INCORPORATION OF BUILDING INFORMATION MODELLING INTO QUANTITY SURVEYING PROGRAMMES SYLLABUS IN MALAYSIA

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Abstract
Building Information Modelling (BIM) provides positive influences towards the efficiency of construction industry. Quantity surveyors as one of the main professionals in construction industry should have adequate BIM knowledge and skills. Therefore, it is essential for Quantity Surveying (QS) programmes in Malaysia to incorporate BIM into its syllabus. The aim of the paper is to study the incorporation of BIM into QS programmes syllabus in Malaysia. In order to achieve the aim, the research seeks to examine the benefits and barriers of incorporation of BIM into QS programmes syllabus in Malaysia, to expose the incorporation as well as to suggest strategies in enhancing the incorporation. Case studies approach involving six higher education institutions offering QS programmes in Malaysia is adopted for the research and data are collected by means of semi-structured interview and document analysis. The research reveals that the incorporation of BIM into QS programmes syllabus in Malaysia is still at the low level and lack of standardization. BIM should be incorporated into variety of subjects instead of only focusing on the core subject of QS. In conclusion, collaboration with industry, academic and professional bodies is recommended in order to enhance the incorporation.

INTRODUCTION

Different people may have different definition of BIM (Olatunji et al., 2010). Despite of the differences, BIM provides significant benefits to the professionals in the construction industry. In context of quantity surveying, it allows for automation of quantification and enhances accuracy of estimation (Aouad et al., 2007; Zhou et al., 2012) by eliminating human errors and promoting collaboration (Zhou et al., 2012). Fung et al., (2014) added that BIM allows for quick cost appraisal, clash detection, cost checking, intelligent information management and cost update. Obviously, there is a considerable potential for BIM to influence QS profession (Masidah and Khairuddin, 2005).

Hence, it is essential for quantity surveyors to adopt BIM in their practices. However, Han and Bedrick (2015) argued that BIM adoption will suffer without its incorporation into education. Higher education institutions need to incorporate BIM into their programmes with the support from government and industry (NATSPEC, 2013). This will ensure the production of BIM-ready graduates for the construction industry.

BIM IN EDUCATION

Based on the UK's Higher Education Academy (HEA) report of BIM in taught programmes, there are three types of learning outcomes for BIM incorporation that need to be taken into account which are knowledge and understanding, practical skills and transferable skills. Ghosh et al. (2013) added that theory, practical and technology aspects are also essential in order to ensure effective incorporation of BIM into education programmes. There are a number of approaches that have been adopted to incorporate BIM in education (Sacks and Barak, 2009; Burr, 2009; Denzer and Hedges, 2008).

In Malaysia, Kherun Nita and Nur Emma (2014) developed a BIM educational framework for QS graduates and it has been accepted by the QSAC. The framework comprises of four objectives which are visualization, quantification, planning and scheduling and management. Each of the objectives are achievable by means of several mediums as listed in Table 1 below.

Table 1: Objectives and mediums of BIM educational framework for QS graduates (modified from Kherun Nita and Nur Emma (2014))

Visualization	**Quantification**	**Planning & Scheduling**	**Management**
Draughtmanship	Measurement	Cost Planning & Scheduling	Contract
Construction Technology	Cost Estimating	Cost Analysis	Professional Practice
Construction Services			Project Management

Therefore, in order to incorporate BIM into QS programmes, higher education institutions in Malaysia should ensure that the four objectives are attainable through the mediums that they offer in their QS programmes. The research seeks to study the incorporation of BIM into QS programmes syllabus in Malaysia. In order to achieve the aim, the research seeks to examine the benefits and barriers of incorporation of BIM into QS programmes syllabus in Malaysia, to expose the incorporation as well as to suggest strategies to enhance the incorporation.

