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THE ADOPTION OF BUILDING INFORMATION MODELING (BIM) FOR PROCUREMENT OF WORKS IN GHANA

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ABSTRACT

The introduction of the Public Procurement Act in 2003 in Ghana is over ten years, however research has indicated that value for money was not being achieved in both government- and donor-financed procurement resulting in poor project performance. There is therefore the need to improve on the efficiency, timeliness, and quality of construction and maintenance work in many developing countries. The aim is to investigate the prospects of Building Information Modeling for implementation of procurement of works in Ghana. The following objectives were identified to be of paramount importance in achieving aforementioned aim: to conduct a comprehensive literature review on Building Information Modeling; to identify the benefits of Building Information Modeling on Procurement and determine barriers affecting the use of Building Information Modeling for procurement of works in Ghana. The research is qualitative; literature review was conducted to collect the data for barriers affecting the use of Building Information Modeling for sustainable procurement of works in Ghana and the level of awareness among the procurement professionals for works. A content analysis was conducted to identify the benefits of the use of Building Information Modeling procurement activities. From the study 30 factors were identified to be the barriers affecting the utilization of Building Information Modeling in Ghana. It was concluded that education of BIM as a subject be taught at the built environment departments of the tertiary institutions in Ghana.

Keywords: BIM, Implementation, Procurement, Construction, Ghana

INTRODUCTION

The Public Procurement Act 2003 (Act 663) which has been in operation for ten years in Ghana was enacted in 2003 to address the weaknesses in public procurement. This study explores the major issues in construction procurement in Ghana and analyses the potential impact of the Public Procurement Act on project time performance using Building Information Modeling (Bim).

ISO 10845:2010 defines procurement as the process through which contracts are created, managed and fulfilled, including all the steps from the establishment of the project or products to be procured, soliciting and evaluating tender offers, awarding and administering contracts and confirming compliance with requirements.

Eastman et al, (2008) defined Building Information Modeling as a modeling technology and associated set of processes to produce, communicate and analyze building models.

Tholhath and Ibrahim (2013) argued that Building Information Modeling will improve implementation co-ordination by increasing construction productivity and prefabrication with less rework on site. Tholhath and Ibrahim (2013) noted that effective collaboration will improve implementation co-ordination and integration through BIM during building process with innovative planning.

The National Building Information Modeling Standards (NBIMS) (2007) defines BIM as: " a digital representation of physical and functional characteristics of a facility. A BIM is a shared knowledge resource for information about a facility forming a reliable basis for decisions during its life-cycle; defined as existing from earliest conception to demolition. A basic premise of BIM is collaboration by different stakeholders at different phases of the life cycle of a facility to insert, extract, update or modify information in the BIM to support and reflect the roles of that stakeholder."

The use of Building Information Modeling is compulsory on public projects in Finland and Denmark since 2007 and widely used in USA. However the gap that exists in Ghana is no work has been done at the moment on the use of Building Information Modeling in procuring works.

Problem Statement

Since the introduction of the Public Procurement Act in 2003 in Ghana, successive research have revealed substantial inefficiencies and concluded that value for money was not being achieved in both government- and donor-financed procurement resulting in poor project performance (Anvuur *et al.* 2006*).* There is therefore the need to improve on the efficiency, timeliness, and quality of construction and maintenance work in many developing countries.

Anvuur *et al* (2006) argue that contracts for both works and services take very lengthy periods to reach financial closure and are subject to unnecessary delays. Anvuur *et al* (2006) attribute the causes of the delays to extensive post-award negotiations, delays in the preparation of technical specifications and drawings, delays in evaluation, reviews and approvals.
Bondzi (2010) admits that the manual of the Public Procurement or traditional procurement processes has certain disadvantages that increase cost as well as cause delays in the procurement process.

Some policy measures and success factors for the development of public procurement practices in developed economies are found to be easy in theory but difficult in practice for the developing countries because of the intrinsic and unique nature and heterogeneity existed among the developing countries.

Aim

The aim is to investigate the prospects of Building Information Modeling for implementation of procurement of works in Ghana.

Objectives

The following objectives were identified to be of paramount importance in achieving aforementioned aim:

1. To conduct a comprehensive literature review on Building Information Modeling
2. To identify the benefits of Building Information Modeling on Procurement of works
3. To determine the barriers affecting the use of Building Information Modeling for sustainable procurement of works in Ghana.

