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BIM Awareness: The Kenyan and UK Scenarios.

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Abstract. In the global context, Building Information Modeling (BIM) is a catalytic agent for innovation, productivity and efficiency in the construction industry. BIM adoption in Kenya is rare whereas the volume of construction is poised to increase and the gains that can be achieved via its use could be enormous. In the UK, all projects are to use a minimum of level two BIM to enhance collaboration and coordination with visual aids and a common data environment that enhances communication with the project proponents and all the other stakeholders. The main aim of this study was to determine the BIM gaps in terms of awareness and use in order to form a basis for the development of future adoption strategies in infrastructure projects in Kenya. The research was carried out in Nairobi and London. The study was designed as a survey that started with a desk study followed by semi structured interviews. Analysis of the data was done using content analysis. The findings identify significant differences in BIM awareness and use, the influence of which could provide insight for the developed and developing countries. The state of research, training and practice pertaining to BIM in Kenya remains largely undocumented whereas in the UK, there are national level initiatives driving its adoption. This paper concludes that BIM success is dependent on close collaboration between the client, consultants, contractors and suppliers along with the establishment of a well-developed BIM protocol and the lessons learnt from the UK can easily be used by Kenya as it embarks on its BIM journey for an efficient and harmonious working environment in this era of globalization.

Keywords: BIM, Infrastructure Projects, Collaboration, Project Stakeholders, Sustainable Development.

1 Introduction

The World invests about $2.5 trillion annually in infrastructure projects. However, according to McKinsey and Company [1], from 2016 through 2030, the world needs to invest an average of $3.3 trillion annually in economic infrastructure to support the expected population growth rates. This is an average increase of 32% in infrastructure investment. According to World Bank [2], Kenya faces a significant financing deficit of about $2.1 billion annually which constrains growth and development.

Productivity is a major issue for the entities that plan, construct and operate infrastructure assets with cost overruns averaging 20 to 45 percent [3]. This points to a colossal opportunity that can result in saving tax payers money through increased productivity by embracing innovation and improving the planning, project management, operational capabilities of all stakeholders involved in infrastructure projects. There are many problems that make productivity growth in the construction sector slow or negative in many economies namely fragmentation, skill gaps, insufficient planning and design, risk aversion, performance dispersion, project mindset of companies, ineffective procurement processes, workflow split and limited use of technology [4]. These challenges arise because the construction process is usually complex and involves many processes and parties, information is usually exchanged through the use of sketches, texts, emails, images, documents and drawings which can result in miscommunication and could hinder productivity in a construction project.

In the past three decades, technology has contributed immensely to the development of various nations. Building Information Modeling (BIM) is one of the most promising recent developments in digital engineering in the construction industry. The early concepts of BIM, date back to 1970s and 1980s when computer-aided design (CAD) was introduced. A brief history of BIM is shown below.

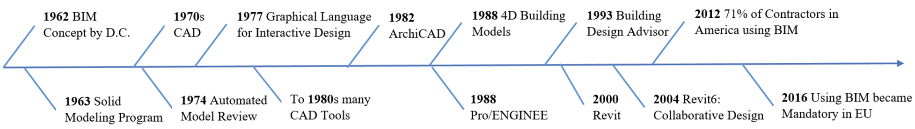

Fig. 1. The History Line of BIM (Source: [5]).

BIM provides a new set of tools and new ways of working within the industry that are attributed to increase in efficiency and reduction of wasteful activities in infrastructure projects [6]. Therefore, BIM is one of the most promising developments in digital engineering in the construction industry and it needs to be implemented in infrastructure projects.

The UK is known as a global leader in BIM implementation [7]. However, it continues to face cultural related challenges followed by management, legal and financial problems [5]. Kenya on the other hand, is facing huge challenges from the construction industry players because they are reluctant to change the traditional processes and this is closely related to human and organizational culture coupled with upgrading technology, interoperability, compatibility and complexity of BIM processes.

In the UK, BIM for infrastructure has gained traction, increasing its adoption levels from 13% in 2010 to more than 50% in 2015 [8]. In contrast, BIM use for infrastructure in Kenya is largely undocumented because of its very low adoption rates. In the UK, there is a government mandate for the use of BIM maturity level two which is fully collaborative. The mandate specifies BIM to be used on all public projects. This means that BIM should be used in rail, roads, utilities and energy projects that are longitudinal in nature compared to the generally vertical nature of building projects [6].

