A Framework to Deploy Mobile Business Intelligence within Small and Medium Enterprises in developing countries

Case Study of South Africa And Nigeria

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***Abstract*— Over the years, there has been emergence of varieties of decision-support applications. System evolved due to the rapid growth in data complexity and need for accurate information in a dynamic environment. Due to increase in mobility and automation of activities within enterprises, huge amounts of data are rapidly generated than they could be instantaneously utilized in heterogeneous, intra or inter-organisational business processes. Developing countries' Small and Medium Enterprises (SMEs) are faced with challenges of accessing intelligent information for decision making at different operational sites. SMEs in developing countries are paying a huge business opportunity cost by not utilizing Mobile Business Intelligence (MBI) systems. This is as a result of lack of MBI framework to inform the deployment of MBI solutions in developing countries' SMEs. This study therefore is envisioned to design a framework for the deployment of MBI in developing countries' SMEs. So as to achieve this, the study adopted various scientific approaches (Textual Analysis, Principal Component Analysis, and Structural Equation Modelling) systematically. This study is expected to contribute towards the literature and the methods in establishing and determining the factors needed for the development of frameworks in Information Systems studies. Practically, the study is expected aid deployment of MBI for SMEs in developing countries' contexts.**

Keywords*— *Mobile Business Intelligence; Principal Component Analysis; Small and Medium Enterprises; Textual Analysis

I. INTRODUCTION

Data leads to information which in-turn leads to knowledge and therefore aids insight as well as intelligence (Bernstein, 2011). According to [3], comprehensive ability to use existing experience or knowledge to adapt to new situations or solve new problems is intelligence. The upsurge in the mobility of information has given rise to various enterprises ambitious interest in adopting mobile business inventiveness, which is also strengthened by the benefits such as, facilitating access to important and crucial information at any given location, experienced by the workers within such an organization [8]. A few researchers such as [7], [11], and [1] have outlined the benefits of Mobile Business Intelligence (MBI) comprising but not limited to; accessibility, usability, collaboration, and improved workforce productivity. Many SMEs come up with their specific individual Business Intelligence (BI) services to provide adequate guidance for their decision makers ([19]; [17]; [5]; [15]). The level of interest in this subject has grown significantly when opinions from literature emphasize that BI systems are an important component of a modern enterprise's information infrastructure, as they contribute to its success and competitiveness [8]. However, much as BI is widely used by bigger enterprises such as telecommunications and banking, its implementation by small enterprises is still generally limited [13].

With the discrepancy in policies established in different countries, the classification of SMEs varies. The study used Active Number of Employees due to its broad similarities across South Africa and Nigeria. Active Number of Employees Less than 10 for small to Less than 130 for Medium, for IT related SMEs in both South Africa and Nigeria.

II. STUDY PROBLEM

With the noticeable increase in mobility of SMEs, and dynamism in information gathering, the need for strategic information cannot be overemphasized [4]. Although the importance of MBI to SMEs is well acknowledged, there are few documentations of optimal utilization of MBI in SMEs [14]. The study of MBI in SMEs has not been well acknowledged and documented as it has been in larger enterprises [11]. The implementation of MBI in SMEs is more of a challenge than in bigger businesses in developed countries ([2]; [16]; [9], [12]). [10] confirms that there is a gap in the literature on MBI related factors in SMEs. Distinct to developed countries, very minimal research on MBI penetration in SMEs has been undertaken in developing countries [18]. [6] stressed the need to investigate contextual factors of MBI that are unique to enterprises in different geographical regions in order to harness positive outcome(s) and co-operative goal(s). More so, hardly any framework based factors centered on SMEs in developing countries have been developed to inform the implementation of MBI ([2]; [16]).

Based on the grey areas in the 'integration of MBI in SMEs', this study sought to identify pertinent factors in the development of a framework for MBI deployment in SMEs in developing countries. South Africa and Nigeria are the two study locations owing to their entrenched SMEs in the socio-economic setup and logistical factors.

