The benefits of implementation of BIM technologies and tools in significantly construction wastes in the Malaysia construction industry

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Abstract. Malaysia, as a rapid developing nation with a ballooning construction industry, has fallen victim to a predicament that has affected most similar developing nations, which is the mass outflow of construction wastes. The expeditious advancements made by this sector couple with an all-time high demand of a list of development projects ranging from infrastructure to residential and commercial centres, has led to the production of large amounts of construction wastes which is made exponentially worse by the emplacement of flawed, inconsistent and insufficient practices in dealing with the ever-expanding rates of construction wastes. As a potential solution in mitigating this problem, Malaysia has been looking at the introduction of BIM tools and technologies, as an industry norm, to all construction practices and stages. However, the proper and systematic assimilation of the BIM systems in Malaysia has not proven to be entirely possible yet, particularly in a scale that would be significant enough where it could sufficiently be utilised in the reduction of construction wastes. This limitation, can be attributed to many factors such as the perceptions and acceptance of industry players to learn and adapt to this relatively new software, reluctance in replacing the conventional methods, which the industry players are all too complacent with, of waste managements that have been in-place for decades, coupled with an incomprehension of the myriad of benefits such an implementation could bring about to the local construction industry, as exemplified by many other developing nations that have jumped on the bandwagon of incorporation of BIM into their practices for years now.

1.0 Introduction

BIM, regarded as a relatively new technology due its limited use, can be defined as the exploitation of Information Technology (IT) to develop a combination of advanced process and technology, that offer a collaborative platform to all associated parties of any given construction project it is utilised upon. Conventionally, it is time-consuming to manually verify the accuracy and checking of discrepancies, of approved 2-Dimensional (2D) designs and drawings, particularly for complex designs. BIM, due to its reliance to 3-Dimensional (3D) technologies, produced using computer-aided-design (CAD) software, which permit information to be traded in digital formats amongst all associated parties of a construction projects aside from the existence of a reliable pool of information and effective clash detection features, executed by overlying 2D designs in visualizing locations of the project components in a 3D space, that significantly minimizes errors that are typically committed by humans.[1],[2] BIM facilitates the quantification of cost and project materials by a quantity surveyor, in a much shorter period of time, whereby in some instances, a reduction of up to 80% can be
observed, especially when compared to conventional taking-off methods. In addition to that, enhancements in terms of project productivity and reductions in terms of project cost and duration are some of the primary benefits of BIM which have been demonstrated in many projects (Eastman et al., 2010). More importantly, BIM tools are equipped with advanced features that are able to detect and reduce waste-related costs and materials in construction projects [4]. The typical way BIM is adoption in the various stages of a construction project. [3]

2.0 Limitations in BIM Implementation

Despite the numerous benefits from the utilisation of BIM, [5] identifies the failure to implement new information technology (IT) in construction industry happens because of technical issues rather than social issues such as lack of technical expertise, the complexity of the system and lack of support system. Software interoperability is another major issue that has inhibited the implementation of BIM. [6] on the contrary, through a survey carried out, revealed that the biggest hurdle of BIM implementation is the reluctance of employees to adapt to a completely new and foreign software due to their complacency with current work environments and practices. The reluctance of organizations in implementing BIM is attributed to the fear of these that their business processes would be reshaped, which can prove to be a costly endeavour and could jeopardize their work systems. Productivity of project is also at affected as the transition process from being fragmented to collaborative in nature will render the project outcomes and clients’ expectations at risk. Employees might also have the fear of being unemployed owing to the fact that these advanced technologies could possibly take over their roles. [7]

3.0 Research Methodology

3.1 Quantitative Method

This method involves the gathering of facts in the form of data followed by finding connections between said facts. This enables for the establishment of some sort of a comparison basis between these factual connections with facts that were discerned in previous studies in the same field. In a complete contrasting fashion to the qualitative method, the quantitative method embraces a objective and scientific nature. It aims to, basing on predetermined hypotheses, inquire an established social issue with the utilisation of by uses practical and reliable approaches such as surveys, questionnaires and experiments, number and statistic-based methods which are then evaluated and explored with statistical procedures. This provides a framework for the determination of the predetermined hypotheses to see if they stand true or if there is room for improvement. Quantitative methods are therefore regarded as reliable, accurate and tangible as they scrutinize a sample that is large and truly representative of the population being generalized.

