Using Kochika Model in Ascertaining the Information and Communication Technology (ICT) Maturity in the Manufacturing Sector of a Recessed Economy

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ABSTRACT
The usefulness and meaningfulness of Information and Communication Technology (ICT), cannot be overemphasized in attaining organizational growth and survivability. Several organizations have over the years benefited assiduously from the integration of ICT tools in their organizational processes. The neglect within the manufacturing sector has facilitated this research with the aim of ascertaining the ICT maturity based on Kochikar model. Quantitative and qualitative questionnaires were developed and distributed to several manufacturing organizations withi Edo state, Nigeria. Preceeding data analysis, it was identified that the manufacturing sector still sits within The BASIC level of the Kochikar model. Therefore rapid and prompt integration are necessary to facilitate assiduous improvement.

Keywords
Kochikar, ICT, ICT maturity, ICT Maturity

1. INTRODUCTION
Information and Communication Technology (ICT) is an umbrella term for information and communication [10]. ICT poses huge economic potential and incentives which can be explored through various human endeavors; facilitating economic and social development [10]. The application of ICT concepts, techniques, policies and implementation strategies in the banking sector have become a subject of fundamental importance and concerns to all banks, financial warehouse and indeed a prerequisite for local and global competitiveness [6]. ICT has affected the decision processes within various organizations. It has continued to change the way banks and their corporate relationships are organized worldwide and the variety of innovative devices available to enhance efficient service delivery [6]; [14]

In the Educational sector, the presences of ICT has also been felt tremendously. ICT has provided innovation for teaching and learning, and has engendered advances in research [9]. It has enhanced the development and implementation of policies and procedures necessary to ensure the effective, secured and appropriate use of universities information resources and services.

The health sector has not been left out. The healthcare sector has always relied on technologies which form the bedrock of its service delivery in preventing, diagnosing and treating varied illnesses and diseases [16]. The advancement of information and communication technology in the 21th century has led to an accurate healthcare profile of individual health risk to understand better basic physiological and pathologic process and to revolutionize diagnoses through new imaging and scanning technologies [17]

Agricultural enterprises use computers and ICT tools in all aspects of agricultural business management. Internet has enabled organizations to coordinate work, worldwide among its employees or allowed customers to query relevant information. E-agriculture continues to evolve in scope as new ICT applications continue to be harnessed in the agriculture sector [18]

The Nigeria manufacturing sector till date, still requires an urgent and sharp paradigm shift from the local (conventional and traditional) approach to work process that characterized almost all indigenous companies in Nigeria by adopting and using relevant ICT facilities [8]. There is increasing evidence of the connection of structural characteristics and industry-specific factors on the intensity of ICTs adoption in business applications which are difficult to perceived in manufacturing [15]. The rate and ease with which ICTs are adopted is influenced not only by industry specific factors, but also by the level of the country's economic development.

Therefore it is the intent of this research paper to measure the maturity level of Information and Communication Technology (ICT) within the manufacturing sector.

2. LITERATURE REVIEW
2.1 ICT Maturity Models
The measurement of Information and Communication technology (ICT) in various sectors has been established from literatures based on various models. These models include:

2.1.1 Knowledge Management Maturity Model:
The Knowledge Management Maturity Model (KMMM) is a long-term roadmap spread across eight levels of increasing sophistication for companies to follow in their pursuit of organizational self-actualization. These levels include; Standardized Infrastructure for Knowledge Sharing, Top-Down Quality-Assured Information flow, Top- Down retention Management, organizational Learning, Organizational Knowledgebase, Process-Driven Knowledge sharing, continual process Improvement, Organizational self-Actualization.

2.1.2 Capability Maturity Model (CMM)
The Capability Maturity Model (CMM) for software, developed by Carnegie Mellon's software Engineering Institute and Various Industry and government affiliates in early 1990s, is a process maturity model or framework that helps organizations improve their software life cycle processes. The model is particularly adept at enabling organizations to prevent excessive project schedule delays and cost overruns by providing the appropriate infrastructure and support necessary to help projects avoid these problems. It is made up of five main levels; initial, repeatable, defined, managed and optimized.

2.1.3 NESCO's Model of ICT Maturity

UNESCO's model of ICT maturity has four different levels and they are: emerging stage, applying stage, infusing stage and transforming stage.

2.1.4 Nolan's Maturity Model:

Nolan's Maturity Model defines the adoption of ICT into an organization or sector as a series of clearly articulated developmental stages. Nolan identified six stages. This is a general model, which describes the role of information technology (IT), and how it grows within an organization. Evolution of IT in organizations begins in an initiation stage, this is followed by expeditious spreading of IT in a contagion, after that, a need for control arises, Next, integration of diverse technological solutions evolves, Administration/management of data is necessitated, to allow development without chaotic and increasing IT expenditures and Finally, in the maturity stage, constant growth will occur.

