The Challenges and Trends of Building Information Modelling (BIM) for Construction and Resources Sectors

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Abstract -

Productivity is a comprehensive problem in many countries. Particularly in construction and resources sectors, low productivity will potentially discourage future investments as building assets is becoming more and more unaffordable and unsustainable. In recent years, Building Information Modelling (BIM) is becoming much more active than ever. In order to fully realize where BIM is believed to be, there has to be a series of mechanisms in place to properly adopt BIM for construction site daily activities, beyond the design and engineering phases. BIM must go beyond itself by being integrated with other technologies towards dynamic planning. The paper also gives an insightful summary of where we are and where we should be, backboned by the BIM cases from construction and resources sectors.

Keywords -

Productivity; Integration; Building Information Modelling (BIM); Challenges; Trends.

1 Introduction

Building Information Modelling (BIM) has been proved as a practical and beneficial technology in numerous projects across the globe. While some parties are promoting the use of BIM in their projects, the governments have regulated certain policies for mandating the use of BIM in their countries. For example, the recent initiative in United Kingdom plans to level-up the mandate for BIM Level Two adoption by 2016. It is about making the construction process quicker and more efficient by digitally modelling a building collaboratively in a virtual environment [1]. The initiative reflects a relatively high level of maturity of BIM adoption in certain countries.

In reality, BIM is regarded to be rather established in building industry, and currently, the technology has moved into other sectors, particularly for infrastructure projects. The infrastructure projects involve complicated processes. The project productivity is always one of the main agendas. BIM is always facing a new challenge to create a productive and collaborative working environment along the entire life cycle process. The paper reckons BIM should be integrated with other technologies or managerial approaches throughout the life cycle. The paper articulates three stages where BIM are integrated to enhance the project productivity, namely, pre-construction phase, construction phase and maintenance phase.

Finally, the paper shares insights into the challenges and the way forward for BIM, particularly for its integration with other technologies in contributing to project performance and productivity in various stages of project life cycle.

2 BIM Integration for Project Performance and Productivity

Design alternatives are coordinated and articulated using BIM in the pre-construction stage. The focus is on an integrated supply chain management, which is a rather infant new research area in BIM applications. Few research attempts have been demonstrated by using BIM in this perspective. Yet, a full integration of BIM with other technologies has yet to be realized. Geographic Information System (GIS) and Global Positioning System (GPS) are the technologies that could improve the supply chain management. The need for real-time tracking information and on-time delivery is obvious, which could cope with the long-lead? supply chain in infrastructure projects. Besides, the integration should extend itself to the construction stage where all of the deviations and changes could be managed and updated in the 4D and 5D BIM. Meanwhile, Radio Frequency Identification technology (RFID) has also been integrated in the construction site for tracking purpose. An automated system of integrating BIM, GIS, GPS and RFID will be the future for creating a smart construction site [4]. As a result, this full integration between the technologies and project phases would

promote waste minimisation and improve the overall project performance.

BIM has been a powerful technology in the construction stage due to its visualisation ability and information traceability. The scope of BIM in construction stage requires an improved coordination in the current practices, particularly for construction processes and engineering management system. Augmented Reality (AR) technology works and integrates well with BIM [5]. A recent study demonstrated a successful integration of BIM and AR for Liquefied Natural Gas projects (LNG) [6]. The integration makes BIM more effective in identifying the interdependence and complex tasks in the construction process. Onsite activities will become more manageable as all the required information of the activities and components of the models can be visualised and retrieved in the real environments [6].

In the maintenance stage, an integration BIM and asset management has been demonstrated in both building [7, 8], and oil and gas industries [9]. There should be more investigations about the incorporation of BIM into asset management. It is about increasing asset value after construction via an effective coordination and maintenance of the physical asset environment of the project. The integration is able to shorten the learning curve in facilitating the services or components of the project. On top of that, the development of BIM model should be integrated with asset management at the earliest stage as possible in the design stage of the project life cycle. It will ensure the full benefits of BIM in asset management to accommodate the complicated human needs in the physical environments.

