UTM UNIVERSITI TEKNOLOGI MALAYSIA

IJBES

International Journal of Built Environment and Sustainability
Published by Penerbit UTM Press, Universiti Teknologi Malaysia
IJBES 11(1)/2024, 85-101

Assessing E-Compliance Maturity of Public Procurement Processes in Nigeria

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ABSTRACT

The manual approach to public procurement is plagued with inefficiencies. To address these problems, efforts were made to digitize the processes in Nigeria. However, the e-compliance readiness of procurement processes is not known. This study attempts to assess e-compliance maturity of public procurement lifecycle in Nigeria. The study adopted a mixed research approach. A qualitative research method was used to establish criteria for evaluating the readiness of public procurement processes for digitization. Focus group interview with Six (6) automation and procurement professionals was conducted to arrive at the parameters used for the readiness assessment. Consequently, a questionnaire survey was administered on experienced public procurement professionals to evaluate the e-compliance readiness of some identified public procurement processes. Best to Worst Method (BWM) was used to evaluate e-compliance maturity level. The study shows that the processes are readily compliant for digitization.

Article History

Received : *18 September 2023*
Received in revised form : *23 November 2023*
Accepted : *25 November 2023*
Published Online : *31 December 2023*

Keywords:

Construction Project Management, Construction Cost Management, Rail Projects, Structural Equation Modelling.

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DOI: 10.11113/ijbes.v11.n1.1205

1. Introduction

The widely known approach to public procurement of goods, works and services is the conventional manual paper-based procedure. This approach has however, been found to be inefficient due to several factors, particularly its susceptibility to manipulations & error, complicated procedures, lack of transparency and aiding of corruption (Adebiyi et al., 2010; Song, et al., 2014; Ogbu & Asuquo 2018; & Abdullahi et al., 2019a). According to a World Bank (2000)'s Country Procurement Assessment Report (CPAR), about 60% of every US $1 spent on public procurement is being misappropriated in Nigeria. Thus, indicating how government resources are ineffectively managed. This has resulted in billions of dollars siphoned from the country's treasury through the abuse of public procurement procedures, inflated final contract sum, incompetent contractor selection, influence peddling, sycophancy, and use of primordial considerations (Oboirien 2006; Ayangade et al. 2009). To curb these challenges, studies have indicated the application of electronic procurement approach as the solution to deficiencies associated the manual based methods and several e-procurement systems have been developed.

Globally, there are several electronic/web-based procurement systems available for public use, most of which capture some processes within the manual procurement lifecycle include the Korean KONEPS, Malaysian ePEROLEHAN, Japan JETRO, USA FACNET, Philippines PHILGEPS, Scotland ePS, JEPP of Belgium, DOIP of Denmark, UK Tender Direct and NPS-eTender (European Dynamic SA; EDSA, 2004; Mohamad et al., 2010; EGMR, 2011; Abdullahi et al., 2019a). However, most of these processes being deployed in Nigeria, do not represent the entire manual procurement cycle (Abdullahi, et. al., 2019a) or even capture critical processes (Aminu, 2021). The absence of a fully digitized e-procurement system results in untimely

procurement process, lack of transparency, inadequacy in audits, unconformity to regulations, documents mismanagement as well as projects abandonment. All these are in contravention with the goals of the Nigerian Public Procurement Act (NPPA, 2007).

The research efforts made in Nigeria to digitize procurement processes range from procurement planning to contract award (Adebiyi et al., 2010; Afolabi et al., 2017; Abdullahi et al., 2019a, 2019b & 2019c). These attempts are limited to the tendering phase of the public procurement lifecycle. Thus, leaving out processes like contract administration and contract management. Some studies attributed this to the lack of explicit backing by the law, supporting the complete automation of most processes within a typical procurement cycle (World Bank MENA, 2012; Aminu, 2021). Thus, a major barrier affecting the full digitization of the public procurement lifecycle (Afolabi et. al., 2020; UNICITRAL, 2014; & The World Bank MENA, 2012). One of the critical steps to developing a robust system that covers the entire lifecycle is establishing whether the entire lifecycle processes are matured enough for digitization or not. A process maturity assessment is very important towards ascertaining which process is ready for digitization (Afolabi et. al., 2020) as well as assessing the status quo and guide decision makers to potential improvements (Wernicke et al., 2021). Although a number of studies have been conducted to digitize public procurement processes in Nigeria (Adebiyi et al., 2010; Afolabi et al., 2017; Abdullahi et al., 2019a, 2019b & 2019c; Yamusa et al, 2020), the assessment of the maturity of the entire processes for digitization has been overlooked. Findings from Sehlin et al., (2019), buttressed that lack of resources and knowledge on areas mature for digitization is among the major factors limiting any automation process. In fact, about 70% of change initiatives fail due to inadequate maturity assessment (The World Bank, 2000; & Aminu, 2021). The importance of having a digital maturity assessment for procurement proceesses cannot be over emphasized, as the absence of such can affect the design and adoption of efficient web-based e-procurement systems. As developing web-based system for processes that are not ready for automation is not only uneconomical, but yields to the deployment of redundant systems. Furthermore, as the e-procurement is gaining serious significance in public sector organizations, the necessity of applying performance measurement approach for measuring and improving the e-procurement processes is also gaining increased attention. This study aims to assess the maturity of the processes in the Nigerian public sector procurement towards complete digitization. This paper establishes areas where attention should be focused on to achieve the digitization of the entire procurement lifecycle of public entities in Nigeria. The remaining sections of this article are as follows: literature review; methodology; results and discussion; and finally, conclusion.

