Status of building information modelling (BIM) in construction practice—UK context

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Abstract. This paper presents the level of Building Information Modelling (BIM) practices in the current UK construction industries. A survey was undertaken which contains a series of a self-explanatory questionnaire. The survey analysis provides an understanding of the level of BIM in practice and how BIM can be incorporated in the future construction industries from theory to practice. Findings suggest that most big companies are in the process of adopting BIM at some level of practice, while small companies are dropped behind. BIM is also very much depending on the clients’ demand and the project complexity. Overall, the infrastructure construction industry is moving forward in the direction of complete BIM in practice.

1. Introduction
Technology, in the 21st century, has much progressed, and there are many commercial software tools available for calculation, drawing and designing the infrastructure and construction projects. Building information modelling (BIM) is a combination of tools in a platform which integrates all parameters of an infrastructure construction project (project management, architectural plans, structural designs, electrical designs, plumbing plans, sustainable energy factors, environmental factors, supervision, and modification) in a centralised system to build a model in various level of detail information. The BIM system is designed to integrate and manage data required for a project development without any error and fragmentation trouble, where participants of the project development have necessary access [1,2]. The BIM stores all information, developed by all individual stakeholder involved in a project, requires for actuating any project from conceptual level to completion. Efficiency in structural design, project management, the materials quantity surveying, detection of conflicts, necessary amendments, and upgradation according to the requirements of the stakeholders during the life cycle can be significantly improved with the adaptation of BIM in a project.

BIM is capable of multi-dimensional representations and analyses. This ranges from the 3D modelling that includes all building component information to scheduling (4D), estimation (5D), sustainability (6D), and facility management (7D) [3]. The multi-dimensional integration capabilities allow the combination of all technical and quantitative service to develop and maintain a project in a single platform.

The UK Government Construction Strategy (GCS) announced BIM requirements in the Cabinet Office in May 2011. Milestones were set to achieve Level 2 BIM maturity in all construction levels to deliver significant benefits. Level 2 BIM includes the methodology of working in a 3D model work
environment with description. Data required for Level 2 can be designed using isolated BIM tools [4]. Enterprise resource planning (ERP) software packages can provide commercial data for BIM. With updated data, level 4D scheduling and 5D cost estimating is also possible to integrate into the model using separate BIM tools. COBie UK 2012 developed a piece of digital information for a building in a spreadsheet data format. A constructive data exchange platform at Level 2 BIM can be linked with COBie UK 2012 data and managed by any company running the construction project efficiently. Also, British standards institution (BSI) road map written by the B/555 team, mentioning standards and documents need for Level 2 BIM maturity requirements.

This study carried out among construction managers, engineers, architects, and BIM specialists in the UK. The objective is to develop a clear understanding concerning BIM dynamic competency materials and tools, market maturity, practical market performance benchmarking, knowledge modelling, and BIM levels achieved across the construction industry. The data and information used in this paper is a part of a final year dissertation project on BIM by M. Al-Hasani in the Anglia Ruskin University in the UK [5].

2. Methodology
A survey was conducted to assess BIM stages in the UK construction industries. To achieve this, a survey questionnaire was prepared, and information was collected from different levels of target professionals and companies. The poll was mostly self-explanatory and electronically sent to various participants where possible. Add to that, and data was collected via a set of interviews with the contractors responsible for managing current construction projects, and with subject matter experts.

Market surveys (questionnaires) along with practical interviews, provide specific understanding about current BIM acceptation levels in the construction world. These guided us to outline practical advancements and principal obstructions for BIM level improvement at the 5D level (i.e., quantity survey integration). Finally, based on these findings, a general recommendation and future direction are outlined for efficient BIM adaptation in the construction industries.

3. Result and discussion
The survey data on BIM is statistically analysed to interpret the results. There were 26 participants representing different construction organisations leading practical project developments. There were 10 self-explanatory questions with multiple choice and 1 open-ended questions.

Question 1 inquired the information regarding the type of organisation that the participant was employed during the survey. The statistical data in the pie chart is presented in figure 1. The most significant target groups were contractors and those that were involved in practical construction projects (57%), second were those project’s managers (16%), followed by (15%) quantity surveyors to understand BIM development towards 5D cost estimation. Next, there were civil/structural engineering (7%), architects (3%), and building service engineers (2%). The contractors are the key in implementing BIM in the project development phase. Hence the overall survey data is expected to be a strong balance between practical field and technical engineering practice in the current state.

Question 2 deals with the process of how different organisations use BIM and exchange models between different operators. The survey data is plotted in figure 2. It is reassuring to note that the majority use established common or shared database platforms (57% to 58%). Further investigation of the survey data asserts that people are also using other forms of data-sharing platforms and are relatively divided. There was only 8% found not to be using any modelling or common data-sharing platforms or clouds.

Question 3 collected information related to the principal reason for BIM adoption by organisations. The statistical data in the bar diagram is presented in figure 3. One of the significant findings of this was that a majority of participants (66%) agreed that they adopt BIM when there is an established model. The influence of clients in this matter was also evident as 34% reported that they prefer to adopt BIM when clients request them to do so. Although there were positive values for adopting BIM in most cases, around 20% of contractors said they have not used BIM to date. There was also a small
percentage (4%) of contractors or participants we met who claimed that BIM was their standard approach to all projects. This is a positive sign for BIM, considering companies have quickly responded before BIM is required for any project.