BIM use Classification System and Structure

(National Institute of Building Sciences (2007) disclosed that BIM uses can be classified primarily based on the purpose for implementing BIM throughout the life of a facility. In addition to the purpose alone, several other characteristics can be defined to properly identify and communicate a BIM Use. These purposes and characteristics (see Figure 1-1) can be defined at varying levels depending upon the level of specificity required for different applications of the Uses.

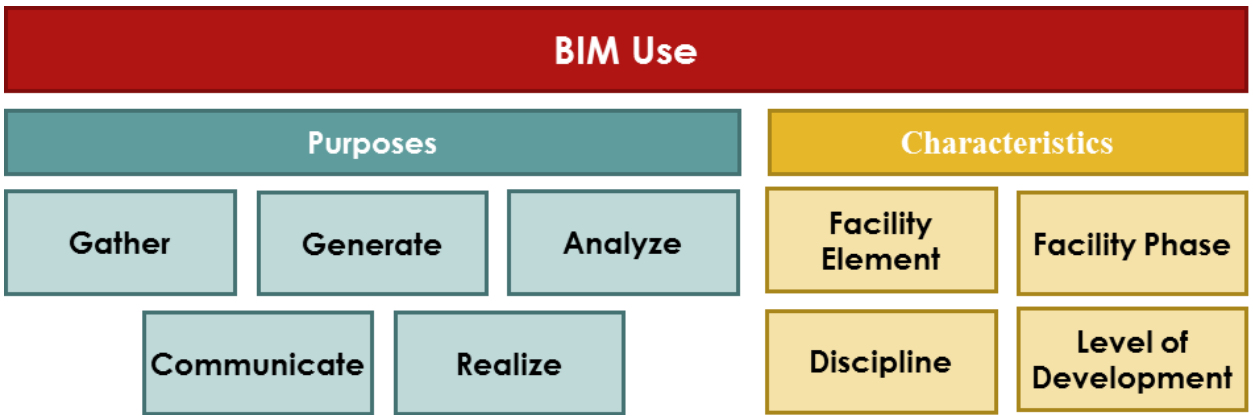

Figure 1-1: The Components of a BIM Use

The BIM Use Purpose communicates the primary objective of implementing the BIM Use. The BIM Use Purposes, shown in Figure 1-2, fall into five primary categories: gather, generate, analyze, communicate, and realize. Of these primary categories there are numerous subcategories that further specify the purpose of the BIM Use.

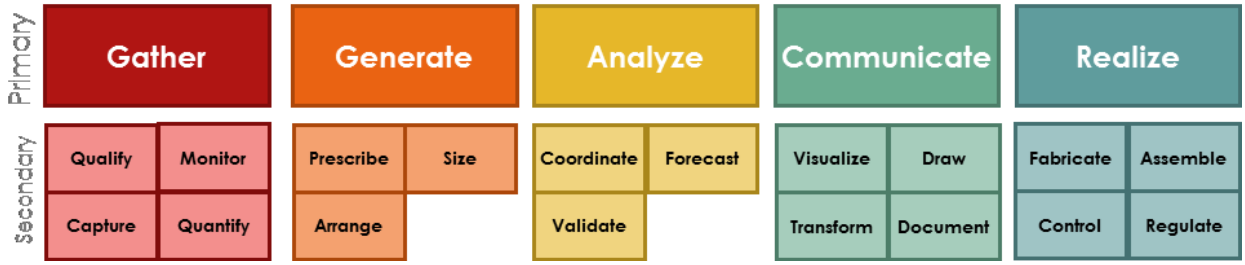

Figure 1-2: The BIM Use Purposes

Gather

The objective is **to** collect or cull facility information. BIM is often used to gather information about a facility at various phases during a facility's life. Whether that is to count the specific amount of an element or determine the current status of a facility element in order to properly manage that asset, the use of BIM can greatly assist in this effort. This sub-purpose of BIM Uses include: Qualifying, Monitoring, Capturing, and Quantify. In this primary purpose of BIM Uses, the author is collecting, gathering and organizing information about the facility. This purpose of BIM Uses does not determine the meaning or make inferences about the meaning of the information gathered, rather it is solely focused on the collection and organization of the information. This is often the first step of a comprehensive series of BIM processes. (NBIMS, 2007)

Generate

NBIMS (2007) holds the view that the Objective is to create or author information about the facility. Within the lifecycle of a facility almost every discipline that interacts with the facility will generate information about the facility. This purpose of BIM Uses includes those where BIM is used to create or author information about the facility. It includes prescribing, arranging, and sizing facility elements to various levels of development. Within the design phase, the design team will be the primary generators of information, while in the construction phase, the subcontractors will generate most of the information. Additionally, in the operations phase, that information could be generated by those maintaining the facility when they update or change that facility. Anytime new information is authored, modeled, or created, it is generated.

