

COMPUTATIONAL MODEL FOR MEASURING THE INFORMATION AND COMMUNICATION MATURITY INDEX OF NIGERIA ECONOMY

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ABSTRACT

The Information and Communication Technology maturity of an enterprise is a strong foundation for successful implementation of knowledge management. The fundamental issue within the Nigeria economy that has resulted in skewed ICT planning is the uncertainty surrounding the stage or level of ICT maturity. This paper therefore, evaluates and measures the level of ICT maturity of selected firms in all the sectors listed in the Nigerian Stock Exchange (NSE) using the ICT maturity model of Small- and -Medium Enterprises (SMEs). This model was based on a 5-stage road map of ICT development in SME: Inactive, Basic, Substantial, Web-based and Knowledge-oriented, in which knowledge-oriented is the highest development stage. The result has shown that the Nigeria economy is web-based in ICT maturity, with an index of 0.67; an indication that the ICT maturity of the Nigerian economy has not grown to the fullest level. This could give SMEs knowledge of their current situation and strengthen their competitive capability for effective management of knowledge resources for their improvement in this knowledge economy.

Keywords: Nigeria economy, NSE, ICT Maturity, SMEs

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INTRODUCTION

Though, during the past years, information and communications technology (ICT) had increased rapidly in terms of adoption and diffusion process, varying degrees in the level of access, use and skills of ICT can be determined, both among countries as well as within them. Decision and policy makers had opined that, these differences among countries are key causes limiting the ICT penetration and thus requires strategies at targeting the development and deployment of ICT which can be applied to many countries. Researchers and managers are majorly

concerned about the benefits from digital age among countries and also concerned about how, these benefits, could be measured and evaluated. Their primary focus, is to get the understanding of the causes which increase ICT adoption, which eventually accelerate ICT deployment. A good number of studies have revealed some hindrances and some driving factors on this deployment. Factors such as income level, investment level and education level could either be aids or hindrances, to ICT deployment increase (Weber et al., 2011).

however lacking. Therefore, the problem the study stands to address is that of ICT mis-planning bedevilling emerging service dominant (digital) economy like Nigeria due to the dearth of understanding of how investments on ICT relates to the benefits from ICT.

To this end, this paper measured the ICT maturity of all the sectors in the NSE as a possible panacea towards unravelling the uncertainty of the level or stage of the ICT maturity in order to effectively harness the potentials of ICT for sustainable improved economy. The most common reason for measuring is to improve internal performance, i.e. management control. The idea is founded on one of the most quoted management slogans; what is not measured, cannot be effectively managed (Skyrme et al., 2003).

LITERATURE REVIEW

This research noted the work of Raef et al. (2019) which was carried out in Saudi Arabia, titled “Impact of Information and Communication Technology on Economic Growth: Evidence from Developing Countries” that was motivated by the question: what is ICT’s impact on economic growth? The aim of their study was to “evaluate the impact of ICT on the economic growth of some selected developing countries in the Middle East and North Africa (MENA) region and the Sub-Saharan Africa (SSA) region. The panel Generalized Method of Moment (GMM) growth model was used for methodology”. According to their findings, mobile phone, Internet usage and broadband adoption were the main drivers of economic growth in MENA and SSA developing countries.

Also, the work of Virginia et al. (2018) car-

ried out in Spain entitled “A study of the value of ICT in improving corporate performance: a corporate competitiveness view” was motivated by the economic crises and strong healthy competition among companies in their country. It was hoped that, proper management of information and knowledge could be a panacea to the crisis. The work was aimed at “analysing the impact that the intensity of firms’ adoption of information and communications technologies (ICT) and industry attractiveness has, on corporate performance”. Ordered Logistic Regression and principal axis factoring analysis were adopted for their methodology and the results showed that there was a significant positive relationship between ICT intensity of use and corporate performance.

