Innovation for Industrial Trasformations Drivers and Barriers in Yobe State Construction Industries Nigeria

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ABSTRACT
The universal demand for industrial transformation in effective project delivery process led to the implementation of an advance innovative technology. However, a number of issues are increasingly becoming relevant with the industrial transformation. The most vigorous among them are the drivers and barriers to industrial transformation. The barrier that need to be addressed for an advance technology to be successfully implemented within the work domain are culture; given that different parties will have different cultures with their own sets of behaviours and working practice. Such pragmatic barriers are said to hinder effective industrial transformation among the parties, which in turn prevents the efficiency improvement within the project delivery process. Such interdependency for success, demands a suitable framework to improve collaboration, by attaining appropriate culture within the project-based industry. The purpose of this research work is to have deep understanding of drivers that facilitate the smooth industrial transformation and the barriers that hinder the industrial transformation in Yobe State construction industry in order to develop a suitable recommendation that will allow the management and employees to deeply understand the vital drivers and barriers for an effective industrial transformation. A set of solutions for managerial, integration and cultural orientations was developed. Empirical data were collected by questionnaire survey which was summarised and analysed using statistical analysis SPSS,and the key challenges of drivers and barriers on industrial transformation in Yobe construction industry were figure out. The empirical research findings are group into three depending on the responses from the questionnaire survey i.e. the industrial detail, the drivers and barriers to industrial transformation. And the outcome of the research shows that the majority of respondent are from private sector organisations that are in construction business for 5-10 years while Architect from design and engineering department in building construction an

Keywords – Innovation, Transformation, Project delivery, Culture, Implementation.

INTRODUCTION

There has been a great concern over the lack of efficiency and productivity in the construction industry worldwide. This has been attributed to so many factors, among which is fragmented process of design, procurement, construction, project delivery and facilities management. (Khalfan and Anumba, 2000). The need for continuous improvement to the conventional design and construction in the industry has been well documented in the literature. Several studies and government reports have enunciated the desire for the construction industry to be transformed from the way it performs its primary activities (Ibrahim and Price, 2006; Ibrahim, 2008).

The Nigerian construction industry is not free from such problems and even more. It has severally been characterized as inefficient with low productivity and lack of capacity to deliver and satisfy its clients. Oyewobi, (2011) attributed the drop in the Nigerian construction industry's contribution to GDP between 1980 and 2007 to poor performance and low productivity. Similarly, Idrus and Sodangi (2007) asserted that the Nigerian construction industry produces nearly 70% of the nation's fixed capital formation yet its performance within the economy has been, and continues to be, very poor. Among other criticisms facing the industry are time and cost overruns, (Kuroshi and Okoli, 2010; Ameh, 2011; Ogwueleka, 2011), inadequate planning and budgetary provisions, contract sums inflation, inefficient and poor service delivery, (Kolo and Ibrahim, 2010; Mohammed, 2012). Hence Aibinu and Jagboro (2002) and Oyewobi, (2011) emphasised the need for an innovation that would transformed the industry, for it to deliver value for money and effectively satisfy the needs of the clients.

There are several reactions to these calls for continuous industrial transformation in efficiency and productivity from different perspectives ranging from new contractual/procurement arrangements like partnering (Ibrahim and Price, 2006); to technological innovations in design and construction processes such as 3D CAD and modelling (Isikdagand Underwood, 2010).

Building information modelling (BIM) is one of such innovative processes that promise to bring about the much desired continuous transformation in the construction industry. BIM has been defined by Lee, (2006) as the process of generating and managing building data during its life cycle. Typically it uses three-dimensional, real-time, dynamic building modelling software to increase productivity in building design and construction. The process produces the Building Information Model, which encompasses building geometry, spatial relationships, geographic information, and quantities and properties of building components. (Nederveen (2010). BIM has also been defined as the digital representation of the physical and functional characteristics of a facility. As such it serves as a shared knowledge resource for information about a facility forming a reliable basis for decisions during its life-cycle from inception onward (Building Smart, 2010).
According to Becerik-Gerber and Rice (2010) BIM is seen as an enabler that may help the building industry to be transformed by improving its productivity and ensuring effective communication and collaboration between all project stakeholders from inception to completion of building projects. Several BIM related researches have been reported, especially those that have to do with its success stories and inherent benefits. There are numerous case studies (Eastman, C., Teichoiz, P., Sackjs, R., and Liston, K. (2011) that provide some evidence to support the fact that the use of

BIM makes the building process more efficient and effective.

According to Succar (2005) BIM has now solidified its position as a promising approach towards addressing the Architectural and Engineering Constructions (AEC's) numerous inefficiencies. Further, evidences abound that many countries of the world like USA, UK, Australia, Netherlands, Singapore, Hong Kong Finland, Norway, Denmark, Hong Kong (Yan and Damian, 2010; Isikdag and Underwood, 2010; Nederveen (2010; Wong *et al.* 2010; Sebastian and Berlo, 2011) and others have adopted BIM technologies at different levels and have experienced substantial improvement in construction project delivery. Some of the benefits of BIM technologies as claimed by its proponents are that it provides for efficient communication and data exchange (Nederveen (2010), auto quantification, improved collaboration, coordination of construction documents, improved visualization of design,(Olatunji 2010; Sacks 2010) clash detection, and cost reduction (Eastman, C., Teichoiz, P., Sackjs, R., and Liston, K. (2011) among others.

Considering the documented benefits of BIM, Olatunji (2010) stressed the need for its full adoption across all disciplines and geographical boundaries. Consequently, it becomes imperative for the Nigerian construction industry, which has been described as a 'sleeping giant' and having no capacity to deliver due to inefficiency and poor service delivery among other problems (Kolo, B. A., and Ibrahim, A. D. 2010; Mohammed, K. 2012), to exploit the widely acclaimed benefits of BIM technologies in order to practice in line with the global best practices and achieve the continuous transformation needed by its players.

However, despite the potentials and documented benefits of this innovative technology(BIM) not much has been reported regarding its implementation in the Yobe construction industry. It is also not clear whether or not the industries are ready to adopt such technologies. Therefore, for BIM to be implementation in Yobe there is a need to identify the drivers' and the barriers that will hinder its successful implementation.

This research is aimed at evaluating the drivers and barriers for implementing an innovation for industrial transformation in the Yobe construction industry with a view to suggesting ways that will enable its effective implementation. The purpose of this research work is to have deep understanding of drivers that facilitate the smooth implementation of an innovative technology (BIM) that would aid in transforming Yobe construction industry and the barriers that hinder its implementation in Yobe State construction industry, and to establish their level of significance.