METHODOLOGY

In order to achieve the aim and objectives of the research, the research adopted case studies approach. This approach is adopted as it provides the potential to study a phenomenon that is impenetrable by technical investigation (Yin, 2003). Also, Johnson et al. (1999) added that this approach allows researcher to exploit available data sources within a case study. Hence, data are collected by means of document analysis and semi-structured interview with programme lead of QS programme of each of the case studies. The researcher approached all public and private higher education institutions offering QS programmes in Malaysia, however, due to time constraint and lack of cooperation, only six of them responded. Collected data are analysed based on four units of analysis including benefits of incorporation, barriers of incorporation, current state of incorporation and strategies of incorporation. According to McClintock et al., (1979),

establishment of units of analysis is the most important step in case studies approach. In the research, units of analysis are established towards achieving the aim and objectives of the research.

BACKGROUND OF CASE STUDIES

Case Study 1 (CS1) is a foreign higher education institution operating locally, offers QS degree programme which is incorporated with BIM for a duration of 3 years. 4 years QS degree programme which is also incorporated with BIM is offered by Case Study 2 (CS2), a public higher education institution. While Case Study 3 (CS3) is another foreign higher education institution operating locally, offers QS degree programme which is incorporated with BIM for a duration of 3 years. Case Study 4 (CS4) is a public higher education institution and is the only case study in the research that offers QS diploma programme for a duration of 3 years. However, the programme is not incorporated with BIM. Similarly, for Case Study 5 (CS5), a private higher education institution, BIM is not incorporated into the 3 years duration of QS degree programme. The final case study (CS6), a public higher education institution offers QS degree programme for a duration of 4 years and the programme is incorporated with BIM.

RESULTS & DISCUSSION

The results and discussion are presented based on the units of analysis as mentioned earlier.

Benefits of incorporation of BIM into QS programmes syllabus in Malaysia

Based on the semi-structured interview, there are many benefits of incorporation of BIM into QS programmes syllabus in Malaysia that have been indicated as listed in Table 2. Obviously, the programme lead of QS programme in each of the case studies are fully aware of positive influences of BIM.

Table 2: Benefits of incorporation of BIM into QS programmes syllabus in Malaysia

Category	Benefits
General	Enhance capabilities of students Improve visualization of students Increase communication among students Encourage collaboration among students
Time-related	Reduce time consumption of tasks Allow for timely completion of tasks Improve productivity of students
Cost-related	Enhance accuracy Automate quantification Simplify cost checking and update Easy cost generation
Information-related	Easy management of information Allow for information integration Enhance coordination of documents
Risk-related	Reduce errors
Value-added	Allow for broad view of QS practice among the students Enhance employability of the students upon graduation

Based on Table 1, there are six categories of benefits of incorporation of BIM into QS programmes syllabus in Malaysia that have been indicated by the programme lead of QS programme at each of the case studies which are general, time-related, cost-related, information-related, risk-related and value-added. In general, BIM will improve visualization of students towards any particular design and enhances their capabilities to manipulate the design as well as familiarize themselves with the design before they proceed with the necessary tasks, for instance, quantification and estimation. Also, high technology used for BIM implementation will encourage excitement among the students and enhance their communication and collaboration.

Next, utilizing BIM will reduce the time taken that is usually required for traditional quantification including time to abstract information, scale, calculate and estimate. This will allow the students to complete any given tasks in a timely manner. Indirectly, the productivity of the students will increase. In context of cost-related category, as BIM provides the potential for automation of quantification and estimation, accuracy is guaranteed with just a single click of a button. Correspondingly, students can easily check and update the costs.

Then, despite of having bundle of paperwork, BIM allows for easy storage and management of information within its database. Therefore, it enhances integration of information as well as coordination of documents. Students can easily save their files on the computer without the need of manual filing and storage. Lastly, BIM enhances collaboration among students and shift the focus of the students towards a broader view of QS practices and aspects rather than focusing most of the time on quantification. This will provide the students with extensive knowledge and skills about many other value-added QS practices and aspects. Hence, this will enhance the students' employability upon graduation.

Barriers of incorporation of BIM into QS programmes syllabus in Malaysia

Although there are many benefits of incorporation of BIM into QS programmes syllabus in Malaysia, still, there are barriers that hinder its incorporation. The barriers of incorporation of BIM into QS programmes syllabus in Malaysia are as listed in Table 3.

