

BIM AS AN INSTRUMENT TO MINIMIZE SOURCES OF CONFLICTS IN CONSTRUCTION PROJECTS

ASANKA RAJAWEERA¹, HIMAL SURANGA JAYASENA² & THILINA LAKSIRI DISSANAYAKE³

¹University of Moratuwa, Moratuwa, Sri Lanka
rajaweera@gmail.com

²University of Moratuwa, Moratuwa, Sri Lanka
suranga.net@gmail.com

³University of Moratuwa, Moratuwa, Sri Lanka
thilinal.dissanayake@gmail.com

Abstract

It is a general acceptance within the construction industry that the conflicts in projects are inevitable; and it is a regular phenomenon due the unique nature of the construction industry. However, this is not the expectation of the clients of the industry and the society at large. A responsive construction industry should therefore take all steps to minimize conflicts in construction projects. Many sources of conflicts were found to be directly or indirectly related to information and communication. With the introduction of Building Information Modelling it was able to reduce the need for re-formatting or re-gathering information. This resulted in an increase in the speed and accuracy of transmitted information, automation of checking and analysis, unprecedented support of operation and maintenance activities and abatement of limitations associated with a lack of interoperability. It is an expectation in the construction industry that, adoption of BIM therefore will reduce the sources of conflicts in construction projects. This research study was aimed on identifying the modes to minimize sources of conflicts in construction projects with adoption of BIM. A desk study analysis was conducted using various standard publications published by construction stakeholders and the collected data was subjected to content analysis. Through findings of the research, modes which can be used to minimize sources of conflicts using BIM were identified. The findings of the research will provide a guideline for the adoption of BIM to minimize sources of conflicts.

Keywords: *Construction projects; Conflicts; Building Information Modeling.*

1. Introduction

Construction projects are more complex because of their unique nature and involvement of various parties during the construction period, with this conflicts are expected to rise which will affect the flow of the project (Yusof, Ismail & Chin, 2011). Conflicts are apparent in construction projects due to number of objectives and various duties of the parties involved in the goal setting stage (Lueng, Liu, & Ng, 2005). According to Yiu and Cheung (2007) these conflicts are arisen due to various sources. Lueng et al. (2005) explained that clients in construction projects expect completion of works within the expected time, quality and within the expected cost limit. Further, these expectations can be disturbed due to various sources of conflicts. Among these sources of conflicts main sources of conflicts has been identified by researchers as poor communication (Verma, 1998), collapsing communication chain among the parties (Ogunbayo, 2013), change of site condition, public interruptions, change order evaluation, defective design, excessive variation in quantities, double meaning of specifications (Acharya, Lee & Im, 2006b).

Proper integration of information leads to reduce risks and sources of conflict in the construction projects (The American Institute of Architects [AIA], 2007). Zhang and Hu (2011) emphasized that BIM is a model that is designed to integrate and digitize entire information related to the projects to express every component of building and their relationships. BIM is not a ready-made model therefore; it is changed according to complexity of construction projects. Further, its collaborative process helps to understand every aspect of the construction projects (Sebastian, 2010). The stakeholders are helped by BIM to understand what is to be constructed in a simulation environment to recognize any possible design, construction and operational outcomes. Further, BIM allows to favourable cooperation and support integration of responsibilities of every stockholder on construction project (Azhar, Khalfan, & Maqsood, 2012)

2. Sources of Conflicts in Construction Projects

The sources of conflicts are generally similar although construction projects are unique in nature (Yousefi, 2009). Sources of conflicts exist in many construction projects, whereas they are not always matured into conflicts. Conflicts will arise only if the project participants have failed to come to an understanding or unclearly formulated the provisions regulating the coverage of extra costs by the parties (Yiu and Cheung, 2007). It is somewhat a common case in a construction project, the contractor expects that the client is more responsible for compensation of extra costs, but the client's point of view is that contractor should obligate to do the additional works at his own cost. Many studies on conflicts and disagreements in the construction

projects exclusively deal with the situations characterizing a conflict and tend to ignore the causes thereof or erroneously present related circumstances as sources (Mitkus & Mitkus, 2014). Therefore, he argued that in order to prevent such misunderstanding it is important to investigate the real sources of conflicts in construction projects. Many researchers have categorized sources of conflicts in various ways. But it is difficult to understand each categorization due to overlapping of some sources of conflicts. Therefore, in this research the sources of conflicts were categorized into employers evoked, consultant evoked and contractor evoked sources of conflicts for analysis.

