EXPLORING BIM ADOPTION AMONG MALAYSIAN CONSTRUCTION ORGANISATIONS

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Abstract: Building Information Modelling (BIM) is a digital industry in construction and a solution for the construction industry in approaching the fourth industrial revolution (4.0). To date, Building Information Modelling (BIM) is used to improve visualization and productivity; to better the coordination of construction drawings and communication; create faster delivery; and lower costs. However, recent studies have revealed that construction organisations are reluctant to adopt BIM in their construction process. Hence, this research aims to seek and explore the overview of BIM adoption among Malaysian Construction organisations. In order to do so, a qualitative approach in the form of unstructured interviews were used in this study to explore BIM adoption among contractor organisations. Then, the findings were analysed using content analysis. Thus, the findings indicated that there was still lack of BIM adoption among construction organisations and the adoption among construction organisations is still at an infancy stage. As a result, this paper is able to provide insight into the Malaysian construction organisation development and form the basis of a valuable BIM strategy, especially for the local construction industry.

Keywords: Building Information Modelling, Construction organisations, qualitative, infancy, stage.
Introduction
Construction industry is one of the most challenging industries in many countries. This is because construction industry has been facing with a lot of issues such as construction waste, cost overrun, project delay for quite a long time. These problems occur due to the construction industry still applying old business methods which consists of many processes and involves various parties (Zakaria et al, 2013). In relation to construction organisations or contractors, the information exchange, coordination among construction players such as architects and engineers are big issues. Moreover, the communication breakdown among these parties will cause errors in the construction site, redundancy work and lastly contribute towards request for information. Therefore, to avoid these problems to continuously happen, BIM is introduced in the construction industry.

In Malaysia, BIM is one of the government’s agendas in the 12th National Key Economic Area (NKEA) which is to enhance business growth in the Architecture, Engineering, Construction (AEC) industry (Takim, et al, 2013). Moreover, BIM is also highlighted in The Construction Industry Transformation Program (CITP) as a productivity thrust and is targeted to minimize rework and redundancies, thus leading towards cost efficiency. Recently the importance of BIM is highlighted in the Construction 4.0 Strategic Plan (2021-2025) as the main accelerator towards the industry 4.0 (CIDB, 2020). Hence, the construction organisations are required to respond with the national and CIDB agenda in order to increase construction productivity and quality. However, Ismail et al., (2015) concluded that construction organisations are yet to utilize BIM due to the unchanged old business practice. Thus, this paper aims to seek and explore the current adoption of BIM among construction organisations.

Literature review
The next section is literature review. This section discusses on three main topics which are; 1) Definition of BIM, 2) BIM in the worldwide scenario and 3) BIM for construction organisations.

Definition of BIM
In literature, there are various definitions of BIM. The definition depends on the understanding of the researcher. In general, BIM is not a software as many people in the construction industry perceive their first impression. According to Erntrom et al., (2006); Young et al., (2009): Smith (2012) and CIDB (2014) BIM is known as a process of creating digital models through the life cycle of a project. BIM is a data-rich, object-printed intelligent, and parametric digital representation of a facility, from which, views and data appropriate to the various users’ needs can be extracted and analyzed to generate information that can be used to make decisions and improve the process of delivering the facility. Thus, Building Information Model consists of various aspects such as building geometry, spatial relationships, geographic information, quantitates and properties of building components which is produced from the process.

In addition, Enegbuma et al., (2014) and The Chartered Institute of Building (2019) also explicated BIM as the collaborative tool of stakeholders in creating, modifying and simulating information from the model. With this practice, the information from the model becomes more correct, accurate and thus facilitates in decision making among the teams. Hence, this will support the definition derived by Shapiai (2015): Haron et al., (2017) and Brahim, (2018) who revealed BIM as a parametric model which helps the users to visualize, coordinate, monitor and control their projects and thus ensures their work success. From the various definitions, BIM
can be described as a collaborative tool in the form of an intelligent 3D model-based process that equips construction professionals to a more efficiently planned, designed, constructed, and manage the buildings and infrastructure successfully across their entire lifecycle.

