Implementing building information modelling in building services engineering in Hong Kong: a focus group study

Roger T. H. Ng (1), Joseph H. K. Lai (2)
1. rogerng@vtc.edu.hk
2. bejlai@polyu.edu.hk
(1) Department of Engineering, Hong Kong Institute of Vocational Education (Sha Tin), Hong Kong.
(2) Department of Building Services Engineering, The Hong Kong Polytechnic University, Hong Kong.

Abstract

Building information modelling (BIM), a drawing-cum-management tool at present, is highly promoted globally to integrate and manage information across the various phases of a building’s lifecycle. But the adoption of BIM for Building Services Engineering (BSE) has not yet reached its expected popularity in Hong Kong. In order to explore how to achieve wider adoption of BIM for BSE, a multistage study was commenced. The initial stage of the study, which reviewed literature for identifying benefits of and barriers to implementation of BIM in building projects, had been completed. This paper presents the tasks and findings of the second stage, in which a focus group meeting was held to solicit views of the representatives of various stakeholder organizations on the adoption of BIM for BSE. Based on the literature review, a questionnaire was designed to guide the focus group’s discussion and the topics covered include usefulness of the key features of BIM for BSE, experiences of the representatives in using BIM, merits drawn from and difficulties encountered in adopting BIM for BSE, and possible ways for promoting the implementation of BIM for BSE. The findings of the focus group study, which were used to confirm that the questionnaire contained all the necessary questions about the benefits, barriers and measures of using BIM for BSE, had been incorporated in developing an online survey for collecting opinions of members of a broad spectrum of building-related organizations in the next stage of the study.

Keywords

Building information modeling; building services engineering; construction industry; focus group; Hong Kong.
Introduction

Building Information Modelling (BIM) has worldwide become a ubiquitous term among architecture, engineering and construction (AEC) industries over the past decade. Public bodies of many countries are now developing their capabilities in adopting BIM while some have even provided a roadmap for full adoption of BIM. China developed two BIM-related national standards in 2014; Singapore implemented a BIM roadmap which requires mandatory BIM submission for new complexes in 2010; the UK published BIM standards and required using Level 2 BIM for all public procured projects in 2012; the US published BIM guidelines in 2007 and required BIM submission for government projects from 2012 (CIBSDR, 2014; CIC, 2014; Cheng and Lu, 2015; Shanghai Government, 2015; BCA, 2016; GSA, 2016).

While other countries are rapidly adopting BIM, Hong Kong is also progressing towards the adoption of BIM in order to follow the global trend in construction and maintain its competitiveness. In 2009, Housing Authority set a target to apply BIM in all new projects by 2014. In 2011, the Hong Kong Institute of Building Information Modelling issued a BIM standard to define the scope, partakers’ responsibilities and deliverable requirements of the projects that use BIM. Since 2013, education on BIM has been emphasized, e.g. Architectural Services Department set up a BIM Development Unit which provides BIM-related training courses for their staff and buildingSMART Hong Kong was inaugurated and began to organize seminars to educate the local industry on BIM. In 2014 and 2015, Construction Industry Council established a roadmap for BIM strategic implementation in the local construction industry and released the first complete version of the CIC BIM Standards for public review (HA, 2009; Collins, 2013; CIC, 2014, 2015).

Much effort has been paid to promote adoption of BIM in the building industry in Hong Kong over the recent years; however the use of BIM in local AEC industries thus far is not as common as expected. The adoption of BIM in building services engineering (BSE) is even scarce, raising calls from BSE professionals for seeking methods to increase the take-up rate of BIM in BSE. The Chartered Institution of Building Services Engineers - Hong Kong Branch (CIBSE-HKB) and the Hong Kong Institution of Engineers - Building Services Division (HKIE-BSD) for this reason jointly initiated to collaborate with The Hong Kong Polytechnic University to undertake a research study, which aims to explore how to achieve wider adoption of BIM in the BSE industry in Hong Kong. In the first stage of the study, a literature review had been completed, and among the main findings are 22 benefits of and 13 barriers to adoption of BIM (Chiu and Lai, 2016). This paper summarizes the tasks and findings of the second stage, in which a focus group meeting was held to solicit the views of the representatives of a number of stakeholder organizations on the adoption of BIM for BSE.

Focus group study

The second stage of the study was a focus group study, for which a questionnaire was designed based on the literature review findings. The questionnaire was divided into
different parts to solicit data on the state of BIM applications, benefits of, barriers to and measures conducive to adoption of BIM for BSE in Hong Kong. The meeting was held in September 2015 and lasted for three hours. A total of 15 representatives of key stakeholder organizations, which included governmental authorities, private sector developers, main contractors, and professional bodies of structural engineers, BSE consulting engineers, BSE contractors, surveyors, facilities managers and O&M personnel, participated in the meeting.