In view of the above, there are potential gains for the infrastructure construction industry through the use of BIM. This study aims to review existing research and industry development in order to determine the BIM gaps in terms of awareness and use, and to form a basis for the development of future adoption strategies in infrastructure projects in Kenya. With review of the UK construction industry, there are distinct and shared similarities in the adoption of BIM. This study presents lessons that can be learned by Kenya from the UK as an early BIM adopter in terms of implementation processes, expected challenges and solutions.

2 BIM and Infrastructure

BIM is the acronym for 'Building Information Modeling' which is commonly defined using the Construction Project Information Committee (CPIC) definition as the digital representation of physical and functional characteristics of a facility creating a shared knowledge resource for information about it forming a reliable basis for decisions during its life cycle, from earliest conception to demolition [9].

In civil engineering, infrastructure is defined as the basic physical and organizational structures and facilities needed for the operational of a society or enterprise [8]. Infrastructure projects range from transportation, energy, utility, recreational and environmental, examples in each category are mass transit hubs, power generation plants, sewer lines, stadiums and dams respectively. In most infrastructure projects, there are longitudinal structures that connect point structures and in relation to BIM, this provides mark differences in data structures, collaborating teams and project sizes that are more expansive than traditional building projects [4].

When getting started with BIM for infrastructure, its best to understand what every project stakeholder wants to achieve with the model during and after project development considering that the model could be used to manage assets once the project is built. Gathering the key information, physical attributes, and relationships of objects within the model is important in defining the standards that help one get started on modeling [6].

The implementation of BIM needs the establishment of standards for the objects used in design. BIM standards can be Model templates, a library within BIM tools or discipline-specific object libraries.

The use of BIM on an infrastructure project should start with the creation of an intelligent existing conditions model with some survey data of the area in question. Laser scanning-based survey/ geographical information systems (GIS) techniques generate detail-rich point clouds of data that can be imported directly into the BIM software.

Fig. 2. Exploration of a new project in the context of existing conditions using BIM (Source: [10]).

This shows that BIM can be used for better collaboration with clients and other projects stakeholders including the general public for example in traffic management. The stakeholders are able to gain insight as to how traffic management will be set up during and after construction and the BIM platform gives opportunities for people to give feedback for the improvement of the project.

With the improved collaboration, communication is improved and there are additional benefits such as reduced changes and errors. Additionally, when ideas are communicated with the aid of a model, testing can be done and the most efficient and cost effective solution should be chosen.

The objects within the model have intelligent attributes with a visually rich context that helps decision makers make informed choices.

A project execution plan is crucial for effective implementation of BIM, this mainly because the design is usually based on intelligent objects and any changes effected on the model have a ripple effect on the whole design. The model should be detailed enough to support all intended uses over the structures lifecycle.

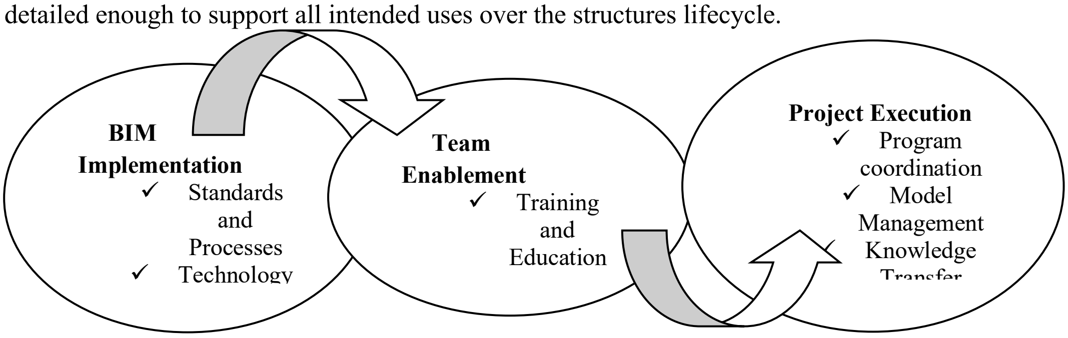

Fig. 2. BIM for Infrastructure Execution Plan (Source: Authors).