2. Literature Review

2.1 E-Procurement Development

In recent times, technology has become an integral part in increasing efficiency and effectiveness on public procurement service delivery. Government and Organizations around the globe have also begin to realize the benefits associated with utilization of e-procurement systems towards effective procurement of public works, goods, and services (Adebiyi et al., 2010; Expert Group Meeting Report (EGMR), 2011; Afolabi et al., 2017; Abdullahi et al., 2019a). Some of these benefits include; transparency, savings on administrative cost, reduction on bureaucratic process, obtaining best value for money and cutting down corrupt practices associated with the manual processes (Singer et al., 2009; Albano and Dae, 2010 & Mahmoud, 2013). Most of these challenges have affected the effective delivery of businesses today. According to Korea Public Procurement Service (2016), in other to eliminate possibilities of corruption due to face-to-face contact, strengthen transparency and trust in public procurement, there is the need to transit from the manual paper based to an automated environment. Several countries have designed and deployed e-procurement systems which captures areas within the public procurement lifecycle. Example of such systems are; Korea ONline Electronic Procurement System (KONEPS), In Philippines, the PhilGEPS, Canada's MERX, Scotland's ePS, JEPP of Belgium, Malaysia's ePerolehan, Japan's JETRO, DOIP of Denmark, FACNET of the United States, and UK Tender Direct (EGMR, 2011 & Abdullahi et al. 2019b). Most of these systems have been found to either capture some aspect of the manual procurement lifecycle. Also, these processes are either represented in the countries central e-procurement system or only represented in the system of some procuring entities (Organization for Economic Co-operation and Development, 2019).

2.2 E-procurement System Design and Development

Several countries around the globe have now commence the digitization of processes within the manual procurement circle. Table 1 summarizes procurement systems of Thirty-Four (34) countries around the globe and their automated processes. The shaded circle (●) indicates processes that are completely automated and are avail on the countries national e-procurement portal, the plane circle (◯) represent process that are both on the central portal as well as that of some procuring entities, the plane square (□) represents processes that are only available on the portal of some entities and multiplication sign (x) indicates areas that are yet to be digitized. From the table countries like Korea, Austria, Costa Rica, Lithuania, Finland and Portugal have automated processes within the manual procurement circle. Processes like announcing of tender notices, provision of tender documents, submission of bids, submission of invoices and online cataloging are available on their national central e-procurement system. While in some other countries these processes are only available on the e-procurement system of some specific procuring entities.

In countries like India, Japan Italy and Germany, some of these processes are not only recognized by some specific procuring entities, but are present in the central portal. This indicates that there is some level of disagreement as to what processes is be automated even within the same countries. Globally, this issue has been one of the major challenges affecting the design and implementation of e-procurement system.

However, in Korea the Korea ONline Electronic Procurement System (KONEPS) by the government of Korea, is currently leading the design and implementation of a fully integrated e-procurement solution as it integrates other electronic government operations, including financial management systems, company registrations, Payment Guarantee, Bid management and evaluation system, tax systems and a user management system for buyer and supplier registration and bid participation management (Aminu, 2021, EGMR, 2011 & Korea Public Procurement Service, 2016).

Since its deployment in 2002, the system has undergone series transformation towards accommodating more areas within the procurement cycle. This transformation involved creation of various sub-system to capture critical aspect within the procurement cycle (KPPS, 2016). Some of the critical development over the years includes Online Technology assessment & evaluation system, Construction cost management system, Biometrics based bidding, subcontract management system and Mobile KONEPS (Figure 1). The online technology & evaluation system has transformed the conventional tender evaluation to a real-time tender evaluation of bids with the presence of all relevant parties. Unlike the conventional approach, where all parties have to be physically present. Also, the construction cost management system provides a standard and up to date price catalogue for material, equipment, labor and other resources against which the submitted tender will be evaluated. Another unique feature of the KONEPS is that it allows contracts to be written and altered online using e-signatures. The system also allows for online inspection and subsequent payment. Full details of the various units of the KONEPS are captured in Table 2.

As a result of this, other countries around the globe went into partnership with the Korea government with the aim offering similar services. Some of these countries include Costa Rica, Vietnam, Mongolia, Jordan, Tunisia, Rwanda, and Cameroon (see Figure 1). The World Bank also have recognized this worldwide spread of e-Procurement systems like KONEPS, and has encouraged others to take similar drive towards increasing public procurement transparency and efficiency in developing countries. Figure 2 captures various collaborations with the KONEPS across the globe.

In Africa, apart from Tunisia, Cameroun and Rwanda countries like Nigeria have since joined the race of designing and deploying e-procurement system. According to the World Banks' MENA regional procurement conference (2012), African countries like Morocco are also developing their homegrown e-procurement system, the initial goals focused on monitoring, information and decision-making management, with more extensive e-procurement features like bulk purchasing, fully electronic tendering process, creating a database of suppliers reserved for a later phase. In Tunisia, a more advanced system was adapted from Korea with a US$5.7 million grant from the Korean Agency for International Cooperation.

Similarly, in Nigeria, although most of the development are research based. Some of the proposed systems were for potential bidders to register & manage their profile, view tender advertisement, download tenders and receive tender award notification (Adebiyi et al. 2010 & Afolabi et al. 2017). Abdullahi et al. (2019a, 2019b & 2019c) also designed a web-based e-procurement system that caters for the entire tendering stage of the procurement circle. The countries Bureau for Public Procurement also has an existing central portal NOCOPO (Nigerian Open Contracting Portal). The web portal allows contractors, consultants, citizens and civil society organizations to track procurement processes on planning, available tenders, awards, on-going contracts and their implementation stages. It also provides an online guide for procuring entities for prepare their annual procurement plan and also uploads their procurement record. In order to meet the global trend, the Federal Government also invested about US$3.5 million in 2020 to support the design & development of a central e-procurement system. Presently, the Federal Government of Nigeria is making strives to deploy an e-procurement system for public entities across the country. This makes it more imperative to assess maturity of the entire process to ascertain their readiness for digitization. This will help Nigeria bridge the existing gap and meet up with the current global trends and directives e.g., EU directives requiring full e-procurement use.