Data collected from different parts of the questionnaire were analyzed quantitatively. Open-ended questions were also asked for the participants to fully elaborate on their responses. Besides, discussion sessions were conducted in between the participants answered the questions of each part. The discussion contents were audio-recorded and transcribed. The resulting transcripts together with the answers to the open-ended questions were studied using the basic thematic analysis, by which recurring phrases/themes were looked for to determine the common views.

2.1 Part A: Participant’s background

The demographic information of the 15 participants in the focus group meeting was firstly collected in Part A of the questionnaire. All of the participants have been working in the building industry for 5 to 45 years.

2.2 Part B: Experience of using BIM and usefulness of BIM

Since the participants in the focus group meeting were all experienced professionals in the building industry, whether they had experience of working on projects that use BIM might provide implications on the current situation of BIM adoption across the industry. For this reason, Question 1, which was a “Yes/No” question, was raised in Part B of the questionnaire. 12 participants (80%) replied “Yes” while 3 (20%) answered “No”. Those who had worked on projects that use BIM were further asked to pinpoint the key issues of their most representative projects. The feedback showed that BIM has been adopted in various types of buildings, in Hong Kong, mainland China and other Asian regions.

<table>
<thead>
<tr>
<th>Salient point</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Better project management</td>
<td>10</td>
</tr>
<tr>
<td>Improvements in interdisciplinary communication, coordination and engagement</td>
<td>10</td>
</tr>
<tr>
<td>Better visualization of design and construction process</td>
<td>7</td>
</tr>
<tr>
<td>Better design and drawing</td>
<td>6</td>
</tr>
<tr>
<td>Better cost management</td>
<td>4</td>
</tr>
<tr>
<td>Improve construction workflow and method</td>
<td>4</td>
</tr>
<tr>
<td>Better time management</td>
<td>3</td>
</tr>
<tr>
<td>Better quality control</td>
<td>3</td>
</tr>
</tbody>
</table>

The results of Question 1 revealed that BIM is gaining its popularity at present. Interest was aroused how the building industry views on the value of adopting BIM in the
projects. Question 2 was followed to make known the participants’ most noticeable issues about the use of BIM. Based on individual experience or knowledge, each participant was asked to point out three most significant factors of the usefulness of BIM in this open-ended question. The responses were examined by the basic thematic analysis. The salient points about the usefulness of BIM that appeared more than two times among the participants’ answers are tabulated in Table 1. It was observed that the negative issues of using BIM were outnumbered by the desirable points.

2.3 Part C: State of BIM applications in Hong Kong

In Part C, the state of BIM applications in Hong Kong was studied. Questions were asked from different angles. The answers were pieced together to paint the whole picture of the state of using BIM in the local building industry. In the UK BIM Working Party’s report, BIM maturity is classified into Levels 0, 1, 2 and 3, subject to the format of the managed CAD (ASHRAE, 2009; BSI, 2015). In order to identify the situation of BIM applications in Hong Kong precisely, Level 1 was broken down into 1a and 1b in the questionnaire of the focus group meeting. The maturity levels of BIM commonly adopted in architecture, structural engineering, BSE and surveying in Hong Kong were investigated by using the multiple choice questions 3 to 6. Figure 1 shows the responses to these questions.

![Figure 1 - Responses to current BIM adoption level in various building professions](image)

The participants had rather diverse views on the current levels of BIM adoption for the four major professions in the local building industry. While half of the participants (50%) perceived that the maturity of BIM in architecture and structural engineering has reached Levels 1b or 2, which means using 3D CAD for construction data management is a usual work process in the two professions, there were also about half (53%) of the participants who considered that surveyors are still working on Levels 0 or 1a, meaning that 2D CAD is yet continued to use as the major data exchange means. As for BSE, the majority (67%) observed that the BIM adoption in this profession remains at Levels 0 or 1a, similar to the situation in surveying, but one-fifth of the participants (20%) noticed that the adoption of BIM for BSE has stepped into Level 1b, which means 3D CAD has become a common data management tool. Fewer participants (13%) observed a mature
BIM adoption for BSE, i.e. Levels 2 or 3. Those believed that the project data management system of BSE has gone to the 4D, 5D or iBIM level were the minority.

