Exploring the conflicts between BIM and existing project processes in Hong Kong

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Abstract

The Hong Kong construction industry has in general, developed a basic appreciation about Building Information Modeling (BIM), migrating from knowing 'what it is' and 'how to use it' to adopting it in a few projects. However, most industry participants are still hesitant to adopt it BIM more widely. This has been allegedly a typical attitude when our industry faces an innovative technology. Meanwhile, the perceived requirements to adjust existing operational processes to achieve further benefits from BIM development leads to many potential conflicts, hence increasing participants' concerns in proceeding further. Therefore, there is a need to identify and understand the main conflicts between BIM and current project processes, mainly referring to organizational structures and operational flows. Based on a series of semi-structured interviews with senior BIM practitioners and experts from different stakeholders in the Hong Kong industry, as well as a BIM questionnaire survey targeting the Hong Kong construction industry, this paper illustrates the main conflicts and apprehensions indicated above. These findings will lead to future research and then contribute to a proposal to develop measures to accelerate progress towards more collaborative processes for BIM implementation and consequential benefits realization in Hong Kong.

Keywords: BIM, conflicts, Hong Kong, project processes

1. Introduction

Taking the 'One Island East' Project (started in 2004 and finished in 2008) to be one of the first projects that substantially implemented BIM in Hong Kong, BIM has gone through at least 8 years' development in the Hong Kong industry. BIM functions have been gradually developed to generate more benefits for the projects, but the current limited benefits still can not persuade most stakeholders to adopt BIM in their projects in Hong Kong, given the cost related to BIM implementation in terms of training, software and hardware. The principal reasons for the perceived industry hesitation are the conflicts/barriers between BIM and the existing project processes.

The relationship between BIM and project processes, being interactive and potentially iterative, can deliver high synergies. BIM provides a much better platform to develop a more collaborative working environment for a project, while a more integrated project process can extract more and deeper benefits from BIM. This point was also illustrated in the guide of Integrated Project Delivery (IPD), a relatively new procurement approach being populaized in the USA (AIA, 2007) that aims to achieve higher level integration in the project processes. The relationship of IPD with BIM was summarized as: Integrated projects could be done

without BIM and BIM could be implemented in non-integrated processes; but only when they were combined together, both of their potential benefits could be maximized (AIA, 2007). Most construction project processes in Hong Kong can be categorized as 'non-integrated processes', which indicates that BIM implementation in Hong Kong may encounter a series of conflicts/barriers in the prevalent industry 'culture' and scenarios. Therefore, this paper is designed to explore the specific conflicts/barriers that limit BIM applications and potential benefits in the Hong Kong industry.

2. Literature review on conflicts/barriers encountered in current BIM implementation

BIM is not an innovative tool applied to only address a single independent issue, since its scope can and should cover the whole project, affect all participants and last over the project lifecycle. Therefore, the factors/barriers affecting the adoption of BIM span over a wide spectrum.

According to Lu and Li (2011), attention is generally drawn to two categories of BIM factors, namely the technical complexities of BIM adoption and the expected collaborative working environment. The two resulting research areas also reflect the tool and process properties of BIM. Gu and London (2010) provided similar categorisations of the two main factors, as: technical tool functional requirements and needs, and non-technical strategic issues.

To be specific, under technical issues, interoperability in BIM is one of the urgent needs from the participants. Research carried out by Grilo and Jardim-Goncalves (2010) concluded that the interoperability in BIM was significant for the interoperability among the participants. Bernstein and Pittman (2005, as cited in Azhar, 2011), also found that the data interoperability across different software was one of the three major technical issues retarding the BIM implementation, the other two issues being the computability of the design data and the information exchange among the BIM components. Besides the interoperability, a questionnaire survey carried out by Tse (2004) revealed other technical barriers, such as poor library, low running speed of the system and lack of table customization.