3 Methods

A qualitative approach was used to provide for an enhanced understanding and generate rich descriptions of the concept of BIM in the Kenyan and UK construction industries. Since there was no prior hypothesis that was to be tested, an exploratory study was used to inform the research. Literature review was conducted to examine the definition, concepts, application and all related issues of BIM. Exploratory interviews were conducted to collect data from the perspectives of purposefully sampled construction industry players (The Government, the general public, Project Managers, Engineers and Contractors) in Nairobi, Kenya and London, UK. 12 semi-structured face to face interviews were conducted over a 2-month period. An interview guide was used to collect data for the fulfillment of the research objectives. Materials from pervious desk studies were used to prepare for the interviews, all interviews were approximately 1 hour in length for each. The respondents had experience in using BIM in at least one of the projects they were involved in. The data was then analyzed by the authors using the technique of context mapping. The data was then analyzed by the authors using the technique of context mapping.

4 Findings

4.1 BIM in Kenya

In Kenya, BIM is facing huge challenges from the construction industry players because they are reluctant to change the traditional processes and this is closely related to human and organizational culture. According to one of the respondents, there are other challenges which include costs related to upgrading technology, interoperability, compatibility and complexity while introducing BIM. Moreover, there is little knowledge about BIM and majority of the respondents believe that the key people in the construction industry do not know why, how, when and what to start. This is mainly because there is no standard of BIM implementation at the national level for them to follow.

To manage these issues, one respondent stated that in his firms' case, they bought a BIM software and one of the key staff members was trained on BIM, then the staff member trained his co-workers and BIM knowledge was disseminated throughout the firm, they created a new role of BIM coordinator. This shows that companies and organizations can assess their individual challenges and develop a custom BIM roadmap which can be as simple as migrating from BIM level 0, to 1, to 2 within a specific time period and strategy.

The approach is different for one of the respondents, from an international civil engineering firm based in Kenya, he stated that their company had to act fast due to their international presence and now use BIM to add value in their profile while bidding for projects. Currently the firm is working on BIM level 2 in selected projects. However, the civil engineer suggested that working together with a BIM expert should be mandatory for first timers as it could speed up the BIM adoption process and minimize associated risks.

From the interviews, it is evident that the readiness for the Kenyan government and local firms to adopt BIM will be heavily influenced by top management support. This is because BIM will change established work processes to a new work process that will require bold decisions.

4.2 BIM in The UK

The minimum requirement by the UK government is level 2 BIM, which is operated by collaborative practices with all projects and asset information, documentation and data being electronic. This is the culmination of a 5 year staged plan which was instigated in 2011 with mandated milestones which showed measurable progress annually up to the end of 2016.

To assist with the adoption of BIM, the Construction Industry Council (CIC) and Building SMART were at the forefront in developing the best practice guidance for BIM adoption and improving the adoption process in data sharing respectively [11]. According to one of the respondents, the private sector also played an important role by forming a group called BIM Industry Working Group.

Findings from the study show that there were three major challenges associated with the adoption of BIM in the UK.

One respondent stated that there was lack of knowledge on how to implement BIM. This challenge was overcome through the formation of an Industry Delivery Team that assisted all the government departments in developing their own BIM adoption strategies in order to meet the governments mandate. The progress of the strategies was reported back to the Government Construction Board. Under the industry delivery team, a specific working group was formed to study and establish work processes and procedures to ensure the construction industry had a smooth transition in BIM adoption. According to Gardezi, Syafiq and Khamidi [12], Regional BIM hubs were also formed to enable SMEs and smaller clients get advice from local networks. The British Standard Institute (BSI) also worked with the teams to develop a BIM standard which includes BS 1192-2 and PAS 91.

There was also the challenge of the lack of technical skills which was overcome by the development of a core set of skills and training requirements. A '2050 Group' was also developed to motivate and capture the technical expertise from the younger generation within the industry.

Additionally, professional and trade bodies teamed up with the government to ensure that BIM was embraced by all communities within the construction sector especially the small practices. There was also risk management which was overcome by incorporating the governments soft landings into the BIM program. Moreover, according to Ryan, Miller and Wilkinson [13], the government also worked with private clients to ensure that the benefits of BIM were shared among parties which included giving incentives.

However, up to date there is the challenge of making BIM fully collaborative across disciplines, this is because firms use different software's and the interoperability with the different software's is a big issue because sometimes data is shared in formats that cannot be opened with the available software's.

5 Discussion

From the foregoing, the absence of clear guidelines is a hindrance for the implementation of BIM in Kenya. In the UK, BIM is in a rapid and pervasive dissemination stage and this is mainly because it was adopted for its potential to address the challenges that the traditional construction technologies could not address. Although some of the companies in Kenya have experienced benefits through the use of BIM, adoption barriers are still being reported by the majority.

Below is a brief SWOT analysis for BIM adoption in Kenya.