Although BIM has been emerged for decades, most of the participants in the focus group meeting perceived that the adoption level of BIM for BSE has not reached a high level. The responses to multiple choice questions 7-9 in the questionnaire which aimed to realize how long BSE professionals have been using BIM in the projects indicated the state of BIM applications from another perspective. Figure 2 shows the results. Regardless of the work natures of BSE, the majority (53-80%) did not observe that BSE professionals have started to use BIM or did not know the situation. Some participants (13-27%) pointed out that BIM has only been used by BSE designers, contractors or O&M professionals for 1 or 2 years. Fewer (7-20%) perceived 3 to 5 years and none perceived more than 5 years.

The findings showed that the history of adopting BIM across the whole BSE field is rather short. The participants further disclosed via multiple choice questions 10 to 12 that their impression on the most common level of BIM implementation were in general
less than 15%, irrespective of that in BSE design projects, construction projects or O&M works. Figure 3 shows the responses. Up to now BSE projects requiring BIM adoption were few. The results revealed that, on the whole, the adoption level of BIM for BSE did not impress most of the participants in the focus group meeting. There is definitely plenty of room for improving the level of BIM adoption for BSE in Hong Kong in the future.

### 2.4 Part D: Benefits of implementation of BIM

In Part D, a total of 22 benefits of adopting BIM in AEC industries, as summarized in the literature review (Chiu and Lai, 2016), were provided for the participants to rate their significance to BIM implementation for BSE by using a 7-point Likert scale: 1-none; 2-very little; 3-little; 4-moderate; 5-great; 6-very great; 7-entire, for statistical analysis. The six main aspects of benefits are: a) better cost management, b) better time management, c) better quality control, d) better risk management, e) better safety management, and f) better security. The 16 elemental benefits are: g) better project management, h) better decision making, i) better visualization of design and construction process, j) better design and drawing, k) better assembly of data and information, l) improve quantity take off and tendering, m) improve construction workflow and method, n) improvements in interdisciplinary communication, coordination and engagement, o) enhanced the value of different discipline, p) better lifecycle asset management and performance, q) earlier occupancy, r) improved environmental performance and promote sustainability, s) improved productivity and business outcomes, t) better customer service, u) improve stakeholder and public engagement, and v) creation of a forward thinking platform. The average rating and the standard deviation (s.d.) of the ratings were calculated for each benefit. Figures 4a-4b present the results, including the maximum and minimum ratings.

The results obtained in Question 13 indicated that the participants did not hold identical views on the degree of impact of the six main aspects of benefits on adopting BIM for BSE. For example, a participant believed that enhancement of safety management is the benefit of BIM that could cause a very great effect to its implementation in the BSE field and so rated it with 6 while another participant thought that the same benefit contributes none in putting BIM into practice in BSE and so rated it with 1. Larger values of the standard deviations (s.d.) of ratings (i.e. 1.0-1.2) among the six main aspects of benefits reflect the divergences. The discussion records also echoed the conflicting viewpoints.

The average ratings of the six main aspects of benefits (a)-(f) were analyzed. It was found that five of these main aspects of benefits, namely “better cost management”, “better time management”, “better quality control”, “better risk management” and “better safety management”, attained an average rating over 4. It means that in general the participants in the focus group meeting perceived that these five benefits could moderately or greatly be achieved by using BIM for BSE. The average rating of “Better security” was however relatively lower (3.9), which could be interpreted that using BIM in a BSE project could merely marginally help to achieve better security than using the conventional information management method.
Figures 4a-4b - Responses to benefits of implementation of BIM

The average ratings of all the 16 elemental benefits (g)-(v) were between 4 and 6, among which i) better visualization of design and construction progress obtained an average rating reached 5.9. The standard deviations (s.d.) of the ratings for almost all the elemental benefits of using BIM (except m) improve quantity take off and tendering) were within 1. The results showed that on the whole the participants in the focus group meeting agreed unanimously that all these benefits could bring moderate, great or very great effect on the implementation of BIM for BSE.

It is worthwhile to note that some participants pointed out more elemental benefits that they believed could significantly contribute in the implementation of BIM for BSE. Their suggestions were considered and two items whose meanings did not duplicate the 16 elemental benefits would be included in the upcoming online questionnaire survey. The two additional elemental benefits are “enhance the efficiency of the service design and construction” and “find out the route for the combined services design”.

