



INVESTIGATION ON THE STATE AND PRACTICE OF
BUILDING INFORMATION MODELLING (BIM)-
BASED COSTING IN THE MALAYSIAN
CONSTRUCTION INDUSTRY

BY

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ABSTRACT

The use of Building Information Modelling (BIM) and BIM-based cost management is still in its early stages of adoption in Malaysia. BIM has proven to be an important tool to take the construction industry into the next stage, yet many hindrances exist on the way to fully incorporating it in the Malaysian construction industry. Moreover, BIM-based cost management is a vital tool that has the ability to save time and costs that is not being fully employed in the country. This research seeks to investigate the adoption of BIM in cost management within the Malaysian construction practice. The study comes to address the lack of BIM and BIM-based adoption. It seeks to identify the current states of BIM and BIM-based cost management in Malaysian practice and to take a closer look at the guidelines and standards available in the country. It also focuses on the difficulties faced when trying to adopt BIM and more specifically BIM-based cost management. Two main approaches are utilized to collect data. Primary data collection is through a semi-structured interview with eleven respondents working in the construction industry. Secondary data collection is through previously published data and research on the subject. The choice of study respondents is based on a set criterion that ensures the respondents have knowledge working with BIM and in construction related occupations to represent a small sample of the people working in the Malaysian construction practice. The outcome of the interviews concluded that the state of BIM and BIM-based cost management adoption in Malaysia is still at its early stages. That was due to a number of reasons including lack of awareness and motivations towards implementing it. Another finding showed that the current standards and guidelines issued by the Malaysian government are not yet up to the level needed by companies. A lot of companies tend to adopt international standards and localize some of their own to fill the gap of not having sufficient information issued by the Malaysian authorities. In regards to BIM-based cost calculations, this study found that is yet to be fully explored in Malaysia due to different reasons, one of which is the lack of experienced workers. Respondents also expressed difficulties implementing BIM-based calculations due to the general low adoption of BIM. Another key finding is that the biggest change can be made through the government's full incorporation and push for more BIM oriented construction practice in Malaysia.

خلاصة البحث

إن استخدام نمذجة معلومات المباني (BIM) وإدارة التكلفة المستندة إليه لا تزال في مراحل مبكرة من تبنيها في ماليزيا. وقد أثبتت نمذجة معلومات المباني أنها أداة مهمة لنقل صناعة التشييد إلى المرحلة التالية ، ومع ذلك يوجد الكثير من العوائق في طريق دمجها بالكامل في صناعة التشييد الماليزية. علاوة على ذلك ، فإن إدارة التكلفة المستندة إلى نظام نمذجة معلومات المباني تعتبر أداة حيوية لديها القدرة على توفير الوقت والتكلفة، ولكن لم يتم استخدامها بشكل كامل في البلاد. ويسعى هذا البحث إلى التحقق من اعتماد نمذجة معلومات المباني في إدارة التكلفة داخل ممارسة التشييد الماليزية. وتأتي هذه الدراسة لمعالجة نقص اعتماد نمذجة معلومات المباني. وتسعى إلى معرفة الأوضاع الحالية لإدارة التكاليف في نمذجة معلومات المباني في الممارسة الماليزية، وإلقاء نظرة فاحصة على الإرشادات والمعايير المتاحة في البلد. كما يركز البحث أيضًا بشكل أكثر تحديدًا على الصعوبات التي تُواجه عند محاولة تبني نمذجة معلومات المباني وإدارة التكاليف. وتم استخدام منهجين رئيسيين لجمع البيانات؛ البيانات الأولية تم جمعها من خلال مقابلة شبه منظمة مع أحد عشر مجيبًا يعملون في صناعة البناء. أما البيانات الثانوية فقد تم جمعها من خلال البيانات والبحوث المنشورة حول هذا الموضوع. واعتمد اختيار المشاركين في الدراسة على معيار محدد يضمن أن المشاركين لديهم معرفة في العمل مع نمذجة معلومات البناء، والمهن المرتبطة بالبناء لتمثيل عينة صغيرة من الأشخاص الذين يعملون في ممارسة البناء الماليزية. وخلصت نتائج المقابلات إلى أن وضع إدارة التكلفة القائم على نمذجة معلومات البناء في ماليزيا لا يزال في مراحله المبكرة. ويعزى ذلك إلى عدة أسباب منها عدم وجود الوعي والدوافع نحو تنفيذها. كما أظهرت النتائج أن المعايير الحالية والمبادئ التوجيهية الصادرة عن الحكومة الماليزية لم تصل بعد إلى المستوى الذي تحتاجه الشركات. والكثير من الشركات تميل إلى تبني معايير دولية وتوطين بعض المعايير الخاصة بها لسد فجوة عدم وجود معلومات كافية صادرة من السلطات الماليزية. وفيما يتعلق بحسابات التكلفة المستندة إلى نمذجة معلومات المباني ، وجدت الدراسة أنه لم يتم تبنيها بالكامل في ماليزيا لأسباب مختلفة ، منها نقص العاملين ذوي الخبرة. كما أبدى المستجيبون صعوبات في تنفيذ العمليات الحسابية المستندة إلى نظام BIM نظرًا لاعتماد نموذج BIM بشكل عام. وهناك نتيجة أخرى هي أنه يمكن إجراء تغيير أكبر من خلال الدمج الكامل ودفع المزيد من عمليات ممارسة التشييد الموجه في ماليزيا.