### Table 1. Summary of BIM Definition

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Authors</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Erntrom et al., (2006)</td>
<td>The development and use of a computer software model to simulate the construction and operation of a facility. Hence, as a result, the Building Information Model is produced with rich information, object-oriented, intelligent and a parametric digital representation in order to help users in making decisions.</td>
</tr>
<tr>
<td>3</td>
<td>Smith (2012)</td>
<td>BIM is a process with intelligent planimetric 3D modelling through life cycle construction.</td>
</tr>
<tr>
<td>4</td>
<td>CIDB (2014)</td>
<td>A modeling technology and an associated set of processes to produce, communicate and analyse digital information models for the construction life cycle.</td>
</tr>
<tr>
<td>5</td>
<td>Enegbuma et al., (2014)</td>
<td>The collaboration tool for construction stakeholders in going through the project lifecycle to extract and modify the information for their uses.</td>
</tr>
<tr>
<td>6</td>
<td>Shapiai (2015)</td>
<td>Tool for AEC industries in a parametric model with digital information that can be visualized and simulated in order to achieve better coordination and integration among stakeholders.</td>
</tr>
<tr>
<td>7</td>
<td>Haron et al., (2017)</td>
<td>A BIM software model used in design, project planning, monitoring and controlling the construction project and thus ensuring the successness of the project.</td>
</tr>
<tr>
<td>8</td>
<td>Brahim (2018)</td>
<td>The process to improve the performance of work for the construction players.</td>
</tr>
<tr>
<td>9</td>
<td>The Chartered Institute of Building (2019)</td>
<td>The process of creating a model for the building and infrastructure through the collaboration of the stakeholders in order to improve efficiency of decision making.</td>
</tr>
</tbody>
</table>

### BIM in the Worldwide Scenario

BIM was initiated by the United States through the US General Serviced Administration or GSA who are responsible in promoting and providing strategic implementations for the US public projects since 2007. The adoption of BIM among GSA was for visualization, coordination and simulation from the 3D model up to the 4D model in order to improve project efficiency (Harun et al., 2016). However, the United Kingdom that is currently the BIM leader, emphasizes to adopt BIM in aiming to minimize the public sector asset costs, reduce the carbon footprint as well as to improve the construction information management (Hamma-adama & Kouider, 2019). Thus, four (4) strategies which are leadership, vision, collaborative framework and client and industry capability and capacity was developed to assist public sectors in implementing BIM successfully (Waterhouse & Philp, 2016). Apart from that, other leaders of
BIM adoption are from The Scandinavian Region countries such as Norway, Denmark and Finland (Smith, 2014). Thus, the BIM adoption incentives that were organised by these government bodies such as Finland Senate Properties, The Palace and Properties Agency of Denmark and Norwegian Agency were to boost the adoption rate in these countries. Meanwhile, the Australian government under NATSPEC rigorously implemented various strategies in BIM implementation through proposed work programs (BuildingSMART Australasia, 2012). Nevertheless, currently there are mandates of BIM noted from the Australian government (Smith, 2014).

In Asian countries, the adoption of BIM was indicated by Singapore through the Building and Construction Authority (BCA) with the IT initiative agenda from the Construction and Real Estate Network (CORENET) (Teo & Fatt, 2006). This included the introduction of the e-Plan Check System that allows the applicants to submit a partial model for checking at any stage in order to verify the design or submission of the final work for checking approvals (Liebich et al., 2002). Meanwhile, The Hong Kong Housing Authority has its standards and requirements in BIM adoption and implementation such as stressing out on collaboration, incentives and proven benefits, standard and common practices, legal and insurance, information sharing and handover, promotion and education, compliant BIM tools, audits and risk management and global competitiveness (Fung, 2013). Finally in Japan, the engagement and the adoption of BIM showed a positive return in investment or ROI especially for the contractors (Smith, 2014).