Table 3: Barriers of incorporation of BIM into QS programmes syllabus in Malaysia

Category	Barriers
Time	Inadequate of time to incorporate BIM into the syllabus
Industry expert	Difficulty to appoint industry expert Lack of collaboration with industry expert
Database	Limited types of component databases
Cost	Require high cost of databases Require high cost of software & hardware
Academic expert	Lack of knowledge and skills to teach BIM Lack of knowledge and skills to incorporate BIM into the syllabus
Reference	Lack of reference materials
Software & hardware	Inadequate skills to utilize software & hardware among the academics Require software upgrading from time to time
Space & facilities	Lack of space and facilities to accommodate BIM

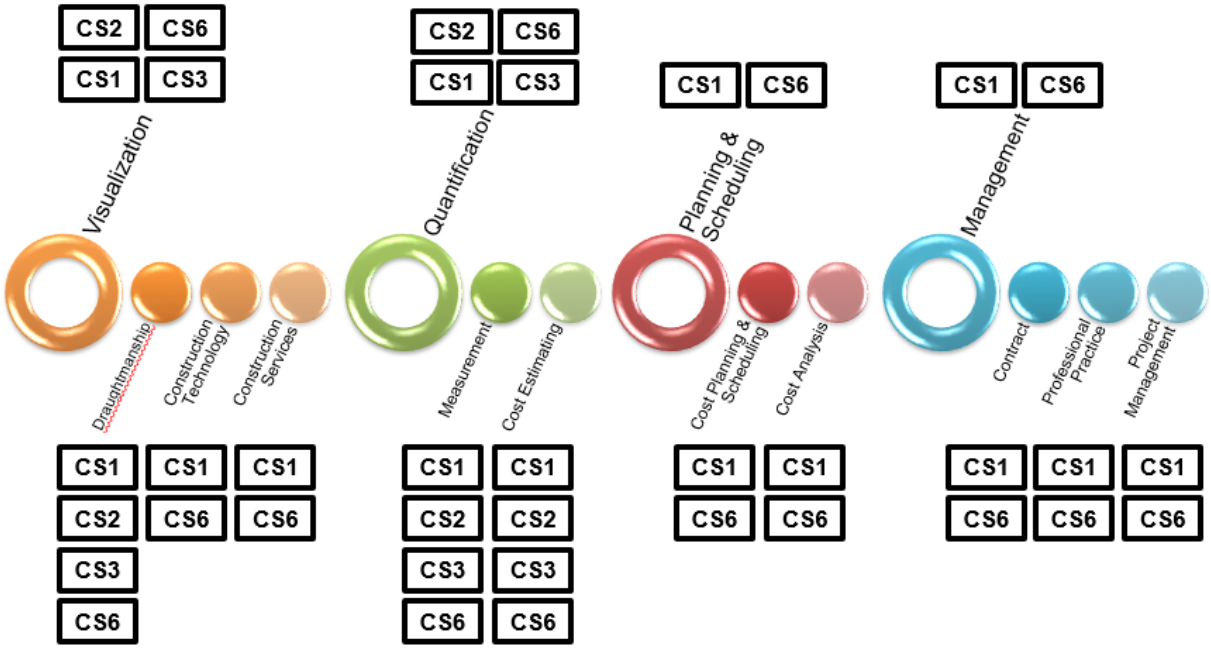
In order to incorporate BIM into the QS programmes syllabus, knowledge among the academics is vital. Insufficient knowledge about BIM will render difficulties in developing the syllabus. Also, to develop the syllabus, adequate time is required. Inadequate time will lead to unsatisfactory syllabus development. In relation to the insufficient knowledge of BIM among the academics, higher education institution may opt to appoint industry expert to contribute in the development of the syllabus. However, the research reveals that it is difficult to appoint industry expert as they have their own commitment with the professional practices and services. Also, CS5 admitted that they are lacking of collaboration with the industry expert which hinder BIM incorporation into their programme. Database is another barrier indicated as there is a limited choices of component databases.