2.1.5 Cloud Maturity Model:

A Cloud Maturity Model is an ideal unifying program for IT because it is holistic in terms of how it can address both business and IT requirements. It encompasses everything that is currently cutting edge in terms of new IT, while also dealing with very practical issues like achieving value for money through IT outsourcing.

2.1.6 Kochikar Model for Measuring ICT Maturity:

Kochikar Model is made up of five levels; Level 1 – Inactive: no current use of ICT in the sector. Level 2 – Basic: The sectors include word processing and other desktop packages. Level 3 – Substantial - the sector will not just include word processing and other desktop packages, but will also include networking PCs and several applications. Level 4 – Web Base - the sector will have word processing and other desktop packages, networking PCs and several applications will be available, and it will then extend into e-commerce with many web-based services. Level 5 – Knowledge oriented- the sector will have word processing and other desktop packages there will also be networking of PCs and several applications will be available, there will also be web-based services in the sector. There will also be integration, the application of ICT and using ICT tools for innovation and management of the agricultural sector.

3. RESEARCH METHODOLOGY

From the above specified models, considering the conceptualization of various ICT maturity models as exposed, the Kochikar model was adopted in ascertaining the ICT maturity level in the manufacturing sector. Quantitative and qualitative number of questionnaires were developed. The items in the questionnaires were structured according to the order of the research and evaluated using Kochikar model based on the following reasons:

a. Being a knowledge driven model, it extensively defines ICT knowledge management which can help companies in assessment of their ICT captured data and information.

b. Its well defined structure is easy to comprehend and provides accurate result.

The Kochikar Maturity model was employed to measure the maturity level of ICT in the manufacturing sector, constraining the sample size to Edo state, Nigeria. Several manufacturing industries were visited within the state. Kochikar Model was exemplified as a mathematical formula. The formula is given below;

$$ICTMI = \frac{(I + O + M + P)}{4} \quad (0 \leq I, O, M, P, ICTMI \leq 1)$$

$$I = \frac{\sum_{l=1}^{4}(\frac{\sum_{k=1}^{n_1} I_{lk}}{n_l})}{4}$$

$$O = \frac{\sum_{l=1}^{4}\left(\frac{\sum_{k=1}^{m_1} O_{lk}}{m_l}\right)}{4}$$

$$M = \frac{\sum_{l=1}^{4}\left(\frac{\sum_{k=1}^{p_1} M_{lk}}{p_l}\right)}{4}$$

$$P = \frac{\sum_{l=1}^{4}(\frac{\sum_{k=1}^{q_1} P_{lk}}{q_l})}{4}$$

(I_{lk}, $O_{lk,}$ M_{lk}, P_{lk}: indicators of stage1; $n_{l,}$ m_l, p_l, q_l: number of respective indicators of stage1).

All of the above indicators are to be quantized from 0-1by some means such as; Percentage, Maximum value, andFrequency.In the course of our research percentage will be used.The result from this set of mathematical formulae could be attached to the five stages of ICT maturity as follows;0 - inactive; *1*/5 - basic; *2*/5 - substantial; *3*/5 - web based; *4*/5 - knowledge oriented. By the end of the evaluation we will be able to determine ICT maturity level.

4. ANALYSIS OF QUESTIONNAIRES

Table 1 below shows the various indicators contained in the questionnaires. It gives us an analysis of how the respondents in the Nigeria manufacturing sector replied to the questions in the questionnaires. A total of 150 questionnaires were distributed to various respondents. It shows the number of people out of the 128 who agree to have the various indictors and those who do not. It also shows the different ICT stage of each of the indicators. The stages as said earlier are; Inactive, Basic, Substantial, Web based, and Knowledge oriented.

Simple percentage was used to arrive at what stage each of these indicators is in the Nigeria manufacturing sector.

Table 1: Questionnaires Data Analysis

MAIN FACTORS	INDICATORS	YES	NO	ICT STAGE
ICT INRASTRUCTURE	Functional hardware(like servers, computers, telephones, data centers etc)	128	0	5
	Network	95	33	4
	LAN	54	74	3

	WAN	5	123	1
	LAN/Wifi	36	92	2
	Internet bandwidth	1	127	1
	Security and backup system	78	50	3
	Network Administrator	73	55	3
	Website	94	34	4
	Domain name	40	88	2
ORGRANIZATION SOFTWARE	Standard Software (MS Word, Excel, etc)	101	27	4
	Enterprise application software	42	86	2
	Application updates	32	96	2
	Online Payment System	40	88	2
	e-mail/ IM, WhatsApp Communication	80	48	4
	Management System	50	78	2
MANPOWER RESOURCE	Routine IT training for staffs	62	66	3
	Institute sponsored ICT training	67	61	3
	Personal computer	32	96	2
	IT expert	58	70	3
ICT ORGANIZATION POLICY	Quality Policy	61	67	3
	Regular Policy	60	68	3
	Security Policy	66	62	3
	Privacy Policy	28	100	2
	Hardware/Software Upgrade	45	83	2

Since we have five stages, the percentage 100 will be divided equally, where each portion is assigned its range. The formula for simple percentage is shown below:

Percentage = ((Number of YES) / (Total number of YES+NO))*100

The range of each ICT stage is: 0%----20% is stage 1,
21%----40% is stage 2, 41%----60% is stage 3,
61%----80% is stage 4, 81%----100% is stage 5

4.1 For Infrastructure

The calculated values identify the response of for Infrastructure.