On the other hand, on the issues related to collaborative working environment and project processes, Lu and Li (2011) believed that BIM would change the traditional construction industry over a wide range of its typical characteristics, including those of people, processes, communication and work culture. Grilo and Jardim-Goncalves (2011) also claimed that BIM was changing the way that companies were working, as well as providing new processes for collaboration. Indeed, it is commonly accepted that BIM is both a new tool and a new process. A new process requires relevant changes in the existing project processes to generate a more collaborative working environment. However, changes will never be easy, especially for the 'traditional' construction industry. For example, one of the key factors to ensure a truly well-implemented BIM is the early involvement of the key participants, but the present procurement systems leave little room for this to happen. The architects or engineers still carry out the design work independently in most projects in Hong Kong,

without any input from the contractor, although there are positive moves towards 'Early Contractor Involvement' (ECI) in some countries (Rahman and Alhassan, 2012).

This paper will mainly focus on exploring the second issue mentioned above, namely the conflicts/barriers between BIM and existing project processes in the Hong Kong industry. This paper will present Hong Kong based findings from: 1) a series of semi-structured interviews with senior BIM practitioners and experts from different stakeholders, and 2) a BIM questionnaire survey targeted at the Hong Kong industry.

3. Research methods

As mentioned above, although case studies are also being conducted in the ongoing parent study, two main research methods were applied in the reported research to explore the conflicts/barriers when implementing BIM in current project processes in Hong Kong, namely semi-structured interviews and a BIM questionnaire survey. Since both the interviews and the questionnaire survey were carried out in Hong Kong, the research findings mainly reflect the Hong Kong industry's present landscape.

3.1 Semi-structured interviews

Totally 18 individual interviews were conducted to collect practitioners and researchers opinions about the conflicts and barriers mentioned above.The composition profile of the interviewees is shown in Figure 1.

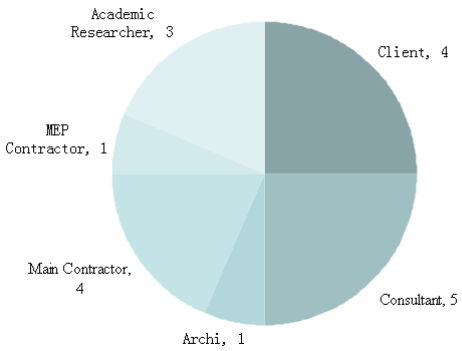

Figure 1: Profile of the interviewees

As in Figure 1, the interviewees are from various industry groupings in the Hong Kong industry and hence play different roles in their projects. This cross-section is believed to make the interview findings comprehensive enough to provide a reliable reflection of the current situation in the Hong Kong industry.

Each interview lasted from 45 minutes to 60 minutes and the interviewee was invited to provide his/her opinions on each of a series of BIM related questions, such as motivations

for BIM adoption, current BIM implementing processes in Hong Kong and conflicts/barriers in integrating BIM in the existing project processes. Findings related to conflicts/barriers were derived from the interviews and are presented in Section 4 of this paper.

3.2 BIM questionnaire survey

Compared with the individual interviews conducted in this research, this questionnaire survey presented a broader view about BIM development in the Hong Kong industry. One of the objectives of this questionnaire survey was to explore the gaps and constraints that retarded collaborative working in the BIM environment, being designed to help to probe the conflicts/barriers mentioned above.

To be specific, in the third section of the questionnaire survey, respondents were asked to express their opinions on the frequency and difficulty of the technical issues and non-technical issues resulting from BIM implementation in their projects, as well as their level of agreement on constraints that retard the collaborative working environment for BIM. A '1~5' Likert scoring scale was used to quantify their responses. For example, 1 indicates 'never' and 5 expresses 'always' on the frequency of a particular issue, as listed in the options.

This questionnaire survey involved of two rounds of delivery, since the number of responses was considered inadequate after the first round. Questionnaires were delivered to the following target groups through emails:

1) Members of the Hong Kong Institute of Building Information Modeling (HKIBIM) (142);
2) Interviewees of the individual interviews (31);
3) Committee members of Civil, Building Service and Structural Divisions of Hong Kong Institution of Engineers (HKIE) (77);
4) Randomly selected Honorary Fellows, Fellows and Members of HKIE from Civil, Building, Building Service and Structural Divisions of HKIE (645);

HKIE is the internationally recognized multi-disciplinary institution of engineers in Hong Kong and randomly picked members from its civil division, building division, building service division and structural division can represent the industry's common opinions on the iisues probed in the survey. Meanwhile, HKIBIM is an institution particularly for BIM practitioners, whose members have BIM related working or research experiences in Hong Kong. Therefore, the target groups are appropriate to provide opinions that can reflect the industry's attitudes and perceptions.