Cost is also a barrier to the incorporation of BIM into the programme as undeniably, BIM requires database, software and hardware. These require high amount of money to be spent on and some of the case studies are having budget constraint. Also, the software and hardware need to be updated on timely basis. In context of academic expert category, to teach BIM, academic expert must acquire high knowledge and skills of BIM. Then, lack of reference materials to guide the process of incorporation will also render difficulties for the incorporation. Last barrier indicated from the research is the lack of space and facilities to accommodate the incorporation. Indeed, as for instance, BIM incorporation requires practical skills in computer labs.

Current state of incorporation of BIM into QS programmes syllabus in Malaysia

The current state of incorporation of BIM into QS programmes syllabus in Malaysia is illustrated in Figure 1.

Figure 1: Incorporation of BIM into QS programmes syllabus in Malaysia



Legends: CS1 – Case Study 1; CS2 – Case Study 2; CS3 – Case Study 3; CS6 – Case Study 6

Based on Figure 1, CS 1 and CS6 are incorporating BIM thoroughly into their QS programmes syllabus. Certainly, all of the objectives are achievable by means of subjects that they offer. Also, CS2 and CS3 are incorporating BIM into their syllabus but partially. As illustrated in Figure 1, both of the case studies are aiming at achieving only two objectives which are visualization and quantification as BIM is incorporated only on subjects that are related to these two objectives. Obviously from Figure 1, none of CS4 and CS5 are illustrated as both of these case studies have admitted since the early phase of the research that their programmes are not incorporated with BIM. CS1 and CS6 have strong links with BIM initiatives in Malaysia and therefore, both of the case studies are fully aware on the needs and requirements of BIM incorporation into their programmes. Also, they obtain full support from their institutions for the incorporation.

While, CS2 and CS3 are lacking of comprehensive pedagogy of incorporation which render them to focus only on certain objectives of the framework. Olantunji et al. (2010) argued that different people may have different definitions of BIM. Possibly, both of the case studies limit their definitions to only major QS practices which are visualization and quantification. CS4 and CS5 offers programme that are not incorporated with BIM at all. This might be due to some of the barriers mentioned earlier. Also, CS4 mentioned that their programme is not incorporated with BIM as students can acquire BIM knowledge and skills in their subsequent QS degree studies. However, this is unfair for the students who do not intend to further studies upon diploma graduation. Therefore, some strategies need to be proposed to overcome this situation.

Strategies of incorporation of BIM into QS programmes syllabus in Malaysia

Clearly from Figure 1, incorporation of BIM into QS programmes syllabus in Malaysia is at the low level and lack of standardization. Hence, the research proposes several strategies to enhance the incorporation. Firstly, collaboration with another higher education institutions with full commitment of incorporation. It is always better to learn from others who have more experience. This collaboration allows for sharing session of ideas and skills in developing a thorough pedagogy that incorporate BIM into the programmes. Also, some planning in context of providing some space and facilities could be planned if space and facilities is one of the barriers that hinder the incorporation of BIM into the programmes. Secondly, collaboration with professional bodies could also enhance the incorporation. This is because professional bodies know what are the demands and needs from the construction industry and how to provide the correct path to move towards it. Lastly, collaboration with industry as they are the one who will employ the graduates once they graduated. Pedagogy of QS programmes should be based on the needs of the industry so that graduates will be BIM-ready.

CONCLUSIONS

In conclusion, only two among the six case studies have fully incorporated BIM into their QS programme syllabus. While, another two incorporate BIM by focusing only on two main aspects of QS which are visualization and quantification. Sadly, the remaining two case studies do not incorporate BIM into their QS programmes at all. It is essential to incorporate BIM into the QS programmes syllabus in Malaysia so as to ensure that higher education institutions will produce BIM-ready graduates for the construction industry. So, collaboration between the higher education

institution with industry, other higher education institutions and professional bodies is vital. This collaboration will reduce the barriers that hinder the incorporation and will be beneficial to the higher education institutions. The research recommends that further studies should be conducted in context of developing a framework of collaboration between the higher education institution with industry, other higher education institutions and professional bodies that could be the base to produce BIM-ready graduates for the construction industry.

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