APPROVAL PAGE

I certify that I have supervised and read this study and that in my opinion, it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Master of Science (Asset and Facilities Management)

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Mohd Fairullazi Ayob
Supervisor

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CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND OF THE STUDY

It is important to utilize technologies that are available to improve businesses and this is specifically true for the construction business. Companies and practitioners in the built environment have to employ the existing software and equipment to produce the best possible results. Current software developments have the ability to reduce cost and provide faster results with higher quality. This on its own has the ability to transfer the construction business and elevate the economy (Farr, 2011)

Shin & Cho (2015) identified cost calculations as one of the most crucial parts of a project in its different stages. Starting from planning, designing and up to construction. Shin & Cho (2015) also stated that cost management can determine the success of a construction project. Moreover, Krigsvoll (2007) discussed Building Information Modelling (BIM) as yet another tool that provides great assistance in conducting cost calculations within the different stages of a construction project. Krigsvoll (2007) also pointed out that BIM has the ability to drastically improve the speed and accuracy in which cost calculations are done by incorporating costs in BIM models and provide a seamless storing of data for future use.

In the past, two-dimensional quantity calculations, which are basically conducted either on paper or with the use of spreadsheets and has no three-dimensional models attached to them, took up a considerable amount of time, contained errors, and made editing and changed certain numbers a tedious task when carrying on cost calculation

works. However, BIM revolutionized the process of determining costs through providing immediate quantity calculations and its availability in different formats and compatibility with other software. Commercial BIM programs can export their data as Excel spreadsheets that allows ease of use. BIM-enabled cost calculations provide related information on an immediate basis and saves time in the early stages of the construction project (Shin & Cho, 2015).

The current construction practice needs to cope up with the changes and be ready to achieve its full potential. Software such as BIM has the ability to produce future cost calculations that are useable and accurate while also achieving development and sustainability goals. The continuous and increasing incorporation of digitally based technologies allows for innovative solutions to current problems, faster work times, and overall better quality of work (BSI-PAS, 2015).

1.2 STATEMENT OF THE PROBLEM

While in countries such as UK, Singapore, Australia, clear guidelines and implementation of Building Information Management (BIM) has been successfully adopted, Malaysia still falls behind (Zahrizan et al. , 2013). There is little effort from the Malaysian government to issue regulations and to a certain extent force the use of BIM software in the construction industry, and although the private Malaysian construction sector sometimes takes the lead in utilizing new technology, the government must adopt a proactive approach in this matter (Zahrizan et al., 2013).

The existence of government regulations and availability of common standards and software in the construction industry can prove to be time-saving and cost-effective as

well as ensure quality of work. These standards are meant to provide accessible instructions and information that form a reference in a country's operations. Guidelines for BIM and cost management provide the necessary structure for managing life cycle information and focus on the main operations and the common processes that are carried on throughout the work (ISO, 2014).

Barret (2014) discusses construction practice and how companies face challenges like the lack of complete 3D data that allows for accurate calculations, the lack of implementation of BIM-based costing in the earlier stages of the project, and using multiple software to generate the different aspects of one model. Barret (2014) calls for a more proactive approach to adopt BIM and realize its possibilities and advantages.