Percentage for Functional hardware

(128/128) * 100 = 100%. So it falls between 81% and 100%, and the is stage 5

Percentage for network

(95/128) * 100 = 74.21875%. The 74.21875% falls between 61% and 80%, that is stage 4

Percentage for LAN

(54/128) * 100 = 42.1875%. The 42.1875% falls between 41% - 60%, that is stages 3

Percentage for WAN

(5/128)*100 = 3.90627%. This falls between the range of 0% -20%, and that is stage 1

Percentage for LAN/Wifi

(36/400) * 100 = 28.125%. The 28.125% falls between the range of 21% 40%, which is stage 2

Percentage for internet band width

(1/128) * 100 = 0.78125%. 0.78125% falls within the range of 0% and 20% that is stage 1

Percentage for security and backup system

(78/128) * 100 = 60.9375%. 60.9375% falls within the range of 41% and 60% that is stage 3

Percentage for network administrator

(73/128) * 100 = 57.03125%, 57.0313% falls within the ranges of 41% and 60% that is stage 3

Percentage of Website

(94/128)* 100 = 73.4375%. 73.4375% falls within the ranges of 61% and 80% that is stage 4

Percentage of Domain name

(40/128) * 100 = 31.25%. 31.25% falls within the ranges of 21% and 40% that is stage 2

4.2 For Organization Software

The calculated values identify the response for Software

Percentage for standard software

(101/128)*100 = 78.90625%. 78.90625% falls within the ranges of 61% - 80%, that is stage 4

Percentage for enterprise application software

(42/128)*100 = 32.8125%. 32.8125% falls between the ranges of 21% - 40%, that is stage 2

Percentage for Application updates

(32/128)*100 =25%. 25% falls between the range of 21% - 40%, this is stage 2

Percentage for online payment system

(40/128)*100 =31.25%. 31.25% falls between the range of 21% - 40%, this is stage 2

Percentage for email/IM, WhatsApp communication

(80/128)*100 =62.5%. 62.5% falls between the range of 61% - 80%, and this is stage 4

Percentage for management system

(50/128)*100 =39.0625%. 39.0625% falls between the range of 21% - 40%, and this is stage 2

4.3 For ICT Manpower Resources

The calculated values identify the response of for Manpower resources

Percentage of Routine IT training for staffs

(62/128) * 100 = 48.4375%. 48.44% falls within the range of 41% and 60% that is stage 3

Percentage for institute sponsored ICT training

(67/128) * 100 = 52.34375%. 52.344% falls within the range of 41% and 60% that is stage 3

Percentage of Personal Computer

(32/126) * 100 = 25%. 25% falls within the range of 21% and 40% that is stage 2

Percentage of IT Expert

(58/50) * 100 = 45.3135%. 45.31% falls within the range of 41% and 60% that is stage 3

4.4 For Policy

The calculated values identify the response of for policy

Percentage for Quality Policy

(61/128) * 100 = 47.65625%. 47.656% falls between the range of 41% and 60% that is stage 3

Percentage for Regulatory Policy

(60/128) * 100 = 46.875%. 46.8% falls between the range of 41% and 60% that is level 3

Percentage for Security Policy

(66/128) * 100 = 51.5625%. 51.56% falls between the range of 41% and 60% that is stage 3

Percentage for Private Policy

(28/128) * 100 = 21.875%. 21.875% falls between the range 21% and 40% that is stage 2

Percentage for Hardware/Software Upgrade

(45/128)* 100 = 35.15625%. 35.156% is within the range 21%and 40%, and that is stage 2.

5. CONCLUSION

Information and Communication Technology (ICT) is an intricate facet of any well-meaning organization, facilitating organizational processes in most sectors of the world's economy. In Nigeria, the manufacturing sector is ascertaining world global standard, therefore ascertaining it maturity level is important for survivability and sustainability. The kochikar model was used in ascertaining this maturity within the Nigeria economic restricting the research toward Edo state. From the analyzed result, it was observed that the Nigeria manufacturing sector sits within the BASIC level of the Kochikar model. Therefore rapid improvement will be necessary to enhance progress and rapid developmental stride via ICT tools within the manufacturing sector.

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