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DETERMINANTS OF BUSINESS INTELLIGENCE SYSTEMS ADOPTION IN DEVELOPING COUNTRIES: AN EMPIRICAL ANALYSIS FROM GHANAIAN BANKS

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Abstract

Keen competitions among banks to attract and maintain clients, together with issues such as risk management, and loss prevention are some of the common phenomena in the banking sector recently. As a result, Business Intelligence (BI) technologies which can be used to analyze and detect fraud, predict and understand the behavior of clients have come to the rescue of the banks. This study explores the factors that influence Ghanaian banks to adopt BI Systems and also determines the extent of its implementation. This was done with the development of a structural model through the lens of the Diffusion of Innovations Theory, Technology-Organization-Environment framework, and the Institutional Theory. A sample data from 130 Bank executives were subjected to partial least squares structural equation modeling (PLS-SEM). The results showed that technological factors (Relative Advantage and Complexity), organizational factors (Presence of Champion and Organizational Readiness), and environmental factors (Regulatory Body) account for BI Systems adoption in Ghanaian banks. Also, the analysis revealed that Ghanaian banks have reached a high level in terms of BI Systems implementation. This study contributes to enrich the Information Systems (IS) literature by identifying the contextual factors that organizations especially in sub-Saharan Africa (SSA) countries should focus on with their BI Systems implementation effort. Other implications are also discussed.

Keywords: Business Intelligence Systems; Adoption; Technology-Organization-Environment Framework; Ghanaian Banks; PLS-SEM; Developing Countries

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INTRODUCTION

The financial services industry is rapidly changing with issues such as globalization, deregulation, mergers and acquisitions, competition from non-financial institutions, and technological innovation, forcing companies to rethink their strategy [1]. Recently, issues such as detection and suppression of fraud, risk management, customer management, product management, and loss prevention have emerged as primary concerns of financial institutions [2]. Also, in a modern bank network, hundreds of millions of customer data records are generated daily. Thus the growing competition and increased speed of business changes have dramatically triggered/increased the need for bank intelligence [3].

However, research shows that adopting BI Systems is based on several factors [4,5]. Moreover, BI Systems implementation can be costly, involving a complex undertaking which requires appropriate infrastructure and resources over a lengthy period of time [5,6]. Thus, scrutinizing the key factors organizations should focus on when embarking on such project is justified especially in the developing country context where little is known about it.

Ghana currently has 29 licensed Commercial (also known as universal) Banks (classified as Class 1) operating in the country as at the end of December 2015. Out of these, 12 are local Banks whilst 17 are foreign. Of the 12 local banks, 3 are publicly

owned by the state whilst 9 are privately owned (www.bog.gov.gh). According to the Ghana Banking survey (2014), Ghanaian banks are facing a lot challenges. These include: customers demanding improved service delivery at reasonable cost, customers' attrition, competition, legislation and regulations, technology, and the performance of the domestic economy. From the survey, 81.8% of the executives surveyed consider competition as a major challenge. In addition, 72.7% see regulations as a challenge whilst 63.6% are of the view that technological factors will have the greatest influence on the future of banking in Ghana. Hence, the need for bank intelligence to tackle these challenges. Also, currently, although few studies have looked at the adoption of BI Systems in the Ghanaian banking sector, yet their focus was on adoption of BI on the individual level [7], and using BI application to detect fraud [8].

Therefore, the purpose of this study is to add to the existing literature of BI Systems by exploring the factors influencing its adoption in the banking sector in Ghana. Also, the extent of BI Systems implementation in the Banks is also examined. This study was motivated by the fact that there are few empirical studies on BI Systems adoption based on organizational adoption theories generally, and much fewer when it comes to developing countries context especially sub-Saharan African (SSA) countries.

The rest of the paper is as follows: the next section discusses the literature review which is followed by the development of the research framework. Subsequently, the methodology, data analysis, and findings are also discussed which will be followed by summary of findings, conclusions and implications.

LITERATURE REVIEW

Many researchers have reported about the potential usefulness of BI Systems to organizations. These include: getting the right information to the right user at the right time; an increased efficiency and effectiveness of the organization through a faster flow of and easier access to information within the organization; an effective tool for decision making; creating competitive advantage to organizations, and so on [9-14].

BI Applications in the Banking Sector

In the banking sector, some of the common BI applications and areas that BI Systems are used are explained below:

According to Ubiparipovi and Durkovic [15] and Curko and Bach [2], banks are applying BI applications in: Customer Relationship Management (CRM), Business Performance Management (BPM), Risk Management (RM), Asset and Liability Management (ALM), and Compliance. They gave examples of actual issues BI systems handles as: customer complaints, market analysis, transaction analysis, customer profitability, location profitability, an interest rate risk analysis, liquidity analysis, suspicious activity analysis, reducing churn rate, avoiding a loan default and detection of fraud, predicting if customers will use a new product or service and whether the product will be profitable, and so on.

Related Studies on BI Systems Adoption

A recent literature survey on BI systems from Aruldoss et al. [16] have revealed that BI applications development have received a lot of attention with little focus on BI systems adoption.