2.3 Procurement Maturity Model

Higher level of procurement maturity is linked to improved overall performance for organizations (Schiele, 2007). This led to several research efforts to assess the level of maturity and develop maturity models to measure and improve procurement processes. Rendon (2008) developed the Contract Management Maturity Model (CMMM) to assess, measure and improve procurement processes for organizations. The study found the CMMM to be beneficial to performance measurement and for improving processes. Bemelmans et. al. (2011) developed a procurement maturity tool using design science research approach. The model serves as a basis for organizations to ascertain their level of procurement maturity and provides performance improvement possibilities. van Lith et. al. (2015) later validated the model using the same organizations. They found the organizations to have improved in their general procurement maturity, and specifically, in strategic relations management. The organizations have also attained a level where they are coordinating their procurement activities. More recently, Abduh et. al. (2022) assessed the maturity of procurement units to handle public construction projects. The study used location groupings, overall maturity index, dimensions, and elements. The study found the procurement units' maturity in handling construction projects to be at a low level. Table 3 presents a summary of some prior studies related to procurement maturity model.

Building on the existing studies, this study will assess the maturity of the processes in the Nigerian public sector procurement towards complete digitization. The scope of this study will cover Goods, Service and Construction within the Public Sector Procurement.

Table 1 Global review of E-Procurement system and automated processes (Adapted from OECD, 2016)

S/No	Countries	Announcing Tenders	Provision of Tender Documents	Submission of bids	E-reveres auctions	Notification of award	E-submission of invoices	Online catalogue
1	Australia	●	●	●	×	●	×	×
2	Austria	◯	◯	◯	□	●	●	□
3	Belgium	●	●	●	●	●	□	●
4	Canada	●	●	×	×	●	□	□
5	Chile	●	●	●	×	●	×	●
6	Denmark	◯	□	◯	□	◯	◯	×
7	Estonia	◯	◯	●	●	●	□	×
8	Finland	●	●	●	●	●	●	□
9	Germany	◯	◯	◯	×	◯	×	×
10	Greece	●	●	●	●	●	×	×
11	Hungary	●	●	×	×	●	×	×
12	Iceland	●	●	×	×	●	●	×
13	Ireland	●	●	●	×	●	×	×
14	Israel	◯	◯	×	●	●	●	×
15	Italy	◯	◯	◯	□	◯	●	●
16	Japan	◯	◯	◯	×	◯	◯	◯
17	Korea	●	●	●	●	●	●	●
18	Latvia	◯	◯	●	×	◯	×	×
19	Mexico	●	●	●	●	●	×	×
20	Netherlands	●	●	●	×	●	×	●
21	New Zealand	●	●	●	●	●	□	●
22	Norway	●	●	□	×	●	□	*
23	Poland	●	□	×	●	●	×	●
24	Portugal	●	●	●	●	●	×	●
25	Slovak Republic	●	●	●	●	●	×	×
26	Slovenia	●	●	×	●	●	●	●
27	Spain	●	●	●	×	●	●	●
28	Sweden	□	□	□	□	□	□	×
29	Turkey	●	●	●	×	●	×	×
30	United Kingdom	●	□	□	□	●	□	□
31	Columbia	●	●	●	×	●	●	●
32	Costa Rica	●	●	●	●	●	●	●
33	India	◯	◯	◯	◯	●	×	□
34	Lithuania	●	●	●	●	●	●	□

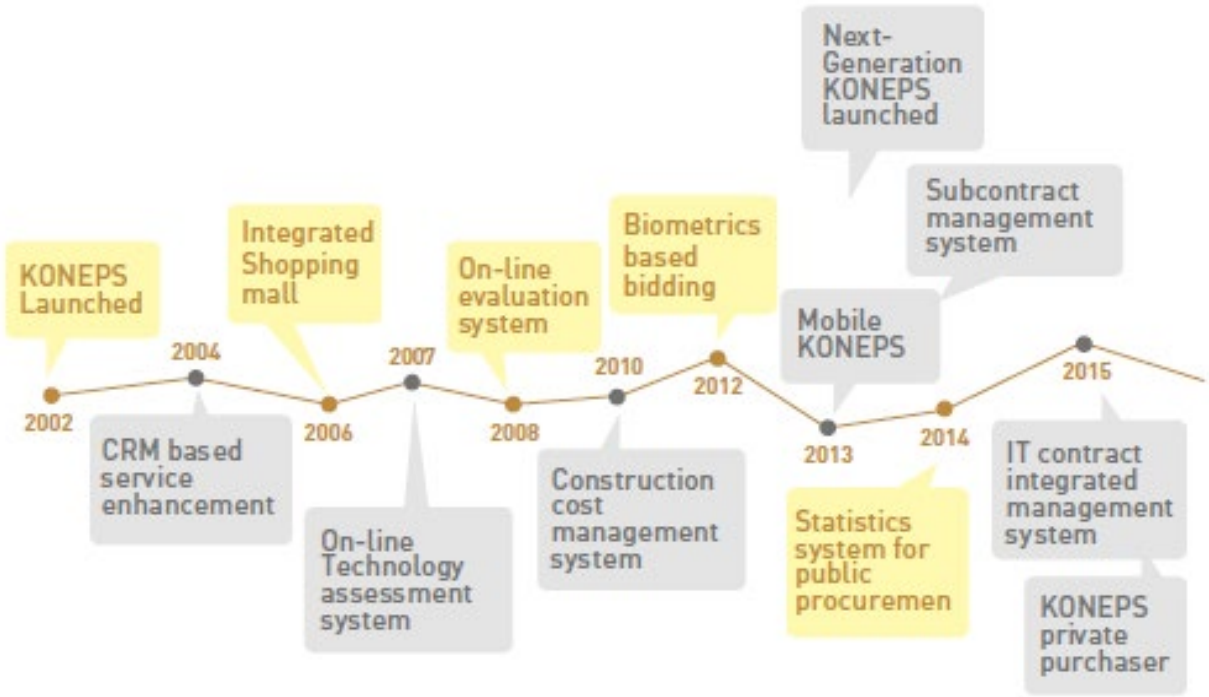

Figure 1 Evolution of the KONNEPS (Adapted from KPPS, 2016)