The work of Oladimeji et al. (2018) which focused on Nigeria and entitled “ICT and its Impact on National Development in Nigeria: An Overview”, explored the growth benefits that ICT sector has provided and its impacts on the Nigeria economy. According to their findings, the work showed that, “ICT services have helped in some economic areas like, improving on the markets, reduction in transaction cost and increased productivity”. Most contentious is the work of Ekuobase and Olutayo (2016), entitled Study of Information and Communication Technology (ICT) maturity and value: The relationship motivated by the challenge within the service industry which centres on how the benefits from the ICT adoption and diffusion (ICT value) relate to the degree of adoption and diffusion of ICT (ICT maturity). The main purpose of their study“ was to determine whether a relationship exists between ICT maturity and value for some selected service firms and to determine the type of such relationship. In their study, the quasi-experimental research method was used for

methodology. The empirical results according to their findings show that, there is a negative-weak correlation between ICT maturity and ICT value in the service industry, which shows that the benefit from ICT adoption and diffusion is not traceable to the degree of ICT adoption and diffusion in the service industry". They also submitted that, the work could be extended to all the formal sectors of a country in-order to assess the level of ICT adoption and ICT value of the nation.

The researches by Raef et al. (2019) and Virginia, et al. (2018) made use of secondary data that could contain some sort of bias at the point of collection which could no longer be verified. Their view about ICT maturity definition appear faulty, they were equating ICT maturity to be ICT investment and ICT value to be economic benefit. Their concerns were only centered on economic benefits which is the tangible value while both tangible value and non-tangible value are the main concerns of the service scientist. None of these works made reference to ICT maturity and value models, let alone using them. However, these ICT models are critical to measuring ICT maturity and ICT value in any organization, sector or economy. In-fact, Oladimeji, et al., (2018) only carried out a review of the impact of ICT on national development and did not make use of any data. However, in the work of Ekuobase and Olutayo (2016), the gaps in the work are: sample size of the work was small, with only 23 service firms willing to complete their questionnaires. Very importantly, the work only focused on service sector, out of other several sectors of the companies listed in Nigeria Stock Exchange (NSE).

MATERIALS AND METHODS

Research design

Research design is a plan or blue print which specifies how data relating to a given problem should be collected and analysed. Research design that was adopted in this study was quasi-experimental research method, because it allows both the use of a model and a questionnaire survey method. Also, it does not allow the manipulation of the independent variables by the researcher.

Population and Sample size

The target populations of this study were the firms listed in NSE. There are eleven (11) sectors in the NSE and one hundred and seventy-two (172) firms. Of these 172 firms a total of 61 firms across the eleven sectors of NSE were investigated. Thus, the sample size of this study is about 35% of the total population which exceeds that of similar studies by Ekuobase and Olutayo (2016) and Chan et al. (2012) whose population samples were about 32% and 25% of their total population respectively. Out of these sectors; agriculture had 2 firms, ranging from F1 to F2, conglomerate had 3 firms, ranging from F3 to F5, Construction had 3 firms, ranging from F6 to F8, Consumer_goods had 7 firms, ranging from F9 to F15, financial_services had 18 firms, ranging from F16 to F33, health_care had 5 firms, ranging from F34 to F38, ICT had 3 firms, ranging from F39 to F41, industrial_goods had 6 firms, ranging from F42 to F47, natural_resources had 2 firms, ranging from F48 to F49, oil_and_gas had 4 firms, ranging from F50 to F53, services had 8 firms, ranging from F54 to F61 (Table 1). The firms were specifically instructed that the nine questionnaires should be distributed three each per levels of management namely operational, middle and top management levels. This is to avoid a possible pitfall of position prejudice observed in Chan et al.

(2012) for companies in mainland China where one questionnaire per firm was administered. Distributing three questionnaires per managerial level did not only grade the effect of position prejudice but also weakened bias within a managerial level.