Definition of Building Information Modelling (Bim)

BIM is a new paradigm with the result of tremendous transformation for every professional involved in the construction industry Harris, (2011) BIM is not just software; it is both a technology and a process. The technology component of BIM helps project stakeholders to visualize what is to be built in a simulated environment to identify any potential design, construction or operational issues. The process component enables close collaboration and encourages integration of the roles of all stakeholders on a project (Azhar, S., Hein, M., and Sketo, B.2008).

Several researchers have found that BIM is the process of creating a digital parametric model which represents the physical and functional characteristic of a building in full detail and further shared knowledge pool which can be used to form reliable decisions during the design, construction phases and throughout the life cycle of the facility (Eastman, C., Teichoiz, P., Sackjs, R., and Liston, K. (2011).

; Suranga and Weddikkara, 2012). To create relationship between objects with in a virtual building model BIM uses parametric object modelling technology. These relationships include physical and functional characteristics as well as project life cycle information (Azhar, S., Hein, M., and Sketo, B.2008).

According to Wong and Fan (2013) BIM consists of information representing the entire building and the complete set of design documents stored in an integrated database. Hence it is clear that all the information is parametric and thereby interconnected. If any changes to an object within the model automatically it will affect the related assemblies and constructions. Furthermore, Jayasena and Weddikkara (2012) added that, BIM is not a software application. Instead it is an IT solution for integration of software applications and IT tools to design a building in a common platform, a platform which is independent of the software we use.

Therefore BIM can be clearly differentiated from traditional Computer Aided Design (CAD).
BIM as a lifecycle evaluation concept seeks to integrate processes throughout the entire lifecycle of a construction project. The focus is to create and reuse consistent digital information by the stakeholders throughout the lifecycle (Figure 1). BIM incorporates a methodology based around the notion of collaboration between stakeholders using ICT to exchange valuable information throughout the lifecycle. Such collaboration is seen as the answer to the fragmentation that exists within the building industry, which has caused various inefficiencies. Although BIM is not the salvation of the construction industry, much effort has gone into addressing those issues that have remained unattended for far too long (Jordani, 2008).

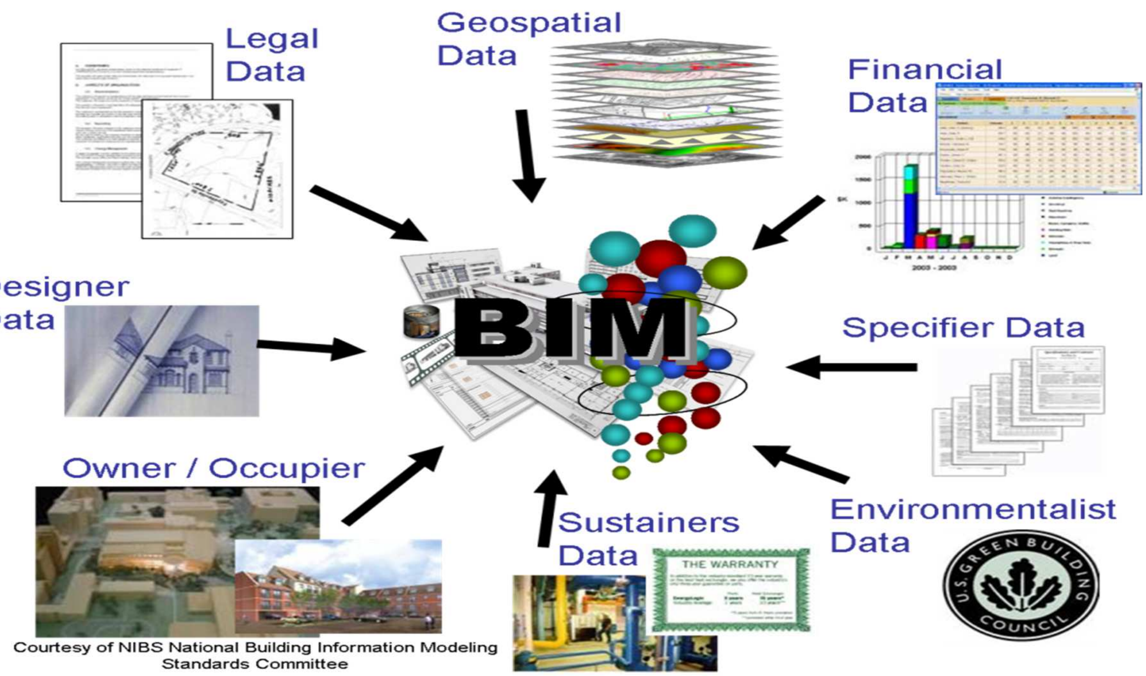

Figure 1: Communication, Collaboration and Visualisation with BIM model (NIBS, 2008)

It is vital to have thorough knowledge and understanding of the definitions of aBuilding Information Model and Building Information Modelling, in order to apply thesame in the construction industry, due There is no standard universally accepted definition of BIM as a result of that many definitions from different individuals of many background and profession came about, some of which are as follows;

Building Information Modelling (BIM) is a set of interacting policies, processes and technologies generating a “methodology to manage the essential building design and project data in digital format throughout the building's life-cycle (Succar, 2009, p.1).
A modelling technology and associated set of processes to produce, communicate, and analyse building models (Campbell, 2006, in Eastman, C., Teichoiz, P., Sackjs, R., and Liston, K. 2011., p.13).

BIM is the creation and use of coordinated consistent information about a project, information that enables you to visualise design in contact, accurately predict performance, analyse real world structural behaviours and make design decisions earlier in the process all before the project breaks ground (Autodesk, 2009)

With few other variations Lee (2006) identified Building Information Modelling as the process of making and/or utilising a Building Information Model. According to this definition, Building Information Modelling is to be promoted as an essential tool that plays a major role in attaining the objectives associated with the construction project.

On the other hand, the definition of Building Information Modelling as a tool has been acknowledged. According to AIA (2007) BIM is defined as a digital, three dimensional models which are found to be associated with a database providing all aspects of project information. It is also promoted that BIM can blend with other criteria denoting construction project success, including design of construction, availability of information fabrication, instructions related to construction, and logistics related to project management in a single database. It encourages the blending of project goals throughout the project's design and construction.

Eastman, C., Teichoiz, P., Sackjs, R., and Liston, K. (2011)made a contradictory statement that BIM is not solely a software package, but a process. According to them, BIM can be identified as a modelling technology with well-knit procedures to create, interact and examine building models. Building Information Modelling is a word utilised for the description of tools, processes and technologies that are associated with digital, machine readable documentation. This documentation is about a building, its functioning, its planning, and its construction and, last but not least, its operation. Hence, BIM is said to depict an activity and not any type of entity or substance.

