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# BARRIERS TO THE ADOPTION OF BUILDING INFORMATION MODELING IN QUANTITY SURVEYING PRACTICE IN SOUTH AFRICA

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## ABSTRACT

One of the occupations in the construction sector is quantity surveying (QS). This duty is essential to the accomplishment of a construction project since it decides whether it will be finished on schedule, on budget, and to the requisite standard. The practice has received several criticisms for failing to correctly carry out her duties. Adoption of contemporary technology like Building Information Modeling (BIM) in its practice has become necessary to eliminate mistakes, inaccuracies, and omissions. However, South African QS practitioners face challenges in implementing BIM. Hence, this study seeks to examine these challenges. A survey approach was utilised. Ninety (90) of the one hundred and fifteen (115) questionnaires that were distributed to quantity surveyors in Guateng Province, SA were returned and considered appropriate for analysis Kruskal-Wallis, percentage, mean item score, and standard deviation were used to analyse the collected data. The results indicate that the main obstacles to the adoption of BIM in QS practice are a lack of BIM competence, a lack of government enforcement, opposition to change, and a lack of client demand for BIM. This study therefore suggests that BIM trainings be given top priority and that the government take the initiative in promoting BIM adoption throughout the nation, especially for public projects.

## KEYWORDS

BIM Adoption, Barriers, Profession, Quantity Surveying, South Africa.

## INTRODUCTION

The quantity surveying profession is one the construction professions, who's most common duties are to measure the quantity of materials as well as the workmanship required to get a construction work done (ASAQS, 2018). In order to establish an accurate estimate for construction work that would be utilised in the tendering processes that are necessary before any construction work can commence on a building site, the quantities of materials and labour needed to perform a task were measured. However, more responsibilities have been added to the roles of quantity surveyors as a result of the profession's evolution, including estimation for each of the six construction stages, advice and a plan for the client to ensure the best service and value of the product that the client is paying for, as well as recommendations on which contractor to choose, evaluation of the tender documents, Bill of Quantities pricing, valuations

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of the work completed and the work still in progress (Salleh et al.,2020 ). Despite these added responsibilities, quantity surveyors are still making use of the traditional procedures of quantifying and pricing even to this day, which are very time consuming and can give inaccurate figures most of the time (Olsen & Taylor, 2017). These have led to quantity surveyors failing to get the accurate figures when making a construction cost estimates due to the fact that they deal with a lot of unmanageable numbers being quantities as well as rates, while using the traditional method of quantifying and also preparing the bills of quantities. Hence, the profession has received a lot of criticisms due to inaccurate figures which at times leads to cost overrun of projects. As a result, the need for a technological tool capable of taking a lot of burden off the shoulders of quantity surveying professionals.

The Building Information Modelling (BIM) has been working its way into the construction industry. BIM is a novel technology that has been brought to the planning of building structures, their construction, and their digital administration (Raphael & Priyanka, 2014). BIM is a type of computer software that allows building structures to be digitally shown and all necessary digital activities to be taken before any physical construction work can begin. According to Boeykens (2018), the BIM is a tool or model that is used to share, collaborate, and coordinate the data of a specific building structure in terms of its design, construction, as well as its operation. This tool was created to aid in the transformation and advancement of the construction sector. BIM has advanced from 2D drawing to 5D presentation, object modeling, and analysis, making it easier for construction professionals, including quantity surveyors, to execute high-quality work (Boeykens, 2018). Hence, construction professionals are forced to evolve with this technological advancement or run the risk of being left behind. Considering the need to reduce errors, inaccuracies and omissions in the taking-off quantities and estimations of the building costs, and the need for improvement in the delivery of accuracy in quantifications and fast quantification and estimation processes in the South African construction sector, it is important the BIM tool is adopted by the quantity surveying professionals as it would lead to improvement in delivery of their services to the clients of the industry.