Table 2 Units Task for the Early Stage of KONEPS

KONEPS System	Service for Public Agencies	Service for suppliers	Service for Operating Agency
Portal System	- Provide integrated information - User community - Online education - Notifications for operator and public agencies	-Provide integrated information - User community - Online education	-Counseling service Management -Survey management
Integrated Notice	- Bidding notice registration management - Search integrated notices - Bid opening Management	- Search integrated notices - Check bid opening result - Check integrated contract information	-Integrated notice classification management
User Registration Management	Request for public agency, user registration - Search suppliers - Agency user authority management - Ineligible supplier registration	- Request for bidding participant registration and alteration - User, bidding agent registration	- Public agency, supplier's registration management - User authority management
e-Procurement Processing	Procurement request - e-Bidding and	- Goods demand management ordering management	- Unit price contract management

	negotiated contract - Contract management	- Conclusion of joint supply agreement, bidding, Request for evaluation	- Procurement statistics - Service status management
e-Guarantee	- Request for e-Guarantee (bidding, contract, payment, defect)	-Submit e-Guarantee	- Guarantee agency management
Goods List	- cataloging process - Assignment of classification and identification number	- Request for cataloging - Search list	- Classification system management - Request and processing status management
Catalog	- Search cataloged products - Shopping basket, order	- Product detailed information registration	- Cataloged products registration
e-Payment	- Inspection - Receive request for payment	- Request for inspection -Request for payment	- Determine commission - Issue notice
Management of Documents Subject to Examination	- Check suppliers' performance - Check information of technical experts	- Check registered Information - Request for update of registered Information	- Suppliers' performance information management - Information update processing

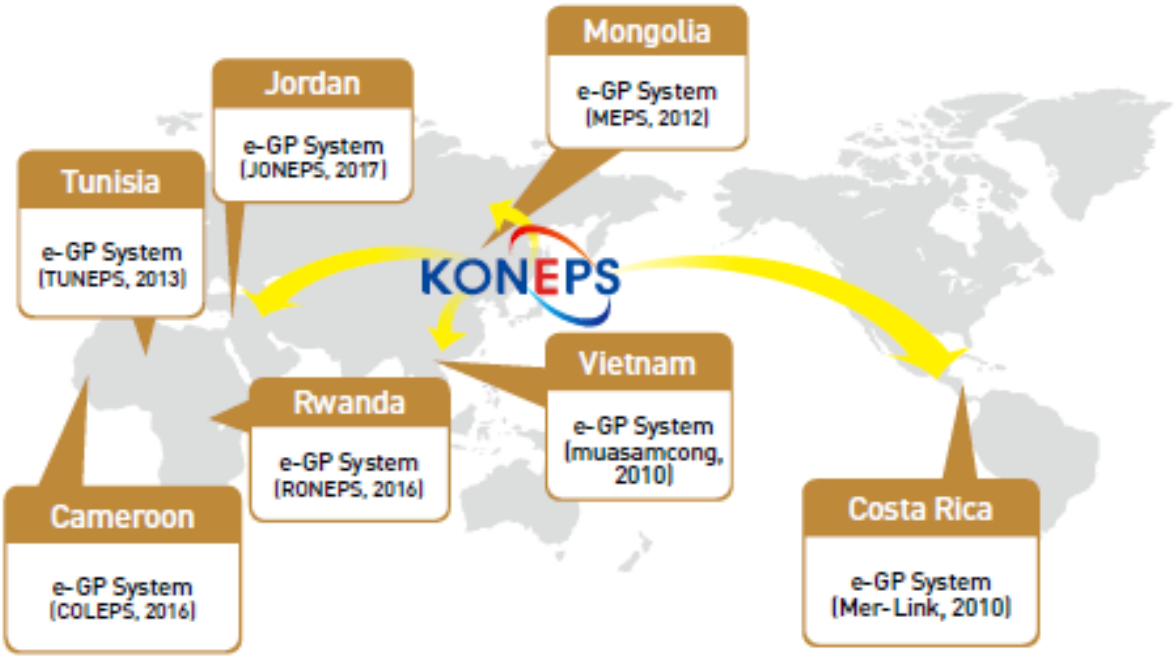

Figure 2 Global KONEPS Collaborations (KPPS, 2016)

Table 3 Prior research related to procurement maturity model

No	Model	Reference	Scope				
			G	S	C	Pu	Pr
1	Procurement Alignment Framework	Batenburg and Versendaal (2006)	√	√			√
2	Contract Management Maturity Model (CMMM)	Rendon (2008)			√		√
3	Proc. Maturity, Alignment & Performance Model	Plomp and Batenburg (2009)	√	√			√
4	SKI Model	Møller et al. (2010)	√	√		√	
5	Procurement Maturity Model	Guth (2010)	√	√		√	
6	Purchasing Maturity Assessment Tool	Bemelmans et. al. (2011)	√	√			√
7	MSU Model	Dang (2011)	√	√			√
8	MSU Model +	Johannsen (2013)	√	√			√
9	IPM2	NPPA (2015)	√	√		√	√
10	Procurement Capability Model	Pongsuwan (2016)	√	√			√
11	PCPM	Oktaviani (2018)			√	√	