Furthermore Ashcroft (2008) identified BIM to be the outcome of a modelling function which can be further described as a digital, machine-readable record of a construction, the related performance, the degree of planning and the delay in construction.

According to Hardin (2009) Building Information Modelling cannot be considered as a simple tool, but it a process involving the use of software to achieve the goals of construction project management. This is in agreement with the views of Eastman *et al*. (2011) they further present the view that a number of contractors proceed with a false conception that the purchase of BIM software automatically promotes integration of BIM software successfully in their operations. Heesom and Mahdjoubi (2004) supported this view by indicating that there is lack of awareness among contractors with regards to the perceived use of BIM. Building Information Modelling not only comprises usage of three-dimensional modelling software, but also requires expertise and innovation on the part of the user.

Furthermore Howard and Bjork (2008) proffered that the moment a company begins to implement BIM technology it will begin to experience a change in its processes. Other procedures that have been suitable for CAD-type technology are not as good as BIM. BIM is capable of adapting to changes in any stage of construction and therefore is the ideal software tool which can be used by a construction organisation.

In line with these views, in this dissertation BIM is considered to be both software and a process which can be used to identify a number of parameters associated with the construction project. However, it is also important to note that the use of BIM involves adapting to the complexities of the project and requires expertise and innovation. As the technology is liable to change, so are the techniques and procedures of the technicians who are handling the technology.

Brief History of Bim

Both the concept and the term "Building Information Modelling" evolved through many years of research and collective works of professionals, academicians and researchers. Back in the 1980s in the USA it was known as "Building Product Models" which was extensively used in the works of Professor Charles M. "Chuck" Eastman, one of the leading researchers and pioneers of BIM, and was believed to be the founding father of BIM (Laiserin, 2007, in Eastman, C., Teichoiz, P., Sackjs, R., and Liston, K. (2011, p.xiii). In Europe it was termed as "Product Information Models" almost at the same time to that in America, but the concept remains the same, not until later the two terms came together and with the verbal elimination of the word "Product" it became "Building Information Modelling" (Laiserin, 2007, in Eastman, C., Teichoiz, P., Sackjs, R., and Liston, K. (2011, p.xiii). The first publication in English of the new name was recorded in 1986 paper by then an employer of the GMW Computers Ltd, Robert Aish. However, the popularity of the term and concept BIM was due to the efforts of Jerry Laiserin and one of the earliest application of BIM as a tool was first done by Graphisoft in 1987 when they introduced the software ArchiCAD which is based on the virtual building concept.

Building Information Modelling (Bim) Implementation

BIM is one of those innovations within the construction industry that is given the biggest trust in order to sort the problems that the industry is faced with (Granroth, 2011). But in order to not perceive BIM as a fashion several contextual issues needed to be dealt with. Adoption according to these contextual issues will lead to changes in the organisational level, with new methods and organisational structures, as well as at a business level, to deal with hindrances such as contractual issues (Gu and London, 2010), collaboration issues and the fragmented relay race that construction projects is today (Granroth, 2011).

According to Becerik-Gerber and Rice (2010) BIM is seen as an enabler that may help the building industry to improve its productivity by ensuring effective communication and collaboration between all project stakeholders from inception to completion of building projects. Several BIM related researches have been reported, especially those that have to do with its success stories and inherent benefits. There are numerous case studies.Eastman, C., Teichoiz, P., Sackjs, R., and Liston, K. (2011) that provide some evidence to support the fact that the use of BIM makes the building process more efficient and effective. For instance:greater integration and collaboration with other disciplines in the production process, adopting technology change to provide a more effective business process, effective intelligent real time response and moving into related building sectors. In addition a practical Case Study of John McCall's Architects (JMA) is attached as an appendix. According to Succar (2005) BIM has now solidified its position as a promising approach towards addressing the AEC's numerous inefficiencies.
Further, evidences abound that many countries of the world like USA, UK, Australia, Netherlands, Singapore, Finland, Norway, Denmark, Hong Kong (Yan and Damian, 2010; Isikdag and Underwood, 2010; Nederveen (2010); Wong(2010); Sebastian and Berlo, 2011) and others have adopted BIM technologies at different levels and have experienced substantial improvement in construction project delivery. Some of the benefits of BIM technologies as claimed by its proponents are that it provides for efficient communication and data exchange (Nederveen (2010), auto quantification, improved collaboration, coordination of construction documents, improved

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However, despite the potentials and documented benefits of BIM technologies, not much has been reported regarding its implementation in the Nigerian construction industry. It is also not clear whether or not the industry is ready to adopt such technologies. Therefore, for BIM to be adopted in Nigeria, there is need to identify the factors that will aid and those that will hinder its successful adoption, and the environment analysed to ensure some level of preparedness for its successful implementation. This research is aimed at identifying the influence of culture on the successful adaptation of Building Information Modelling (BIM) technologies in Nigerian construction industry with a view to suggesting ways of overcoming the impact in order to successfully adopt the improve technology. In order to achieve this, the study identified and assessed the enablers and barriers to BIM adoption in the Nigerian construction industry, to establish their level of significance.

Enablers of Building Information Modelling (Bim) Adoption

For the implementation of BIM there have been three major enablers. The first is the advent of enhanced IT infrastructure and capability of computers to develop and display 3D models with underlying large databases. The second enabler is the creation of the Industry Foundation Classes (IFC) by the International Alliance for Interoperability (IAI). The third is the increasing world wide support for BIM (Furneaux and Kivvits, 2008).

While according to Mu'awiya, A., Yahaya, M. I., and Kabir, B. (2013) the drivers of BIM adoption in the construction industry were identified as government support through legislation, clients' interest, software availability, cooperation and commitment of professional bodies, and collaborative procurement methods. All these have to be in place to enable successful transition of the industry to BIM working.

Why BIM?

The need for continuous improvement to the conventional design and construction in the industry has been well documented in the literature. Several studies and government reports have enunciated the desire for the construction industry to improve and change the way it performs its primary activities. (Ibrahim and Price, 2006; Ibrahim, 2008). Yan and Damian (2008) observed that design of buildings has been done in the traditional way with the use of simple tools such as pen, paper and ruler, until the advancement of mathematics and building material science in the mid nineteenth century when engineers begin to use computers to produce 2D CAD drawings. Paper based communication was used between all project stakeholders on the construction industry with no platform for collaboration and clear visualisation of design. This has resulted to poor documentation and information management and has fuelled the fragmentation in the activities of the construction industry. It has further resulted to a lot of errors and wastes, which were considered part of the reasons for the poor performance, low productivity and inefficiency in the construction industry. A lot have been reported on the nature of complications in some forms of construction activities such as design errors, estimate deficiencies, conflicts between design and construction and fragmented platforms which limit information flow throughout project lifecycle (Olatunji(2010); Building SMART, (2010). BIM is seen as a solution to all these problems, as it serves as a platform for effective collaboration and communication between all parties to a building project.