According to Odubuyi et al (2019), the total construction sector must develop in order to benefit the shareholders or investors in the sector, hence it is essential that quantity surveyors perform their tasks and responsibilities better. The use of BIM is one innovation that can revolutionise the construction industry and is the best strategy to advance the field (Odubuyi et al, 2019). The usage of BIM makes it possible for the quantity surveyors and the entire project team to have access to the data necessary for performing their tasks (Harrison & Thurnell, 2015), while also managing excellently the information that is included in it (Usman et al, 2015). Furthermore, Alhasan et al (2017) posited that every stakeholder or member of the project team wants to see an increase in project productivity. This can be achieved through efficient communication, automated data input, automatic taking-off of quantities, and improved cost estimates capability of BIM. There are several other benefits of BIM to quantity surveying practice that have been identified in existing literature. However, the move to adopt BIM in South Africa's private and public sector (client side) and amongst different building professionals (Quantity Surveyors, Architects, Civil Engineers, and Mechanical & Electrical Engineers etc.) has been very slow. The reason for this has been attributed to several factors. For example, Makenya & Ally (2018) opined that the slow uptake of BIM adoption might be due to lack of BIM expertise, while Criminale & Langar (2017) attributed it to resistance to change by the various professionals within the industry. Thus, the aim of this study is to examine the barriers to the adoption of BIM in quantity surveying practice in the South African construction industry. The conclusions will be useful in identifying the militating factors. An evaluation of the barriers as they were noted in the literature is presented in the following

section. Following are the research techniques used and the findings of the study. The results are then discussed, and conclusions are then presented.

# THE QUANTITY SURVEYING PRACTICES AND BIM

The primary responsibility of a quantity surveyor is to make sure that resources are used appropriately in the construction sector. They are also in charge of monitoring the project's finances and provide cost consulting services to the customer during the whole building process (Raphael & priyanka, 2014). A quantity surveyor's other crucial responsibilities include measuring construction projects and creating bills of quantities, or BOQs (Olatunji et al., 2010). A quantity surveyor's duties include providing advice on procurements, budgeting for construction costs, measuring on-site, organizing the schedule of work, preparing the final accounts, keeping track of expenses throughout the project, and negotiating tenders (Kottathara & Gunavel, 2017). Since quantity surveyors are the most crucial individuals in the construction sector, it is crucial that they carry out their responsibilities correctly and to the best of their abilities. However, when they carry out their duties, quantity surveyors frequently encounter difficulties that cause them to make mistakes in their job, such as errors in the movement or arrangement of data between their files, errors in numbers, duplications, and omissions of certain crucial data (Kottathara & Gunavel, 2017).

BIM makes it possible for those working in the architectural, engineering, and construction fields to plan, design, build, and manage building facilities in an efficient and effective manner (Rakib et al, 2019). Before the advent of BIM, building information was displayed using 2D drawings, making it challenging to understand the dimensions and specifications given. Later, Computer Aided Design (CAD) was introduced, allowing architects to view building plans digitally. This was followed by the development of 3Ds, which provided the realistic digital drawings of buildings (Lorek, 2018). The project's programming and scheduling of the data are integrated with the information from the 3D model in the 4D, which also monitors each action that is undertaken. The 5D then connects the previously mentioned information with the information cost, such as the quantities and prices or rates (Smith, 2007). Even if most quantity surveyors are unsure about it, the implementation of the BIM in a building project may help them increase the efficiency of the job they undertake (Fung et al., 2014). For instance, the usage of BIM can enhance and automate the present quantity surveying methods, such as taking off quantities from the construction drawings that have been created by the architects (Beukes, 2012). This reduces the amount of time required to quantify and estimate using the conventional approach, which South African quantity surveyors have always understood and continue to use. The ability of BIM to extract quantities from 3D designs and create bills of quantities simultaneously has helped reduce the amount of time spent on the building process, which is why BIM has been lauded as a huge technical advancement ever since it was first introduced (Olatunji et al., 2010).

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## LACK OF BIM EXPERTISE

The lack of competent individuals in building information modeling precludes most construction firms' quantity surveyors from implementing BIM in the majority of their procedures (Makenya & Ally, 2018). Chan et al. (2019) also highlighted that it is challenging for BIM to be incorporated in the quantity surveying operations due to the lack of available experienced and qualified professionals who have worked on BIM before.

