IPD AND BIM: MAKING SENSE OF CHAOS?

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ABSTRACT

Why is BIM not working? Where in the world do we really have IPD (integrated project delivery)? The U.K. has failed to achieve its Level 2 BIM goals. Hong Kong is striving to implement true collaborative contracting with pain share/gain share. Where really do the problems lie?

In a recent online article Boutle (2017) stated "Not all of the UK government central departments are BIM Level 2 ready despite being almost a year into the mandate." and followed up with "Supply chain drivers for adopting BIM are mainly to satisfy the end client, not to look at internal benefits of improved information management, smarter working and gaining efficiencies." So, one of the BIM-leading nations that was heading the drive to implement BIM on all government projects by 2016 has missed its target by some considerable distance. It is obvious from the evidence and rhetoric that BIM is not well understood, well accepted nor of value to many in the supply chain. Therefore, it is not the panacea for increased industry efficiency and effectiveness that it was held up to be. Why not?

What is really happening? We present a case study that explores current BIM implementation for MEP (mechanical, electrical, plumbing and fire safety systems) coordination in Hong Kong. Data were collected by ethnographic participant observation over 4 months and one-on-one interviews from a social network perspective. We found that BIM implementation in Hong Kong is currently at a low "maturity" level with little transformation of existing procurement routines and with professionals still following their traditional roles within project teams. Collaborative contracting and IPD exist on very few projects. Plans to add high-value professional expertise into project delivery through BIM-enabled IPD adoption are not working in Hong Kong's construction industry. This is partly due to team members' reluctance to change and the power conflicts (bolstered by arcane contract terms) between organisations in the teams thwarting collaboration. Professionals' perceptions and attitudes towards BIM are embedded in the view they have of their social context. Power conflicts generated from hierarchical organizational structures and silo mentalities are a major challenge in implementing BIM-enabled IPD.

Keywords: *BIM; Integrated Project Delivery (IPD); Process Innovation; Professional Silos; Socio-technical Systems; Social Network Analysis (SNA).*

1. INTRODUCTION

The construction industry has been widely criticized for its fragmentation (Shirazi *et al.,* 1996; Baiden *et al.,* 2006; Howard *et al.,* 1989; Ahmad *et al.,* 1995). This is due to the rational human reflections embedded in the traditional culture of the construction industry over decades (Xue *et al.*, 2010), where the participants focus more on self-protection and economic benefits rather than excellent performance in project delivery (Latham, 2004; Egan, 1998). Increased complexity of construction projects (Gidado, 1996), lack of accurate building information and ineffective communication within project teams (Higgin *et al.*, 1965) are all reasons for this poor collaborative working environment, which leads to unsatisfactory project performance on all dimensions: time, cost, safety and health and quality.

In the last millennium (the 1960s), the Tavistock Institute (Higgin *et al.*, 1965) pilot study of communication in the building industry provided a full picture of communication issues on construction projects. Two major problems emerged: lack of accurate information on buildings to be constructed and poor communication among stakeholders, which led to inefficient building operations. They also indicated that these primary

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communication difficulties stemmed from problems in clearly defining the roles of resource controllers and the complex interaction of technical, economic and social forces (Crichton, 1966). In the follow-up research in 1966, the concepts of interdependence and uncertainty were identified as important characteristics of construction (Crichton, 1966), and were later recognized as the sources of complexity in the construction process (Gidado, 1996). Numerous attempts have been made to construct effective solutions to facilitate communication and collaboration within project teams (e.g. NEC and lean construction).

The integration process of IPD did not start with BIM but was driven by a desire to make project teams more cohesive, collaborative and competent (see, for example, Rowlinson and Matthews (1999) and Cheung et al (2005). However, researchers have suggested that BIM's positive impact as a driving-force on the integration of the construction project team should be emphasized (Taylor and Bernstein, 2009). In their research, they developed four paradigms for BIM implementation, which in terms of evolving order are visualization paradigm, coordination paradigm, analysis paradigm and supply chain integration paradigm. According to their findings, BIM's role in construction team integration evolves from the preliminary paradigm of visualization to advanced level of supply chain integration with increasing project experience at a firm-level. They also assert that each paradigm has a different impact on final project performance: if the paradigm adopted by the stakeholders at firm-level in the AEC industry does not evolve to a higher paradigm, it would be unrealistic to expect to fully realise the advantages that BIM brings (Taylor and Bernstein, 2009). Underpinning this argument, but rarely articulated, is the need for information and information flows that enable collaboration. Thus, currently, we find ourselves in a partial BIM world with imperfectly integrated project delivery.