Also, as BI is an area still evolving, other studies have used qualitative studies to explore in-depth to determine the specific factors to concentrate on but these are mostly case studies involving very few organizations where findings cannot be generalized. Examples of these are: identification of SME-specific determinants of Business Intelligence Systems (BIS) adoption at firm level [17]; investigation of BI adoption in a retail chain based in Slovakia [18]; exploration of the factors that can assist organizations to be more successful in achieving pervasive use of BI [19]. In addition, other researchers have also proposed conceptual models, and the design, implementation and deployment of BI systems in several studies [1,3,20-23].

In particular, empirical studies on adoption of BI Systems using the technological innovation adoption theories at the organizational level are few. Also, most of the existing studies have focused on a combination of industries rather than a specific focus on the banking sector. Examples of some of these studies are also discussed below:

Sujitparapitaya et al. [24] examined ten variables in the technological, organizational and environmental factors that influence adoption of BI in private and public institutions of higher education (IHE) in USA. Data was collected through a survey method from 243 senior administrators of institutional research and information technology units at both two-and four-year institutions. Their results showed that organization structure, institution size, absorptive capacity, organizational legitimacy, stakeholder support, perceived costs, and perceived complexity are significant determinants of BI adoption in IHE and that executive support, competitive advantage, and perceived benefits have no significant effect on the adoption.

Also, Malladi [25] in his study examined the factors associated with extent of organizational adoption of Business Intelligence & Analytics (BIA) using the Technology-Organization-Environment framework. Data was collected from 358 firms across North America through a survey. His results indicate an organization's perceived benefits, technology sophistication in terms of data infrastructure and organization sizes are positively associated with the extent of BIA adoption. Also, the results revealed that firms in knowledge-intensive industries are likely to more extensively adopt BIA but the lack of industry standards hinders adoption.

On the basis of the limited nature of available empirical studies concerning the adoption of BI Systems especially for banking sector alone, this study will thus empirically investigate the factors that influence the adoption of BI Systems in the context of banking sector using the DOI theory, TOE Framework and the INT theory in a developing country context.

Underpinning Theories

As this study is about organizational adoption of BI Systems, the underpinning theories used are Diffusion of Innovations, Technology-Organization-Environment framework, and the Institutional Theory which pertains to adoption of innovations at the Organizational level.

These theories were chosen and combined as many studies have called for the combination of different theories in a study to strengthen the methodology and also give better understanding of the adoption of new technologies [26].

Diffusion of Innovation

Diffusion of Innovation (DOI) theory posits that the rate of adoption of innovations is influenced by five factors: compatibility, observability, relative advantage, complexity, and trialability [27]. Rogers explained further that complexity is mostly negatively related with the rate of adoption, but trialability, relative advantage, observability, and compatibility are usually positively related with the rate of adoption [27]. Consistently however, researchers have found out that technical compatibility, relative advantage, and technical complexity are the main antecedents to innovations adoption [28].

Many studies have used Rogers's theory to predict innovation adoption behavior at both organizational and individual levels [28-30].

Technology-Organization-Environment

Technology-Organization-Environment (TOE) Framework developed by Tornatzky and Fleisher [31] posits that the process by which firms adopt and implement technological innovations is influenced by three elements. These are the technological context, the organizational context, and the environmental context. These three elements can provide both opportunities and constraints for technological innovation adoption [31].

The technological context consists of the internal and external technologies which are essential to the firm and technologies may include both processes and equipment. The Organizational context refers to the firm's characteristics and resources, and may include the firm's size, degree of formalization, degree of centralization, managerial structure, and amount of slack resources, human resources, and linkages among employees and so on. The environmental context comprises of the size and structure of the industry, the macroeconomic context, the firm's competitors, as well as the regulatory environment [32].

This framework has been used to explore the adoption of technological innovation in many areas [17,25,33]. Some studies have also combined the DOI and TOE [24,34-36].

Institutional Theory

Generally, organizations work in environments which are usually dependent on the economic, socio-political, and technological influences [36]. Therefore, for them to succeed, they need to conform to the belief systems and rules prevailing in the environment in which they exist [37-41]. DiMaggio and Powell [41] explained that the drive for legitimacy leads to the processes of institutionalization which in the long run, makes the organizations more similar without necessarily making them more efficient, which then gives rise to institutional isomorphism.

There are three different types of institutional isomorphism which are mimetic, coercive, and normative [41]. Mimetic isomorphism is the powerful forces that encourage firms to imitate others in the same industry. Coercive isomorphism refers to both the formal and informal pressures exerted in the firms by other firms which they depend on, as well as the cultural expectations of the society within which they operate which could include government regulations and policies. Normative isomorphism refers to professionalization in the industry, which is defined as “the collective struggle of members of an occupation to define the conditions and methods of their work, to control the production of the future member professionals, and to establish a cognitive base and legitimization for their occupational autonomy” [41]. As a result, companies in the same industry tend to become homologous over time as competitive, customer, and other stakeholders’ pressures influence them to copy other leaders in the same industry [26].

Recently, some studies have used this theory for innovation adoption [42,43]. Some studies have also combined the TOE framework with the institutional theory [44]. Others have also combined the DOI with the INT [29].