Benefits of Building Information Modelling (BIM)

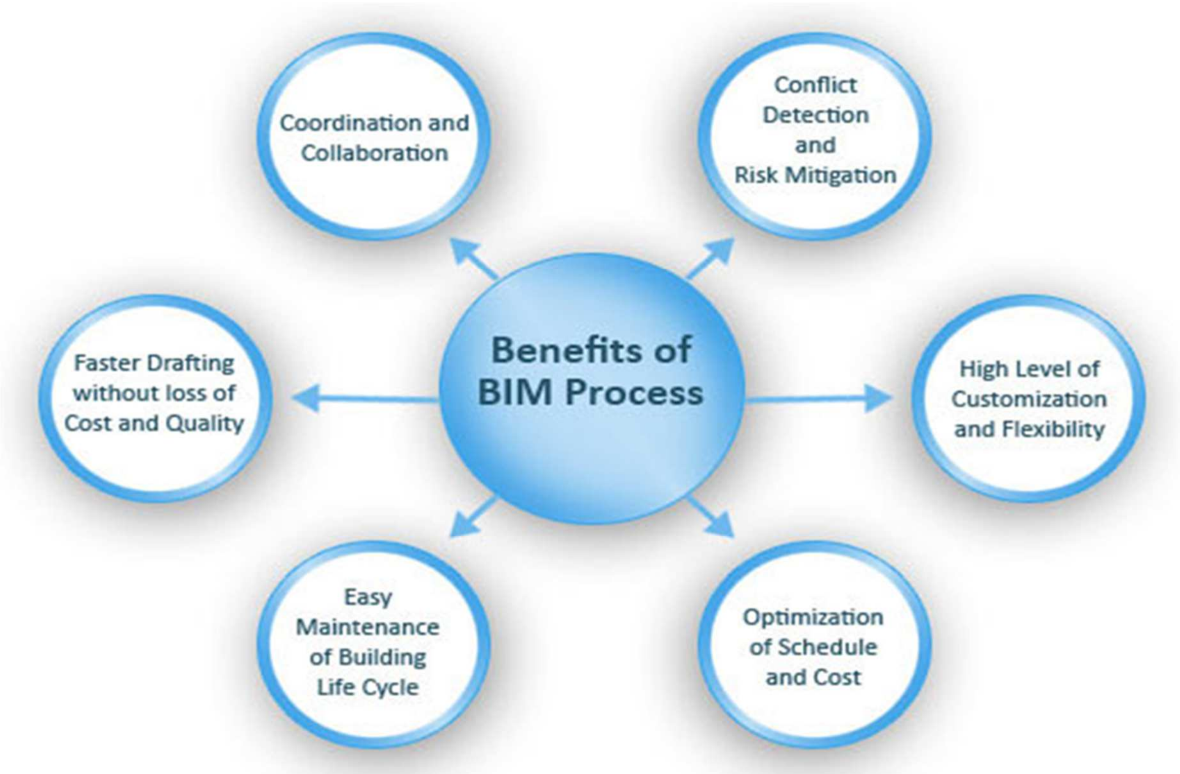
Broadly speaking, BIM has led to a significant improvement in the performance of construction industry professionals especially in design, construction and facility management. Yan and Damian (2008) opined that BIM did not only improve the technology itself, but changes the process of design and build. The following are some of the benefits of BIM as reported by researchers and practitioners.

Simultaneous access to project database by all stakeholders.

Robust information.
Auto-quantification.
Quality communication
Multi-dimensional integration
Project visualisation
Project documentation
Digital facilities management
Clash detection

Time and cost reduction (Olatunji (2010); BuildingSMART, 2010; Eastman, C., Teichoiz, P., Sackjs, R., and Liston, K. (2011).

Figure 2 represents the benefits associated with Building information modelling (BIM) as an integration platform of the entire project life cycle as opined by (BSA, 2007).



Source: http://www.spatialiq.co.nz/Blog/Post/30/Why-WE-care-about-BIM---

Barriers of Building Information Modelling (BIM) Adoption

Beside the versatile usage and tangible benefits of BIM, number of barriers increasingly arises during the adoption of BIM. While progressing with BIM adoption, complexity of the process is intensified, distribution of responsibilities and risks becomes unclear; more critical issues such as habitual resistance, fragmented information flow among the parties, contractual, and interoperability of software are raised (Rosenberg, 2007; Dossick and Neff, 2010; Sebastian, 2010; Andre, 2011). Ashcraft (2008), Andre (2011), and Udom(2012) asserted that the model related legal issues that make frontline obstruction in the open collaborative process are: data copyright, ownership of intellectual properties, confidentiality of data in a blended state, and signing the documents. Furthermore, the other legal issues which often hinder BIM adoption include inappropriate distribution ofrisks and rewards, responsibility of model development, model reviews and updates(Rosenberg, 2007; Sebastian, 2010; Andre, 2011; Azhar, 2011), undefined guidelines and insurance provision for software related error, data access, and model security (Ashcraft,2008), lack of standard documentation and proven protocol (Gu and London, 2010; Andre, 2011; Udom, 2012). The major technical barrier is highlighted as interoperability (Ashcraft, 2008; Gu and London, 2010; Sebastian, 2010; Azhar, 2011). Number of authors claimed cultural barrier as a critical hazard, as it involves potential obstacles that are human related (Ashcraft, 2008; Gu(2008); Yan and Demian, (2008). The human related barriers involve habitual resistance, inappropriate training, and lack of shared understanding (Ashcraft, 2008; Yan and Demian, 2008).

Furthermore, a pilot study by Mu'awiya, A., Yahaya, M. I., and Kabir, B. (2013) identified the frequent power failure and poor internet connectivity as barriers in the case of Nigeria.