Though BIM was proposed as an innovative solution to the fragmentation of the construction industry, the nature of fragmentation itself turns out to be one of the factors inhibiting further successful implementation of BIM (Gu and London, 2010). Observation of current BIM practice indicates that a collaborative atmosphere with collective participation and contributions from all the stakeholders in a building project is highly effective (Gu *et al.,* 2008), rather than the innovation of BIM itself. In fact, Tavistock Institute's study (1965) asserted that improved communication techniques themselves in the construction process will add little value to the improvement of co-ordination and cohesion in the building team. However, the pattern of relationships and responsibilities within project teams have much greater influence on the way communication functions (Higgin *et al.,* 1965). The study conducted by Dossick and Neff (2010) showed that BIM's positive influence on project integration is limited to the technological level; the key to team cohesion is still based on human factors. Our case study in this paper also reveals that BIM's advantages as an efficient and effective collaboration platform are overestimated. Implementation of BIM without moving to IPD and, at the same time, ignoring social and behavioural perspectives that come with process and technological change is the source of many of the problems in leading BIM adopters around the world (Ashcraft, 2008).

Gledson (2017) found that "During implementation stages of BIM innovation adoption, organisations may have to make use of hybrid project delivery methods on initial adopter projects while also working concomitantly with existing systems, processes and personnel not yet ready to adapt to BIM methodology." The key issue he raises is the need for organisational change and development of "hybrid" project delivery processes to enable information flows, information sharing, and information use. Over 50 years after Higgin and Jessop and Crichton the same issues emerge in a more sophisticated socio-technical system. We are still in chaos.

2. SOCIAL NETWORK ANALYSIS

By adopting social network analysis (SNA) to identify and quantify changes in actors' roles and relationships (Pryke, 2004), this case study explored the driving-forces for effective integration of the project team.

An accepted definition of SNA is given by Mitchell (as cited in Loosemore, 1998), which is "a specific set of linkages among a defined set of persons, with the additional property that the characteristics of these linkages as a whole may be used to interpret the social behaviour of the persons involved." Podolny and Page (1998) provided a definition of an inter-organizational level network as various patterns of collaboration, including joint venture, strategic alliances, business groups, franchises, research consortia, relational contracts, and outsourcing agreements. In fact, the concept of social network is widely used from the interpersonal level to the international level (Bazzoli *et al.*, 1998; Park *et al.,* 2009; Schilling and Phelps, 2007; Van Raak and Paulus, 2001). SNA is useful in providing a stage for a fresh perspective on socio-technical studies.

In construction projects, formal and informal relationships of stakeholders can be depicted as social networks, the points or nodes represent the stakeholders and the lines indicate the relationships. By analysing characteristics of social networks, important information can be explored, such as “who is the key stakeholder to the project’s success”, “How do themain contractor and sub-contractors cooperate with each other”, “How effective is cooperation” and “How has each stakeholder performed?”

3. SNA CASE STUDY FINDINGS AND DISCUSSION

3.1. EMBEDDED NORMS AND PROFESSIONALISM

Embedded norms (the customary rules that govern behaviour) `appeared as a great hindrance to successful BIM implementation. Any innovation’s implementation will inevitably go through a process from original tentative or compulsory adoption to norm change and then on to culture formation. Before the innovation is completely accepted by a given group, the old working paradigm plays the role of inhibitor. An interesting phenomenon in our third site visit occurred; we witnessed a direct 2D drawing exchange and submission rather than formal submission to the integrated database of BIM. A designer from sub-contractor A delivered a copy of an updated drawing directly to one of the BIM coordinators. This may save time and effort to submit and download from the database for one team; however, this behaviour led to disputes later because no formal records appeared in the BIM system. Another interviewee flagged this as normative behaviour that happened frequently during team members’ daily information exchanges. This confirmed that BIM is not actually accepted by the construction team as a powerful information storage and exchange system and, more importantly, IPD is thwarted by such actions.

Interviewees indicated that there is indeed a misconception that BIM is a 3D model not an information repository. Thus, it is essential to create a new professionalism within project teams to improve collaboration enabled by BIM systems. Professionals’ motivation to voluntarily collaborate, to share knowledge and sharpen their skills are all based on their value judgments and the formulation of moral and ethical codes, internal power structures and professional silos. SNA enabled the exploration of formal and informal relationships among project teams and the impact on IPD implementation.