RESEARCH MODEL

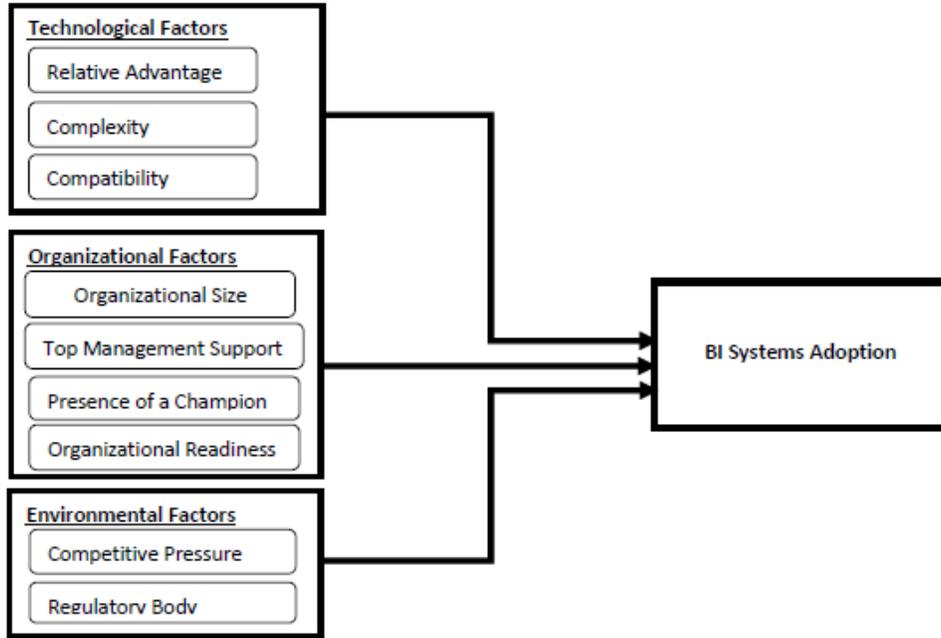
The research model of this study has been built on the review of extant adoption literature based on the underpinning theories described. In all, nine factors were derived which are used as the independent variables and hypothesized to be influencing BI Systems adoption.

The independent variables are categorized into Technological, Organizational and Environment dimension per the TOE framework.

Independent Variables (IVs)

The IVs in this study are: Relative Advantage, Complexity, and Compatibility for the Technological factors; Organizational Size, Top Management Support, Presence of a Champion, and Organizational Readiness for the Organizational factors; Competitive Pressure, and Regulatory Body for the Environmental factors (Figure 1).

Figure 1: Research Frame Work.



Dependent variable (DV)

The DV for this study is BI Systems Adoption.

Measures of the Variables/Hypotheses Development

Technological factors

1. **Relative advantage** - refers to “the degree to which an innovation is perceived to be better than the idea it supersedes or existing systems” [27]. Ifinedo [36] noted that innovations that are perceived to have higher benefits usually tend to have rapid rate of adoption. Many studies have reported about the perceived benefits of BI Systems which has put it on a higher pedestal for adoption and implementation [10,14,45]. A lot of studies have confirmed that perceived benefits of relative advantage are significant and positively related to BI systems adoption and other related technologies [17,18,25,44]. On the contrary, other studies did not find support for relative advantage as having a significant influence on innovations adoption [24,33,46].

On the basis of the above, we therefore hypothesized that

H1: Higher levels of BI applications Relative Advantage is positively related to BI Systems Adoption

2. **Complexity** - refers to “the degree to which an innovation is perceived as difficult to understand and use” [27,44]. Ifinedo [36] explained that adopters rapidly adopt new innovations that are easy to learn and does not require them to learn new skills. The complex nature of BI Systems can sometimes be an inhibitor to its adoption [47]. A lot of studies have found out that complexity is a barrier and insignificant to many various innovation adoption [33,35,36,48]. Others have also found out that complexity is a key determinant in innovations adoption [18,24,33,34,44,46].

On the basis of these, we therefore hypothesized that

H2: Higher levels of BI applications' Complexity is negatively related to BI Systems Adoption

3. **Compatibility** - refers to “the degree to which an innovation is perceived as being consistent with existing values, past experiences and needs of potential adoption” [27,44]. Ideas that are incompatible with the norms, values, and practices of an organization are not adopted as quickly as those that are compatible. Ifinedo [36] noted that technological innovations spread more freely and easily where they appear to match the adopter's processes. A lot of studies confirmed the positive relationship of compatibility and also as a predictor of various technological innovation adoptions in different industries [18,33,44,46]. Conversely, compatibility has been found not to be a determinant or predictor for the adoption of IT/IS in some organizations [35,36].

On the basis of above, we therefore hypothesized that

H3: Higher levels of BI applications Compatibility as being consistent with existing values is positively related to BI Systems Adoption

Organizational factors

4. **Organizational size** - refers to the extent of the organizational resource base (usually in terms of number of employees and annual sales revenue) which can influence the adoption of new technological innovation [35,36,49]. Mostly, bigger firms have more slack resources and thus are able to experiment with and can also take greater risks associated with new innovations [17,47-50]. Many studies have found that organizational size is very important and significant when it comes to technological innovation adoption [17,25,46]. On the other hand, organizational size has emerged to be insignificant when it comes to technological innovation adoption in different industries [36,50].