Notes: G=Goods; S=Service; C=Construction; Pu=Public; Pr=Private

3. Methodology

3.1 Research Approach

This research adopted a mixed research approach and is divided into two parts. The first aspect of the work involved establishing e-compliance maturity assessment criteria for the manual processes. This was sourced from literature and then validated using a focus group discussion with experts comprising of three software developers and one procurement officer with vast knowledge on manual procurement practices. All the members were selected via snowballing to form the team and had not less than five years of experience, except for the procurement officer who was selected purposively. Two among the ICT experts participated in the design of a prototype web-based portal for a reputable public PE in Nigeria. For the procurement expert, he was involved in the focus group discussion to guide the discussion and make sure the discussion is in line with the requirements of the Nigerian public sector procurement. The ICT experts were involved in order to help validating the assessment criteria for e-procurement processes. Four generic processes were identified as the e-compliance maturity assessment criteria for the digitization of the manual procurement processes; Predefined Procedure, Difficulty Level, Nature of Data, and Size of Users. The sub-criteria for the maturity assessment were also established. Each criterion is assessed using a set of sub-criteria as follows: Predefined Procedure - Guidelines and Need for compliance; Difficulty Level - Routine task, Task sensitivity, and Task dependency; Nature of Data - Data Availability and Size & form of data; and Size of Users - User category and Number of users.

The second aspect of the work covers the digital maturity assessment phase. It involved an online questionnaire survey with 79 experts well versed in both manual and electronic public procurement practices. The criteria established from the first part above were used in designing the questionnaire for collecting the data in this second part. About 55% of the respondents also occupy managerial position in their respective organizations and are cooperate members to various professional body.

Table 4 Procurement maturity definition for an indicator.

Levels	Definitions	Rating Scales
Initial (Not Mature)	This level refers to those processes that are mostly ad-hoc in nature with no formal outlined manual procedure as to how it should be carried out. There is no need for any form of digitization at this stage.	0.00-1.00
Developing (improve on manual process)	Processes under this level are defined with well outlined steps, with little need for compliance as its output may not have any significant impact on other process. This stage also may not need any form of digital aid, as the manual procedure is still evolving.	1.01-0.20
Defined (Partially digitize)	Digitization commences at this stage as processes well-structured and the data generated impacts the outcome of the succeeding process. Users begin to realize the need for digitizing, as some form of digital assistance is needed to deliver the required result.	2.01-3.00
Managed (Completely Digitize)	This stage is where complete digitization is required. Processes at this level are well defined and because of the important nature of the data used/generated it have some form of impact on succeeding phases. In most cases, some form of digital aid may be in existence. However, this protocol may not have well-structured and may lack the requisite legal backing as to how they should be carried out for the purpose of uniformity and ease of acceptance.	3.01-4.00
Optimized (Improve)	This level refers to those processes that are have the legal backing with outline structured electronic procedure. The governing law out rightly supports the automation of such processes. Some of these processes may already have existing electronic systems that may only need further improvement.	4.01-5.00

Table 5 Established weight the E-compliance Assessment Criteria

Main criteria	Local weights	Sub-criteria	Local weight of sub-criteria
Predefined Procedure – C1	0.59	Guidelines – C5	0.23
		Need for compliance- C6	0.19
Difficulty Level – C2	0.24	Routine task – C7	0.03
		Task sensitivity – C8	0.13
		Task dependency – C9	0.08
Nature of Data - C3	0.12	Data Availability - C10	0.10
		Size & form of data – C11	0.06
Size of Users - C4	0.06	User category – C12	0.13
		Number of users – C13	0.05

Table 6 Maturity Level for Predefined Procedures as stipulated in the NPPA (2007)

Manual Procurement Processes	Mean	SD	Rank	CW	pMW
Advertisement	4.54	0.77	1	0.59	2.68
Tender evaluation	4.10	0.69	2	0.59	2.42
Mobilization (APG verification and payment)	4.06	0.63	3	0.59	2.40
Prequalification	4.00	0.70	4	0.59	2.36
Receipt and opening of tender documents	3.94	0.70	5	0.59	2.32
Debriefing and complaints	3.81	0.86	6	0.59	2.25
Needs Identification	3.80	0.97	7	0.59	2.24
Categorization of disposal	3.51	0.71	8	0.59	2.07
Distribution of tender documents	3.49	0.82	9	0.59	2.06
Tender reporting and award	3.39	0.71	10	0.59	2.00
Contracts review and amendments	3.33	0.90	11	0.59	1.96
Preparation of tender documents	3.32	1.03	12	0.59	1.96
Appointment of consultants and contractors	3.16	0.88	13	0.59	1.86
Selection of procurement method	3.10	0.81	14	0.59	1.83
Setting timelines and key performance indicator	3.09	0.66	15	0.59	1.82
Progress reporting and valuations	3.06	1.05	16	0.59	1.81
Payments	3.00	0.91	17	0.59	1.77
Negotiations	2.91	0.88	18	0.59	1.72
Contract execution (review, signing & sealing)	2.86	0.84	19	0.59	1.69
Reporting and documentation	2.86	0.87	20	0.59	1.69
Selection of disposal method	2.86	1.13	21	0.59	1.69
Cost planning	2.84	0.74	22	0.59	1.68
Monitoring and evaluation	2.82	0.75	23	0.59	1.66
Disposal planning	2.76	0.96	24	0.59	1.63
Appointment of evaluator	2.75	0.76	25	0.59	1.62
Auctioning	2.71	1.20	26	0.59	1.60

Needs prioritization	2.25	0.72	27	0.59	1.33
Contract closeout	2.03	0.80	28	0.59	1.20

Scale used: NA=Not Adequate, SA=Slightly Adequate, MA=Moderately Adequate, A=Adequate and VA=Very Adequate