### Lack of Awareness

According to Makenya & Ally (2018), there are low levels of knowledge about the implementation of BIM, which means that many individuals are unaware of how BIM may assist them in carrying out their jobs as quantity surveyors. In addition, the study by Criminale & Langar (2017) also mentions the fact that some individuals are not actually aware of BIM, despite the fact that there are not many of them, and on the other hand, others are aware of it but lack sufficient knowledge of it and how it functions.

### Resistance to Change

According to Harisson & Thurnel (2015) and Aibinu & Venkatesh (2015), quantity surveyors are so accustomed to carrying out the majority of their tasks in a conventional manner that they don't appear particularly eager to change their way of doing things. According to Criminale & Langar (2017), the interest in adopting BIM is hampered by the absence of corporate motivation to convert to building information modeling, which is often demonstrated by company leaders. This resistance to change behaviour is also brought on by the fact that the business is highly accustomed to carrying out tasks in a certain method, which makes them reluctant to adapt to the BIM procedures.

### Scarcity in BIM Training and Education

According to Makenya & Ally's (2018) and Smith (2007), the majority of quantity surveyors do not utilize BIM mostly due to a lack of BIM training. The adoption and application of BIM by quantity surveyors are hampered by a lack of training programs that may facilitate the transfer of knowledge and skills (Chan et al, 2019). Another significant obstacle to the widespread usage of BIM technology is a lack of training for users on how to operate it. Organisations don't invest in staff training because they believe it to be time- and money-consuming (Criminale & Langar, 2017).

### Lack of Knowledge of the Business Value of BIM

Makenya & Ally (2018) opined that one of the barriers to the adoption of BIM in quantity surveying operations was the lack of knowledge about the benefits that BIM may provide to these organisations. Another significant barrier to quantity surveyors adopting BIM is a lack of information or comprehension of the return on investments (ROI) brought on by its utilization (Haupt & Hefer, 2016). Another reason for BIM's delayed adoption and lack of acceptance is the challenges associated with monitoring or evaluating its effects on the project (Chan et al, 2019). The other businesses are prevented from adopting BIM technology and understanding the commercial value that BIM models convey because they are unaware of the financial benefits that are achieved by using BIM models (Criminale & Langar, 2017).

### Software complexity

It is highly discouraging for quantity surveyors to accept the usage of BIM in the everyday services they give due to the complexity of the software (Haupt & Hefer, 2016). Criminale & Langar (2017) noted that the complexity of BIM, which prevents many professionals or construction teams from using it to execute their jobs, is one of the obstacles to its acceptance in quantity surveying techniques.

### Additional costs in BIM training

Quantity surveyors in particular will need to receive BIM training, which will incur fees that most employers or business owners will be compelled to pay but most of them are unwilling to do so (Makenya & Ally, 2018). Because of this, most organisations' quantity surveyors are unaware of BIM and how it might help them with their everyday tasks (Horrison & Thurnell, 2015). Although it is also believed that the owners of the organizations investing in BIM may

be a fantastic move owing to the advantages that are connected to the adoption and implementation of BIM.

Other barriers to the adoption of building information modeling in quantity surveying practice as obtained from review of existing literature can be found in Table 1 below.

## RESEARCH METHODOLOGY

The study examined the barriers to the adoption of building information modeling in quantity surveying practice in South Africa. The study deployed a quantitative approach through questionnaires use as instrument for data collection. This approach was utilised due to the possibility of covering a large pool of respondents with the aid of research questionnaire (Tan, 2011). Gauteng Province of South Africa was the study area and the respondents targeted for the research were Quantity Surveyors. Relevant literature were reviewed for this study and information related to the objective of the study were obtained and used for the design of the research instrument, which is a structured questionnaire. The questionnaire had two sections, with the respondents' demographic information elicited in the first section. While the respondents' perspective on the barriers to the adoption of building information modeling in quantity surveying practice were elicited in the second section of the questionnaire. The libertarian scale of 1 (strongly disagree) to 5 (strongly agree) was used to rate the questions presented to the respondents. A total number of ninety (90) of the one hundred and fifteen (115) questionnaires that were distributed to quantity surveyors in Guateng Province, SA were returned and considered appropriate for analysis. Kruskal-Wallis as adopted by Otasowie & Oke (2022), percentage, mean item score, and standard deviation were used to analyse the collected data. In addition, the Cronbach's alpha reliability test was conducted for the purpose of determining the reliability of the data set and a value of 0.932, which represents a high consistency level.