The use of BIM in the built environment is not a seamless process as it is presented with its own set of obstacles and challenges. A lot of practices in the construction industry and within many different countries have faced a few difficulties such as the lack of necessary data and knowledge to adopt BIM in spite of having the technology for it for a considerable amount of time. The challenges faced led many practices to slow implementation of BIM in the construction industry (Smith, 2014).

Kehily (2016) attributes the difficulties that lead to the slow adoption of BIM to the lack of knowledge of what BIM is capable of doing as well as financial obstacles that face many sectors when trying to fully integrate into BIM-based cost management as it hardware and software necessary to carry core functions can be considered a costly investment. NBS report (2017) highlights key reasons towards the slow adoption of

BIM within a country that also include lack of awareness of its importance and therefore lack of request for it by clients.

1.3 AIM AND OBJECTIVES OF THE STUDY

The aim of this study is to investigate the adoption of Building Information Modelling (BIM) and using it to conduct cost calculations and its impact on the construction practice.

The study targets to achieve the following objectives:

- 1- To investigate the current state of Building Information Modelling (BIM) and BIM-based cost management in the Malaysian construction practice.
- 2- To review Malaysian standards and guidelines of Building Information Modelling (BIM) and BIM-based cost management.
- 3- To determine the difficulties in the implementation of BIM and BIM-based cost management.
- 4- To develop possible strategies to overcome the difficulties in the implementation of BIM and BIM-based cost management.

1.4 RESEARCH QUESTIONS

1. What is the current state of Building Information Modelling (BIM) and BIM-based cost management in the Malaysian construction practice?
2. What is the status of the Malaysian standards and guidelines of Building Information Modelling (BIM) and BIM-based cost management?
3. What are the difficulties in the implementation of BIM and BIM-based cost management?

4. What are the possible strategies to overcome the difficulties in the implementation of BIM and BIM-based cost management?

1.5 RESEARCH THEORY

As detailed in the methodology chapter, this research aims to utilize the grounded theory research method. Terrell (2016) explains that grounded theory research starts by looking into a certain phenomenon, in this case it takes a closer look at the adoption of BIM-based cost calculation. He adds that grounded theory research starts by collecting data and carrying on a literature review to further investigate the problem and then goes on to data collection.

In grounded theory research, the theory is the outcome of the different data collection stages including previous literature and publications as well as primary data collection such as interviews. At the end the research is able to form a better understanding of the issue at hand and form a theory in conclusion to the findings. Rather than making hypotheses in the beginning, grounded theory concludes with a theory that offers explanation or understanding of a certain phenomenon (Terrell, 2016).

As a result of the choice of methodology for this research, the following theory was formed as a conclusion to all the data that has been collected throughout the research:

- 1- Theory Part A: The current state of Building Information Modelling (BIM) and BIM-based cost management is in the early stages in Malaysia.
- 2- Theory Part B: The current Malaysian guidelines and standards are not sufficient for the current needs of the construction practice.

- 3- Theory Part C: Difficulties such as lack of experienced workers and lack of efficient software discourage decision makers from adopting BIM in cost management.

1.6 SCOPE OF THE STUDY

The scope of the study began as an exploratory study into the application of Building Information Modelling (BIM) in cost management and within the Malaysian Facilities Management (FM) practice. Throughout the different stages of the research the main focus of the study changed due to the following reasons:

First, it was evident through the literature review that looking into BIM-based cost management within the frame of facilities management was too advance. Kelly et al. (2013) discusses the use of BIM in the facility management practice in the UK. The researcher further noted that BIM in FM is still an emerging field and it was difficult to understand the challenges and also possibilities of BIM in such an early part of its application. The scope in this case appeared to be too specific for an area where BIM adoption has not reached the required level.

Second, the application of BIM in facilities management was not at a level where further investigation into BIM-based cost management can be applied in the context of the Malaysian construction industry. Abdullah et al. (2014) highlighted the lack of sufficient application of BIM within the context of facility management. He also pointed out the importance of BIM and the solutions it can provide to the different issues faced in the practice of facility management.