From 10th May 2012 to 17th September 2012, accounting for 8 overlapping persons and 65 undeliverable emails, 822 questionnaires were successfully delivered to the above groups. Of 68 responses received, only 32 were considered usable and hence analyzed as described in the next section.

4. Research findings: conflicts/barriers between BIM and the existing project processes in Hong Kong

4.1 Findings from interviews

The relevant conflicts/barriers as derived and distilled from the interviewees are as follows:

1) The existing project processes leave little space for the early involvement of the key participants.

2) Clients are not aware of BIM benefits，hence do not drive its implementation.

3) Architects generally follow the traditional processes, since BIM requires more efforts.

4) Contractors are generally hesitant, since not sure of the true benefits from BIM.

5) The Hong Kong industry provides limited time for the design phase in the project process, while the creation of a BIM model usually requires more efforts and more time.

6) Mechanical-Electrical-Plumbing (MEP) contractors are mobilised quite late in the project process.

4.2 Findings from the questionnaire survey

6 technical issues and 5 non-technical issues related to BIM were listed in the questionnaire and respondents could indicate their opinions both on the 'frequency level' and 'level of difficulty' for each issue through a '1~5' scoring system: (a) Level of Difficulty: 1-Quite Easy; 2-Easy; 3-Middle; 4-Hard; 5-Extremely Hard, (b) Level of Frequency: 1-Never; 2-Rare; 3-Sometimes; 4-Common; 5-Always.

For the analysis of difficulty and frequency of the technical and non-technical issues, this study adopted each issue's average scores on difficulty and frequency to conduct the follow-up analysis. The product of difficulty average score and frequency average score were also calculated. Issues with higher product values were considered as more critical conflicts/barriers in BIM implementation. Results are shown in Table 1 and Table 2.

Table 1 Technical issues

Answer Options	Average Score (Difficulty)	Average Score (Frequency)	Difficulty X Frequency
Interoperability	3.10	3.16	9.79
Poor library	2.77	2.97	8.23
Lack of standards/guides	3.00	3.13	9.39
Long learning curve	3.32	3.23	10.74
High cost of the software and hardware	2.97	3.06	9.09

Lack of BIM technician and Software are not mature	3.67	3.67	13.44

Table 2 Non-technical issues

Answer Options	Average Score (Difficulty)	Average Score (Frequency)	Difficulty X Frequency
Changes in the operation process	3.16	3.16	9.99
Changes in the organizational structure	2.97	2.84	8.42
Changes in the information flow, conflicts with the traditional project culture and employees being reluctant to use new technology	3.52	3.39	11.91
Not all the stakeholders are adopting BIM	3.29	3.58	11.78
Not sure about the benefits of BIM	3.00	3.20	9.60

Based on the above two tables, the first four critical conflicts/barriers encountered in BIM implementation in Hong Kong industry are:

1) Lack of BIM technician and Software are not mature (technical);

2) Changes in the information flow, conflicts with the traditional project culture and employees being reluctant to use new technology (non-technical);

3) Not all the stakeholders are adopting BIM (non-technical);

4) Long learning curve (technical).

5. Discussion

This section provides a general discussion of the results and possible reasons for the above conflicts/barriers as derived from the interviews and questionnaire survey from three perspectives: namely industry level, project level and organization level.

At the industry level, the Hong Kong construction industry has developed a fast track culture since the participants always want to complete their projects as quickly as possible. This point was consistent with the 5th and 6th barriers identified in section 4.1 and the 2nd issue identified in section 4.2. In order to achieve early operation so as to reap profits earlier, time spent on design is highly compressed in Hong Kong industry. This leads to numerous changes during the construction phase in many projects in Hong Kong. This scenario is unsuitable for BIM implementation. This compresses the time available for design in the project process to mostly inadequate levels. As an innovative technology that requires more efforts and time to implement, BIM will not be welcome within such kind of project processes and the prevalent fast track culture.