Table 7 Maturity Level for Task Difficulty Level

Manual Procurement Processes	**Mean**	**SD**	**Rank**	**CW**	**pMW**
Prequalification	3.77	0.75	1	0.24	0.90
Tender evaluation	3.77	0.83	2	0.24	0.90
Needs Identification	3.25	0.65	3	0.24	0.78
Needs prioritization	3.23	1.09	4	0.24	0.78
Cost planning	3.15	0.96	5	0.24	0.76
Progress reporting and valuations	3.15	1.34	6	0.24	0.76
Contracts review and amendments	3.14	1.28	7	0.24	0.75
Reporting and documentation	3.10	1.24	8	0.24	0.74
Negotiations	3.09	1.05	9	0.24	0.74
Mobilization (APG verification and payment)	3.00	1.24	10	0.24	0.72
Preparation of tender documents	2.90	1.18	11	0.24	0.70
Receipt and opening of tender documents	2.86	1.01	12	0.24	0.69
Payments	2.85	1.26	13	0.24	0.68
Disposal planning	2.82	0.89	14	0.24	0.68
Monitoring and evaluation	2.81	1.16	15	0.24	0.67
Categorization of disposal	2.81	0.86	16	0.24	0.67
Auctioning	2.76	1.09	17	0.24	0.66
Tender reporting and award	2.67	1.02	18	0.24	0.64
Debriefing and complaints	2.65	0.99	19	0.24	0.64
Distribution of tender documents	2.59	0.97	20	0.24	0.62
Contract closeout	2.59	1.13	21	0.24	0.62
Advertisement	2.53	1.04	22	0.24	0.61
Appointment of consultants and contractors	2.37	0.92	23	0.24	0.57
Setting timelines and key performance indicator	2.34	0.78	24	0.24	0.56
Selection of procurement method	2.24	0.91	25	0.24	0.54
Contract execution (review, signing & sealing)	2.18	0.69	26	0.24	0.52
Appointment of evaluator	2.18	0.76	27	0.24	0.52
Selection of disposal method	2.09	0.58	28	0.24	0.50

Scale used: VE=Very Easy, E=Easy, N=Neutral, D=Difficult and VD=Very Difficult

Table 8 Maturity Level for Nature of Data Used

Manual Procurement Processes	Mean	SD	Rank	CW	pMW
Needs Identification	4.33	1.07	1	0.12	0.52
Prequalification	4.14	0.83	2	0.12	0.50
Receipt and opening of tender documents	4.14	1.02	3	0.12	0.50
Tender evaluation	4.09	1.19	4	0.12	0.49
Advertisement	3.90	0.93	5	0.12	0.47
Tender reporting and award	3.73	1.33	6	0.12	0.45
Distribution of tender documents	3.72	0.73	7	0.12	0.45
Preparation of tender documents	3.61	1.03	8	0.12	0.43
Cost planning	3.22	0.86	9	0.12	0.39
Debriefing and complaints	3.22	0.94	10	0.12	0.39
Progress reporting and valuations	3.22	1.15	11	0.12	0.39
Reporting and documentation	3.08	0.87	12	0.12	0.37
Selection of disposal method	3.08	1.15	13	0.12	0.37
Needs prioritization	3.06	0.90	14	0.12	0.37
Payments	3.06	0.84	15	0.12	0.37
Contracts review and amendments	2.97	1.10	16	0.12	0.36
Mobilization (APG verification and payment)	2.90	1.14	17	0.12	0.35
Disposal planning	2.89	1.13	18	0.12	0.35
Categorization of disposal	2.89	0.95	19	0.12	0.35
Negotiations	2.85	1.00	20	0.12	0.34
Appointment of evaluator	2.77	1.11	21	0.12	0.33
Monitoring and evaluation	2.72	0.95	22	0.12	0.33
Auctioning	2.70	1.03	23	0.12	0.32
Contract execution (review, signing & sealing)	2.68	0.90	24	0.12	0.32
Selection of procurement method	2.63	0.62	25	0.12	0.32
Setting timelines and key performance indicator	2.52	0.62	26	0.12	0.30
Contract closeout	2.27	0.69	27	0.12	0.27
Appointment of consultants and contractors	2.24	0.66	28	0.12	0.27

Scale used: VS=Very Small, S=Small, ML=Moderately Large, L=Large and VL=Very Large

Table 9 Maturity Level for Number of Users Involved

Manual Procurement Processes	Mean	SD	Rank	CW	pMW
Advertisement	4.29	0.87	1	0.06	0.26
Needs Identification	4.16	1.06	2	0.06	0.25
Prequalification	3.96	0.76	3	0.06	0.24
Auctioning	3.87	1.16	4	0.06	0.23
Disposal planning	3.11	1.33	5	0.06	0.19
Monitoring and evaluation	3.03	0.93	6	0.06	0.18

Setting timelines and key performance indicator	3.01	1.02	7	0.06	0.18
Distribution of tender documents	2.95	1.14	8	0.06	0.18
Needs prioritization	2.94	1.02	9	0.06	0.18
Tender reporting and award	2.87	0.82	10	0.06	0.17
Appointment of evaluator	2.84	1.17	11	0.06	0.17
Selection of procurement method	2.78	1.05	12	0.06	0.17
Receipt and opening of tender documents	2.72	0.78	13	0.06	0.16
Appointment of consultants and contractors	2.54	0.95	14	0.06	0.15
Progress reporting and valuations	2.54	0.80	15	0.06	0.15
Cost planning	2.49	0.88	16	0.06	0.15
Receipt and opening of tender documents	2.46	0.73	17	0.06	0.15
Selection of disposal method	2.44	0.83	18	0.06	0.15
Contracts review and amendments	2.39	0.71	19	0.06	0.14
Categorization of disposal	2.37	0.77	20	0.06	0.14
Payments	2.33	1.17	21	0.06	0.14
Preparation of tender documents	2.15	0.80	22	0.06	0.13
Contract execution (review, signing & sealing)	2.14	0.97	23	0.06	0.13
Reporting and documentation	2.14	1.12	24	0.06	0.13
Contract closeout	1.99	0.65	25	0.06	0.12
Negotiations	1.82	0.71	26	0.06	0.11
Mobilization (APG verification and payment)	1.80	1.06	27	0.06	0.11
Debriefing and complaints	1.75	0.63	28	0.06	0.11