Adopting Building Information Modelling

Although many benefits can be gained by the implementation of BIM such as increasing constructability, reducing conflict and requesting for information due to having a good visualisation approach, reducing the time for cost estimation and increasing smooth coordination and information among parties in the construction projects, the pace of adoption of BIM is still slow (Khanzode and Fisher, 2000; Bernstein and Pittman, 2004; Kymmell, 2008 and Azhar*et al.* 2008; NFB, 2012; Hannes, 2013; SCSI, 2014). This is because the majority of construction industry players see BIM as 'disruptive technology' that causes problems in the current construction process by transforming it into a new process according to Eastman, C., Teichoiz, P., Sackjs, R., and Liston, K. (2011) Therefore, the adoption of BIM is facing huge challenges from the construction industry players because they are reluctant to change the established traditional process. Challenges in adopting BIM can be classified into two categories which are non-technical and technical.

Basically, according to Arayici(2011) non-technical challenges are related to human being and organisational culture and these challenges include managing the resistance to change from people, making them understand how BIM offer them more benefits compared to 2D drafting, managing education and training people in BIM and explaining new roles and responsibilities of different stakeholders in BIM. As for technical issue, the most prominent issues arose are upgrading the technology, interoperability, compatibility and complexity (Fox and Hietanen, 2007).

Adopting Building Information Modelling in Nigeria

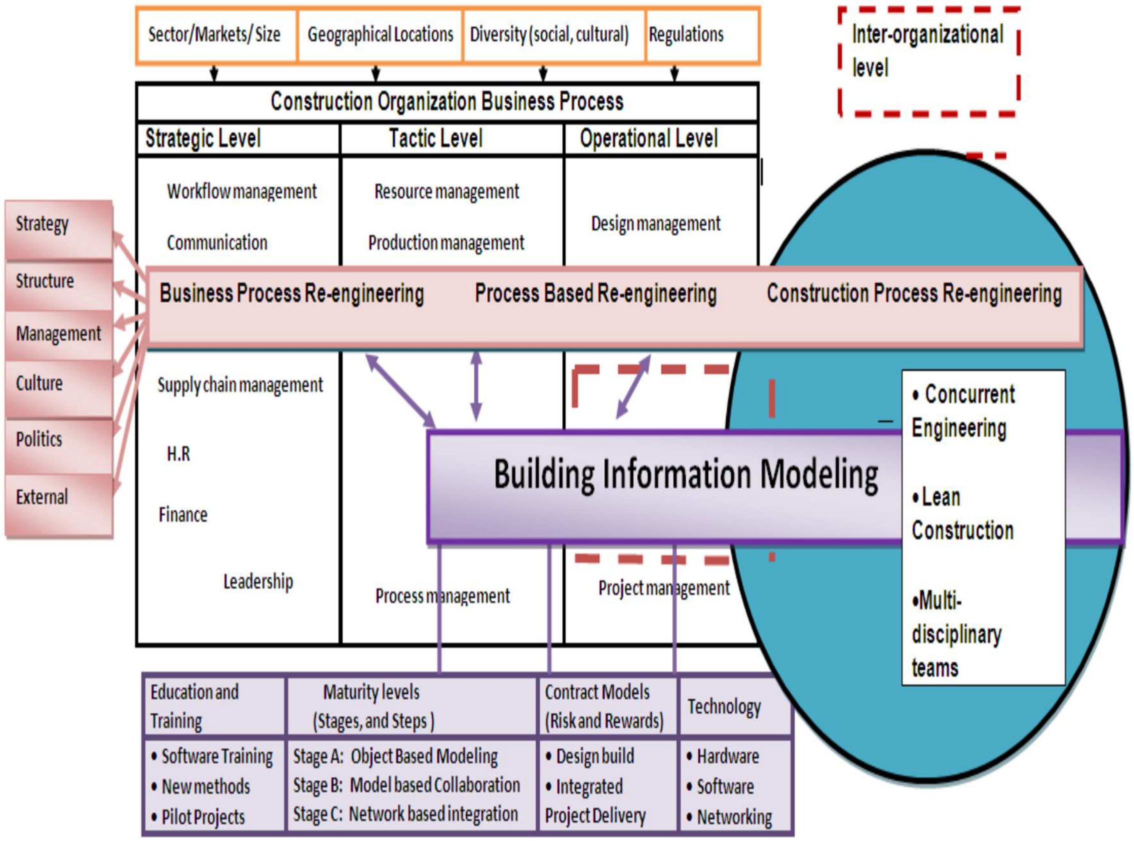
The move to adopt Building Information Modelling in Nigeria's private and public sector (client side) and amongst different building professionals (Architects, Quantity Surveyors, Civil Engineers etc.) has been very slow. Architects have adopted but mainly for enhancing the visual quality of their presentation. This is unfortunate because of its enormous potentials to enhance efficiency, reduce disputes, save costs and curb corruption. The first step in promoting adoption will be to increase awareness of the technique, the tools employed and their benefits. Software vendors and training institutions have a role and commercial opportunity in promoting the awareness. Another critical step is for professional institutions such as the Nigerian Institute of Quantity Surveyors and the Nigerian Society of Engineers to organize training for their members and clients, including or perhaps especially public sector institutions. As this awareness grow the construction press and other informed opinion such as analysts will join in the promotion of the critical cost management tool that the BIM represents (Agele, 2012).

Conceptual Model

BIM provides a comprehensive mechanism to dynamically integrate different activities required for a construction project around a virtual model of a building. BIM provides a new way of design documentation practice by introducing new design deliverables and information exchange mechanisms which not only brings attention to the issue of sequence of development of building process but it also requires a virtual building representation i.e. a BIM model to be integrated into the design and construction process (Arayici (2010). BIM approach thus entails a change in the building documentation process i.e. transition from architectural drawings as design deliverables to computerised model (Arayici (2010).

Examining BIM enabled business process at intra-organisational and inter-organisational level requires tighter interaction and enhanced coordination between temporary project networks, alignment of modelling processes for creation and merging of BIM content between different project partners and timely and accurate accessibility of information to various activities involved in a BIM project (Taylor and Levitt, 2007). BIM is therefore, anticipated to bring paradigm shift in the project delivery through early involvement of design and construction project stakeholders (Hannon, 2007).

Based on the findings of literature review and industry wide survey, Figure 3 is developed which captures the dynamics of relationships between factors that play an important role during BIM adoption and implementation into an organization.



Source: First UK Academic Conference on BIM 5-9 September, 2012.
Figure 3: The factors effecting BIM adoption in the construction organisation.