The availability of BIM expertise within the organisations was surveyed in question 4. The distribution of response is presented in figure 4 as a pie chart. Current data suggested that most of the organisations, 38% of companies use external BIM specialties. The second largest number of participants (34%) reported using a combination of in-house and external services, around 20% were found to have been using completely inside expertise. Another 8% of companies were found to still be in the trial period for BIM implementation and establishing BIM adopting processes. Add to that most advancement in BIM is noted in large size companies dealing with complex and large infrastructure construction projects.
Question 5 investigates the BIM system maturity level in delivering a practical project in the field. The survey data is presented in figure 5. It could be noted while a significant proportion (44%) already reported delivering at level 2 and level 1 BIM, only 1% were found to have adopted complete BIM. In practical construction practices, there were still 19% that were found to be using level 0 BIM. This survey information indicated that there is an apparent inclination of adopting BIM in the construction industries, which is developing over time.

Question 6 collected the information regarding BIM dimension productivities every organisation has accrued within its project implementation stage. A major proportion of participants (66%) reported using 3D digital models linked with attributes followed by 44% who were using 3D models at least in their project delivering workflow (figure 6). It can also be noted that a large proportion of respondents adopted 4D, 5D, and even 6D models along with their established 3D model practice, based on the complexity and demand of the project. Modern software-based model utilisation in the workflow has become the norm in current construction industries worldwide.

Question 7 continues with the theme to discover organisation-wide policies on education and training of their technical experts for acquiring BIM adaptation skills. The survey data is presented in figure 7. While many participants did not respond to this question, it was clear that these organisations/contractors do not have a structured approach to education and training facilities for BIM. Out of the remaining respondents, one-third (30%) acknowledged that they had a wide policy in their organisation along with a structured approach to BIM education and training programs. Similar proportions have reported that they were developing education and training schemes. Around 25% have reported having an approach to train and educate staff at the project level and 18% had absolutely no approach at all. However, 14% confirm that they have facilities for special staff that are particularly interested in BIM model development work. With these negative findings, it could be suggested that most of the 23 respondents appear to use mixed methods (internal and external) for education and training.
Question 8 was for the target audience, those who were not using BIM to date. A remarkable 80% intend to adopt BIM in the workflow chain in a year or two (figure 8). Surprisingly 20% of participants indicated that they have no plan for adopting BIM. This is a positive indication considering that even if they do not have any plans for BIM at this stage, they have an idea that BIM implementation will be required in the near future.

Figure 7. Q7: Does your organisation have any structured education or training for BIM?

Figure 8. Q8: Future adoption of BIM.

Question 9 inquiry about COBie: UK2012 utilisation by organisations for information exchange (figure 9). The answer to this question in the practical construction field was found to be mostly negative (78%). However, others (22%) were found to be using COBie: UK2012 for information exchange.

Question 10 was asked to discover the method that organisations use for dealing with a standard data source environment. The survey data is presented in figure 10. A large group (39%) was found working in a standard data environment online. However, it was found that almost 36% have been found to be not using any particular method. However, a majority (45%) use PAS1192: 2013 followed by 36% that use BS1192: 2007. Furthermore, 17% were found to be using a personal data sharing environment. At this stage, it could be concluded that the role of BIM in the delivery stage must be improved in the future.

Figure 9. Q9: COBie: UK2012 use for information exchange.

Figure 10. Q10: BIM methods use by organisation for managing.
Question 11 was an open question without any pool. The question obtained information on the BIM upskilling scheme available for employees in organisations. Not every respondent answered the open questions. Yet, out of those that answered, the majority indicated that a section of the company is dealing with this matter. Established company employees have reported that all staff will be undertaking a degree of BIM training for minimum awareness only, and other more detailed training, including BIM APs and BIM CPs. There were further indications of training BIM specialists at the project level for upskilling BIM technicians in the organisation.

The field survey indicates that BIM development is still in the developmental stage and organisational approaches towards it were found to depend on five key parameters, as seen in figure 11. These parameters dictate the implementation of BIM in infrastructure construction projects. However, the survey was conducted in 2015 and there is a dire need for similar survey at present time for future studies. The demand of BIM practice in construction is increasing. The future development of smart and connected infrastructure and utilisation of advanced sensory materials as well as sensors systems for structural health monitoring application is expected to require a complete BIM integration in a project at an early stage.

![Figure 11. Key parameters in approaching BIM.](image)

4. Conclusions
The BIM system incorporation and development in the construction industries of the UK is at its starting phase. Although government strategies are approaching to achieve level 2 BIM into practice, current construction practice still does not reflect the scenario. There are five key parameters noted from the survey data analysis that influences the BIM adaptation: client demand, funding, the complexity of the project, experience of the organisation, and BIM framework. Large modern construction companies have adopted BIM much faster, while many of them are considering BIM based on client demand and fund availability. Small companies are not comfortable adopting BIM at a good pace, as it takes a longer time to change their workflow style.

Acknowledgment
The authors are grateful to Prof. Adrian Bell of Anglia Ruskin University (UK) for his contribution and guidance in the project.

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