Scale used: VS=Very Small, S=Small, A=Average, L=Large and VL=Very Large

Table 10. E-compliance Maturity Level for the Manual Procurement Lifecycle in Nigeria

Manual Procurement Process	**Overall Maturity Weight**	**Maturity Level**
Advertisement	4.29	0.87
Advertisement	4.01	Optimized
Prequalification	4.00	Managed
Tender evaluation	3.98	Managed
Needs Identification	3.79	Managed
Receipt and opening of tender documents	3.66	Managed
Mobilization (APG verification and payment)	3.57	Managed
Debriefing and complaints	3.38	Managed
Distribution of tender documents	3.30	Managed
Tender reporting and award	3.26	Managed
Categorization of disposal	3.23	Managed
Contracts review and amendments	3.22	Managed
Preparation of tender documents	3.22	Managed

Progress reporting and valuations	3.10	Managed
Cost planning	2.97	Defined
Payments	2.96	Defined
Reporting and documentation	2.93	Defined
Negotiations	2.91	Defined
Setting timelines and key performance indicator	2.87	Defined
Appointment of consultants and contractors	2.85	Defined
Selection of procurement method	2.85	Defined
Monitoring and evaluation	2.85	Defined
Disposal planning	2.84	Defined
Auctioning	2.82	Defined
Selection of disposal method	2.71	Defined
Contract execution (review, signing & sealing)	2.66	Defined
Appointment of evaluator	2.65	Defined
Needs prioritization	2.65	Defined

3.2 Establishing the Digital Maturity Assessment Criteria

Since there is no existing literature on e-compliance maturity assessment for evaluating the manual procurement process in the context of this study, it becomes imperative to develop maturity criteria and assessment. So, a generic set of criteria was first identified from literature. They were further ranked in order of priority weight using the Best-Worst Method (BWM) developed by Rezaei (2016), as a more reliable and consistent alternative to the common Analytical Hierarchy Process (AHP). Using the BWM approach the following procedures was followed;

Step 1: Determine the digital maturity criteria.

Step 2: Establishing the best criterion (the most important criterion - B) and the worst criterion (the poorest criterion - W) using experts from the focus group.

Step 3: The best decision criterion (B) is determined to be superior to other determined criteria. A 9-point scale is used for this procedure. Numbers 1 to 9 are used on this scale, and 1: B is equally important for j; 9: B is much more important than j. As a result of the process, the best case (BO) vector is obtained according to other criteria.

This vector is defined as follows;

AB = (aB1, aB2, aB3, …… aBn),

(aBj, indicates the superiority of B over j, and aBB is equal to 1)

Step 4: The superiority of all decision criteria over the worst decision (W) criteria was determined. A 9-point scale is used for this procedure. This scale uses numbers 1 to 9 and 1: W is equally important for j; 9: W is much more important than j. At the end of the process, the status (OW) vector of other criteria is obtained according to the worst criteria. This vector is defined as follows;

Step 5: Determine criteria optimum weights (w*1, w*2, …, w*n).

There must be maximum absolute diameters to find optimum weights [$\left| wB - aBjwj \right|$, $\left| wj - ajwwww \right|$] minimized for all js.

$$min\ maxj\ [\left| wB - aBjwj \right|,\ \left| wj - ajwwww \right|]$$

s.t.

$$\sum_j wj = 1$$

Wj ≥ 0, for all J's.

The equation above can also be expressed with the linear problem below;

min ʒL , for all j's

s.t.

$\left| wB - aBjwj \right| \leq$ ʒL , for all j's

$\left| wj - ajwwww \right| \leq$ ʒL , for all j's

$$\sum_j wj = 1$$

Wj ≥ 0, for all J's

3.3 The Maturity Assessment

For the second aspect of the work the data analysis used were mean, standard deviation. The Criteria Weights (CW) was from the BMW analysis, while the process Maturity Weight (pmw) was arrived at by multiplying CW by the mean score of each process.

In order to adequately evaluate the e-compliance maturity level of the various processes within the manual procurement lifecycle, a five (5) level e-compliance maturity categorization

was adopted as shown in Table 4. With 4.01-5.00 was considered to be the most matured process, while those within 0.00 – 1.00 were considered the least matured.

4. Results and Discussion

The validation exercise outcome presented 13 variables which are grouped into 4 criteria and 9 sub-criteria as presented in Table 5.

Predefined procedure (C1) was identified to be the most important criteria that affect procurement process e-compliance maturity, followed by Difficulty level (C2), then Nature of data (C3) and Size of users (C4) was considered as the least important. On the other hand, for the sub-criteria Guidelines, Need for compliance, Task sensitivity and User category returned as the most important, while Data availability, Dependency and size & Form of data are the least important sub-criteria. In line with this output, the result was also evaluated in terms of consistency rate and it was checked whether this value was below 0.25 in accordance with the Best Worst method. A ksi* of 0.12 for the main criteria and 0.16 for the sub criteria, implying that the result of this finding is consistent.