RESEARCH METHODOLOGY

The research methodology for this research is to a large extent quantitative, which indicates that the research process is largely deductive. Approaches were incorporated to provide alternate insight into the drivers and barriers to an innovative technology (BIM) implementation from the construction organisations and practitioners' viewpoint. This start with simple opinions and hypothetical insights was derived from literature. Research methods that were applied include a literature review, with the primary data collected through questionnaire surveys.
A review of literature was carried out for the purpose of articulating issues regarding the concept of an innovative technology (BIM) in the construction industries with particular emphasis on the Yobe state Construction Industries. The review aims at understanding the drivers and barriers for the implementation of an advance technology (BIM) in Yobe state construction industry. The research involves the use of structured questionnaire as a tool for data collection, and was distributed to all building related firms within and around Yobe state. The firms were selected through random sampling method.

Data analysis was undertaken using statistical analysis in order to figure out the key drivers and barriers toan innovative technology (BIM) implementation in Yobe state construction industries. The result from the questionnaire analysis was presented in the form of chart and table which is significant to improve the research effectiveness and reliability (Johnson, 2012).

Data collection and analysis

The data needed to carry out this research work are:

The questionnaire based assessment technique was used to carry out the primary data collection. The questionnaire survey provides an insight into the likely future requirements of Yobe construction industry regarding the evaluation of the drivers and barriers for implementing an innovation for industrial transformation(BIM). While the secondary data was collected from sources such as newspapers, research articles, electronic databases, and so on. Descriptive analysis was made use of, so as to collect quantitative data's from the respondents. Result from questionnaire analysis was presented in the form of chart and table which is significant to improve the research effectiveness and reliability.

RESULTS

The problem in the Architecture, Engineering and Construction industry (AEC-industry) is presented as the increasing fall in construction output with respect to other (non-farming) industry. As described in the theory chapter, the researchers often argued that the reason for this problem is the high level of fragmentation in the AEC-industry, combined with its collaborative needs. In order to be able to complete a building project successfully many different actors have to be involved and contribute, hence the need for collaboration. BIM is presented as a way of addressing these issues by enabling better exchange of information within the project team and throughout the buildings life-cycle. However, to effectively implement BIM there needs to be a change in our culture and technique to project delivery, organizational cultures and information technology practices are required to assume a more essential part in firm performance improvement particularly in the construction organizations. This chapter present and discusses the findings on Drivers and Barriers to an innovative technology (BIM) implementation in Yobe construction industries. The data presented are based on the outcome of the statistical analysis such as a descriptive statistic, frequencies, and so on with the help of Statistics Package for Social Sciences (SPSS), while the discussion on the results has been carried out to provide a clearer picture and understanding of the research.

Table 1: The potential barriers of BIM adoption in Nigeria

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Unwillingness to initiate new processes	40	3	5	4.00	.641

Not enough opportunity for BIM implementation	40	2	5	3.75	.670
Benefits from BIM implementation do not outweigh the cost to its implementation	40	2	5	3.25	.670
Benefits are not tangible enough to warrant its use	40	1	5	3.42	.903
Inadequate infrastructure	40	3	5	4.10	.496
High cost of finance	40	3	5	3.95	.677
Poor data systems and lack of compatibility	40	2	5	4.13	.723
Absence of skilled personnel	40	2	5	3.57	.813
Culture (Attitude and behaviour toward change)	40	2	5	4.48	.640
Unfamiliarity of firms with the use of BIM	39	2	5	4.26	.677
Lack of standards to guide implementation	40	2	5	4.00	.751
Lack of knowledgeable and experienced partners	39	2	5	3.82	.721
Valid N (list wise)	38				

The above table show the descriptive statistics of the potential barriers of BIM. It is indicated that the respondent perception of potential barriers is across a scale ranging from 1 (Strongly disagree, Disagree, Neutral and agree) to 5 (Strongly agree). It is observed that different aspects including culture (attitude and behaviour toward change) (mean = 4.48, SD = 0.640), Unfamiliarity of firms with use of BIM (mean = 4.26, SD = 0.677), Poor data systems and lack of compatibility (mean = 4.13, SD = 0.723), Inadequate infrastructure (mean = 4.10, SD = 0.496) and Unwillingness to initiate new processes and Lack of standard to guide implementation (mean = 4.00. SD = 0.641 and 0.751 respectively) present an average mean score. This indicates that the majority of respondents felt these attributes to be major barriers of BIM adoption in Yobe state Nigeria.

These views are supported in literature by several authors. Ashcraft, (2008),Gu*et al*. (2008) and Yan and Demian, (2008) claimed cultural barrier as an acute threat, as it contains prospective hindrances that are human related. Indeed these challenges may even be compounded in the developing world where infrastructural problems abound. In Nigeria for instance a pilot study by Mu'awiya, A., Yahaya, M. I., and Kabir, B. (2013)identified the frequent power failure and poor internet connectivity as potential barriers. While, Ayarici (2009) acknowledge on the survey conducted in UK that unfamiliarity of firms with the use of BIM as the primary barriers to BIM adoption.

However, the majority of respondents were of opinion that there is limited impact of BIM on the cost of financing the tool (mean = 3.95, SD = 0.677). The opinion was in line when considering the tangible benefits BIM will bring on implementation, which outsmarted the cost of financing the BIM software. Eastman, C., Teichoiz, P., Sackjs, R., and Liston, K. (2011) supporting this by

explaining that clients are now realizing benefits that BIM can offer them as owners when adopted. While on contrast to the finding of the survey.Ayarici (2009) indicate high cost of software as the primary barrier to BIM adoption on the survey conducted in UK.
Additionally the majority of respondents questioned on the lack of knowledgeable and experienced partner for BIM implementation (mean = 3.82, SD = 0.721), Not enough opportunity for BIM implementation (mean = 3.75, SD = 0.670), Absence of skilled personnel (mean = 3.57, SD 0.813), Benefits are not tangible enough to warrant its use (mean = 3.42, SD = 0.903) and Benefits from BIM implementation do not outweigh the cost to its implementation (mean = 3.25, SD = 0.670) by showing low score.

The finding from the survey was in contrast to those in literature. Ayarici(2009) reported that on a survey conducted in UK, reluctance to train staff or initiate new work flows, lack of opportunities to implement, and lack of proof for tangible benefits of BIM are identify as primary barrier. Figure 1: Indicate how various potential barriers of BIM adoption in Nigeria are rated by the respondent in a bar chart below.

