Building Information Modelling (BIM): Barriers in Adoption and Implementation Strategies in the South Africa Construction Industry

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***Abstract*—**This study identifies and evaluates the critical barriers to the adoption and implementation of BIM in construction, and further relates the findings to the South African construction industry. The study also suggests ways of overcoming the identified barriers to the full adoption and implementation of BIM in the South African construction industry. The study is conducted using existing theoretical literature which includes published journals, books, and conference papers. The study is mainly a research on the critical barriers to the adoption and implementation of BIM within the South African construction industry. The study revealed that the major barriers to the adoption and implementation of BIM can be attributed to contractual issues such as licencing, insurance etc., and personnel inadequacies in terms of education, training, and skills development. Due to the population growth in South Africa, infrastructure is needed to accommodate this growth and the needs that arise from it. Having appropriate systems for the construction and management of these facilities is important for the well-being of South African people, and the economy. This study shows the advantages of incorporating BIM into modern day construction for all stake holders.

***Keywords*—**Barriers to adaptation, Building Information modelling, construction projects.

I. Introduction

BUILDING Information Modeling is a concept that has been defined by authors in many different ways. Azhar [1] defines Building Information Modeling (BIM) as a technology that digitally constructs an accurate virtual model of a building, while Gu and London [2] defines BIM as a IT enabled approach that involves the application and maintenance of a fundamental digital representation of a building and all its information throughout the different stages of the project. BIM produces a model known as the building information model which according to Azhar [1], can be used throughout all the project stages to, and including the operation and maintenance of the facility. When completed, the model of the building, which will be in 3D, will depict the exact dimensions of the building while assisting the professional team with the required information in terms of the design, procurement, fabrication/manufacturing of materials and construction activities of the building [3], and furthermore with the maintenance of the facility post the construction.

Over the last two decades, BIM has slowly been introduced and eventually implemented in the construction industries of countries such as the United States of America and Australia, and most recently the United Kingdom. Ku and Taiebat [4] have found that the BIM technology has been welcomed by professionals in these countries, and others, to reduce cost, time, and enhance quality as well as environmental sustainability.

The implementation of BIM largely depends on the willingness of the South African construction industry's stakeholders. The co-operation and investment of time and money into attaining the skills required to carry BIM fully depends on stakeholders. Such investments and efforts will not go to waste as BIM will induce a positive outcome for all parties involved.

The most important aspect of BIM is that it allows the design team as a whole, from the client right down to the suppliers, to collaborate better and work more accurately and efficiently [1]. As a result of the nature of BIM, working relationships have become more solid and effective by virtue of making it possible for stakeholders to update their portion of work as soon as one of the stakeholders adds or eliminates some information on the database. This is possible because the whole virtual model of the building, as well as the information of the project will be housed on the very same database; this can also be known as a single project file [5].

II. Barriers To The Adoption And Implementation Of Building Information Modeling

Although BIM is proving to be the answer to a lot of construction related problems, it has also been widely noted by authors such as Brewer et al. [6] and Ashcraft [7] that BIM doesn't come without its challenges. The fact BIM is a new

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phenomenon that aims to change the way established construction industries have conducted their practices, makes it even harder to adopt and implement.

From the literature that was reviewed, the researcher found that there were two major issues which were turning out to being barriers to the adoption and implementation of BIM in construction industries across the world. These barriers could be divided into two groups namely contractual issues as explained by Ashcraft [7], and personnel issues as explained by Ku and Taiebat [4].

Ashraf [7] have identified certain legal issues that that stand in the way of the full adoption and implementation of BIM in our modern society. These issues provide headaches with regards to who should be taking responsibility for which parts of the model, as well as the distribution of risk amongst all the professionals within the project team.

A. Some of the barriers to the implementation of BIM that were identified by Ashraf [7] include the following:

- *Standard of care of using BIM*

This looks at the inability of the professionals to identify and rectify any physical conflicts (clash detection) that may occur during the project life using BIM. The resulting consequences of such 'negligence' may include delays and cost overruns due to reworks that will be required once clashes are detected.

- *Design delegation and professional responsibility*

This clause looks to define and identify the roles and responsibilities of the parties involved in the project. The process between design, construct and ownership of the building normally puts the architect and/or engineer as the person with the most responsibility for the model. Alternatively, a new position such as a BIM-modeler can be created [6] to carry out the same responsibilities.

- *Intellectual property*

This refers to the challenges that will arise in terms of what is the design and who owns it amongst others. Such problems are only resolved by contractual agreements at the commencement of the design process. Failure to do so may lead to violations because the model holds the parts of the design.

- *Insurability*

This relates to who has rights in the model of the project at hand. Hence the rights to the models have to be insured. Insurance brokers involved in the construction industries are yet to allow stable and assured policies with regards to these issues.

- *Data translation*

This relates to the sharing/feeding and/or transferring of information into the model. The appropriate interoperability of the information is a fundamental aspect of BIM. The ability for different tools in the model to adequately send and receive information is of utmost importance. The ethics of the professionals plays a role in ensuring the smooth-running of this part of the model.

- *Other barriers to the implementation of Building Information Modeling*

Ku and Taiebat [4] study did not concur with the work of Ashraf [7]; they had different view of which barriers affect the adoption of BIM the most. These findings were conducted when they distributed electronic surveys to companies who were working with or have worked with BIM on their current or previous projects. From the number of respondents that they received, and observation was made that the levels of experience in the field of BIM were low amongst most companies. Simultaneously, they found that most of the issues that prevent the full implementation of BIM in the construction industry were the personnel elements of the companies.

Due to the fact that most companies carry out the bulk of the BIM related work in house, the researcher has found that one of the biggest challenges faced by companies and professionals is a lack of skill [4]. Together with that, they have also identified issues such as lack of company investment in BIM, a reluctance to co-operate from other professionals, lack of collaborative working processes, lack of legal agreements and interoperability, which looks at the capability of BIM being used or operated reciprocally.

In the study of Ku and Taiebat [4], it was also identified that other barriers contributing to the reluctance of the full adoption and implementation of BIM include the comprehension levels of BIM amongst professionals, professionals' collaboration capabilities as well as software related.

III. Research Methodology

The study is conducted using existing theoretical literature which includes published journals, books, and conference papers. The study is mainly a research on the barriers in adoption, and implementation strategies of building information modelling.

IV. Lessons learnt from the literature

Literature has revealed that the full adoption and implementation of BIM would be beneficial for the advancement of the South African construction industry. However, literature has also revealed that this change will not be one that comes with its own problems and barriers. These barriers have been identified as either being due to personnel issues (where the professionals are at fault for the stagnation in the implementation of the BIM technology), or contractual issues (where the gap in information has led to a lot of uncertainty with regards to things such as ownership, insurance, etc.).

As a result of these barriers, the full adoption of BIM will remain a problem unless the barriers are addressed urgently. Furthermore, the construction stakeholders will need to

devise ways of minimizing, if not eliminating, the identified barriers.

V. Conclusion

This paper has examined literature relating to the barriers to the adoption, and implementation strategies of BIM. The literature has identified different barriers that exist to the full adoption of BIM. Furthermore, the literature has divided the barriers into categories to make them easier to identify, and ultimately rectify.

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