Hence, as a newcomer of BIM; Malaysia, the adoption experiences from other countries were necessary to be taken as lessons learnt in order to avoid any shortcoming problem. Thus, the first action had already been initiated by The Malaysian Public Work and Department (PWD) by introducing BIM to construction players as early as 2007. Nevertheless, during the early introduction of BIM, there were faced with a lot of problems and only in 2010 the first project which was the National Cancer Institute was to be built by adopting BIM. Since that, many private sectors have also taken the actions of adopting and implementing BIM in their organisations as well as the construction players. As it is the national agenda to embrace new technology, the Construction Industry Development Board (CIDB) have organised various programmes in order to improve the adoption rate among the construction players such as providing BIM roadmaps, BIM committee, BIM Portal, seminars and conferences related to BIM development, collaboration with academician and industry players, providing the MyBIM Centre as a one stop centre of BIM development and the latest to provide a strategic plan for the Construction 4.0 (2021-2025) which stresses on the Fourth Industrial Revolution 4.0 as the main agenda (CIDB, 2020).

**BIM for Construction Organisation**

In a traditional method delivery of a project, construction organisations are involved at the last stage of construction (before facilities management take place). However, various problems occurred due to late involvement. Construction organisations play an important role in a construction life-cycle project as they transfer the information and data from the drawings into reality. Thus, the coordination and communication among various stakeholders is vital to ensure the accuracy of the products. Eadie, et al., (2013) also reported that construction organisations play the role of the design manager during the early stages of the design process to communicate, facilitate, and advice the process. They also contribute in the design to meet and ensure that the client's scope is within the available budget, minimize the reworks and satisfy the client’s needs.
The information given by the upstream (designers) will be used by the construction organisation (downstream) for their works. The construction organisation as the downstream team will consider the information nature as ‘garbage in and garbage out’. This means that, if the input from the designer is incorrect, the output from the construction organization will also become incorrect and vice-versa. This is included in the application of BIM either from planning, design construction or facilities or the operation stage. As such, according to Ahn et al, (2016), the prevalent construction organisation obtains benefits of BIM through visualization, cost estimating, phase planning (scheduling), site analysis, spatial coordination, communication, site logistics, prefabrication, material procurement, building permit process, and resources analysis.

For example, in the coordination process. As the federated model is used for the clashes detection analysis, the model will become free from clashes before the construction begins. It enables the construction organisation to visualize the model and construct precisely on site. Hence, this process will be able to minimize the change order as well as rework at the site as all the components have already been confirmed and fixed earlier. With the adoption of BIM in construction planning, the construction organization is able to simulate and visualize the BIM model for project planning and scheduling. The construction organization will be able to estimate the working hours, resources analysis, estimate the start and finish of the work and estimate their risk of the project. While for the extraction of quantities, the construction organization is able to extract the quantities easily, automatically and is able to avoid redundancy of the works. Nevertheless, all these benefits that will be obtained will depend on the richness of the data supply to the BIM model as well as the model detail level.

Research methodology
A literature review is conducted in this study in order to seek the information regarding the BIM definition, overview of BIM adoption over the globe, the importance of BIM for construction organisations, journal articles, conference papers and reports such as from Construction Industry Development Board (CIDB) report are gathered. Meanwhile for the primary data, qualitative approach in the form of unstructured interviews were conducted. According to Saunders et al., (2019) qualitative research is associated with such concepts and are characterised by their richness and fullness based on the opportunity to explore a subject as real a manner as is possible. While, an unstructured interview is defined as loosely structured and informally conducted interviews with one or many themes to be explored by researchers (Saunders et al., (2019). They further added that an unstructured interview is conducted without having a proper list of questions to work through.

Hence, the information was collected from four (4) respondents which represented two (2) public organisations (Public Work Department and Construction Industry Development Board (CIDB) in Malaysia. The selection of these respondents was due to the fact that the Public Work Department and Construction Industry Development Board (CIDB), are important bodies that enhance the development of BIM in Malaysia as well as the capability to provide sufficient data related to BIM adoption among the construction organisations. Hence, in this study, the respondents were labelled with R1 to R4. Then, the information gathered from these unstructured interviews were recorded and analyzed in the form of content analysis.
Finding and discussions
The information gathered from the data collection was discussed in the following section. It consists of two sections as captured from the unstructured interviews (i.e.; section 1; respondents background and BIM definition and section 2; current adoption initiatives for construction organisations in Malaysia.