Third, it was also observed through personal communications and interviews that Malaysia is still struggling to fully adopt BIM-based cost management and that the area of BIM-based cost management within the facility management practice is not a valid area for this specific study at this point. Mr. Ahmed Tarmizi, a respondent in this study and a BIM strategist in Malaysia, noted during the data collection phase that BIM-based facility management (also known as 7D) is not currently a priority as they are still facing issues in the country with the more basic 3D BIM and hoping to achieve BIM-based cost management as one of the coming steps.

For all the above reasons, the scope for this research is BIM-based cost management within the Malaysian construction industry. This study looks at the adoption of Building Information Modelling (BIM) and its use in cost calculations in the different stages of a project's life cycle beginning with conception. It reviews the guidelines, standards and regulations available in Malaysia. It explores the difficulties that are faced when adopting BIM to provide recommendations through experiences in other markets with the intent to help better improve the Malaysian experience of BIM. It also aims to achieve a basis for future research addressing more specific areas in cost management such as BIM-based cost management within the scope of facility management.

1.7 JUSTIFICATION OF THE STUDY

Based on my current knowledge and research into the available literature and studies, the area of BIM-based cost management has not been fully explored. Although many literature is available on the use and implementation of BIM in global markets as well as the Malaysian construction industry, there is a lack of data on the implementation

of BIM-based cost calculations globally and locally. This has been stated before in Zahrizan et al. (2013) research into the application of BIM locally in Malaysia, while globally it has been stated through different research such as Kehily (2016). This study aims to fill a gap in this research area and provide basis for future research and further exploration of BIM-based cost management.

1.8 SIGNIFICANCE OF THE STUDY

The significance of this study lays in the fact that it comes to highlight an important area of study in Malaysia and has the potential to positively shed more light on the importance of adopting BIM and BIM-based cost calculations. Through exploring this scope, it aims to provide current difficulties and issues faced with adopting BIM within the scope of cost management. Moreover, it hopes to provide valid recommendations to deal with emerging concerns. It also stresses the importance of the government's participation in creating common ground for the construction industry to operate in order to cope up with the amount of data and work today's projects need.

1.9 ORGANISATION OF THE RESEARCH

This research is made up of six chapters. Figure 1-1 shows the interconnection between the research chapters in relation to the research aim and objectives. The following is a short discription of the chapters:

- 1- Chapter one is an introduction of the research.
- 2- Chapter two is the literature review and contains definitions of key terms as well as background research and research in relation to the topic of the topic and the main aspects it covers.

- 3- Chapter three is the methodology and it contains the methodological strategy to carry out this research.
- 4- Chapter four is the data analysis and it details the process of analysing the data for this research and gives further details on the data collection process.
- 5- Chapter five is is the research findings and discussion chapter and it looks at the outcomes of the data collections and discusses it in relation to previously published data.
- 6- Chapter six is the conclusion of the research, it highlights the findings and ensures the fulfilment of the study aim and objectives as well as mention the limitations of the study. It also includes recommendations on tackling the research subject.