Table 1: Types of sector, Firms name and their code

Type of Sector	Firms Name	Firm Code	NO OF FIRMS
AGRICULTURE	FTN COCOA PROCESSORS PLC	F1	2
	LIVESTOCK FEEDS PLC	F2	
CONGLOMERATE	JOHN HOLT PLC	F3	3
	SCOA NIGERIA PLC	F4	
	TRANSNATIOAL CORPORATION PLC	F5	
CONSTRUCTION	ARBICO PLC	F6	3
	JULIUS BERGER PLC	F7	
	SMART PRODUCTS NIGERIA PLC	F8	
CONSUMER_GOODS	7UP BOTTLING PLC	F9	7
	CADBURY NIGERIA PLC	F10	
	DANGOTE FLOUR MILLS PLC	F11	
	GUINNESS PLC	F12	
	HONEYWELL FLOUR MILLS PLC	F13	
	NESTLE NIGERIA PLC	F14	
	PZ PLC	F15	
FINANCIAL_SERVICES	ACCESS BANK	F16	18
	BANK OF INDUSTRY	F17	
	DIAMOUND BANK PLC	F18	
	ECO BANK	F19	
	FBN INSURANCE	F20	
	FCMB	F21	
	FIDELITY BANK	F22	
	FIRST BANK	F23	
	GTB	F24	
	NEM INSURANCE	F25	
	NPF BANK	F26	
	SKYE BANK	F27	
	STACO INSURANCE	F28	
	STERLING BANK	F29	
	UBA	F30	
UNITY BANK	F31		
WEMA BANK	F32		
ZENITH BANK	F33		

HEALTH CARE	EKO CORP	F34	5
	EVANS MEDICAL	F35	
	FIDSON	F36	
	GLAXO	F37	
	PHARMADEKO	F38	
ICT	CHAMS	F39	3
	CWG	F40	
	E-TRANSACT	F41	
INDUSTRIAL_GOODS	AFRICAN PAINTS	F42	6
	AUSTIN LAZ	F43	
	AVON	F44	
	BERGER PAINTS	F45	
	BETA GLASSS	F46	
	CAP	F47	
NATURAL_RESOURCES	ALUNMINIUM	F48	2
	BOC GASES	F49	
OIL_AND_GAS	BECO	F50	4
	CAPITAL OIL	F51	
	MOBIL_OIL	F52	
	SEPLAT	F53	
SERVICES	ACADEMY_PRESS_PLC	F54	8
	AIRLINE SERVICES	F55	
	ASSOCIATED BUS COMPANY	F56	
	CAPITAL HOTEL	F57	
	CAVERTON OFFSHORE SUP- PORT PLC	F58	
	DAAR COMMUNICATION	F59	
	IKEJA HOTEL	F60	
	INTERLINK TECHNOLOGY_PLC	F61	

Instrumentation

The field work exercise was a questionnaire survey meant to capture the necessary data to measure the ICT maturity of these firms. The questionnaire modelled after the ICT Maturity Model of SMEs (Pham, 2010) is a three-part document. The first part introduced the questionnaire and contained demographic data (name and type) of firms and respondents' managerial position. The second part consisted of 50 indicator questions grouped under the four major factors of observable capabilities of SMEs: Infrastructure (eleven indicator questions), Application (thirteen indicator questions), Hu-

man Resource (twelve indicator questions) and Policy (fourteen indicator questions). The third part captured the respondents contact (mobile phone and e-mail address). Questionnaires with similar connotations and indicator value had been used by Pham (2010), Pham et al. (2013), and Ekuobase and Olutayo, (2016), as survey instrument for research purpose.