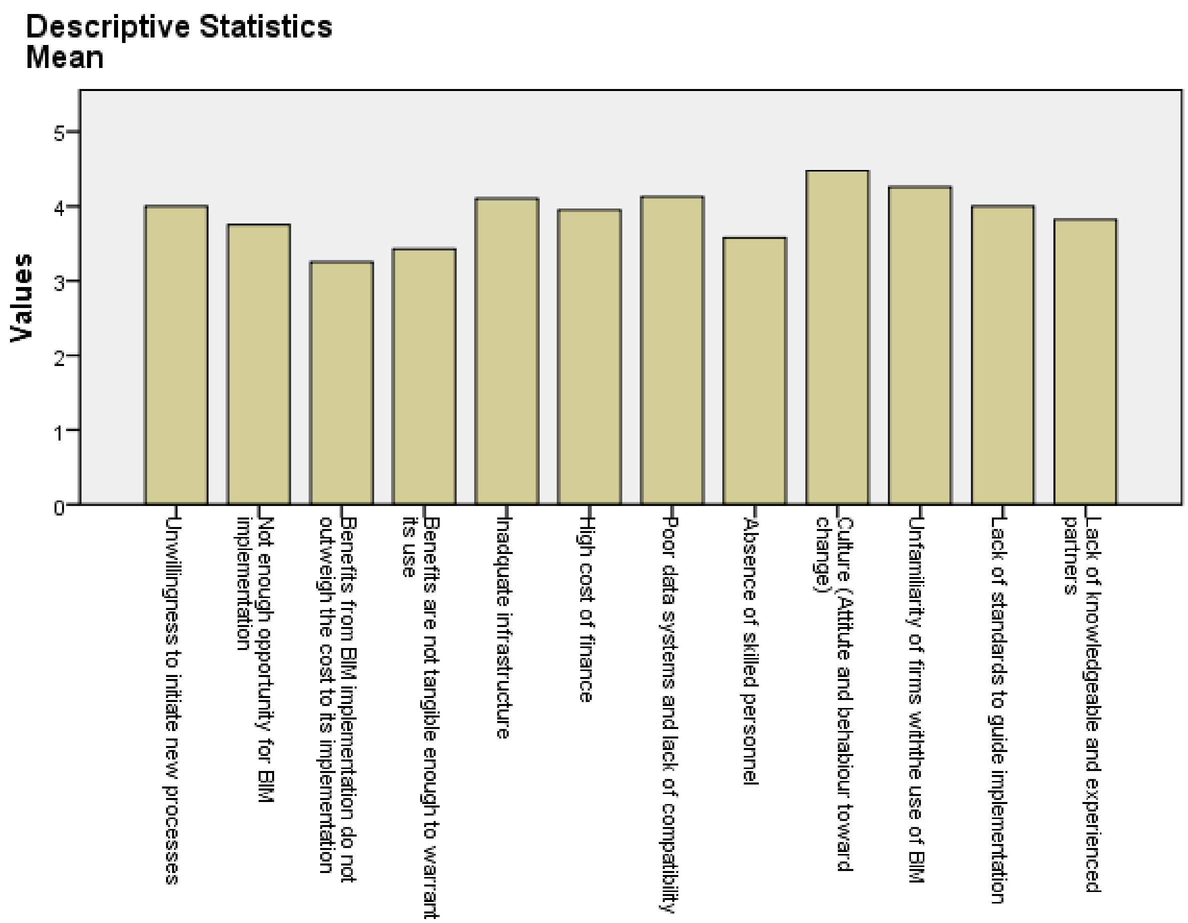


Figure 1: The potential barriers of BIM adoption in Nigeria

Table 2: Drivers of BIM adoption

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Attractive future plan	39	2	5	3.77	.777
Government Support	40	3	5	4.53	.554
External pressure and donor support	40	2	5	3.67	.730
Rising customers' expectations	40	2	5	3.45	.749
Technical change, modernisation and globalisation	39	3	5	4.28	.560
Client interest in BIM	40	2	5	4.00	.816
Software availability	40	3	5	4.43	.636
Cooperation and commitment of project team	40	2	5	3.67	.694
Adoption of collaborative procurement method	40	2	5	3.52	.751
Need to achieve cost savings and effective monitoring	40	2	5	4.13	.757
Desire to improve communication	40	3	5	4.03	.698
Reliable internet access	40	2	5	4.45	.714
Need to design health and safety into the construction process	40	2	5	3.78	.862
Valid N (list wise)	38				

The above table show the descriptivestatistics of the Drivers of BIM adoption. It is indicated that the respondent perception of drivers of BIM is across a scale ranging from 1 (Strongly disagree, Disagree, Neutral and agree) to 5 (Strongly agree). It is observed that different aspects such as Government support (mean = 4.53, SD = 0.554), Reliable internet access (mean = 4.45, SD = 0.714), Software availability (mean = 4.43, SD = 0.636), Technical change, modernisation, and globalisation (mean = 4.28, SD = 0.560) Need to achieve cost savings and effective monitoring (mean = 4.13, SD = 0.757) and Desire to improve communication (mean = 4.03, SD = 0.698) present an average mean score. This indicates that the majority of respondents felt these qualities to be major drivers of BIM adoption in Yobe state of Nigeria.

These views are supported and questioned in the literature. Mu'awiya, A., Yahaya, M. I., and Kabir, B. (2013) identify the drivers of BIM adoption in the construction industry as government support through parliament, clients' interest, software availability, collaboration and commitment of professional bodies, and collective procurement process. Similarly, some of the views such as (Technical change, modernisation, and globalisation) were comparative to those in the literature. Furneaux and Kivvits, (2008) mention the advent of improved IT infrastructure and ability of computer to develop and show 3D models with underlying substantial databases as one of the significant enablers of BIM adoption.

Though, the majority of respondents were of opinion that Client interest in BIM (mean = 4.00, SD = 0.816) partially facilitatesthe adoption of BIM. The research finding on this aspect was in contrast to those in literature. As Mu'awiya, A., Yahaya, M. I., and Kabir, B. (2013)acknowledge Client's Interest in BIM as one of the potential drivers among others. Furthermore, Liu *et al.* (2010) further confirm that external forces from clients and competitors play a large role in BIM adoption. Similarly Robert *et al.* (2013) highlighted Client/competitive pressure as enablers to BIM adoption.

Moreover the majority of respondents questioned the Need to design health and safety into the construction process (mean = 3.78, SD = 0.862), Attractive future plan (mean = 3.77, SD = 0.777), External pressure and donor support and Cooperation and commitment of project team (mean = 3.67, SD = 0.730 and 0.694 respectively), Adoption of collaborative procurement method (mean = 3.52, SD = 0.751) and Rising customers' expectations (mean = 3.45, SD = 0.749) by showing low score. These views are in contrast to those stated in the literature. Mu'awiya, A., Yahaya, M. I., and Kabir, B. (2013)identify some of the aspect such as cooperation and commitment, Adoption of collaborative procurement method as potential drivers of BIM adoption. Similarly, Robert (2013) listed various authors such as Liu (2010),Azhar, (2011), Eastman, C., Teicholz., P., Sacks., R., and Liston, K. (2011), among others pinpointing some aspect like Need to design health and safety into the construction process, cost savings and monitoring as the potential drivers for BIM adoption in architectural engineering and construction industry (AEC-industry). Figure: 2 shows how various drivers of BIM adoption are being rated by the respondent in a bar chart below.