## FINDINGS AND DISCUSSION

The background information of the respondents revealed that 22% of the respondents has Diploma, 52% had a bachelor's degree, another 22% had an Honours degree, and 4% had a master's degree. Furthermore, 49% of the sample assessed was Contractor Quantity Surveyors, 14% were Professional Quantity Surveyors, 5% were Candidate Quantity Surveyors, and 32% were Junior Quantity surveyors. In addition, 36% of the respondents had ten (10) to fifteen (15) years of experience, 29% of the respondents had five (5) to ten (10) years of experience, and 35% had less than five years of experience as quantity surveyors in the construction industry. Finally, 58% of the respondents work for the contracting firms, 22% work for government, and 20% work for consulting firms. These findings suggest that the study's target respondents, who were quantity surveyors, were fairly represented and that they had a sufficient degree of education to comprehend the study's questions (Otasowie & Oke, 2022).

Table 1 below shows the barriers to the adoption of building information modeling in quantity surveying practice in South Africa in a ranked order from the highest mean to the lowest mean. It can be observed that barriers with the same mean were ranked based on their Standard Deviation (SD) from the mean. A scenario in which most data are close to the mean is represented by a small SD, while a large SD shows that the data point is widely apart from the mean (Field, 2005). Hence the barrier with the same mean were ranked based on this. The mean of each barrier is the average of the responses obtained from each respondent.

The results show lack of BIM expertise as the highest ranked barrier (MIS=4.22, SD = 0.86). This was closely followed by lack of government enforcement (MIS=4.20, SD = 0.88); Resistance to change (MIS=4.13, SD = 0.93); lack of knowledge of BIM value (MIS=4.02, SD = 1.09); no client demand for BIM (MIS=4.00, SD = 0.91); high initial cost of BIM (MIS=4.00,

SD = 0.97); additional costs in BIM training (MIS=3.98, SD = 0.92); lack of support from company's executives (MIS=3.93, SD = 0.91); scarcity in BIM training (MIS=3.89, SD = 0.95).

Table 1: Barriers to the adoption of building information modeling in quantity surveying practice in South Africa

| Barriers | Rank | MEAN | SD |
|---|---|---|---|
| Lack of BIM expertise | 1 | 4.22 | 0.861 |
| Lack of government enforcement | 2 | 4.20 | 0.877 |
| Resistance to change | 3 | 4.13 | 0.933 |
| Lack of knowledge of BIM value | 4 | 4.02 | 1.090 |
| No client demand for BIM | 5 | 4,00 | 0.911 |
| High initial cost of BIM | 6 | 4.00 | 0.971 |
| Additional costs in BIM training | 7 | 3.98 | 0.921 |
| Lack of support from company's executives | 8 | 3.93 | 0.908 |
| Scarcity in BIM training | 9 | 3.89 | 0.945 |
| Lack of BIM standards in construction | 10 | 3.85 | 0.899 |
| Lack of IT infrastructure | 11 | 3.85 | 1.172 |
| Scarcity in BIM education | 12 | 3.83 | 0.986 |
| Issues with skills transformation | 13 | 3.72 | 1.089 |
| Increased client cost | 14 | 3.70 | 1.127 |
| Lack of amendments in forms of contract | 15 | 3.69 | 0.865 |
| Lack of awareness | 16 | 3.59 | 1.141 |
| Software complexity | 17 | 3.56 | 0.925 |
| Changes in the duties of quantity surveyors | 18 | 3.50 | 1.005 |
| Difficulties using BIM | 19 | 3.43 | 1.143 |
| Threat to the QS | 20 | 3.39 | 1.172 |
| Technical risks | 21 | 3.31 | 1.146 |