**Section 1: Respondent’s background**
The following table 1 shows the respondents’ background. From Table 1, it shows that 3 out of 4 respondents (75%) have experience in the construction industry with more than 10 years, while only one (1) respondent had experience between 6-10 years. Most of them are from the managerial level and Top management level. Hence, the valuable, rich information provided from these respondents are reliable as the respondents come from various types of designations and working experience in the construction industry.

<table>
<thead>
<tr>
<th>Respondents</th>
<th>Designations</th>
<th>Experience in Construction</th>
<th>Organization types</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1</td>
<td>Project Manager</td>
<td>11-20 years</td>
<td>Construction Industry Development Board (CIDB)</td>
</tr>
<tr>
<td>R2</td>
<td>Assistant Manager</td>
<td>6- 10 years</td>
<td>Construction Industry Development Board (CIDB)</td>
</tr>
<tr>
<td>R3</td>
<td>Head of IT Department</td>
<td>11- 20 years</td>
<td>Construction Industry Development Board (CIDB)</td>
</tr>
<tr>
<td>R4</td>
<td>Assistant Manager</td>
<td>11- 20 years</td>
<td>Public Works Department</td>
</tr>
</tbody>
</table>

**Section 1: BIM definition**
The following findings as shown in Table 2 reveals the definition of BIM from the respondents. Most of the respondents agreed that the definition of BIM is more towards the process of managing the information of the construction project in one platform and to facilitate the construction organisations to gain their projects seamlessly. These findings echo by various researchers for instance (Young et al., 2009; Smith 2012; CIDB 2014; The Chartered Institute of Building, 2019). Apart from that, respondent 2 and 3 also agreed that BIM acts as the collaborative tool. This is in align with (Enegbuma et al., (2014); The Chartered Institute of Building, 2019) who revealed BIM as a central collaborative process as all the data are collated and harnessed in its forms and thus creates value of its aggregation. It also allows collaboration among the project teams through the exchange of project information through the models and its associated data in structured manners, transparency and efficiency coordination.
Table 3: Definition of BIM by respondents

<table>
<thead>
<tr>
<th>Respondents</th>
<th>Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1</td>
<td>“BIM is a collaborative tool which consists of process creating and managing the information for the entire lifecycle.”</td>
</tr>
<tr>
<td>R2</td>
<td>“we have already established the definition of BIM which is emphasized as a process of modelling to produce a digital information model (3D), to communicate and analyze within one platform for the construction life-cycle purpose.”</td>
</tr>
<tr>
<td>R3</td>
<td>“BIM is a process to create and manage the information for the project throughout the entire project cycle. BIM is unable to be done by only one party. There must be collaboration among the stakeholders in the organisation. For example, if one department in the company only adopts BIM but the other department is still reluctant to do it, BIM will still fail.”</td>
</tr>
<tr>
<td>R4</td>
<td>“The process of managing construction information in a single respiratory to gain more ease, faster and effectively.”</td>
</tr>
</tbody>
</table>

Furthermore, all the respondents (R1 - R4) agreed that BIM is defined as perceived benefits or advantages to the construction organisations. This is consistent with Erntrom et al., (2006); Shapiai (2015); Haron et al., (2017) and Brahim (2018) that defined BIM as a tool that gives benefits and effects to the user’s project performance. As such, 75% (3 out of 4 respondents) agreed that BIM is able to minimize conflicts through the clashes detection process. This is because the mistakes and errors in the BIM model are discussed and amended earlier prior to the beginning of construction. Thus, during the construction stage, the construction organisations will be able to use clash free model as the construction drawing. With this practice, the construction process will be seamless and request of information, change order as well as rework on site will be minimized. Subsequently, the construction organisation will also be able to manage the construction projects’ waste and improve the quality of the project.