2.1 MAIN SOURCES OF CONFLICTS IN CONSTRUCTION PROJECTS

Through many researches, researchers have identified, that there are sources of conflicts which significantly affected to the conflicts in construction projects. Mitkus and Mitkus, (2014) has hypothetically proved that unsuccessful communication process as a main source of conflicts. Further they have identified that unfair behavior and effects of psychological defenses are also main conflicts sources. Through his research Kumaraswamy, (1997) has identified root (main) sources of conflicts through investigation as, unfair risk allocation, unclear risk allocation, unrealistic time/ cost/ quality targets, uncontrollable external events, unrealistic tender pricing and inappropriate contract type. Acharya et al. (2006a) has revealed the owner as a more responsible party for sources of conflicts in construction project. Acharya, Lee and Im (2006b) confirmed that by identifying six main sources of conflicts which are caused by owner in construction. These are differing site condition, public interruptions, difference in change order evaluation, errors and omission in design, excessive quantity of works and double meaning in specification. Further, they highlighted that through their investigation, differing site condition and public interruptions are the most critical sources of conflicts among those. In addition, they have found that misrepresented shop drawings as the largest source of conflicts in construction projects due to complex nature of the today's construction projects. Also, delaying of shop drawing and its vague nature will lead to conflicts.

3.0 Building Information Modelling (BIM)

BIM is not just a three dimensional representation. Instead, it is a digital simulation of the capability that can be viewed, tested, constructed designed, and deconstructed digitally. This stimulates iterative design optimization and the ability to rehearse construction before ever moving labor, material, and equipment into the site (Ashcraft, 2008). BIM can be used as proper decision making device for construction projects (Moon, Kim, Kang & Kim, 2012)

because BIM provide proper information flow in construction projects (Ding, Zhou & Akinci, 2014), which is an expected improvement exceeding the traditional practice.

3.1 BIM AS AN INSTRUMENT TO MINIMIZE SOURCES OF CONFLICTS

BIM makes integrators, designers, manufacturers benefit in design quality control and efficiency. BIM improves communication within the design and construction participants and the digitally based, virtual and dynamic environment create a well-set database (Linowes, 2009). Apart from the improvement in communication, the collaborative environment where more ideas have to flow between team members in a common platform (Aragon, 2006) is also expected to act as a mode of minimizing sources of conflict. Moreover, the employer and facility manager can avail within the model and in between the residence of the building. Outcome of the information from that model can assist the stakeholders to be more effective and also makes new chances for earning expansion (Nell, Allison & Black, 2010). BIM includes inbuilt sources of information for all stakeholders which governs the smooth flow of project (Volk, Stengel, & Schultmann, 2014). This information sharing mechanism is also expected to minimize the sources of conflict among project participants.

4.0 Research Methodology

In this research, research technique mainly consisted of two processes as data collection and data analysis. Even though the research focus is on BIM, local industry still does not practice BIM and only a handful of local professionals are aware of this system. Therefore data collection methods such as interviews, case studies, or industrial surveys which could have been used are not practicable for the study. Industry experiment is also a possible way of gathering solid data, yet BIM environment is not matured enough in the local context for such a prolific methodology. Therefore considering the impracticability of industry data collection, the data was collected through a desk study which reviewed various different sources of information which are not usually accepted as proper sources for literature review. These included inter alia publications such as manuals and user guides, online blogs and discussion forums. These represented the experience and opinions of BIM experts at various levels. O'Leary (2004) explains the major rule of any form of study is to move from raw data to meaningful understanding. Therefore, data analysis includes the compilation and interpretation of the data collected. Analysis depends on the nature and form of the data which have been recorded. Content analysis was the data analysis technique used to interpret meaning from the content of text data referred.

5.0 Content analysis and findings of the research

Through the content analysis, it was found that out of the many sources of conflicts identified in the literature review, twenty conflicts could be minimized by BIM. Those are five number employer evoked sources of conflict, five number of consultant evoked sources of conflict, ten number of contractor evoked sources of conflicts, one number of third party evoked sources of conflicts and two number of other matters evoked sources of conflicts can be minimized through adoption of BIM for construction projects.

5.1 EMPLOYER EVOKED SOURCES OF CONFLICTS.

Employer evoked sources of conflicts were analyzed under five topics such as delay in getting permits, inadequate contract administration, Inappropriate contract type, Slow current response and Unclear risk allocation.

Getting permits by the government authorities is more time consuming task, it may be due to checking of the codes, guidelines and understanding design parameters. New York City department confirms, code validation software can be integrated with BIM, which reduces the code design errors. It further mentions that since the employer is less knowledgeable in this respect it has to be accompanied by the design team. When it comes to contract administration and inappropriate contract type, many sources mention that BIM has collaborative tools consisting with software packages, 4D models and platform created through web, can be used assisting contract administration.

Addressing the slow response rate, sources explain that BIM visualize construction sequence providing clear understanding about the construction projects, Therefore, it provides information about construction events to employer efficiently, which enables expedite responses. When unclear risk allocation is considered, parties mention that in BIM database it has been clearly defined each participant's tasks and responsibilities. In addition various models can be used to analyze probable risk events.