The BIM integrations would benefit each phase of the project life cycle. Yet, the management of the BIM integrations is another important step in closing the loop of the challenges and trends in BIM in the future. Different types of management and contract administration are required for different levels of BIM adoption and maturity. Some managerial approaches like Lean concepts [10] and Integrated Project Delivery [11] should be adopted in the overall management and contract administration for BIM. Moreover, some tools of information technology could be considered in streamlining the management process, such as database system or data warehousing [10, 11], cloud computing [12], etc. Thus, the project is expected to secure a better results and performance in the project.

3 Discussions and Conclusions

Australian economy is in transition for a better sustainability. Construction and resources sectors play a critical role in boosting economic growth. Productivity is imperative for the economic stability.
Nevertheless, the full benefits of BIM have yet to be achieved. To unleash its true potential, it is recommended that intensive research and development should be carried out to bridge the gap between the academic evidence and industrial practice. Project Echo [4, 15] is one of the practical examples, where it serves as a collaborative research platform for the practitioners and academic researchers. It is envisaged that BIM will become either a culture or a technological breakthrough in transforming the conventional construction practices in the near future.

References

[1] Building (2014). The route to BIM in 10 steps. Retrieved from http://www.building.co.uk/the-route-to-bim-in-10-steps/5049305.article.

[2] Chong, H.Y., Zin, R.M., and Chong, S.C. Employing Data Warehousing for Contract Administration: e-Dispute Resolution Prototype. Journal of Construction Engineering and Management, 139(6): 611-619, 2013.

[3] Irizarry, J., Karan, E. P., and Jalaei, F. Integrating BIM and GIS to improve the visual monitoring of construction supply chain management. *Automation in Construction*, 31: 241-254, 2013.

[4] The Australian (2014). Woodside tags a smart savings idea. Retrieved from http://www.theaustralian.com.au/technology/woodside-tags-a-smart-savings-idea/story-e6frgakx-1226923166565.

[5] Park, X, Lee, C., Kwon, D., and Wang, X. A Framework for Proactive Construction Defect Management using BIM, Augmented Reality and Ontology-based Data Collection Template. *Automation in Construction* 33: 61-71, 2013.

[6] Wang, X., Truijens, M., Hou, L., Wang, Y., and Zhou, Y. Integrating Augmented Reality with Building Information Modeling: Onsite construction process controlling for liquefied natural gas industry. *Automation in Construction*, 40: 96-105, 2014.

[7] Arayici, Y., Towards building information modelling for existing structures. *Structural Survey*, 26(3): 210-222, 2008.

[8] Singh, V., Gu, N. and Wang, X. A theoretical framework of a BIM-based multi-disciplinary collaboration platform. Automation in

Construction, 20(2): 134-144, 2011.

[9] Hou, L., Y. Wang, X. Wang, N. Maynard, et al., Combining Photogrammetry and Augmented Reality Towards an Integrated Facility Management System for the Oil Industry. *Proceedings of the IEEE*. 102(2): 204-220, 2014.

[10] Forgues, D., and Becerik-Gerber, B. Integrated project delivery and building information modeling: Redefining the relationship between education and practice. International Journal of Design Education, 6(2): 47-56, 2013.

[11] Arayici, Y., Coates, P., Koskela, L., et al. Technology adoption in the BIM implementation for lean architectural. Automation in Construction, 20(2): 189-195, 2011.

[12] Chong, H. Y., Balamuralithara, B. and Chong, S. C. Construction contract administration in Malaysia using DFD: a conceptual model. *Industrial Management & Data Systems*, 111(9): 1449-1464, 2011.

[13] Chong, H. Y. and Phuah T. H. Incorporation of database approach into contractual issues: Methodology and practical guide for organizations. *Automation in Construction*, 31: 149-157, 2013.

[14] Chong, H. Y., Wong, J. S. and Wang, X. An explanatory case study on cloud computing applications in the built environment. *Automation in Construction*, 44: 152-162, 2014.

[15] LNG World News (2014). Woodside Launches LNG Smart Tag. Retrieved from http://www.lngworldnews.com/woodside-launches-lng-smart-tag/