Analyze

NBIMS (2007) recognises the importance to analyze and this is **to** examine elements of the facility to gain a better understanding of it. Elements of the facility often require further analysis to determine their viability for the facility. The analyzing purpose of BIM Uses includes those uses in which a methodical examination of the facility elements is needed. The Uses of this purpose include coordinating, forecasting, and validating. It is in these BIM Uses data is often taken from what was gathered or generated and put into the format into which it can be used for decision making.

Communicate

NBIMS (2007) captured the essence of communication as to present information about a facility in a method in which it can be shared or exchanged. One of the primary Uses of BIM is to communicate facility information. The communication purpose of BIM is intended to present information about a facility in a method which can be shared or exchanged. This is often the last step of many other processes when a visualization, transformation, drawing, or document is developed to communicate information from that process to the next user of that information. This is one of the most valuable uses of BIM. It promotes and enhances communication and often reduces the time it takes to communicate. Additionally, communication of the data is often a byproduct of the processes to accomplish other BIM Uses.

Realize

The Objective is to make or control a physical element using facility information BIM is beginning to allow the industry to remove the direct input of human interaction to develop specific elements of the facility. The realize purpose of BIM Uses includes those Use in which facility data (BIM data) is used to make or control a physical element of the facility. This BIM Use purpose gives the industry the ability to fabricate, assemble, control, and regulate elements of the facility. It is this ability that could eventually lead to the improved productivity of both construction and operations of facilities. (NBIMS, 2007)

The BIM Use Characteristics

Kreider, and Messner, (2013) noted that BIM use Characteristics are used to more precisely define the BIM Use beyond the purpose and objective alone. Depending on the facility's BIM utilization, it is possible to have multiple disciplines implement multiple BIM Use purposes during multiple phases on multiple facility elements to multiple levels of development.

Facility Element

(Kreider, and Messner, 2013) admitted that it is necessary to determine on which facility elements the BIM Use(s) will be executed. Elements or other applicable element breakdown structures, the team can determine which facility elements are part of the BIM use.

Facility Phase

After determining the discipline, the planning team should determine during which facility phase they will be implementing the BIM Use. Facility phase designation often results in multiple BIM uses and multiple disciplines. For example, the design team may be responsible for coordination analysis during the design phase and the construction team may be responsible for the coordination analysis during the construction phase. (Kreider, and Messner, 2013)

Discipline

Kreider, and Messner, (2013) indicated that the disciplines include planning, design, investigation, project management, construction, facility use, and support. While the primary discipline may be identified, this does not preclude other disciplines from being responsible for part of the BIM Use. Additionally it is possible to have multiple disciplines responsible for the BIM Use. This would then make for separate BIM Uses.

Level of Development

For each of the BIM Uses, the level of development should be identified in order to maximize the benefit from the BIM Use. The Level of Development describes the level of detail / granularity to which a Model Element is developed. AIA / BIM Forum has recently released a major revision to the level of development specification. This revision further specifies level of development for specific elements of the facility. Table 3-2 shows a description of the Level of Development definitions. (Kreider, and Messner, 2013)

BIM Penetration in Europe

BIM strategy is seen as being a key factor in promoting the recovery of the UK construction sector and in enabling UK industry to compete more effectively in export markets.

The benefits of BIM, used progressively, are stated to include reducing the cost, time and uncertainty of design, construction and the operation of buildings, by making previously laborious, manual and repetitive processes quicker, automated and more accurate. Recently, following a review, the UK Government announced that BIM had contributed in saving the Government £1.7 billion last year on major projects, noting that Secondary School buildings in the UK now cost 40% less through better contracting and innovation **(**Construction News, 2013)

This implies that each contributor's input during the construction process is merged in a single, consistent model environment held on the Web, whilst, at the same time, all contributions can be identified, tracked and audited. One of the key benefits of a BIM-enabled approach is that collaboration across the supply chain is supported and rewarded by each of the parties having a fuller and more up to date picture of the progress of the works. As noted by Saxon (2013), by providing better visualisations of the works to be carried out and by encouraging cooperation and coordination in the field it is also expected that the full adoption of BIM will result in far lower levels of conflict in the construction process.

BIM and the European directive on public procurement

The European Parliament has adopted a legislative resolution concerning public procurement: 2011/0438(COD).

