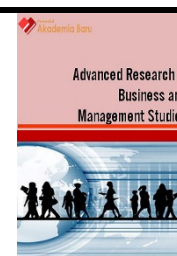




## Journal of Advanced Research in Business and Management Studies

Journal homepage: [www.akademiabaru.com/arbms.html](http://www.akademiabaru.com/arbms.html)

ISSN: 2462-1935



# An overview of contract documents for building information modelling (BIM) construction projects

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### ARTICLE INFO

### ABSTRACT

#### Article history:

Received 7 July 2017

Received in revised form 15 July 2017

Accepted 15 August 2017

Available online 25 August 2017

Building Information Modelling (BIM) enables close collaboration among project stakeholders to visualize what is to be built in a simulated environment by identifying any potential design, construction or operational issues. Despite the fact of its well-documented benefits, the extensive integration of BIM throughout the project lifecycle remains sporadic. The conventional contracts used in the Malaysian construction industry were established before the development of BIM. As BIM becoming ingrained in the delivery process, the inadequacies of these existing contracts have become visible. This paper presents a review of recent studies through a procurement approach of BIM to establish the contractual context by addressing the commercial considerations and probable legal risks of professionals in Malaysia and other countries. This paper also outlines the reasons why the implementation of BIM will foster the evolution of integrated contract delivery methods.

#### Keywords:

Building information modelling (BIM),  
contracts, issues, legal risks,  
procurement

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## 1. Introduction

Building information modelling (BIM) promises outstanding results of the construction process. The results can be determined through the measurement of the yardstick and an international benchmark for efficiency in Architectural, Engineering, and Construction (AEC), and host of other building services [1,4]. The process of BIM can enhance knowledge sharing for information of a building or facility. It forms a strong fundamental for decision making throughout the life cycle phase from the conceptual design to demolition [2,8]. BIM is a useful multidisciplinary integrated source of information technology that posts benefits and disputes in the construction industry. This model is well recognized as fragmented, adversarial and possibly significant for or during the process of cultural revolution [4,6]. The legal issues of BIM are considered challenges that need to be addressed accordingly. One of the issues is the need to establish contractual arrangements to accomplish BIM

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positive outcomes [6]. The existing laws, regulations and the contract model lack relevant provisions for the cooperative design and the information versions of all stakeholders collaborated in the construction project could not cooperate extensively [2,8]. It has significant impacts on how project stakeholders collaborate and the legal implications that can emerge from any disputes.

BIM has become the potential risk to construction projects contracts because there is no legal status of electronic information and electronic versions could not be filed, which results in duplication of information gathering work [8]. It is crucial to understand the purpose of using BIM and the way it benefits a project, which is likely to facilitate the essential foundation to form the applicable contractual context [6,11]. The structure of this paper is as the followings, section 2 introduces the research methodology that details out the various aspects of the proposed research. Section 3 aims to provide an overview of probable project risks and barriers that are minimized administratively or contractually relating to BIM. Subsequently, section 4 analyzes and synthesizes the literatures towards developing a new framework and strategy to contract delivery may necessarily need to expand.

## **2. Research Approach**

The focus of this paper is on BIM contract documents conceptualization and implementation. Databases were searched for construction projects articles using the key words, 'building information modelling (BIM)', contracts, legal risks, issues, and procurement with further subcategories. The key aims and objectives of this paper are to provide a better understanding of BIM to conceivably evolve the construction industry's avenue of approach to the current challenges of contract delivery methodologies in both theoretical and practical aspects. The challenges involve people, policy, process, and technology that determine the stakeholder roles, their information rights and liabilities, their BIM access (read, write) or their obligation to provide a special functionality or data output [10].

## **3. Findings of the Review**

Besides considerable benefits of BIM for project stakeholders, there are several risks and barriers to implementing BIM. However, for the purpose of this study, these hindrances are categorized according to specific aspects namely; BIM as an information source, BIM legal and contractual impediments, intellectual property (IP), liability and process-related risks.

### **3.1 BIM as an Information Source**

BIM is usable for multiple purposes, which requires the source of interrelating information by providing the structure, format and relevant content [12] where the model and the data can be extracted and reused to prevent rework or the need to reproduce work. Kuiper et al.,[6] indicates that there appears probable risk scenario for owners' responsibility in building/infrastructure assets with regards to traditional contracting delivery methods and to be applied at each stage of the built environment cycle. Alternatively, an industry may differentiate the terms between 'Design Intent BIM' (known as Design BIM) and 'Construction BIM'. In particular, 'Design Intent BIM' encompasses the information commonly originated by designers or consultants, while 'Construction BIM' incorporates the mechanical, architectural and structural details for assembly and installation as prescribed by trade contractors [2,4].