5.2 CONSULTANT EVOKED SOURCES OF CONFLICTS.

Consultant evoked sources of conflicts were analyzed under four topics such as design failures, drawing errors, inaccurate tender evaluation, inadequate design documentation.

The reason behind many design failures and drawing errors is because of not having a pre analysis technology on the design and drawings before construction. Many sources mention that BIM integrated software package provides best solution for designs with proper solutions. Autodesk states that number of analysis tools and effective 3D models in BIM provides a superior foresight on design. Moreover, many sources identify that drawing errors can happen because different participants making up the final drawings. Coordination among project participants is essential in such a situation, which is provided by the collaborative environment provided by BIM.

Answering the inaccurate tender evaluation, the sources mention that pricing schedules can be produced using BIM, and these schedules can be used to compare BOQ prices as well various analyzing reports can be created compared with the engineering estimate. Moreover 4D models in BIM enhance the correct construction programme and proper resource allocation in selecting the prospective bidder. According to the sources, variations are the common most of the construction projects. These variations change the design of construction projects some extent. Traditionally with each change, a set of design documents has to be submitted to the contractors or subcontractors; the BIM software automatically coordinates the change in the drawings, clashes will be detected and the integrated BIM system will assist in providing adequate design documents

5.3 CONTRACTOR EVOKED SOURCES OF CONFLICTS.

Contractor evoked sources of conflicts were analyzed under five topics such as changes in errors in interim payment applications, lack of knowledge of site conditions, less progress of works, material wastage, misunderstanding of scope of works

Errors in interim payment application are common in construction project. BIM provides favorable solution to overcome such errors because BIM is consisted with fictional software which can generate relevant information. According to the published sources, extraction of accurate quantities, in built pricing schedules and relevant generated information can be assisted to generate error free interim payment application.

The reason for the lack of knowledge of the contractor on the site conditions is twofold. It's being the contractors and consultants negligence. In addition to that it may be the reason that there is no proper site analysis technology to analyze site condition effectively. But with the adoption of BIM, it provides effective site analysis mechanism. This happens because with the contractors

being allowed to work on the model, they become aware of the site conditions in the virtual space.

When the progress of the works is concerned, the sources point out that today most of the construction projects are used pre-fabricated items. It tends to increase the progress of the work. When BIM is considered it can be connected to the pre-fabrication process. Therefore, more accurate pre-fabricated items can be constructed within less time period. Moreover 4D models enable the scheduling process to expedite work. Material wastage is addressed through BIM, by the selection of material in accurate dimensions from BIM software; also build up of material schedules will reduce the material wastage.

According to sources, visualization offers best solution for the issue of misunderstanding the scope of works. Because BIM integrated software provides clear visualization of model. Most of the parties mention that parametric elements model can be created using BIM. Therefore, each and every construction participants can understand which scope; have to be completed by them.

6. Conclusions and Recommendations

Building Information Modeling is the process of generating and managing BIM during project life cycle by using three-dimensional, real-time, dynamic building modeling software to increase productivity in building design and construction to produce Building Information Model, which consist building geometry, spatial relationships, geographic information, and quantities and properties of building components. When BIM is used for new construction projects, it is important that having knowledge about what purposes BIM can be used. This study addressed the adoption of BIM to minimize sources of conflicts in construction projects. To achieve this aim, the sources of conflicts, main sources of conflicts and the BIM features were identified using literature. Moreover, sources of conflicts which have potential to be minimizing using BIM were identified. Finally new sources of conflicts which can be minimized through BIM were identified. According to findings of this study it can be concluded that BIM can be adopt to minimize sources of conflicts in construction projects.

Considering the finding of the research, following recommendation can be derived as the implications to the construction projects. If BIM is implemented for the construction projects, sources of conflicts which are evoked by employer, consultant and contractor can be minimized to achieve a successfully completed project within the time, cost and quality originally

anticipated. Furthermore, before BIM is implemented for the construction projects it is important to consider on the way of minimizing sources of conflicts which cannot be minimized through BIM. Therefore, it is important having strategic plan to minimize sources of conflicts, when BIM is implemented for construction projects. When software vendors are considered, they can upgrade BIM software and BIM related software to overcome or minimize identified sources of conflicts. Moreover, when software is purchased client can consider which BIM software will facilities minimize or overcome sources of conflicts in constructions projects.