The formal relationships embedded in the contract and the organization chart stimulate power conflict and hierarchy among team members. This works against developing an effective mechanism to facilitate better collaboration. In the Hong Kong context team members’ decisions depended on their superiors’ instruction, reducing project team efficiency. However, by appropriately utilizing the formal system, the effectiveness of team collaboration can be improved. In our cases, for example, if an individual started to exert a negative influence on team collaboration, complaints were made to senior managers; by rearranging members in intra- and inter-team groups collaboration effectiveness was enhanced although the decision-making process was less efficient.

Compared with formal structure, informal networks of relationships are less powerful in decision making but engender mutual trust and social capital enabling smoother information exchange and knowledge sharing (see, for example, Koh *et al.,* 2015). In the context of IPD, responsibilities are more explicit but professionals are driven to learn across disciplines. Knowledge sharing is a characteristic of successful IPD implementation.

3.2. ROLE CHANGE AND PROFESSIONAL SILOS

Nominal role change was observed during the IPD implementation process. With BIM, new positions such as “BIM coordinator, model coordinator and BIM manager” emerge. These coordinators were promoted from positions of draftsman, modellers, CAD supervisors or MEP engineers. They do the same coordination work in an IPD project as they did in the previous traditional projects, in other words, the role changes are nominal with similar work content and procedures. BIM merely provided advanced visualization techniques for clear coordination rather than a new pattern of collaborative relationships under the role changes. Information was oftentimes not included (physical model LOD1) or not used if it was included. Thus, we have the newly crowned BIM king without his clothes.

On the other hand, the introduction of IPD and BIM brought about role changes. For instance, engineers are skilled at checking section views of drawings and updating all revised 2D drawings in their head. However, it is more convenient and precise to check all the information in the BIM model and so the role of these engineers changed. In our case, the need for engineers reduced as the project proceeded. This change is unnerving for professionals if not managed by training, redeployment and providing employee satisfaction with a more rewarding and less stressful role (see, for example, Yip et al, 2008 and Lingard *et al*, 2007)

3.3. ORGANIZATIONAL BIM CAPACITY AND PROFESSIONAL SILOS

An organization's BIM capacity is based on its professional competences. If organisations can discard the criteria of profit growth and cost reduction first and combine social and environmental considerations during their business operations, they will appreciate BIM's core value for facilitating the removal of fragmentation in the construction industry through providing an information processor for IPD. The goals and ideals of IPD can be achieved through this facilitation only if the change is managed. This change is causing organisations to rethink and redefine "the nature and scope of their service, as well as the concept and understanding of project value". The focus is moving toward improving IPD capacity in order to meet or to drive the market trend in Hong Kong towards collaborative contracting underpinned by the NEC contract with pain share, gain share.

3.4. LOCATION-DEPENDENT CHANGE AGENT AND PROFESSIONALISM

The nature of the change agent is of great importance to an innovation's adoption. The agent often needs to come from a different location and cultural background because the vast majority think in traditional system paradigms that are closed and ingrained. For instance, institutions such as the American Institute of Architects, University Offices of Physical Plant and several major engineering companies have driven IPD implementation in the USA. In Australia, several major contractors are enthusiastic proponents whereas MEP companies are driving BIM adoption in a non-IPD environment. In mainland China, due to institutional stasis and rigid governance structures, further BIM implementation for integrated project delivery is facing tremendous challenges.

3.5. MATURITY OF IPD, BIM AND PROFESSIONALISM

Based on his Capability Maturity Model, Succar (2009) assesses BIM (and IPD) maturity within industry, organizations, and individuals. The term maturity defines the quality, repeatability, and degree of excellence within a specific field, be it BIM or IPD. In his studies, Succar defined each stage as having specific attributes (Succar, 2010):

- Initial / Ad-hoc stage
- Defined stage
- Managed stage
- Integrated stage
- Optimized stage

Recognizing where an organization sits and moving it through planned change is essential for IPD implementation. This socio-technical system is reliant on people with talent and training, organization structures that are flexible, responsive and supportive and technology that is readily accessible and facilitates information sharing. Companies need to make use of maturity models to facilitate and monitor improvement of their capabilities and achieve the benefits that come from process improvement (Dossick and Neff, 2010).

The professional silos need to be broken and a climate of trust and collaboration engendered, with best for project philosophy underpinning the project teams' actions. The technological change agent has been BIM. To continue this process, the social change agent must be institutional and team leadership. IPD is a process that is facilitated by information sharing (BIM) and is founded on trust and collaboration (people).

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