On the basis of the above, we therefore hypothesized that

H4: Organizational Size is positively related to BI Systems Adoption

5. **Top management support** – refers to “active engagement of top management with IS implementation” [51]. Indeed, top manager’s act as the change agents in the adoption process of new technological innovations and technology acceptance tends to be low in firms where they are put on hold for other organizational priorities [36]. A lot of studies have shown that top management support encourages technology usage, gives better performance, as well as being one of the strongest enablers of innovation implementation [17,19,35,36,44]. Conversely, in other studies, executive support did not emerge as a determinant of innovation adoption [24].

On the basis on the above, we therefore hypothesized that

H5: Higher degree of Top Management Support is positively related to BI Systems Adoption

6. **Presence of champion** – refers to a highly enthusiastic person with in-depth knowledge of the business processes of the organization as well as the technological innovation being discussed and committed to the innovation [5]. Champions promote the innovation by providing information, creating awareness, material resources, political support and gaining organizational acceptance of the innovation which are crucial for the successful adoption and implementation [48,52,53]. The existence of project champions with related backgrounds to the innovation being considered tends to bring higher adoption levels in organizations [17]. A lot of studies have consistently confirmed that the presence of a champion is a key determinant to innovations adoption [4,5,17,48].

On the basis of the above, we therefore hypothesized that

H6: Presence of a Champion is positively related to BI Systems Adoption

7. **Organizational readiness** – refers to the human knowledge of IS that exists in an organization, the financial resources, and the organizational IT sophistication [35,51]. Usually, it is the specialized human resources in the organizations with the skill and knowledge to implement and manage the innovation being considered, and they improve the technological readiness of an organization [54]. Puklavec et al. [17] noted that BI Systems generally exercise higher level of voluntariness and is more sensitive for resources availability, therefore, slack could be an important factor of BI Systems adoption. Many studies have found out that organizational readiness is a facilitator and significantly influence the adoption of BI Systems and other technological innovations [17,33,44,49,55,56]. On the contrary, organizational readiness was found to be insignificant in some studies [36].

On the basis of the above, we therefore hypothesized that

H7: Higher levels of Organizational Readiness to accept new innovations is positively related to BI Systems Adoption

Environmental factors

8. **Competitive pressure** - refers to “the degree of stress that the company feels from competitors within the industry” [50,55]. Themistocleous et al. [57] noted that these competitions make firms look for better approaches to raise their efficiency and increase their productivity thereby leading to competitive advantage. In addition, Ifinedo [36] emphasized that organizations tend to adopt innovations as a results of pressure from its external forces comprising of partners, customers, and competitors. Also, pressure from a firm’s competitors can lead to environmental uncertainty which can increase the rates of adoption of innovations in various industries [36]. A lot of empirical studies have confirmed that competitive pressure significantly influences innovation adoption [35,46,48,55,58]. On the contrary, competitive pressure was found to be insignificant in other empirical studies [24,36,49,59].

On the basis of the above discussion, we therefore hypothesized that

H8: Higher levels of Competitive Pressure is positively related to BI Systems Adoption

9. **Regulatory body** - refers to “the legislative regulations that the organization needs to comply with which may pose requirements or limitations to BI systems adoption” [60]. Additionally, Zhu et al. [61] refer to the regulatory support as the support a government authority gives to firms in order to encourage them to adopt innovations. Pan and Jang [62] moreover, emphasized that the regulatory environment is proven to be a critical environmental factor affecting innovation diffusion. Furthermore, Oliveira et al. [54] stated that influences of the existing regulations and laws can be very crucial in the adoption of new technologies. Many empirical studies have confirmed that regulatory body is a predictor and significantly influences innovations adoption [57,62]. Conversely, regulatory body did not emerge as significantly influencing innovations adoption [49,59].

On the basis of the above discussion, we therefore hypothesized that

H9: Higher levels of Regulatory Body legislative regulations in the industry is positively related to BI Systems Adoption

MATERIALS AND METHODS

The quantitative approach through a survey method was used for this study. Sukamolson [63] emphasized that survey research involves sampling, questionnaire design, questionnaire administration, and data analysis. Since the main purpose of this study is to examine the factors influencing the banks to adopt BI Systems, the survey method was deemed fit and hence its use.

Operationalization of Constructs

For this study, the constructs were operationalized comprising of several reflective indicators/measures for each construct. The items were adopted from extant IT/IS adoption studies and modified to suit the context of this study.

1. In the technological context, Relative Advantage has six items, complexity has six items, and compatibility has four items. These constructs were measured with items adapted from [35,36,47,49,64,65].
2. In the organizational context, Organizational Size has two items, Top Management Support has five items, Presence of a Champion has four items, and Organizational Readiness has eight items. These constructs were measured with items adapted from [35,36,47-49,52,53,56,61,63-70].
3. In the environmental context, Competitive Pressure has five items, and Regulatory Body has four items. These constructs were measured with items adapted from [35,49,63,65,66].
4. BI Systems adoption has five items. This construct was measured with items adapted from [35,36,49].

Sampling and Subjects for the Study

The Non-Proportionate Stratified Sampling Technique and Non-Probabilistic Purposive sampling were used due to the technicalities of the subject under investigation [70-73].

The subjects for this study are Chief Information Technology Officers (CIOs)/Information Technology/Information Systems Managers and their deputies as well as Business Analyst and other managers who are involved in varied analysis in the Banking sector.