The research's findings corroborate a study by Makenya & Ally (2018) that found that most construction firms' quantity surveyors are not adopting the usage of BIM in their regular quantity surveying operations since there aren't enough competent individuals in building information modeling. The study concurs with a study by Chan et al. (2019) that found it challenging for quantity surveying practices to embrace BIM due to a lack of more seasoned and knowledgeable workers that have expertise with it. The study goes on to further concur with a study by Harrison & Thurnel (2015) that found there was insufficient government enforcement of policies that would have allowed the BIM to be included into the tasks performed by the design, construction, and engineering industries. It acknowledges that the absence of government initiative to adopt and use BIM is impeding and limiting its application in projects. Makenya & Ally (2018) agreed with this as well. Furthermore, according to Harrison & Thurnel (2015), whose study the present study confirms, opined that quantity surveyors are so accustomed to carrying out the majority of their tasks in the traditional manner that they don't even appear to be open to change in their working style. The findings of this study further corroborates that of Criminale & Langar's (2017), that the interest in adopting BIM is hampered by the lack of corporate willingness to convert to building information modeling.

In order to compare respondents' perspectives based on their years of experience, a Kruskal-Wallis test was conducted. It was shown that the mean values for the barriers to the adoption of building information modeling in quantity surveying practice in South Africa do not differ significantly. From the P-values in Table 2, it can be deduced that both entry level and experienced quantity surveyors that were the respondents for this study all responded and ranked the identified barriers similarly.

Table 2: Kruskal-Wallis Test Showing P-Values for Barriers to the adoption of building information modeling in quantity surveying practice in South Africa

| Barriers | P-Values |
|---|---|
| Lack of BIM expertise | 0.053 |
| Lack of government enforcement | 0.057 |
| Resistance to change | 0.053 |
| Lack of knowledge of BIM value | 0.090 |
| No client demand for BIM | 0.051 |
| High initial cost of BIM | 0.072 |
| Additional costs in BIM training | 0.081 |
| Lack of support from company's executives | 0.058 |
| Scarcity in BIM training | 0.054 |
| Lack of BIM standards in construction | 0.091 |
| Lack of IT infrastructure | 0.075 |
| Scarcity in BIM education | 0.086 |
| Issues with skills transformation | 0.079 |
| Increased client cost | 0.067 |
| Lack of amendments in forms of contract | 0.062 |
| Lack of awareness | 0.641 |
| Software complexity | 0.058 |
| Changes in the duties of quantity surveyors | 0.065 |
| Difficulties using BIM | 0.073 |
| Threat to the QS | 0.072 |
| Technical risks | 0.066 |

# CONCLUSION

This study evaluated the barriers to the adoption of building information modeling in quantity surveying practice in South Africa. Relevant literature were reviewed for this study from which barriers to the adoption of building information modeling in quantity surveying practice were identified. The findings of the study show that lack of BIM expertise is the most significant barrier to the adoption of building information modeling in quantity surveying practice. Furthermore, the findings of the study revealed other barriers to include lack of awareness, lack of amendments in forms of contracts lack of BIM standards in construction, lack of government enforcements, lack of IT infrastructure, lack of support from the company's executives, lack of knowledge of BIM value, resistance to change, scarcity in BIM training, software complexity, additional costs in BIM training, high initial costs of BIM, changes in the duties of quantity surveyors, no client demand for BIM. These findings suggest the need for the government to make the use of BIM compulsory in construction projects in South Africa. This will in turn make quantity surveyors in the country to embark on BIM related trainings to improve their awareness and knowledge of the technology. Furthermore, there is the need to make provision

for the training of quantity surveyors on BIM technology in the country to increase profitability, and improve the efficiency of quantity surveyors for greater cost certainty/ improve the cost estimation. In addition, by holding seminars, more quantity surveyors would be made aware of what BIM is all about. In order to consistently add value and improve their professional services, quantity surveyors must constantly reinvent themselves. Finally, although the current study provides insights into significant barrier to the adoption of building information modeling in quantity surveying practice, the study was conducted in the Gauteng Province of South Africa, which could be a limitation. Hence, similar studies should be conducted in other provinces within the country.

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