2.5 Part E: Barriers to implementation of BIM

What are the factors that hinder the use of BIM for BSE in Hong Kong? In Part E, the participants in the focus group meeting were provided with a total of 13 barriers obtained from the literature review (Chiu and Lai, 2016) in the questionnaire. They are:
a) IT infrastructure and software related problem, b) project participants related issues, c) lack of client demand, d) lack of training or education, e) lack of studies to quantify the value of BIM, f) lack of government support, g) lack of legal standards or specification to cope with BIM adoption, h) lack of new or amended form of contract, i) widespread of mistakes and errors produced, j) timing issues, k) investment and costing issues, l) too new and complicated for use, and m) no opportunity to use. In Question 14, the participants were requested to rate the degree of impact of these barriers on the adoption of BIM for BSE by using the same Likert scale for statistical analysis. Figure 5 shows the results.

![Figure 5 - Responses to barriers of implementation of BIM](image)

Similar to the results in Part D, the participants had diverse ideas about the effects of these barriers on the implementation of BIM for BSE in Hong Kong. Relatively large values of standard deviations (0.98 – 1.64) of the ratings of the barriers obtained from Question 14, except i) widespread of mistakes and errors produced, showed the variance. It was found that all the barriers, excluding m) no opportunity use, attained an average rating over 4, which indicates that the participants in general perceived that most barriers have a more-than-moderate effect on BIM adoption for BSE. In particular, b) project participants related issues, c) lack of client demand and g) lack of legal standards/specification to cope with BIM adoption, which had an average rating of much more than 5, would most likely be the three largest obstacles to the implementation of BIM in the local BSE industry.

As mentioned previously, the participants could suggest more items that they perceived as hindering BIM adoption in local BSE projects. Some of them pointed out these extra barriers: n) too short design period, o) difficult to re-use the building services design when there is a change in client requirements, p) lack of industry support, q) lack of coordinated efforts/drive from the top, r) fragmented market, s) not able to specify the exact product to be used due to tender consideration, and t) liability of the BIM files. These additional barriers would be considered in the future.

2.6 Part F: Measures conducive to adoption of BIM

Most of the participants in the focus group meeting agreed that BIM has plenty of
benefits for the various types of BSE projects at the different stages of a building’s lifecycle. The results of the previous part however identified that some barriers are currently obstructing BIM implementation for BSE in Hong Kong. Therefore, before proposing any solutions to solve the BIM promotion problems, it is of interest to realize what actions have been taken to attract the building industry to use BIM in the projects. In Part F, an open-ended question (Question 15) was firstly used to collect participants’ views on the most salient points of the existing measures, beneficial or unfavourable, that have been conducted with the aim of encouraging engineers and professionals to adopt BIM in their projects.

The participants of the focus group were active in bringing up the most prominent ideas about the current promotion methods of BIM in both the questionnaire and discussion sessions. A wide variety of noticeable and missing items of these methods were identified. The thematic analysis was used to study the participants’ responses so that these responses were grouped, rephrased and presented in accordance with their themes and implications. Table 2 summarizes participants’ perceived upside and downside of the salient points of the existing measures currently taken for promoting BIM adoption BIM in Hong Kong.

<table>
<thead>
<tr>
<th>Upside</th>
<th>Downside</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Government authority requires the use of BIM in their projects</td>
<td>• Benefits of using BIM have not adequately been identified</td>
</tr>
<tr>
<td>• CIC provides support on BIM adoption</td>
<td>• Government has not adequately supported BIM adoption for BSE</td>
</tr>
<tr>
<td>• Showcases/sharing sessions of benefits gained in successful BIM projects are frequently held</td>
<td>• CIC standard does not cover BIM for BSE</td>
</tr>
<tr>
<td>• Competitions of BIM projects are constantly organized</td>
<td>• BEAM Plus does not require the use of BIM for BSE</td>
</tr>
<tr>
<td>• Training and guidance on the use of BIM are being provided</td>
<td>• Traditional BSE practice has not been changed to adopt BSE</td>
</tr>
<tr>
<td></td>
<td>• Client and stakeholders have not adequately driven or participated in the adoption of BSE</td>
</tr>
</tbody>
</table>

Question 16, a Likert scale tick box question, was raised to collect the participants’ views on the effectiveness of 13 measures for promoting BIM adoption for BSE. were extracted from previous studies regarding the methods of encouraging the building industry to use BIM all over the world and included: a) provide key messages and case studies to explain the benefits of BIM, b) define clearly BIM input and output requirements, c) set up industry wide body to promote collaboration among project participants, d) appointment of BIM manager in the project team, e) develop initiatives to encourage client and stakeholder participation, f) establish standards, specifications and new forms of contracts for wider use of BIM, g) provide training and guidance on the use of BIM, h) review procurement practices, intellectual property rights and contract provisions, i) set up data exchange standard and management framework for information sharing, j) provide institutional support to expedite the development of BIM capacity and capabilities, k) expedite the industry’s capacity and capability for the development of BIM, l) provide compliant BIM tool, and m) adopt a strategic risk management process.
Since the above items might not cover all the possible measures that the participants might think effective for the local building industry, spaces were provided in the questionnaire for them to suggest more methods for promoting BIM adoption among the professionals. The same Likert scale was applied and the data collected via this question was statistically analyzed. The maximum and minimum ratings, the average and standard deviation (s.d.) of the ratings of each measure were calculated and shown in Figure 6.