Validity and Reliability Test

Content validity of the instrument was done by expert review where a professor, senior lecturer, and a top executive in IS/IT were given the draft to check for clarity, readability, understandability, scope, and purpose [36,47] to ensure the instrument covers all constructs' items it is supposed to measure [74].

All the measures have closed-ended questions and were evaluated with a seven-point Likert Scale having end points of "1=Strongly disagree" and "7=Strongly agree" except the respondents' demographics, and Organizational Size which was measured with "Number of Fulltime employees" and "Annual Sales Revenue".

The instrument reliability was then subjected to confirmatory factor analysis with a pilot study of 30 respondents from selected three banks. The test results obtained from the pilot study and analyzed through Smart PLS 3.2.6 Ringle et al. [74] indicate that all the constructs meet the acceptable indicator reliability value of 0.7 and above as shown by the Cronbach alpha and composite reliability values Hair et al. [75], Nunnally [76]. Also, the average variance extracted (AVE) value meets the acceptable threshold of 0.5 and above. All these indicators have proven that the instrument used for the final survey has

been well constructed.

Data Collection

The data was gathered through a self-administered questionnaire technique. 22 out of the 29 licensed commercial banks operating in Ghana were used. The target respondents were mostly located in the Head Offices of the banks all located in Accra (Table 1). In all, 240 questionnaires were distributed. After several calls and follow ups for a period of eight weeks, 142 were returned representing a response rate of 59.2%. However, some questionnaires were not answered well, with a lot of missing values exceeding 15% of non-responses, as well as some also having suspicious response patterns [75]. Thus, 12 (5%) respondent's questionnaires were not used in the final sample. As a result, 130 valid questionnaires representing 54.2% response rate was used for the analysis.

DATA ANALYSIS AND RESULTS

Descriptive Statistics

Table 1: Descriptive Statistics of the Demographics – Frequencies and percentages of respondents Gender, Age, Educational Level, Job Category, Ownership Structure of Banks, Number of Fulltime Employees, and Annual Sales Revenue.

Variable	Item	Frequency	Percentage
Gender	Male	91	70.0
	Female	39	30.0
	Total	130	100.0
Age	Below 20	1	.8
	20-29	26	20.0
	30-39	63	48.5
	40-49	32	24.6
	50-59	8	6.2
	Total	130	100.0
Educational Level	HND	4	3.1
	Bachelor	58	44.6
	Masters	68	52.3
	Total	130	100.0
Job Category	CIO	8	6.2
	MIS Manager	39	30.0
	IT Director/Manager	24	18.5
	Business Analyst	31	23.8
	Other(s)	28	21.5
	Total	130	100.0
Ownership Structure of Bank	Local Public	21	16.2

	Local Private	27	20.8
	Foreign	82	63.1
	Total	130	100.0
Number of Fulltime Employees	Less than 50	1	.8
	51-99	5	3.8
	100-499	18	13.8
	500-999	79	60.8
	1000-5000	27	20.8
	Total	130	100.0
Annual Sales Revenue	Less than 200 m	22	16.9
	201 m-400 m	27	20.8
	401 m-600 m	20	15.4
	601 m-800 m	4	3.1
	More than 800 m	57	43.8
	Total	130	100.0

The Descriptive statistics from Table 1 shows that majority of the respondents are Males with ninety-one (70%) whilst thirty-nine respondents (30%) are Females. Also, most of the respondents' ages were found in the range of 30-39 with sixty-three (48.5%), followed by those in the range of 40-49 with thirty-two (24.6%) respondents. In addition, majority of the respondents have Master's degree with sixty-eight (52.3%), followed by Bachelors' with fifty-eight respondents (44.6%). Again, most of the respondents are MIS Managers with thirty-nine (30%), followed by Business Analyst with thirty-one respondents (23.8%). Furthermore, most of the respondents belong to the foreign banks with eighty-two (63.1%), followed by the Local Private with twenty-seven respondents (20.8%), and then Local Public with twenty-one respondents (16.2%). Moreover, with seventy-nine respondents (60.8%), most of the banks employees' sizes are within the range of 500-999, followed by twenty-seven respondents (20.8%) within the range of 1000-5000. Lastly, with fifty-seven respondent (43.8%), majority of the respondents' banks have annual sales revenue of more than 800 m, followed by twenty-seven respondents (20.8%) with annual sales revenue in the range of 201 m-400 m.

Levels of BI Systems Adoption

Descriptive statistics were used to determine the level of BI systems adoption.

Table 2 shows the level of BI systems adoption in Ghanaian banks. Forty-eight (36.9%) respondent's banks have implemented "Data Warehouse, Analytics, and Strategic Tools (e.g. SCM, CRM Applications)", followed by Forty (30.8%) respondents banks that have implemented all the BI technologies evaluated together with a real-time BI. The rest are Twenty-one (16.2%) respondents banks have implemented data warehouse, and nineteen (14.6%) have implemented data warehouse and analytics. All these are indications that Ghanaian banks have reached a high level of BI Systems adoption.

Table 2: Level of BI Systems Adoption.