III. METHODOLOGY

Mixed method approach was adopted for this study. Related literatures were reviewed (content search), so as to gather secondary data lead to identification of several factors with pertinent attributes which informed the development of MBI framework. Textual Analysis (following the required systematic approach) was then carried out to evaluate and validate the factors in order to eliminate recurrences of constructs detected from various repertories hence reducing and categorizing them. Principal Component Analysis (PCA) was also used in this study for an in-depth factor reduction and categorization. A measuring instrument was also developed centered on the model, which was in the form of close-ended questionnaire that was used to gather the primary data. The closed-ended questionnaire was coded and then transcribed into Statistical Package for Social Scientists (SPSS) after data were collected. After the collection of data, Confirmatory Factor Analysis (CFA) was adopted to analyze the data and Structural Equation Modeling (SEM) was applied to validate the MBI framework.

IV. FINDINGS AND DISCUSSION

A. Content search

Numerous repositories were examined during the process of content search and the identified factors are illustrated in Table 1. The search was based on the following key terms: MBI, MBI deployment, Critical Success Factor of MBI, and so on. Table 1 below shows few of the 70 factors retrieved.

TABLE I. SUMMARY OF IDENTIFIED FACTORS ON MBI IN SMES

Factors	Category
financial resources	Organizational Factors
Perceived Ease of Use /Complexity	Technology complexity
Top Management Support	Organizational Factors
Management Expectations	Organizational Factors
Satisfaction and Systems Satisfaction	Relative advantage
Vendor and Consultant Support	Vendor factors
Top Management Support	Environmental factors

B. Textual analysis

All the factors were widely inspected as well as the comprehensive significance appended to it during textual analysis. Hence, identified factors named in any other way yet conveying comparative implications were assembled collectively as a single factor. After subjecting the 70 factors to Textual Analysis, following the systematic approach stated above, the factors were reduced to 49. Table II shows few of the final 49 factors grouped in different categories with their respective frequencies.

TABLE II. RANKING OF FACTORS

Item	Category	Metric	Frequency
1	Organizational Factors	Top Management Support	41
		Management Expectations	23
2	Security factor	Information Security Policy	29
		User privacy	36
3	Environmental factors	government regulations	32
		Loans and grants	16
4	Compatibility	mobile platform	34
		Graphical User Interface	24
5	Entrepreneur competences factors	Information utilisation	11
		flow of information	12
6	Technological characteristics	Graphical User Interface	25
		storage capacity	15
7	Vendor factors	training session	14
		Vendors/technicians location	17

C. Component Analysis

Principal Component Analysis (PCA) was used to analyze a transcribed questionnaire completed by experts within the research context/domain. The questionnaire was developed from the identified factors derived from Textual Analysis. This approach was adopted to contextualize the factors. Using PCA, the 49 factors that were gathered through Textual Analysis were analyzed and thereafter 38 factors were reserved for additional analysis. Few of the outcomes are revealed in Table III which indicates that 38 factors loaded with eigenvalue greater than 1 and were acceptable.

TABLE III. RELIABILITY STATISTICS

Component	Total Variance Explained Initial Eigenvalues		
	Uni-TVE	***% of Variance***	***Cumulative %***
1	6.025	74.675	54.553
2	8.543	78.786	80.729
3	5.979	68.642	85.012
4	1.444	56.653	88.438
5	1.368	56.553	91.609
6	1.765	57.007	94.275

D. *Validating the conceptual framework*

After the operationalization of the factors within the context of the study, a conceptual framework was developed using the 38 identified (contextual) factors. A questionnaire was developed from the conceptual framework. The study also tested the reliability of questionnaire using SPSS. The results have α-coefficient of 0.841 which is above the average of 0.700. The outcome of the questionnaire reliability is shown in Table IV below.

TABLE IV. RELIABILITY STATISTICS OF THE QUESTIONNAIRE

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.841	.832	38

The study adopted the steps by Arbuckle (2008) which state that, latent variables are the independent, silent ones and measurable attributes or items, referred to as observed variables when it belongs to a certain latent variable. The latent variables represented by circles in this study are; OF, TF, EF, TCPLX, TCOMP, RA, VF, ECF, SF, INF, and Deployment (ENP). Figure 1 below displays the measurement model.