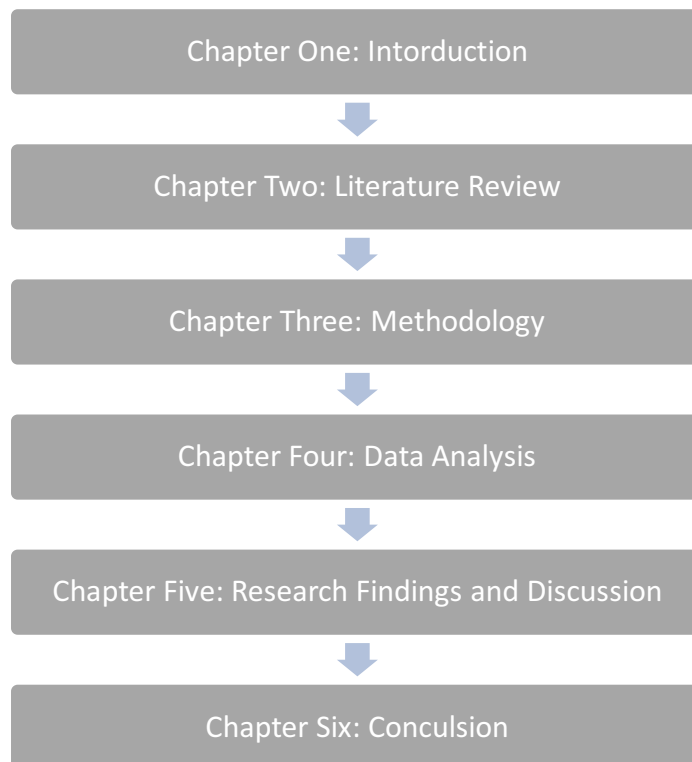


Figure 1-1: The Interconnection Between Research Chapters

1.10 CHAPTER SUMMARY

This chapter sets the tone for the whole dissertation. It states the topic of the dissertation and why it was chosen in the form of the importance and scope of the study. It also identifies the objectives and questions necessary to direct the path of the whole research. While it contains only brief guidance of the chapters to fully, it clearly identifies the direction this research is taking.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter comes to address the literature review that is relevant to this research. It starts with the definition of key terms that are significant to this study. Next, it includes background information that is collected from various research in regards to Building Information Modelling (BIM) and its applications within the construction industry. Moreover, it includes further studies and publications in relation to the main objectives of the study including BIM based cost management and its benefits, standards and regulations in regards to BIM adoption, and difficulties implementing BIM-based cost management. It also includes a section on the United Kingdom's BIM status as one of the leading countries in the field of BIM as mentioned by Smith (2014). The chapter concludes by literature review on possible strategies and recommendations to overcome difficulties implementing BIM within a country.

2.2 DEFINITIONS OF TERMS

Building Information Modelling (BIM)

“BIM is essentially value creating collaboration through the entire life-cycle of an asset, underpinned by the creation, collation and exchange of shared three dimensional (3D) models and intelligent, structured data attached to them.” (RICS et al., 2015, p. 5)

According to Barrett et al. (2014, p.207) “Building information modelling describes an approach rather than a technology”. He describes it as an approach that developed

from a two-dimensional drawings of projects to make an “intelligent” depiction that allows measurement and smart simulations.

Cost Management:

The following terms are defined in their relation to cost management and to provide further understanding of their meaning:

1- Whole Life Cost (WLC):

BRE-UK (2016, p. 4) defines Whole Life Cost as “a tool to assist in assessing all significant and relevant initial and future costs and benefits of an asset, throughout its life cycle, while fulfilling the performance requirements”.

2- Life Cycle Cost (LCC) :

“Life cycle cost is the TOC (total ownership costs) of a product over its useful life. Life cycle costs are all the anticipated costs associated with a project or program throughout its life. They are the sum total of the direct, indirect, recurring, nonrecurring, and other related costs incurred, or estimated to be incurred, in design, research and development, investment, operations, maintenance, retirement, and other support of a product over its life cycle (i.e., its anticipated useful life span).” (Farr, 2011, p. 2).

3- Life Cycle Costing (LCC):

Life cycle costing is a “methodology for a systematic economic evaluation of life-cycle costs over a period of analysis, as defined in the agreed scope”.

“Life-cycle costing can address a period of analysis that covers the entire life

cycle or (a) selected stage(s) or periods of interest thereof. Life-cycle costing should also be influenced by non- construction costs and wider occupancy costs, as well as local, national or international policies, allowances, taxes, etc.” (BRE-UK, 2016, p. 4).

Life-cycle costing is a valuable technique that is used for predicting and assessing the cost performance of constructed assets. Life-cycle costing is one form of analysis for determining whether a project meets the client's performance requirements (BRE-UK, 2016, p. 4).

4- Life Cycle Cost Analysis (LCCA):

“Life cycle analysis should cover a defined list of costs over the physical, technical, economic or functional life of a constructed asset, over a defined period of analysis.” “LCCA may include allowances for foreseeable changes, such as future occupancy levels or changing legislative or regulatory parameters. LCCA may also form part of a strategic review of procurement routes or objectives” (BRE-UK, 2016, p. 4).

2.3 BUILDING INFORMATION MODELLING (BIM) WITHIN THE CONSTRUCTION INDUSTRY

The construction industry is undergoing a phase of speedy development which has been made possible through the use of Building Information Management (BIM) and the rising use of 21st century technology in the different fields of managing and maintaining a business. The result will transform the different phases of a project's life cycle. Existing undergoing projects as well as new ones that are going to develop