Level of BI Systems Adoption	Frequency	Percent
Only basic IS (e.g. OLTP, DSS, EIS, KMS)	2	1.5
Only Data Warehouse (and/or Data Mart)	21	16.2
Have Data Warehouse and Analytics (e.g. OLAP, Data Mining)	19	14.6
Have Data Warehouse, Analytics, and Strategic Tools (e.g. SCM, CRM Applications)	48	36.9
Have all of them mentioned above with BI real-time	40	30.8
Total	130	100

Evaluation of the Reflective Measurement Model and the Structural Model

Partial Least Square Structural Equation Modelling, SmartPLS 3.26 [74] was used for the statistical analysis.

All the indicators used in this study were measured reflectively; as such the evaluation of the reflective measurement model as suggested by Hair et al. [75] was followed. First the measurement model was subjected to confirmatory factor analysis to evaluate its internal consistency reliability and validity before proceeding to the structural model [70,77-80].

Hair et al. [75] defined indicator reliability as “the square of a standardized indicator's outer loading” which “represents how much of the variation in an item is explained by the construct and is referred to as the variance extracted from the item” (Table 3). A higher outer loading on a construct is an indication that the associated indicators have much in common and thus explains indicator reliability. Other researchers Wong [80,81] have suggested 0.7 or higher is preferred for indicator reliability but if the study is an exploratory research, 0.4 or higher is acceptable.

Table 3: Construct Reliability and Validity, R Square value, f square, and Q Square values.

Constructs	Cronbach Alpha	Composite Reliability	AVE	R Square	R Square Adjusted	f Square	Q Square
BISysAdopt	0.897	0.925	0.714	0.612	0.583		0.417
Cmplx	0.893	0.912	0.635	0	0	0.055	
Cmptb	0.940	0.957	0.848	0	0	0.011	
CompPres	0.883	0.914	0.679	0	0	0.000	
OrgRead	0.911	0.928	0.617	0	0	0.043	
OrgSize	0.769	0.711	0.582	0	0	0.002	
PreChamp	0.870	0.912	0.722	0	0	0.176	
RegBody	0.912	0.932	0.775	0	0	0.032	
RelAdv	0.940	0.953	0.770	0	0	0.025	

TopManSup	0.906	0.930	0.728	0	0	0.001	
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Table 3 shows the results of the construct reliability which is evaluated by both the traditional Cronbach alpha technique as well as the composite reliability. As both Cronbach's alpha values and composite reliability values of the constructs are above 0.7, is an indication that the constructs used in this study have high levels of internal consistency.

After the evaluation of the internal consistency of the constructs, researchers are also urged to evaluate the constructs convergent and discriminant validities.

Convergent validity of this study was evaluated by the average variance extracted (AVE). Also, from Table 4, the AVE value for each construct exceeds the 0.5 threshold recommended by Bagozzi and Yi [81] and also in consistent with Fornell and Larcker [82] guidelines. This is an indication that all the constructs have high levels of convergent validity.

The discriminant validity was evaluated through the Heterotrait-Monotrait Ratio (HTMT) which is based on the multitrait-multimethod matrix Henseler et al. [83]. Table 4 shows the discriminant validity results evaluated by the HTMT method. All the values are below the acceptable threshold of 0.85 as suggested by Kline [84], Fornell and Larcker [80], Henseler [83] implying a discriminant validity has been established.

Again, the R^2 value also referred to as the coefficient of determination, represents all the exogenous latent variables' combined effects on the endogenous latent variable as well as the amount of variance in the endogenous constructs explained by all of the exogenous constructs linked to it [75]. Table 4 shows the R^2 value of 0.612 which indicates that all the exogenous latent variables explain 61.2% of the variance of the endogenous construct BI Systems Adoption.

In addition, the effect size, represented by f^2 , is a measure used to assess an exogenous construct's contribution to an endogenous latent variable's R^2 value [75]. From Table 4, with a value of 0.176, Presence of Champion emerges as having the highest effect size on BI Systems Adoption. Complexity, Organizational readiness, Regulatory Body, and Relative Advantage all have small effect sizes on BI Systems Adoption. However, exogenous latent variables Compatibility, Competitive Pressure, Organizational Size, and Top Management Support have no effect size on BI Systems Adoption in this model. Therefore, their exclusion from the model would not have a significant effect on the model's predictiveness.

The model's predictive relevance was evaluated through the Stone-Geisser's Q^2 value Stone [85], Geisser [86]. This study used the Blindfolding procedure through the cross-validated redundancy approach as recommended by Hair et al. [75], to calculate the Q^2 value. From Table 4, the Q^2 value of 0.417 indicates the endogenous latent variable BI Systems Adoption path model has predictive relevance.

Table 4: Discriminant Validity - Heterotrait-Monotrait Ratio (HTMT).

Constructs	BISys Adopt	Cmplx	Cmptb	CompPres	OrgRead	OrgSize	PreChamp	RegBody	RelAdv	Top Man Sup
BISysAdopt										
Cmplx	0.189									
Cmptb	0.581	0.136								
CompPres	0.553	0.185	0.520							
OrgRead	0.740	0.176	0.788	0.604						
OrgSize	0.226	0.322	0.182	0.172	0.203					
PreChamp	0.770	0.119	0.487	0.680	0.710	0.257				
RegBody	0.227	0.572	0.077	0.428	0.182	0.189	0.319			
RelAdv	0.470	0.243	0.558	0.350	0.519	0.190	0.327	0.128		
TopManSup	0.625	0.236	0.738	0.426	0.836	0.274	0.644	0.122	0.460	

The evaluation of the structural model usually involves the examination of the model's predictive capabilities, the relationships between the constructs, the model's effect sizes, and the predictive relevance of the model [75]. The model's coefficient of determination, effect sizes, and predictive relevance are already shown and explain in Table 4.