Method of Data Analysis

The questionnaires were then sorted and coded using the indicator stage value as proposed by Pham (2010). The ICT maturity index (ICTMI) was calculated using the for-

$$ICTMI = \alpha I + \beta A + \gamma H + \theta P \dots\dots\dots (1)$$

Where $0 \leq I, A, H, P, ICTMI \leq 1$ and $\alpha + \beta + \gamma + \theta = 1$; and

$$I = \frac{\sum_{t=1}^4 \left(\frac{\sum_{t=1}^{nl} Ilt}{nl} \right)}{4} \quad A = \frac{\sum_{t=1}^4 \left(\frac{\sum_{t=1}^{ml} Alt}{ml} \right)}{4}$$

$$H = \frac{\sum_{t=1}^4 \left(\frac{\sum_{t=1}^{pl} Hlt}{pl} \right)}{4} \quad P = \frac{\sum_{t=1}^4 \left(\frac{\sum_{t=1}^{ql} Plt}{ql} \right)}{4} \dots\dots\dots(2)$$

Where Ilt, Alt, Hlt and Plt are indicators of stage l; nl, ml, pl and ql are number of respective indicators of stage l.

The ICT maturity data were then extracted and processed to realize the ICT maturity indexes of the selected firms and sectors in NSE using a visual C++ program designed and implemented. Thereafter, the results of ICTMIs were mapped to the ICT maturity levels using the following stratification proposed by Pham (2010): Inactive (0.0 – 0.2), Basic (0.2 – 0.4), Substantial (0.4 – 0.6), Web based (0.6 – 0.8) and Knowledge oriented (0.8 – 1.0).

This study made use of ICT maturity model of SMEs not only because it has been improved to be able to handle any category of enterprises but because it is simple, generic, quantifiable, popular, strongly aligned with modern business enterprises and yet powerful (Pham, 2010; Chan et al., 2012).

The model was designed by Australian Communication Authority in 2008. It is based on four main factors: Infrastructure, Application, Human Resource and Policy. It originally consists of four phases namely: (i) Inactive; (ii) Basic; (iii) Substantial and; (iv)

Sophisticated. However, based on the above classification of ICT development in SMEs, Pham (2010) in consideration of recent development trends as well as conditions for knowledge management maturity, the ‘Sophisticated’ phase is suggested to be divided into two stages: Web-based and Knowledge-oriented. Thus, we now describe this model as consisting of five phases:

1. Inactive – no current use of ICT in company.
2. Basic – including word processing and other desktop packages.
3. Substantial – extending into the networking of PCs and several applications.
4. Web-based – extending to e-commerce with many web-based services.
- 5 Knowledge-oriented – integration of applications and using ICT tools for innovation and knowledge management.

Each of the maturity levels is characterized by certain observable capabilities of four major factors: Policy, Infrastructure, Application and Human Resource, with maturity level ranging from level 1 to level 5 which is the highest level (Table 2).

Table 2: ICT Maturity Stages and Its Features

	Maturity level	Level 1	Level 2	Level 3	Level 4	Level 5
	Development Trend	Inactive	Basic	Substantial	Web based	Knowledge Oriented
Infra-structure	Connectivity & Mobility	Telephone	PC, laptop	Network	Internet	Wireless
ICT HR	Sophisticated & Innovation	Unskilled	Business skills	Technology skills	MIS skills	Learning skills
Applica-tion	Integrated applications	No appli-cation	Office, E-mail	MIS ap-plications	E-commerce	E-business
Policy	Flexibility & Mobility	No policy	Stand-ardize	Modern-ize	Coopera-tion	Outsourc-ing

In general, it is very difficult for an enterprise to build up a knowledge system without appropriate ICT infrastructure and previous ICT applications. Moreover, to strengthen the competitive capability of SMEs, it is very important to apply appropriate ICT applications at the right time rather than adopting latest information systems. Therefore, the SMEs model will be useful to generate information needed for effectively improving companies' ICT maturity knowledge-oriented business outfits.

RESULTS AND DISCUSSIONS

The respondents gave a fair distribution across the managerial levels where middle management level had 50.49% (Table 3). The majority of the respondents were from financial services sector with 29.77% and operational level had the least percentage with 29.45%.