7. References

- Acharya, N.K., Lee, Y. D., and Kim, J. K. : 2006. *Critical Construction Conflicting Factors Identification Using Analytical Hierarchy Process*. Retrieved from <http://download.springer.com/static/pdf> (accessed 23rd February 2014).
- American institute of Architects. :2007. *Integrated Project Delivery*. Retrieved from <http://www.aia.org/groups/aia/documents/pdf/aiab083423.pdf> (accessed 5th March 2014)
- Aragon, P., : 2006. *Reinventing Collaboration across Internal and External Project Teams*. Retrieved from AEC Bytes: http://www.aecbytes.com/viewpoint/2006/issue_28.html (accessed 29th November 2015).
- Ashcraft, H. W. : 2008. *Building Information Modeling : A Framework for Collaboration*, 28(3), 1–14. Retrieved from http://www.hansonbridgett.com/Publications/pdf/~media/Files/Publications/bim_building_information_modeling_a_framework_for_collaboration.pdf (accessed on 24th May 2014)
- Azhar, S., Khalfan, M., & Maqsood, T. : 2012. *Building Information Modeling (BIM): Now and Beyond*. Australasian Journal of Construction Economics and Building, 15-28. doi.org/10.5130/AJCEB.v12i4.3032
- Ding, L., Zhou, Y., & Akinci, B. :2014. *Automation in Construction Building Information Modeling (BIM) application framework : The process of expanding from 3D to computable nD*. 1-94. Automation in Construction. doi:10.1016/j.autcon.2014.04.009.
- Hsieh, H. F., and Shannon, S. E. : 2005. *Three Approaches to Qualitative Content Analysis*. Qualitative Health Research, 1277-1288. doi: 10.1177/1049732305276687.
- Kumaraswamy, M. M. :1997. Conflicts, claims and disputes in construction. *Journal of engineering, construction, architecture management*, 95-111. doi.org/10.1108/eb021042
- Leung, M., Liu, A.M.M., and S. Ng, S.T. :2005. *Is there a relationship between construction conflicts and participants' satisfaction?* Construction conflicts, 149-167. doi.org/10.1108/09699980510584494
- Linowes, J. G. (2009). BIM:New era of design=new era of communication. Retrieved from <http://www.softconference.com/aia/sessionDetail.asp> (accessed on 29th November 2015)

- Nell, D.M., Allison, H. and Blank, W. : 2010. *Building information modelling*. Infocomm international.
- Mitkus, S., and Mitkus, T. : 2014. *Causes of conflicts in a construction industry : a communicational approach*. Procedia - Social and Behavioral Sciences, 777–786. doi:10.1016/j.sbspro.2013.12.922.
- Moon, H. S., Kim, H. S., Kang, L. S., & Kim, C. H. : 2012. *BIM functions for optimized construction management in civil engineering*, gerontechnology: International journal for fundamental aspects of technology. 11(2), 2–6. doi:http://dx.doi.org/10.4017/gt.2012.11.02.251.00
- Ogunbayo, O. : 2013. *Conflict management in Nigerian construction industry: Project Managers' View*. Journal of Emerging Trends in Economics and Management Sciences (JETEMS), 140-146. Retrieved from <http://jetems.scholarlinkresearch.org/articles/Conflict%20Management.pdf> (accessed on 20th May 2014).
- O'Leary, Z. (2004). *The essential guide to doing research*. London, UK: Sage Publications Inc.
- Sebastian, R. :2010. *Changing roles of the clients, architects and contractors through BIM*. Engineering, Construction and Architectural Management, 176-187. doi.org/10.1108/09699981111111148
- Verma, V. K. :1998. *Conflict management*. In J. Pinto, The Project Management Institute Project Management Handbook. Retrieved from <http://www.iei.liu.se/pie/olsson-rune/material/konflikthantering/1.320924/confliManagementVer.pdf> (accessed 28th June 2014).
- Volk, R., Stengel, J., & Schultmann, F. : 2014. *Automation in Construction Building Information Modeling (BIM) for existing buildings — Literature review and future needs*. Automation in Construction, 109–127. doi:10.1016/j.autcon.2013.10.023.
- Yiu, T.W., and Cheung, S.O. : 2007. *Behavioral Transition: A Framework for the Construction Conflict–Tension Relationship*. IEEE transactions on engineering management, 498-505. doi: 10.1109/TEM.2007.900784
- Yusof, A.M., Ismail, S., and Chin, L.S. : 2011. *Procurement method as conflict and dispute reduction mechanism for construction industry in Malaysia*. 2nd International Conference on Construction and Project Management, 215-219. Retrieved from <http://www.ipedr.com/vol15/42-ICCPM2011A10021.pdf> (accessed 23rd May 2014).
- Yousefi, S. : 2009. *Attitude-Based Strategic and Tactical Negotiations for Conflict Resolution in Construction*. Retrieved from https://uwspace.uwaterloo.ca/bitstream/handle/.../yousefi_saied.pdf.pdf? (accessed 19th March 2014).