
Building Information Modelling for Collaboration

1. Introduction

In AEC (Architecture, Engineering and Construction) industry construction process is a vast course that includes different phases under it. Interdisciplinary teamwork has traditionally revolved around the distribution of 2D drawings and documents in the architecture, engineering and construction (AEC) industries, until recently collaborative practices remained 2D-Based (Singh, Gu and Wang, 2011). Numerous individuals in professional have differentiated collaborative work within the team of consultants and contractors as a working technique that can enable corporations to become more competitive and profitable (Yeomans, Bouchlaghem and El-Hamalawi, 2006). Collaboration in construction method is a need to advance the quality, design management and time management of each project. The term “collaboration” was defined by Anon (2010) as the act of “working together”. “Construction projects are becoming much more compound and difficult to manage” (Alshawi and Ingirige, 2003, Chan et al., 2004, Williams, 2002). Collaboration on construction projects is closely linked to connectivity and seamless exchange of knowledge among stakeholders (Walker et al., 2017). Recent improvement in internet collaboration over various software give Architecture, Engineering and Construction (AEC) industry the ability to follow innovative trends instead of conventional methods (Johnson et al., 2002). As one of the most ground-breaking developments in the Architecture, Engineering and Construction industry, BIM (Building Information Modelling) will help project management in the areas of procurement, design management, collaboration, pre-manufacturing and facility management (Bryde et al., 2013). BIM-enabled projects are typically managed by BIM-based Construction Networks (BbCNs) comprising associates of special groups, which are contracted to perform BIM-related works (Grilo et al., 2013). BIM is one of the significant areas of current research into Virtual Reality (VR) and is expected to see effective collaboration and improved data integrity (Ellis et. al, 2006). Building Information Modelling (BIM) as a course is defined by international standards as the “shared digital depiction of the physical and functional features of any built object that provides a reliable basis for decisions by using different software like Revit and Autodesk Navisworks (ISO 29481-1, 2010). Figure 1 Explains about the lifecycle of BIM which includes various headings focusing on collaborative projects. It is about the integration of research completed by various team to create a mutual structured model for a explicit project on a given platform. Collaboration involves contractors, engineers, architects, and other subcontractors working on a project.

Figure 1. BIM LIFECYCLE by Planning, BIM & Construction Today, 2018

2. Literature Review

Collaboration is central in the effective execution and implementation of any form of project Construction is a highly project-based industry (Morris, 2004), in which various companies must work together through complex working partnerships with each other (Cao et al., 2018). Since construction projects include complex tasks, team members working on these projects need to collaborate (Alreshidi, Mourshed and Rezgui, 2016). Collaboration in AEC (Architecture, Engineering and Construction) industry includes people who work together by sharing information and processes through interaction, communication, exchange, coordination and

approval; therefore, team collaboration is required in order to share visions among stakeholders and to optimize team effort on an explicit job (Ilich et al., 2006).

2.1 Design Management

When a combination of AEC professionals come and work together, Design management and building projects usually take place. Design management can be enhanced by using new practices and approaches pioneered by building information modelling (BIM), and lean construction. Figure 2 Clarifies about the design management process by using BIM to reduce errors and collaborate with all the consultants working together for a specific project. It initiates with the project documentation to further design and operation of the project.

Figure 2. Design Management using BIM by Gu and London, 2010

2.2 Building Information Modelling for Collaboration

[bookmark: bbb0340]Building Information Modeling (BIM) within the AEC business, which can be defined as a socio-technical process; integrating man-made technology with social behaviors to allow collaboration across the lifecycle of the project (Building Smart, 2016) has revolutionized change management in projects. With the advent of BIM, its technical capacity to promote a collaborative atmosphere was a significant motivator for building projects in their push toward execution of BIM (Hosseini et al., 2016). The BIM-Level 2 collaboration framework has revolutionized the detection, review, tracking and regulator processes of change (Karen B. Blay et., al, 2017). Collaboration has been developed between Level 2 teams, followed by BIM phase as per Singh et al., (2011). The BIM Framework collaboration offers information for those who are 'ready' to BIM or who are actively implementing BIM, including those market participants who tend to be at the following levels at levels 0, 1 and 2 (RAIA, 2009). BIM capability levels (or BIM phases) define minimum BIM requirements (Succar, Sher and Williams, 2012). The following BIM stages/levels are listed in Figure 3.