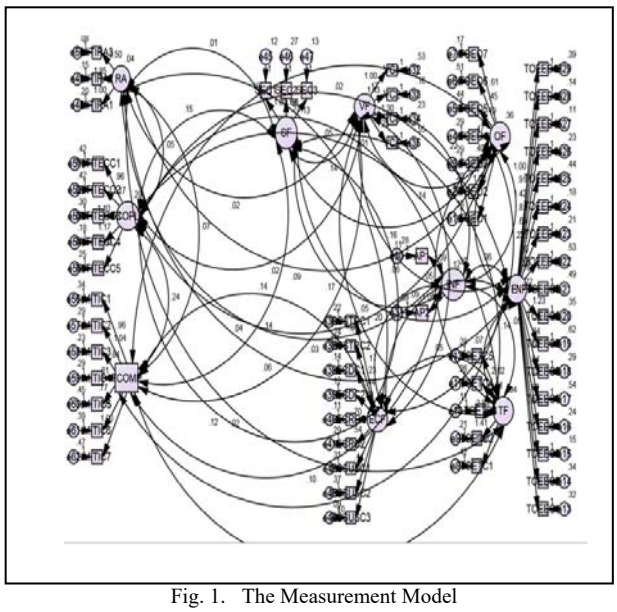

Fig. 1. The Measurement Model

The model was then tested for fitness using 5 fit indices namely; Chi-square ($\chi 2$), Root Mean Square of Error Approximation (RMSEA), comparative fit index (CFI), Standard Root Mean Square Residual (SRMR) and Goodness of Fit Index statistic (GFI). The measurement model was modified to obtain accurate outcomes. Tremendous improvement was achieved after the modified model was run. The outcomes of the modified model are shown in Table V below.

TABLE V. RELIABILITY STATISTICS OF THE QUESTIONNAIRE

Fit Indices	Measure-ment Model	Threshold	Recommendations for the Measurement Model
Chi Square	8.195	Ratio $2.1 \leq \chi 2/d.f) \leq 3.1$	$\chi 2/d.f$ is too big and out of the rage of threshold. This shows model needs modification
CFI	0.452	CFI ≥ 0.950	Less than the threshold, suggests model need modification
RMSEA	0.185	$0.05 \leq$ (RMSEA) ≤ 0.080	More than the threshold, suggests model need modification
SRMR	0.069	RMR ≤ 0.08	Above the threshold value. Shows needs modification
GFI	0.63	GFI ≥ 0.90	Less than the threshold, shows model need modification

In addition, Figure 2 shows the final attuned Structural Model of this study, which was extracted from AMOS.

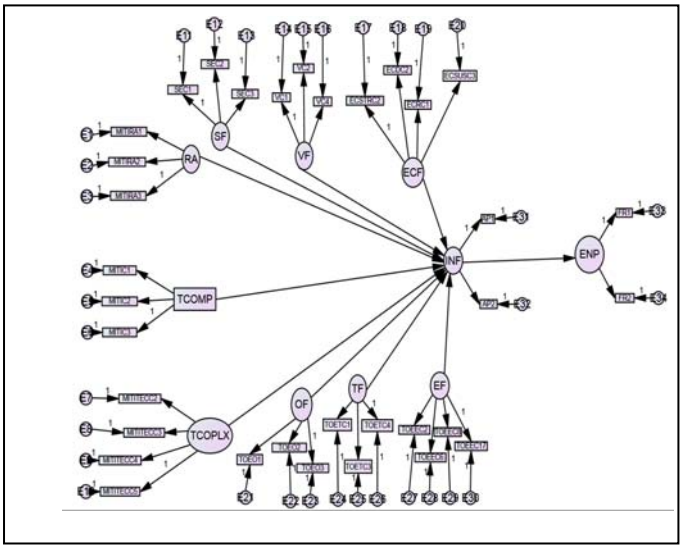

Fig. 2. Attuned Structural Model

The study tested the existing relationships between the constructs and the indicators, as soon as the model was established to be fit. Seven of the ten hypothesized relationships amongst the identified latent variables gotten after running the structural model are shown in Table VI.