Strengths

- Saves time and money (Reduces waste, the team gets it right at the first time).
- Improves 3D design capacity.
- Simulates construction sequences.
- Reduces Risks and errors.
- Reduces energy use over a building's lifecycle.
- Can be used by SME's.

Weaknesses

- There's no culture of collaboration across disciplines.
- The focus is on the infrastructure not information.
- The government needs to take the lead.
- Design firms and contractors need to work together.
- There's no universal design standards.
- There are initial hardware, software and training costs.

Opportunities

- Linkage with international leaders in BIM education.
- Integrating with simulated training innovations.
- BIM is the DNA of future construction.
- Development of new skills and knowledge for the local industry.
- Kenya can be a leader in BIM education and use in Africa.

Threats

- BIM will change the traditional ways of working in the local construction industry.
- New types of contracts/ contract addenda will be needed.
- There's limited understanding of BIM.
- There are few firms working together, across disciplines.
- Resistance to change.

6 Conclusions and Recomendations

Global trends have indicated an increase in BIM implementation and this is set to continue accelerating into the future. Government initiatives in the United Kingdom are helping all construction industry stakeholders realize the benefits of this technology. Such developments should encourage BIM implementation on a wider scale as developing countries like Kenya might be left behind if they don't keep pace with the trendsetters in the BIM field.

The transition from the traditional approach to BIM in the Kenyan construction industry will not be an easy process. It will need decision making and change management strategies which will be guided by top management in the government and private sector. The government will be very instrumental during the transition period from previous traditional workflows to BIM workflows, convincing professionals about the potential of BIM, developing education and learning strategies and understanding new roles.

Firms and practices should also understand that when implementing BIM, there will be initial costs. To reduce the risks associated with BIM, the management at the firm level will have to phase BIM implementation gradually moving from BIM level 0, to BIM level 1, 2 and 3 eventually.

Since current BIM implementation in Kenya lies between BIM level 0 and BIM level 1, recognition and support from the government will improve the productivity of the construction industry and implementing BIM in public infrastructure construction projects should lead the way. However, the strategic benefits of developing BIM expertise in Kenya will only be realized if the government and the private sector work together creating a push and pull situation.

References

1. McKinsey and Company, “Bridging Global Infrastrucutre Gaps,” no. June, 2016.
2. World Bank, *Global Economic Prospects, January 2019: Darkening Skies*, no. January. 2019.
3. B. Flyvbjerg, “Survival of the unfittest: Why the worst infrastructure gets built-and what we can do about it,” *Oxford Rev. Econ. Policy*, vol. 25, no. 3, pp. 344–367, 2009.
4. B. I. M. F. O. R. Infrastructure and Autodesk, “BIM FOR INFRASTRUCTURE BIM for Infrastructure : A vehicle for business transformation,” *Autodesk*, pp. 1–18, 2012.
5. J. Majrouhi Sardroud, M. Mehdizadehtavasani, A. Khorramabadi, and A. Ranjbardar, “Barriers Analysis to Effective Implementation of BIM in the Construction Industry,” *Proc. 35th Int. Symp. Autom. Robot. Constr.*, no. Isarc, 2018.
6. M. Mattsson and M. Rodny, “BIM in Infrastructure. Using BIM to increase efficiency through the elimination of wasteful activities,” p. 102, 2013.
7. A. (McCullough Wallwork, R. Niemann, and G. Gelic, “BIM BAM BOOM

– Getting BIM right in Australian Standards contracts," no. February, 2016.
8. Z. Basri, "No Titleпрроо," *Ммит*, p. 2016, 2016.
9. D. Sinclair, "BIM overlay to the RIBA plan of works," *RIBA Enterp. Ltd Publ.*, no. May, 2012.
10. R. Ryan, "BIM In Infrastructure - Challenges & Solutions."
11. S. Metal, W. Paper, and W. M. Hill, "Legal Implications of Building Information Modeling," vol. 112, pp. 1–9, 2008.
12. S. Gardezi, N. Syafiq, and F. Khamidi, "Prospect of Building Information Modeling (BIM) in Malaysian Construction Industry as Conflict Resolution Tools," *Int. J. Proj. Manag.*, vol. 3, no. 11, pp. 346–350, 2013.
13. a Ryan, G. Miller, and S. Wilkinson, "Sucessfully Implementing Building Information Modelling in New Zealand: Maintaining the Relevance of Contract Forms and," *Library.Auckland.Ac.Nz*, no. 2009, 2013.