3.2 Qualitative Method

This method of research, origination from social sciences, strives to comprehend the way people see and interact with one another thus allowing for the examination of social and cultural phenomenon. Therefore, it can be said that this method of research takes on a ‘subjective’ nature with strong emphasis placed on interpretations, experiences and definitions. Qualitative research can be further divided into two categories, namely, exploratory and attitudinal. It is harder to analyse qualitative data than quantitative data as it necessitates a rigorous process of filtering and sorting, among other treatments to the collected data in preparation them so that they can be analysed and discriminated.

3.3 Data Collection Techniques

A questionnaire consists of a set of questions sent to a number of potential respondents that are determined when the sample size is identified. These respondents are required to thoroughly read and comprehend the questions that are asked and then, record the most appropriate answers to the questions asked. Questionnaires distinct themselves from interviews as when conducting the latter, an
interviewer, a person tasked to ask or elaborate on a prepared list of questions is necessary before recording down the respondents’ answers. Therefore, it is vital for questions set in questionnaires are direct and simple so that they are easily comprehensible, readable and have a sequence that is uncomplicated and clearly segregated. It is a good practice to complement questions that might come across as sensitive or complex an elaborating statement that explains the relevance of the question.

3.4 Design Sampling
The distinction between quantitative and qualitative methods of data collection continues in selecting the sample of a research. In the former samples are selected in a completely unbiased manner so that it represents the population that is being studied while in the latter, sampling has the purpose of coming up with inferential analyses from the responses given by the selected group. Sample sizes selected in quantitative methods base on availability of resources at hand. While there are any predetermined sample sizes guiding qualitative researches, it is important to set a data saturation point which is a point beyond which no further information will be collected.

4.0 Result and Discussion

4.1 Benefits of BIM Implementation

Table 1: Precise and rapid quantity take-offs

|                | Frequency | Percent | Valid Percent | Cumulative Percent |
|----------------|-----------|---------|---------------|--------------------|
| Valid          | 56        | 61.5    | 61.5          | 61.5               |
| Agree          |           |         |               |                    |
| Strongly agree | 35        | 38.5    | 38.5          | 100.0              |
| Total          | 91        | 100.0   | 100.0         |                    |

The above Table 1 illustrate respondent’s responses on if precise and rapid quantity take-offs are benefits of BIM implementation. It is shown that all of the respondents either ‘Agree’ (61.50%) or ‘Strongly Agree’ (38.50%) that precise and rapid quantity take-offs is indeed a known BIM benefit. This corresponds well with the studies linked previously that denote such an advantage as one of the biggest selling points of BIM tools and technologies.

4.2 Synchronisation of Design, Site and Materials

Figure 1: Synchronisation of design, site and materials

The above Figure 1 showcase respondent’s results on if synchronization of design, site and materials are benefits of BIM implementation. As it can be seen, all 91 of the respondents either ‘Agree’ (57.10%) or ‘Strongly Agree’ (42.90%) that the seamless synchronisation of design, site and materials
feature that BIM software provides is indeed a known BIM benefit. BIM is prominently known, locally and even more so abroad, especially in “First World” countries such as Japan, Australia and the United States, for its capability of functioning as a platform that permits the synchronisation of various information pertaining to a construction project, whether in regards to the design of a project, the project site or material that are to be utilised in the project. This has become a salient point in promoting the widespread use of BIM software in those countries as it removes all of the hassles that would typically exist if tradition methods were to be employed instead.

4.3 Barriers in Implementation of BIM

| Barrier BIM 1 | Pearson Correlation | 0.485** |
|---------------|---------------------|---------|
| Sig. (2-tailed) | 0.000               |         |
| N             | 91                  |         |

The Pearson Correlation test was used to analyse the correlation between lack of demand from clients and the barriers in implementation of BIM software. The results in Table 2 indicates that the correlation between lack of demand from clients and the barriers in implementation of BIM software is of moderate strength \( r = 0.485 \). As the Pearson’s \( r \) value falls in the positive range, therefore this correlation is a positive correlation, whereby an increase in the lack of demand from clients will result in an increase in the barrier strength in implementing BIM software into construction projects. The correlation is also deemed to be a statistically significant correlation as the Sig. (2-tailed) value is less than 0.05 which means that the increase or decrease in the lack of demand from clients will have a direct impact on the barrier in implementation of BIM software.