One of the goals of this initiative for a new EU directive is the inclusion of the "best quality-price ratio", which can be evaluated through a life-cycle cost-effectiveness approach.

According to the position of the European Parliament "For public works contracts and design contests, Member States may require the use of specific electronic tools, such as of building information electronic modelling tools or similar."

The benefits of BIM are numerous: it can act as a catalyst for delivering better value through improved project management and increased collaboration, as well as being a consistent digital tool to provide more reliable data exchange, more coherent formats for estimating costs.

The new legislation will allow EU countries to encourage, specify or mandate the use of BIM for public sector construction and building projects by 2016. Denmark, Finland, the Netherlands, Norway and the UK already require the use of BIM in the procurement of public buildings.

Key benefits of adopting BIM for Public Procurement Projects

Anumba,(2013) recognizes Industry Motivation for BIM as a drive for improved productivity; increasing need for interoperability b/w systems ; move towards more collaborative working in integrated project delivery (IPD) and Public-private partnerships (PPP). Anumba,(2013) confirms that BIM encourages sustainability.

Zelles (2014) argues that BIM results to Cost Savings for Taxpayers: Public procurement plays an important role in the overall economic performance of the EU, where public purchasers spend approximately 18% of GDP on supplies, works and services. According to a 2012 report issued by the European Commission, public entities that have already implemented e-procurement solutions report savings of between 5% and 20% of their procurement expenditure. The total size of the EU's procurement market is estimated to be more than 2 trillion Euro, so each 5% saved could result in about 100 billion Euro of savings per year – the equivalent to building more than 150 large-size hospitals Zelles (2014)

Economic Boost to the Construction Sector: The European construction sector generates almost 10% of the region's GDP and provides 20 million jobs, mainly in micro and small enterprises. Construction is also a major consumer of intermediate products, such as raw materials, chemicals, electrical and electronic equipment, and related services. Because of its economic importance, the performance of the construction sector can significantly influence the development of the overall European economy. (Construction News, 2013)

Zelles (2014) asserts that there is higher impact for sustainable design: In addition to the economic benefits observed by introducing technology to construction, existing buildings contribute approximately 40% of greenhouse gases emissions and consume energy by a similar proportion. Tackling the energy performance of existing buildings also falls within the scope of the PPD.

Many multinational contractors are patronizing the use of BIM or Building Information Management to deliver benefits such as increases in construction management efficiency of up to 70%, reductions in the duration of the works of up to 65% and reductions in waste during the works of up to 20% (CITA, 2013).

Barriers affecting the use of Building Information Modeling for sustainable procurement of works in Ghana

Anumba,(2013) outlined some of the practical problems and barriers as lack of investment in industry standards; Building Information Modeling (BIM) currently means different things to different people that leads to confusion and uncertainty in the market; training and "on the job" experience still in infancy and Cost of investment in BIM technology considerable and entry cost too high for smaller players especially in current.

Anumba,(2013) identified some technical barriers to include data portability and management; bandwidth issues; safety of data from corruption; software compatibility across

formats and systems and need for model server technology to improve the use of the model in rural areas.

In their research covering the construction industry, Peansupap and Walker (2005), identified several factors underlying the slow uptake of information and communication technology (ICT) by organizations. These factors include: the complex nature of the construction industry; ICT immaturity levels; poor availability of tools for evaluating the benefits of using ICT; and lack of understanding of ICT implementation processes. These factors are likely to apply as well to BIM - as a technology-driven process within the construction industry - and need to be addressed if BIM is to be adopted and its benefits realized.

CONCLUSION

Building Information Modeling **(**BIM) competence could be mandated as a pre- qualification requirement on particular, appropriate public sector tenders. As a small, open, innovative economy sector, the adoption of a BIM approach in Ghana may stimulate the economy suite of contracts.

It is submitted that there is now an opportunity for the Ghana Government to consider the hard experiences of over ten years since the implementation of the Public Procurement Act 663 suite of contracts and to move forward with a fairer contractual environment which will be of benefit to the economy as a whole.

Electronic procurement system should be introduced to reduce the bureaucratic nature of the process in relation to time.

Building Information Modeling **(**BIM) has come a long way, current industry uptake is encouraging but business and cultural changes need to be addressed.

Avoiding delays in the procurement process not only saves time and money, it also permits the timely award of contracts. A delayed contract award could cause a chain reaction of delays on other dependent procurements. This is especially important in project procurement management because it could delay the completion of the project.

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