At the project level, most projects in Hong Kong are delivered by the Design-Bid-Build procurement route that indeed isolates key participants within different project phases, limiting the potential benefits from BIM. Early involvement of the key participants ensures early input from contractors, installers, fabricators and so on (AIA, 2007; Ralman and Alhassan, 2012), which is an important route to maximizing BIM benefits. However, this situation is hard to achieve in present project procurement processes in Hong Kong, such as Design-Bid-Build. This was the 1st barrier identified in section 4.1. As discussed previously, a delivery process that enables early involvement of key participants can maximize the benefits of BIM, while conversely, this type of delivery process will run smoother on a BIM based platform that facilitates information exchange across both project phases and project sub-teams.

For companies themselves, at the organization level, many clients are not fully aware of BIM's potential benefits, many architects are not willing to expend extra efforts on creating BIM model and contractors are apprehensive about the unknown net benefits of setting up their own BIM divisions, which reflect the 2nd, 3rd and 4th barriers identified in section 4.1 and 1st, 3rd and 4th issue identified at the end of section 4.2. Most interviewees have high expectations of clients' positive attitudes as well as facilitative actions for BIM implementations. BIM related costs need special upfront funding. It also needs more efforts to create and use the BIM model. These also require incentive mechanisms or measures from the clients to motivate the various teams, otherwise most stakeholders will not take the initiative to adopt BIM. Furthermore, since BIM is able to span the whole project lifecycle, clients have the greatest potential to benefit from BIM most. Meanwhile, considering the current major BIM applications such as clash detections, contractors also share the benefits of BIM implementation. However, except for a few projects in Hong Kong where 'pain-share and gain share' mechanisms (DTF, 2006) have been incorporated in Target Cost Contracts (Kumaraswamy and Rahman, 2006), architects share few BIM benefits but incur far more efforts to create and use BIM models. Thirdly, most contractors in Hong Kong hire BIM consultants to handle any BIM related work stipulated in the contracts. It is a reasonable choice when there are just a few projects that require BIM implementation, given the high cost of setting up permanent in-house BIM divisions to deliver on-off and ad hoc BIM requirements. Along with the development of BIM in Hong Kong, more and more contractors have to answer the question of whether it is better to set up in-house BIM divisions, or to hire a BIM consultant. The relatively high cost of setting up a BIM office is quantifiable, while the benefits are not so clear to many contractors, hence retarding BIM development at the firm level. Drawing on the experiences of other countries, such as UK and Singapore, clients, especially the government clients, should take the lead to integrate BIM in the current project processes (BIM industry working group, 2011; Cheng, 2011).

6. Conclusions

A set of relevant conflicts/barriers was identified through semi-structured interviews and two types of conflicts/barriers to BIM implementation were probed in the questionnaire survey, namely technical issues and non-technical issues. Generally, under the current Hong Kong

industry culture, the existing project processes have retarded the implementation of BIM. BIM's benefits are limited in such project processes, so the clients are less motivated to encourage or promote, leave alone proactively drive BIM adoption. Other participants are unlikely to take the initiative to adopt BIM if the client is passive. In order to advance BIM implementation in Hong Kong, the existing project processes need to be revised in some ways to provide opportunities for the early involvement of key participants such as contractors and operators so as to derive many more benefits from BIM to convince participants (Sing and Dunn, 2008). It is difficult, if not impossible, to immediately replace the existing project processes with some new processes that are capable of providing a better environment for BIM, such as IPD (AIA, 2007). What is reasonable is to revise the existing project processes step by step, gradually approaching more appropriate project environment for BIM, for example in moving from non-contractual partnering to contractual partnering, e.g using the New Engineering Contract (NEC) as has been successfully piloted in public work project in Hong Kong (Tsui, 2012) and is now being introduced to many ongoing and upcoming projects.

Limitations of the reported research are seen as: 1) 18 interviews and 32 questionnaire responses may not be enough to reflect a comprehensive scenario of the Hong Kong industry; and 2) Conflicts/barriers derived from the interviews and questionnaire survey have not been validated. It will also be useful to develop some suggested measures, even proposals, to address the finally identified conflicts/barriers. Therefore, ongoing and future works target more interviews and case studies in the Hong Kong industry, proposal development based on relevant guides or principles and a focus group meeting to validate the reported conflicts/barriers, as well as the suggested measures/ proposals to address these conflicts/barriers.

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