Generally speaking, the participants in the focus group meeting agreed that all the 13 measures would have moderate to approaching very great effect on the promotion of using BIM for BSE. This comment was made based on the ground that the average ratings of these 13 measures were all above 4, among which, f) establish standards, specifications and new forms of contracts for wider use of BIM attained the highest rating on average (5.67). It is also noted that the average ratings of e) develop initiatives to encourage client and stakeholder participation and g) provide training and guidance on the use of BIM were relatively high. The findings indicate that from the perspectives of the participants, if a BIM standard is tailor-made for BSE industry, government or statutory bodies could provide financial support or certification for increasing the reputation of the projects that use BIM, and more education on the functions of BIM is provided for BSE professionals, then BIM should be more desirable for the BSE field to adopt.

The relatively small magnitude of the standard deviations (s.d.) of the ratings (i.e. 0.8-1.1) reflected that the general opinions of the participants tended to be close to the level of effectiveness of promoting the adoption of BIM interpreted by the value of the average rating for each measure. For example, for a) provide key messages and case studies to explain the benefits of BIM, the range of the ratings the participants gave was between 4 and 6 and the standard deviation of its ratings was only 0.8. The results strongly confirm that the participants held rather consistent ideas about the great effect of these measures on encouraging the use of BIM in the BSE industry in Hong Kong.

The participants in the focus group meeting suggested more measures that they believed
are able to facilitate the usage rate of BIM for BSE in Hong Kong. These measures are: n) stakeholders, industry and senior management support, o) government support (e.g. commitment to adopt BIM in all disciplines), p) change of BSE practice; bring the parties involved forward to the design stage, q) set up a library to store the required information, r) conduct sharing session/workshop to change the mind set of professionals for BIM adoption, s) 3D printing promotion, t) more sharing of benefits gained in some projects, u) allow enough time frame for BIM model development, v) accreditation of BIM qualification, and w) standardize the iconic/legend of BSE system for integration with other disciplines for BIM adoption. These 10 measures would be considered in designing the questionnaire for the next stage of the study.

3 Conclusions

The results of the focus group study revealed that the vast majority observed the unpopularity of BIM and the non-change use of 2D CAD as the major means for data exchange among the BSE professionals in Hong Kong. Most of the participants indicated that BIM was generally adopted in less than 15% of BSE design, construction or O&M projects. They pointed out that, regardless of the work nature, generally, BIM has not yet begun to be adopted in any BSE projects. All of these findings reflected that BIM has not yet widely penetrated to be used in the BSE industry and there is plenty of room for BIM to be promoted to adopt in the BSE field in Hong Kong.

In general, the participants of the focus group meeting agreed that the benefits of and barriers to implementation of BIM in the global AEC industries are also the benefits of and barriers to implementation of BIM in the local BSE projects. Measures which are conducive to adoption of BIM for BSE have also been identified and recommended in the focus group meeting. Among the 13 conducive measures suggested in the questionnaire, the top three measures believed to be effective are: “establish standards, specifications and new forms of contracts for wider use of BIM”, “develop initiatives to encourage client and stakeholder participation” and “provide training and guidance on the use of BIM”. Together with other additional measures ever mentioned in the focus group meeting, the questionnaire had been incorporated for use in an online survey for soliciting opinions of more stakeholders in the next stage of the study.

4 Acknowledgements

The study team is very grateful for the support of the Hong Kong Polytechnic University (PolyU) and the research grant (No. H-ZJKB) jointly given by the Chartered Institution of Building Services Engineers - Hong Kong Branch (CIBSE-HKB) and the Hong Kong Institution of Engineers - Building Services Division (HKIE-BSD). Special thanks are due to the advice of Dr P.L. Yuen and Ir Antonio Chan throughout the study period and the contribution of the focus group participants. (Note: The study commenced in May 2015 and Dr. Roger Ng had continued to participate in the study since he left PolyU in Jan 2016.)
5 References