### *3.2 Legal and Contractual Impediments with BIM Deployment*

Significant efforts have been devoted on the implementation of BIM in the AEC Sector to boost the development of Information and Communication Technology (ICT) in Malaysia and other countries [3]. However, Steward et. al., [11] stresses that many industry players are unable to gain the benefits of BIM besides technological and cost hurdles from the context of BIM legal issue [1,7]. Research on BIM legal challenges has focused on two primary aspects. The first aspect is to identify the legal issues [1,7,9] and potential challenges in the construction industry. The second aspect is to develop a procurement framework for delivering a BIM in the light of collaborative work-practices [1,6]. Nevertheless, the time-lapse of previous research is quite long where the current contract documents fall off behind technological advancements that do not extensively consider the interrelation between legal issues and the procurement approach faced by the project stakeholders [6,8,11]. Therefore, there is the necessity and feasibility of establishing contracting document management system that allow the deployment of an integrated BIM.

### *3.3 Intellectual Property (IP)*

The protection of intellectual property is crucial for project stakeholders to identify and define in any event that requires consideration to regulate the ownership of IP (and any licensing arrangements, either actual or implied) in a BIM contextual setting [6]. To distinguish IP in the model, areas that need considerable attention include element parts, trade secrets such as construction techniques and sequencing embedded data or databases, file formats in an integrated system, and private information [7,8]. Given that the demand for BIM is increasing, Azhar et. al., [2] asserted that the development of more sophisticated platforms is imperative to enhance the level of achievement by delivering IP in a collaborative environment, then it increases the complexity of IP allocation. As far as the authors are concerned, significant efforts have proposed the need to define IP in integrated BIM models and the virtual collective working environment.

### *3.4 Liability*

Professional Indemnity (PI) is a primary concern for design authorities who are involved in a BIM collaborative atmosphere [9]. These authorities are obliged for the design contributions to non-professionals, including automatic changes by software. The promising multidisciplinary platform where information is provided by an author or BIM contributor (as a recognized professional) and adopted (or relied upon) by other BIM contributors or another party were acknowledged as part of a process related risk [2]. The issue could arise in contract negligence (either as a duty to a client, contractor/consultant or to a third party) which was not foreseeable [6,7]. Therefore, it is necessary to develop collaborative and integrated contracting methodologies to avoid disputes among project teams involved. Hence, future research should highly consider the design delegation to non-professionals and subcontractors, as well as the effect of software on design updates.

### *3.5 Process-Related Risks Allocation*

Legal, contractual and organizational risk are different forms of risks associated with creating, using and managing BIM-related information. Due to a lack of determination of ownership of the BIM data, the protection of ownership is needed regarding copyright laws and other legal channels [2,6]. When BIM is adopted by the project stakeholders or contracting parties, it is essential for them to

develop specific agreements or contractual provisions to address any contractual interfaces, BIM-related requirements, and the limitations of contractual documentation in the current Malaysian market. The best solution for the disagreement over copyright issues is to set forth the documents ownership rights, responsibilities, authorized users, and sensitive information in integrated project delivery (IPD) [4,6].

#### 4. A Way Forward of BIM Contract Documents

According to the integrated project delivery (IPD) system, the existence of project procurement systems from the practical, technical and industrial advancements alter the project's delivery to implement effective BIM [6,10,11]. American Institute of Architects (AIA), the Associated General Contractors of America (AGC) and Consensus Docs work on respective contractual guidelines and publish contract samples [3,5,11] in enabling BIM project stakeholders (including contracting parties) to plan, design, review, program, cost or manage projects. However, the standard practice of International Federation of Consulting Engineers (FIDIC) contract documents in Malaysia, the contractor constructs the works; designed, civil, mechanical, and electrical and construction works following the design provided by the employer [13]. Essentially, it signifies opportunities to expedite (or even partially automate) the transition from Design Intent to Construction BIM through developing a dataset of digital mechanical, electrical and plumbing components that can be integrated into the design and for modelling. Nonetheless, issues relating to legal uncertainties in BIM implementation and fee specifications in the local and international construction industry remain unresolved. Since many processes in facility management (FM) and deconstruction are not aligned with BIM, there are no specific contracts developed and standardized for integrated practices to date [3,10].

Although the updated BIM content is crucial for maintenance, retrofit, and deconstruction planning, the onus of the model and content management during the maintenance has not been addressed by previous studies and legal frameworks [2,6]. The rapid development of new technology combined with the lean principles have also guided the project teams to eliminate waste during the construction process [6,8]. Therefore, it is essential to develop new approaches to and strategy for BIM contractual document frameworks. When these tools are used properly, they can change the way an owner makes a contract with a project team.

#### 5. Conclusion

The systematic reviews have identified some obstacles when deploying the integrated BIM contract documents. Several elements such as intellectual property, liability and project-related risk should be considered in the current projects that are delivered for contractual and administrative purposes, which are expected to align with the optimal use of BIM. The applicable approach is vital as solution of the perceived fragmented and isolated approach in the current construction practices. This may also represent a new frontier for innovation in the construction industry of Malaysia. In fact, the integrated BIM contracting provides significant opportunities that are yet to be discovered in this particular industry.

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