TABLE VI. RELIABILITY STATISTICS OF THE QUESTIONNAIRE

Hypothesis	Path			S.E.	C.R	Comment
H6	INF	<-	RA	2.380	.694	Accepted
H5	INF	<-	TCOMP	.396	.044	Accepted
H7	INF	<-	VF	.329	.064	Accepted
H1	INF	<-	OF	.154	.108	Accepted
H2	INF	<-	TF	-.027	.055	Rejected
H3	INF	<-	EF	1.977	.469	Accepted
H10	ENP	<-	INF	.243	.039	Accepted

From Table VI above the following conclusions can be made.

H1: Organizational factor will have an influence when infusing MBI in SMEs business process. **H2:** Technology factor will have no significant influence when infusing MBI in SMEs business process. **H3:** Environmental factor will have a significant influence when infusing MBI in SMEs business process. **H4:** Technological complexity factor will have a significant influence when infusing MBI in SMEs business process. **H5:** Technological compatibility factor will have a significant influence when infusing MBI in SMEs business process. **H6:** perceived relative advantage will ultimately influence infusion of MBI in SMEs business process. H7: Vendor factor will ultimately influence infusion of MBI in SMEs business process. **H8:** Entrepreneurial competencies will considerably influence infusion of MBI in SMEs business process. **H9:** Security factor will ultimately influence infusion of MBI in SMEs business process. **H10**: Infusion of all cogent MBI factors in SMEs will considerably lead to successful deployment of MBI. Figure 3 below, shows the final framework for MBI deployment within SMEs in developing countries.

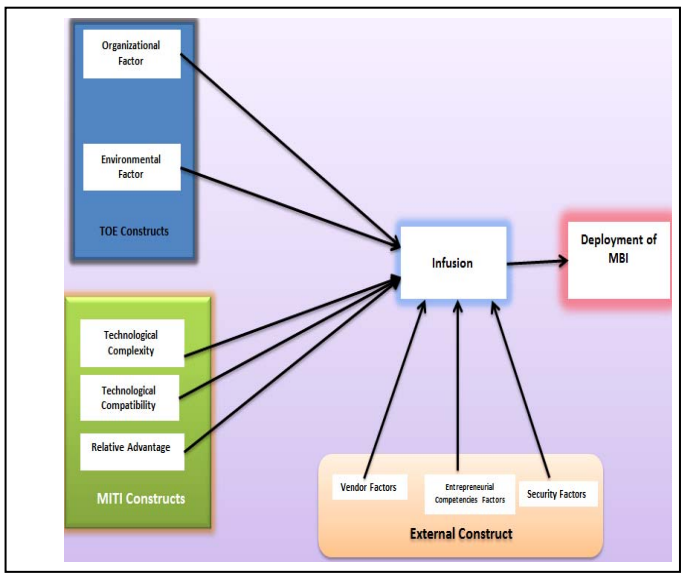

Fig. 3. Framework for MBI deployment in developing countries SMEs

V. CONCLUSION

In conclusion, the study outlined an explicit review of BI, focusing on MBI platform. The importance of MBI to organization (including, SMEs) was highlighted. However, this study further elaborated on the identified problems and gaps related to the deployment of MBI by SMEs in developing countries. MBI factors were identified using textual analysis and further contextualized using PCA. The data gathering instrument (questionnaire) was designed and tested for reliability. The validity of the framework was tested using AMOS as well as the hypothesis. The accepted hypothesis formed the final MBI framework of this study. The study outcomes highlighted that; organizational factor, environmental factor, technological complexity, technological compatibility, relative advantage, vendor factor, entrepreneurial competencies, security factor, and infusion are factors that are pertinent in the deployment of MBI in developing countries' SMEs.

Though the study was specifically for SMEs in South Africa and Nigeria, it can be used as a baseline for research in other developing countries' SMEs, particularly in Africa as a whole. The developed framework in this study will serve as a baseline in the integration of MBI hence, helping SMEs to avoid having failed MBI projects. Even though, efforts were put in place in this study to mitigate gaps that could have led to inaccuracies nevertheless, it is common that there are constraints beyond the control of the researcher(s). Hence, for further research, the study suggests the need to carry out a longitudinal study to see the changes in the deployment. In addition, the study suggests the use of action research to establish best practice in the process of deployment of MBI.

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