Figure 3.- Levels of BIM by Source: Gu and London, 2010

Asghcraft, 2008 stated that Without collaboration BIM-enabled project means nothing but 'scratching the surface'. Instance for collaboration in BIM- based construction networks (BbCNs) was synthesized into the so-called Collaboration Pentagon. These backgrounds to BbCN 's collaboration are "context", "team", "process", "task" and "actor". Figure 4 Illustrates the collaboration pentagon.

Figure 4. Collaboration in BbCNS through collaboration Pentagon by Oraee, 2017

2.3 Scope and Future of Collaborative working

With BIM, there is a scope in collaborative working. BIM comfort out the work for exchanging statement between the teams working for a project. Implementing BIM in building projects can solve construction problems such as delays, design conflicts, and disagreements among build parties. Figure 5 explains about the possibility of collaboration with implementing BIM in a project indicating direct and indirect contribution with the mentioned work.

Figure 5. Scope of Collaboration using BIM by Zhao et al., 2015

Cloud-based computing enabled collaboration in real time and enabled BIM design to be extended to the construction phase (Porwal and Hewage, 2013). With this innovative feature, designers can share the data online with all other team crews while giving them access to edit and upload update files. (Underwood and Isikdag, 2010) Points that 'cloud computing' will enable the next generation to make full use of 'BIM' in which the virtual structure model moves around the building cycle.

Innovative BIM-enabled tools like Knotworking which is practiced in building design is another futuristic tool for collaboration work in AEC industry. Knotworking helps in coordinating with different design discipline through collaborative task. Through knotworking a team of members, are organized to work for minimum period to solve any error or problem occurring the task (Eadie et al., 2013). The tool is a flexible practice in which consultants and professionals work through collaboration (Kerosuo, 2017). Knotworking enables a new way to set up meetings instead of traditional meetings. Knotworking gives immediate solutions to problems (Koskela et al., 2002). Knotworking is more likely to Big Rooms in which all the technical team works under a roof and share instant information to get solutions more effectively rather than working separately (Kanzode and Reed, 2008)

Conclusion

The paper critically elaborated on AEC (Architecture, Engineering and Construction) industry and how vast it is. Due to increment in late project deliveries and errors due to lack of collaboration, there is a huge demand of advance collaboration techniques for the architects and other technical consultants working in the same field. In addition, Application of BIM (Building Information Modelling) in construction could lead to effective project building by enhancing collaboration between the stakeholders and the consultants working for a project. For any project, management is a major factor to deliver it on time while maintaining the quality of work done. BIM (Building Information Modelling) tools for Design Management will aid in management of construction projects by making diverse processes to work on a definite project. Research indicates that the dimensions of stakeholder engagement related to its implementation yield the highest positive financial impact within Building Information Modelling (BIM) during the life cycle of a project (Eadie et al., 2013). Different levels of BIM show various new techniques to ease out the work for the experts working in the field. Collaboration is done at Level-2 BIM in between the consultants. Apart from that, there is a huge scope in future of innovative techniques for doing collaboration for instance, cloud computing. Avoiding traditional meeting manner and opting new tools for instance, Knotworking and Big Room will enhance the work quality by avoiding technical errors occurred while working with different teams of consultant. However, BIM implementation in the AEC (Architecture, Engineering and Construction) industry will be the key benefit in resolving the key challenges of the remote construction projects. BIM can take forward the industry to benefit in aspects like online collaboration, data sharing, design management, construction planning and monitoring.

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