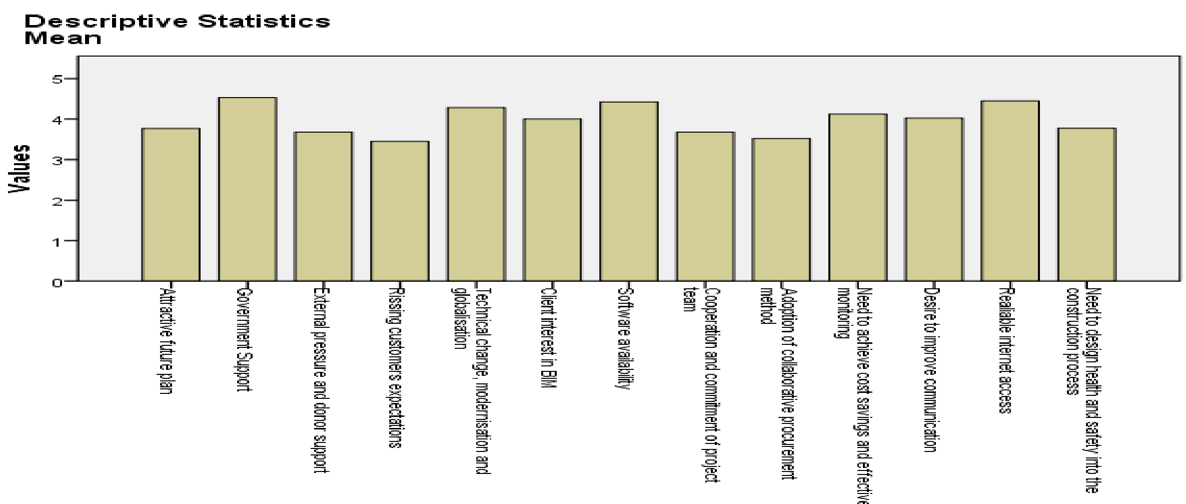


Figure: 2 the potential drivers of BIM adoption in Nigeria

CONCLUSION AND RECOMMENDATION

The first objective, study outline the need for BIM implementation because industry requires dramatic improvements in efficiency, performance, strengthening margins, collaboration and knowledge sharing. The chapter describes history of BIM and reveals that BIM as a concept is in fact not that infant at all. Its roots reach as far as to early 1980's. Further highlighted in the chapter two that, the technology of BIM has benefits over traditional 2D technology. By improving the ability to manage information in construction projects, better collaborative work processes can be adopted. These processes can streamline the work in an Architect, Engineering and Construction project and thereby improving productivity. Improved productivity on a project scale is however not the only possible outcome of BIM adoption. BIM can be used at smaller scale by individual actors, with smaller potential benefits.

The adoption of BIM must however correspond to the sought-after goal with the BIM adoption. BIM is not a goal by itself, the technology can enable changes in processes, making them more efficient, but BIM has no value in its own right. BIM has a value as a tool to reach other goals, but is not a goal by itself. Therefore the goal with BIM adoption must be developed before the processes for how the technology should be used are developed. The slow adoption of BIM is linked with many different barriers, and there is no single one problem that could be solved individually to enable wide scale BIM adoption. BIM will enforce a paradigm shift in the industry with large consequences to how construction projects are performed. With adoption of this new ICT technology more efficient work processes need to be adopted. How these new processes affect the industry in regards to business models and practises is currently not fully developed.

The individuals working with these new tools also need education to be able to use the BIM tools. BIM will change many individuals‟ roles in the project and there has to be a general understanding of the changes in practice. Together this means that technical issues are not alone the greatest barrier to BIM. When trying to break down the barriers to BIM adoption it is important to remember the process changes and needs of the individuals actually working with the new tools. Organisations that undertake the construction. Unfortunately, changing competitiveness in the worldwide business sector has made difficulties for some organizations and people. To manage with this changing domain, organizational cultures and information technology practices are required to assume a more essential part in firm performance improvement particularly in the construction organizations.

The data collected strengthened the fundamental relationships conceptualised in the model. The model therefore delivered a suitable basis for the development of the questionnaire. The questionnaire was designed to capture project features, measure change implementation. Correlation analysis were employed to explore and draw inferences about the relationships between the different barriers, drivers of BIM adoption in construction industries within the sample. The results indicated that the sample was generally representative of construction industries in Yobe.

RECOMMENDATIONS FOR INDUSTRY

(a) Education and training were identified as important parts of BIM implementation due to the process and technological changes it brings in an organisation. Ayarici (2009). This research therefore recommends that BIM training programs should be provided by the academic institutions and other stakeholders in the construction industry to make our professional design consultants well acquainted with BIM processes to ensure successful take up of the technology. BIM should also be incorporated in the curriculum of all tertiary institutions in Nigeria taking construction related courses, in order to tackle the dearth of well trained professionals to handle BIM tools in the construction project organisations CPOs.

(b) It is recommended that Nigerian construction stakeholders including the government and professional regulatory bodies should work hand-in-hand in ensuring that the enablers of BIM adoption such as the provision of regulations and industry standards guiding the implementation are provided and strengthened to make the industry ready enough for BIM adoption.

c) Consultancy companies should further assess their capabilities and address all the issues highlighted in the different categories of willingness to create an enabling environment for them to fully adopt BIM in their practice

d) Through continued efforts in identifying ways to overcome the construction industry's resistance to transformation, by modifying traditional work habits, by improving current technical limitations, and by encouraging the use of innovative ICT and Internet-based solutions, will undoubtedly help increase the overall knowledge, awareness and skills, of all industry stakeholders, in bringing about industrial transformation. This will result in a major social and technological impact that will integrate the construction industry in a unique, distinctive, and never before experienced way.

RECOMMENDATIONS FOR FUTURE RESEARCH

Further research should be conducted to establish an in-depth awareness to all other sectors of the Nigerian construction industry for the barriers that hinders the adoption of BIM technologies. This is because the adoption cannot just be achieved by one section of the industry, but is a collaboration issue which needs all the sections of the industry such as contractors, clients, suppliers, manufacturers and government to have a fair level of awareness if the industry is to benefit from the adoption of the technology.

A framework should also be developed for the full adoption of BIM in the Nigerian construction industry.

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