-line while at the same time, investment in ICT does not have any significant effect on the level of liquidity in Nestle Nigeria.

Also, as shown in the analysis, Investment in ICT is closely related to the level of profitability in Nestle Nigeria. In addition to this, investment in ICT has a positive effect on the level of profitability of Nestle Nigeria. This, therefore, means that the higher the level of investment in ICT, the higher the expected profit of Nestle Nigeria. This result corresponds to the outcome of the study conducted by Bhatt et al. (2017), Osunsanmi et al, (2018), Izuniido & Antonio (2018) where they discovered that interoperability led to the high performance of industries.

On the other hand, the level of investment in ICT shows a low level of relationship with the liquidity of Nestle Nigeria. Also, it further reveals that there is a negative relationship between the level of investment and the liquidity position of Nestle Nigeria. This can reasonably be explained as the more funds invested in ICT, the lower the level of funds (liquidity) available at the disposal of Nestle Nigeria. Although, the result of the ANOVA test reveals that this is insignificant and thus it is safe for Nestle Nigeria to invest in ICT as this will though reduce liquidity but only a negligible margin.

**5. Conclusion**

This study was carried out with the aim of examining interoperability on the effectiveness of industries in the sub-Saharan Africa with focus on Nestle Nigeria plc as a case study. It was concluded in this study that investment in technology will boost the profit performance of Nestle Nigeria & investment in technology will reduce the level of liquidity of Nestle Nigeria in a negligible proportion.

*Policy Implication and Recommendation*

To boost the financial performance of Nestle Nigeria, this study has shown that investment in technology is a significant decision to be considered. To achieve this based on the result obtained in this study, it is recommended that the management should intensify investment in technology and set funds aside that will facilitate interoperability in their operations.

*Limitation of this Study and Area of Future Study*

In carrying out this study, getting data for a longer period posed a great challenge. However, the study was limited to the observation of 6 years based on

the annual reports that were obtained for this study. Also, many manufacturing companies did not publish the cost of investments made to facilitate interoperability in their companies. This affected expanding the scope to include many companies in the Sub-Saharan African region for the study.

As a suggestion for future study, more observation period (number of years) can be looked into and across several manufacturing companies for generalization of the result.

Finally, the field survey approach can also be employed in future studies to generate data from experts on the field in the conduct of such study.

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