However, as suggested by Hair et al. [75], before evaluating the structural model to determine the model's predictive values as well as test for the hypotheses, the model was evaluated against collinearity issues (Table 5). Collinearity arises when two indicators are highly correlated, and it is referred to as multicollinearity if it involves more than two indicators [75].

Table 5: Collinearity Statistics.

Constructs	BISysAdopt	Collinearity Detected (VIF>5)?
BISysAdopt		
Cmplx	1.547	No
Cmptb	2.924	No
CompPres	2.172	No
OrgRead	3.791	No
OrgSize	1.313	No
PreChamp	2.423	No
RegBody	1.793	No
RelAdv	1.511	No
TopManSup	2.959	No

Table 6 shows that no collinearity issues were found in the structural model as indicated by the VIF threshold values of below 0.5 [70,75].

Test for Hypotheses

The bootstrapping method was used to test for the hypothesis. The t value generated by SmartPLS 3.2.6 [74] provides the statistical significance of the causal path between the constructs in the hypothesized model. In PLS-SEM, the “popular critical t values for a two-tailed test are 1.65 ($\alpha=0.10$), 1.96 ($\alpha = 0.05$), or 2.57 ($\alpha = 0.01$) [75].

Figure 2 below shows the bootstrapping results from the Structural Model indicating the t-values causal relationships between the latent variables. At 5% significance interval (t-value ≥ 1.96), Cmplx \rightarrow BISysAdopt (t=2.134), PreChamp \rightarrow BISysAdopt (t=3.796), and RegBody \rightarrow BISysAdopt (t=2.221) are found to have significant relationships with BI Systems Adoption. Also, at 10% significance interval (t-values ≥ 1.289 [from the t-distribution table]), OrgRead \rightarrow BISysAdopt (t=1.686), and RelAdv \rightarrow BISysAdopt (t=1.540) are also found to have a significant relationship with BI Systems Adoption. These are also shown in Table 6 and Figure 2 below.

Table 6: Path Coefficients after the Bootstrapping procedure showing the T-Values, P-Values and hypotheses status.

Hypotheses	Relationships	Beta	t-values	P Values	Hypotheses Supported?
H2	Cmplx \rightarrow BISysAdopt	-0.182	2.134	0.033	Yes**
H3	Cmptb \rightarrow BISysAdopt	0.110	0.861	0.389	No
H8	CompPres \rightarrow BISysAdopt	0.003	0.031	0.975	No
H7	OrgRead \rightarrow BISysAdopt	0.252	1.686	0.092	Yes*
H5	OrgSize \rightarrow BISysAdopt	-0.029	0.516	0.606	No
H6	PreChamp \rightarrow BISysAdopt	0.406	3.796	0.000	Yes**
H9	RegBody \rightarrow BISysAdopt	0.150	2.221	0.026	Yes**
H1	RelAdv \rightarrow BISysAdopt	0.122	1.540	0.124	Yes*
H4	TopManSup \rightarrow BISysAdopt	-0.027	0.253	0.800	No

**p<0.5; *p<0.1

DISCUSSION OF FINDINGS

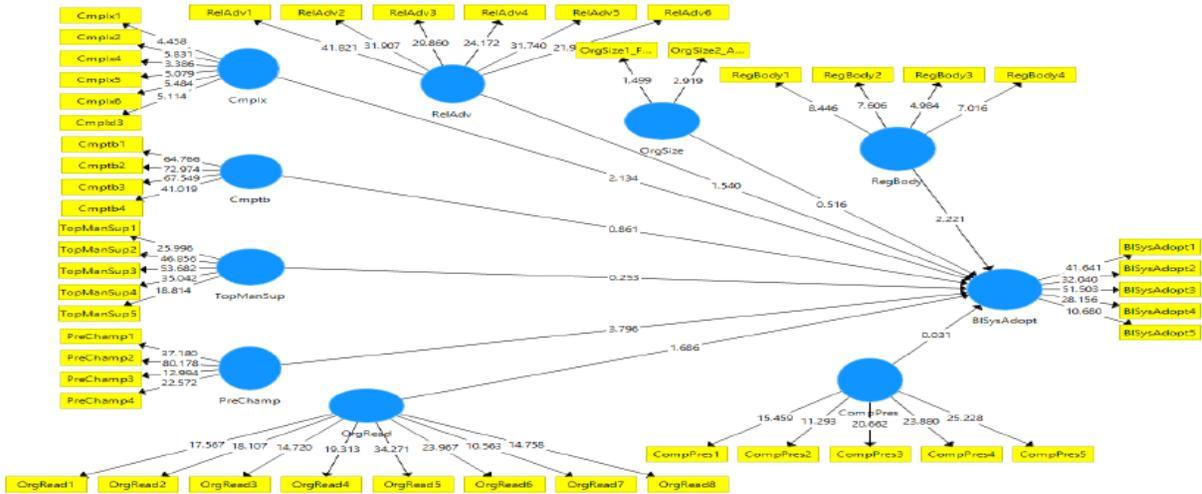
This study developed a structural model which was used to empirically examine the factors influencing BI Systems adoption in Ghanaian banks through PLS-SEM.