Table 3: Definition of BIM by respondents

<table>
<thead>
<tr>
<th>Respondents</th>
<th>Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1</td>
<td>“BIM provides advantages for the construction organisations work such as clash detections, visualization of the overall construction project and extraction of quantities.”</td>
</tr>
<tr>
<td>R2</td>
<td>“for the construction organisation, BIM is used for minimizing conflicts through the coordination process which is in the form of clashes detection.”</td>
</tr>
<tr>
<td>R3</td>
<td>“we would not be able to gain benefit from BIM now, but these benefits such as reducing cost, time and improving quality will be obtained if we adopt it in our project.”</td>
</tr>
<tr>
<td>R4</td>
<td>“with BIM, we are able to use it for clash detection, improve visualization among the teams and thus providing better communication.”</td>
</tr>
</tbody>
</table>

Section 2: Current adoption of BIM among construction organisations in Malaysia
The next results indicate that the adoption of BIM among the construction organisations are very low and is still in the infancy stage as all of the respondents (100%) agreed that the data of adoption among them is still limited. This is also supported by various researchers such as (Bidin, 2015; CIDB, 2016 : Jusoh, 2017: Idrus & Bahar, 2018) who revealed that the adoption
of BIM among the construction organisations are reported to be low and stagnant. This resonates with the findings made by (Haron, 2013: Zakaria et al, 2013 : Hadzaman et al., 2015: Ismail, 2017) which revealed that the adoption of BIM among the construction players still lies at level 0-1. This may be due to the facts that the Malaysian Construction organisations are still at the transition level from CAD to BIM. The probable reasons for this predicament could be due to BIM software being too expensive, lack of skills and training in the software application, lack of enforcement on the use of BIM by the client, legal and contractual issues that causes most stakeholders to be reluctant towards the technology.

As mentioned by the second respondent, CIDB has conducted many seminars and forums relating to BIM adoption and the implementation for construction projects among various classes of Contractors (G3-G7). However, CIDB was not aware on the number of those who have really adopted and implemented BIM in their projects. Moreover, the respondents also mentioned that there are still many construction organisations that are not aware of what needs to be done with BIM after attending the said seminars or forums. This is also supported by respondent 3 which highlighted that construction organisations are still looking for the right path in adopting BIM. This finding was agreed by Zakaria et al (2013) that states that they are unaware of the where, when and how to start as there is no national BIM standard and guideline for them to follow. Apart from that, Hadzaman et al., (2015): Brahim (2018) found from their findings that construction organisations are required to understand the concept of BIM because it is new in the industry but most people are not able to accept and adopt it. Thus, the following ‘quotes’ in Table 4 are emphasised by the respondents;

<table>
<thead>
<tr>
<th>Respondents</th>
<th>Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1</td>
<td>“we are in the progress of updating the number of construction organisations who adopt BIM in their projects. We are focusing on G7 contractors as they are more capable in adopting BIM as compared to SMEs contractors. As for SMEs, they still lack the budget to invest and knowledge.”</td>
</tr>
<tr>
<td>R2</td>
<td>“since the adoption of BIM in Malaysia has been embraced since 2014, we have conducted various seminars, talks and conferences to varies types, grades and classes of contractors to adopt BIM. However, the effectiveness of these initiatives is still questionable. It is because we still do not know how many of them have adopted BIM.”</td>
</tr>
<tr>
<td>R3</td>
<td>“currently, CIDB is in the process of updating the number of construction organisations that have adopted BIM since there is lack of record regarding this matter. It seems that the construction organisations are still looking for the correct path to adopt BIM”</td>
</tr>
<tr>
<td>R4</td>
<td>“since BIM will provide benefit to the construction organisations, thus it is vital for them to adopt BIM for their project. Moreover, they also need to explore new methods to remain competitive in the industry. Nevertheless, until now the adoption among them is still stagnant”</td>
</tr>
</tbody>
</table>
Conclusion
In a nutshell, this paper presents the findings on the exploration of BIM adoption among construction organisations. It confirms the literatures made from previous researchers in investigating the issues of BIM adoption. From the findings, it can be deduced that BIM adoption and implementation for construction organisations in Malaysia is still at a low rate and is still in the infant stage. This has already been proven by the interviews done with four (4) respondents. Thus, a valuable strategy, especially for BIM adoption and implementation among construction organisations is inevitable in order for construction organisations to remain competitive in the industry. This paper aims to be another recommendation for the said method.

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References