All the sectors appeared to be in the same ICT maturity level i.e., web based, also consumer goods sector had the highest ICTMI with 0.723975 followed by ICT sector while Industrial Goods had the lowest ICTMI with 0.621107 (Table 4).

Table 3: Management Levels of the Respondents

Sector Type	No of firms in sector	Operational management	Middle management	Senior Management	Total Type	% Type
AGRICULTURE	2	3	7	2	12	3.88
CONGLOMERATES	3	3	9	2	14	4.53
CONSTRUCTION	3	3	12	4	19	6.15
CONSUMER GOODS	7	9	21	5	35	11.33
FINANCIAL SERVICES	18	33	48	11	92	29.77

COMPUTATIONAL MODEL FOR MEASURING THE INFORMATION ...

HEALTH CARE	5	4	12	7	23	7.44
ICT	3	10	8	1	19	6.15
INDUSTRIAL GOODS	6	9	9	7	25	8.09
NATURAL RE- SOURCES	2	2	6	2	10	3.24
OIL AND GAS	4	4	8	10	22	7.12
SERVICES	8	11	16	11	38	12.3
Total	61	91	156	62	309	100
% of managerial Level		29.45%	50.49%	20.06%	100.00%	

Table 4: The ICTMI and Quantized ICTMI of all the Sectors in Nigeria

SECTOR NAME	I	P	H	A	ICTMI	QUAN- TIZED ICTMI
AGRICUL- TURE	1.693576	2.043403	1.333333	1.575149	1.661365	0.664546
CONGLOM- ERATES	2.00372	2.096726	1.456845	1.662628	1.80498	0.721992
CONSTRUC- TION	1.711075	2.141447	1.202851	1.59187	1.661811	0.664724
CONSUMER GOODS	2.01369	2.110119	1.528571	1.587372	1.809938	0.723975
FINANCIAL SERVICES	1.689312	2.017889	1.460485	1.657269	1.706239	0.682495
HEALTH CARE	1.775815	2.004529	1.344656	1.597244	1.680561	0.672224
ICT	1.850877	2.003289	1.396382	1.589051	1.7099	0.68396
INDUSTRIAL GOODS	1.573333	2.003333	1.214583	1.419821	1.552768	0.621107
NATURAL RE- SOURCES	1.64375	1.977083	1.216667	1.525	1.590625	0.63625
OIL AND GAS	1.833807	2.022727	1.339489	1.561688	1.689428	0.675771
SERVICES	1.831963	1.889803	1.334156	1.487312	1.635808	0.654323

Table 5: ICT Maturity of Sectors in NSE

SECTOR	ICT MATURITY INDEX
AGRICULTURE	0.664546
CONGLOMERATE	0.721992
CONSTRUCTION	0.664724
CONSUMER_GOODS	0.723975
FINANCIAL_SERVICES	0.682495
HEALTH	0.672224
ICT	0.68396
INDUSTRIAL_GOODS	0.621107
NATURAL_RESOURCES	0.63625
OIL_AND_GAS	0.675771
SERVICES	0.654323
Nigeria Economy (Average)	0.672852
Standard Deviation	0.03122

DISCUSSION

The ICT maturity of the various sectors of the Nigeria economy presently converges at 0.67 which by Pham (2013) classification is web based. The implication of this is that the various sectors of the Nigeria economy have attained about same level of ICT maturity. The various sectors now know their current situation, which is the first step for them to make a plan for improving their ICT maturity. This would help them to strengthen their competitive capability and lead to effective management of resources for their development in the age of knowledge economy.

CONCLUSION

Nigerian Economy is Web based in ICT maturity. Therefore, managers of the Nigerian Economy are now better positioned towards a sustainable improvement of ICT based service delivery in Nigeria. Also, this paper contributes to practical aspect of building a knowledge system by doing the first step, which is measuring the ICT maturity. Based on this result, Managers of the

Nigeria Economy can start making a plan for improving their ICT maturity towards Knowledge-oriented in order to use their knowledge resource effectively for development in the future.

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