The findings from the analysis indicate that Relative Advantage, Complexity, Presence of Champion, Organizational Readiness, and Regulatory Body significantly influence BI Systems adoption in Ghanaian banks.

However, Compatibility, Organizational Size, Top Management Support, and Competitive Pressure emerged insignificant. These findings are discussed below.

The perceived benefits of BI systems have been highlighted in many studies as influencing in its adoption in organizations. In this, study, Relative Advantage of BI applications have been found to be a predictor and significantly influence BI systems adoption in Ghanaian banks thus confirming the findings of [17,18,25,44].

Figure 2: Bootstrapping results from the Structural Model.



Thus hypotheses H1, H2, H6, H7, and H9 are supported. However, hypotheses H3, H4, H5, and H8 are not supported.

The perceived complexity of many innovations has been reported as a barrier to their adoption. Consistent with this, Complexity of BI Applications was also found to be significantly influencing BI systems adoption in Ghanaian banks negatively thus, confirming the findings of [33,36,48].

The presence of business centric and project champions have been found to be a high contributor of many technological innovations adoption in organizations as champions play a key role in terms of ensuring adequate resources are in place, creating awareness, etc. In this study, Presence of Champion(s) in Ghanaian banks has also been found to be a predictor and significantly influencing BI Systems adoption in line with studies by [4,5,17,48,87].

As BI Systems implementation requires a high level of infrastructure in terms of time and cost [78,79] organizations must prepare adequately when embarking on such a project. Consistent with other studies [17,33,44,49,50,56], Organizational Readiness also emerged significant in influencing BI Systems adoption in Ghanaian banks.

Existing legislative regulations and their upgrades from time to time have been found to be a key contributor to much technological innovation adoption. Regulatory Body was also found to be a predictor and significantly influencing BI Systems adoption in Ghanaian banks in line with studies by Themistocleous et al. [57] and Pan [62].

In line with studies by Côté-Real et al. [33] Ifinedo [36], compatibility was found to be insignificant in the adoption of BI systems in Ghanaian banks.

Organizational size has been found to be a predictor of many innovations as large organizations tend to have slack resources and thus can practice before adopting and implementing new innovations [17,47,49]. However, in this study, organizational size was also found to be insignificant in terms of Ghanaian banks adoption of BI Systems in consistent with studies by Ifinedo [36] Thiesse et al. [88], Oliveira et al. [59].

Pressure from competitors have been found to be a predictor and significantly influences the adoption of various technological innovation adoption [89-93]. However, in this study, surprisingly, despite the keen competitions in the banking sector, Competitive Pressure was found not to be significantly influencing BI systems adoption in Ghanaian banks in line with studies by Sujitparapitaya et al. [24], Ifinedo [36], Chaveesuk [49], Oliveira et al. [59].

CONCLUSION

The main objective of this study was to empirically examine the factors that influence BI systems adoption in Ghanaian banks, and also determine the extent of adoption in the banks. Nine factors were derived from the DOI, TOE, and the INT theories which were hypothesized and subjected to SEM to investigate the factors that influences BI Systems adoption in the banks. The findings from PLS-SEM have revealed that in the Ghanaian banking sector, BI Systems adoption are influenced by the Relative Advantage of BI Applications, Complexity of BI Applications, Presence of a Champion, Organizational Readiness, and Regulatory Body. Also, the descriptive statistics revealed that Ghanaian banks have high levels of BI Systems implementation in place although there are variations among the banks.

Theoretical Implications

This study contributes to the body of knowledge by the development of an integrated model from the DOI, TOE, and INT theories which were validated with a survey data through a PLS-SEM approach. A thorough review of the literature has shown that in the context of BI Systems adoption in organizations, most analysis was done with the first generation statistical analysis. However, with this study, a SEM approach was used which offers a richer statistical power and better explains the phenomenon being discussed. In addition, out of the 29 licensed commercial banks operating in Ghana, 22 of them were used for this survey; hence the findings provide a high level of generalization in the Ghanaian banking sector.

Managerial Implications

BI Systems are in their early stages in Ghana. As a result, the technological, organizational, and environmental factors that organizations should focus on when adopting BI are very crucial.

Findings from this study have revealed that Ghanaian banks are adopting BI systems as a result of the Relative Advantage of BI applications, the Presence of Champions in the banks, the Organizational Readiness (human resources, the financial resources, etc.) of the banks, as well as the Regulatory Body supervising the banks.

With an effect size of ($f^2=0.176$), Presence of Champion emerged as the highest contributing factor predicting BI systems adoption in the banks. This implies that organizations should promote business centric and project champions in order to enhance their BI implementation efforts.

Also, organizations must prepare adequately in terms of Organizational Readiness which also emerges significant in this study.

Again, regulators in other industries in Ghana must ensure a lot of regulations are put in place to enhance adoption and implementation of new innovations such as BI systems which organizations cannot do away with because of a lot of benefits it brings as explained in the literature.

Suggestions for Future Studies

This study focused on the determinant factors influencing banks to adopt BI Systems and also evaluated the extent of BI systems implementation in the banks. Future studies can further validate the findings of the quantitative analysis with a qualitative study which can lead to the development of a framework for BI systems adoption in Ghana.

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