4.1 *E-compliance Maturity Assessment*

Result for the first category assessment as shown in Table 6, presents Advertisement, Prequalification, Mobilization, Prequalification and Receipt and Opening of tender as the highest ranked when it comes to the level of details and procedural guide. Reference to their criteria weights (CW) for the group, the process maturity weights (pMW) for these top processes are 2.68, 2.42, 2.40, 2.36 and 2.32 respectively. Also, the least defined processes are Monitoring and evaluation, Disposal planning, Appointment of evaluator, Auctioning, Needs prioritization and Contract closeout with pMW of 1.66, 1.63, 1.62, 1.60, 1.33, and 1.20 respectively. This result portrays those processes that are mature with respect to the first class of the e-compliance maturity assessment. The result tallies with findings of studies like that of Betts et al. (2006) and Fong and Yan (2009) that pointed out advertisement as one of the earliest developments in e-procurement. This only suggests its development over the years, leading to its high maturity as part of a predefined process.

The findings in Table 7 identified Prequalification and Tender Evaluation as the most difficult task with the same mean score of 3.77 and pMW of 0.90. Needs identification, Needs prioritization and Cost planning were ranked 3rd, 4th and 5th with a pMW of 0.78, 0.78, and 0.76 respectively. The least difficult task identified include; Appointment of consultants and contractors, setting timelines and key performance indicator, selection of procurement method, contract execution (review, signing & sealing), appointment of evaluator and selection of disposal method. The result is pointing towards the attention received by bidder prequalification and tender evaluation as a difficult task especially due to its subjectivity. This result is in line with recent efforts to digitise bidder prequalification and tender evaluation by Abdullahi et al. (2019a, b, c).

In Table 8, Needs Assessment emerged with the highest mean score of 4.33 and 0.52 as the pMW was found to require some reasonable amount of data from the various units within the procuring entity. Prequalification and receipt & opening of tender documents were also among the top ranked processes in this stage they both had 0.50 as pMW. Another critical process identified at this stage was Tender evaluation which involves the analysis of the various tenders received towards identifying the lowest responsive bids. It has a pMW of 0.49 and is line with the findings from the process validation exercise. The findings are supported by Abdullahi et al. (2019a, b, c) who has demonstrated that the processes can be digitised.

Apart from the top ranked processes, some of the least ranked processes and their pMW include; Selection of procurement method (0.32), Setting timelines and key performance indicator (0.30), Contract closeout (0.27) and Appointment of consultants and contractors (0.27), as they require very little information to come to a decision at the end of each process.
The result from the survey identified captured in Table 9 shows Advertisement with a pMW of 0.26 to be the most matured process at this stage of the assessment. Other processes include Needs identification (0.25) and Prequalification (0.24). The findings are supported by Abdullahi et al. (2019a, b, c) who has demonstrated that the processes can be digitised.

Finally, the final result for the maturity level of the manual procurement processes as contained in Table 10 shows the aggregation of the responses from the four-maturity assessment class.

Advertisement returned as the most matured manual process ready for full automation with an overall maturity weight (OMW) of 4.01 and also being the only process within the Optimised (Improve) level. This means that amongst the 28 manual processes, advertisement is the only processes is fully e-compliance matured. The second process is prequalification with an OMW of 4.00 slightly outside the Manage (completely digitize), it has well defined procedures however lacks any standards as to how this should be carried out in a digitise environment. While the next 3 processes and their OMW are Tender evaluation = 3.98, Needs identification = 3.79 and Receipt & opening of tender = 3.66 respectively but on the manage category (completely digitise). Works by Abdullahi et al. (2019a, 2019b, 2019c), have reported similar findings for the tendering stage of the procurement circle.

The subsequent processes are within the defined category (partially digitise) and their OMW are as follows: Cost planning = 2.97, Payments = 2.96, Reporting and documentation = 2.93, Negotiations = 2.91, Setting of timeline and key performance indicators = 2.87, while for the least matured processes are Auctioning = 2.82, Selection of disposal method =2.71, Contract execution = 2.66, Appointment of evaluator = 2.65, Need prioritization = 2.65 and Contract close out =2.21 and are also within the Defined Category. Most of these processes still have key aspect being carried out manually as they still require some form of human reasoning in coming to a

decision. However, this is a deviation to existing e-procurement best practices as outlined in the reports on by KPPS (2016) as processes like payment, auctioning, and negotiations already have existing e-compliance equivalent in operation in Korea and other affiliate countries.

5. Conclusion

In conclusion, the manual procurement circle is mature for digitizing as most of the critical processes that affect that affect the effective delivery of projects are within the Optimized (Improve) and Managed (completely digitize) maturity levels. The identified process areas that are readily mature for the deployment of e-compliant equivalent include Advertisement, Prequalification, Tender evaluation, Needs identification, Preparations of tender document, Receipt and Opening of tender. Most of these findings are in line with the works on tendering by Abdullahi et. al., (2019a, 2019b, 2019c). However, this study indicates that the other processes overlooked in the digitization of the Nigerian public procurement processes are mature for deployment. The study therefore presents a useful basis for going beyond the Tendering Phase in the development of a more robust e-procurement system in Nigeria. The maturity assessment was only for the processes. Hence, further research can be conducted to assess readiness of the public procuring entities and other available technologies like machine learning for deployment of semi-autonomous systems.

The implication of this study reveals the avenue for Nigerian public procuring entities in harnessing information and communications technology and World Wide Web to improve the public procurement sector. Hence, public procuring entities in Nigeria should are endeavor to adopt digital procurement processes. Also, the regulatory body of the Nigerian public procurement sector, the Bureau of Public Procurement, should enforce this effort.

A major limitation of this study is that it is conducted using the public procurement regulatory guide of Nigeria, the Nigerian Public Procurement Act (NPPA, 2007). As such, its applicability is limited to the country of development. However, lessons could be drawn given that the 1966 United Nations Commission on International Trade Law (UNCITRAL) is the basis of government procurement laws in most.

Acknowledgements

The authors of this study would like to acknowledge and thank the Tertiary Education Trust Fund (TETFUND) under the National Research Fund (NRF) of 2019 for providing the grant under which this study was carried out.

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