4.4 Recommendations for the Successful Implementation of BIM

| Frequency | Percent | Valid Percent | Cumulative Percent |
|-----------|---------|---------------|--------------------|
| Valid     |         |               |                    |
| Agree     | 14      | 15.4          | 15.4               |
| Strongly agree | 77      | 84.6          | 100.0              |
| Total     | 91      | 100.0         | 100.0              |

Corresponding to table 3 above, it is shown that all 91 of the respondents either ‘Agree’ (15.40%) or ‘Strongly Agree’ (84.60%) that introductory seminars and conferences initiated by the government could prove to be a recommendation that leads to the successful implementation of BIM software by industry players. The collaboration between BIM practitioner, academia and researchers can give vital exposure to industry members particularly undergraduates and even postgraduates. This collaboration would not only aid in enhancing knowledge and skills in utilising BIM by would also provide the participants with a sense of familiarity towards BIM software so that it would not feel as foreign and complex as it may be perceived.
4.5 Training to Top Managerial Positions

The data in Figure 2, exhibits that from a total of 91 respondents, all respondents either ‘Agree’ (25.30%) or ‘Strongly Agree’ (74.70%) that training to top managerial positions is an important method to increase BIM implementation in construction projects. Top managerial positions play a significant role in propelling BIM implementation as they hold the rights and full authority in deciding whether or not such implementation would take place in their firms. Providing training to such positions would not only enlighten them on all important aspects pertaining to BIM but also motivate them to embrace BIM implementation as they are aware of how beneficial such implementation would be to their firm and industry as a whole.

5.0 Conclusion and Recommendation

BIM as discerned previously, has tremendous potential to offer its proponents, substantial and diverse benefits. The collection of data from questionnaires distributed ranks benefits pertaining to BIM implementation as follows:

- Effective planning and scheduling of activities;
- Synchronisation of design, site and materials; and
- Detection of errors, discrepancies and clashes.

From the received questionnaire responses, the respondents are in agreement that effective planning and scheduling of construction activities is one of the greatest benefits that comes with the implementation of BIM into a construction project. Given that planning and scheduling forms the backbone and gives structure to the progression of any given project, it therefore becomes imperative for industry members to be able to have unrestricted access to an evolved system of planning and management, contrasting out-dated and irrelevant conventional processes and management tools, that complements and goes hand-in-hand with the increasing complexity of construction projects. Next is the capability of BIM software to provide a platform furnished with synchronisation features that are able to take in information arriving in a number of data formats, from various other platforms utilized by industry players. In doing so, an easily navigable hub that securely envelopes all crucial data concerned with an assumed project is created. Aside from that, BIM implementation is hugely advantageous, particularly when it is pitted against conventional tools and technologies of data storage, in the automated detection of errors, discrepancies and clashes. The coding on this BIM
software enable them to execute checks to each and every quantity for all the elements enlisted. Not only that, checks are also done on the design of the project itself for the detection of any anomalies that could pose a problem in future.

6.0 Recommendation for Action
The utilisation of BIM tools and technologies in Malaysia in comparison to our neighbouring countries, is still at a considerably low rate, attributed to the various inhibitory factors limiting its implemented as it has been established in this study. Following are some recommendations that could accelerate the rate at which BIM software are adopted in Malaysia:

- Intensifying the efforts made by government in urging construction players to expedite the transition from implementation of conventional software and methods to modern and relevant BIM-based software by demonstrating the benefits and features of the software.
- Increasing subsidies and incentives provided by the government in purchasing and enrolling for training for such software, to motivate construction players to make the shift of implementing BIM-based software.
- Inviting firms’ members and industry players that have been able to successfully adapt and adopt BIM implementation to share their stories, suggestions and opinions at BIM conferences or seminars.
- Firms that own this BIM software should build their reputation and win the trust of industry players by providing excellent after-sales service and feedback to any issues or concerns faced by their customers as well as ensuring all their information pertaining to BIM products are constantly up-to-date.

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