

THE LEGAL FRAMEWORK FOR DESIGN LIABILITY IN BUILDING INFORMATION MODELLING

Thilina Laksiri Dissanayake*, Himal Suranga Jayasena and Mahesh Abeynayake
Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

Building Information Modelling (BIM) is a solution to achieve productivity, efficiency, life cycle enhancement and sustainability in the construction industry. It also promotes the two symbiotic factors information sharing and collaborative approach among the professionals. Transference from the conventional practice to BIM will make the design liabilities change and create legal uncertainties among the professionals. This was expected to be acting as an obstacle to achieve the desires in BIM's wider adoption and a suitable legal framework was found to be necessary. The solutions for the legal uncertainties arising from the new environment needs to be formulated and on the other hand in order to adopt BIM in an effective manner it requires identifying of these legal uncertainties and provides a clear vision for the client and the design team on how they should work in the changed environment. With this prime intention, this research was conducted adopting mixture of legal and scientific research methods. Initially preliminary literature synthesis was carried out which discussed the present legal environment with the expected change through BIM. The legal analysis was carried out following the flexible iterative style where the researchers' opinion blends with the experiences from primary sources of law to build up the tentative hypothesis. Through semi structured interviews with a group of experts representing different proficiencies in the construction industry, this tentative hypothesis was tested; the collected data from construction industry experts were subjected to content analysis based on opinions and suggestions, these findings were then interpreted to identify the suitable legal framework. The legal framework which was identified includes the preventive mechanism of negligent acts, liabilities of the human factor, process and enforceability, actions, proposed provisions and suggestion. Hence, this framework is recommended to be implemented in the BIM environment.

Keywords: Building Information Modelling (BIM); Construction Industry; Design Liability.

1. INTRODUCTION

Building Information Modelling (BIM) is gaining its popularity in the construction industry as the latest innovation where the project team members are to work in a common platform. While working in such environment the possibility of legal uncertainties arising are high, particularly in terms of design liability. These legal concerns in fact are a reason for the reluctance of BIM adoption. The research study presented in this paper aimed to identify the legal framework for BIM's wider adoption.

2. BACKGROUND

The construction industry is being transformed by the Information and Communication Technology (ICT) which has the capability to provide better information to create cooperation between team members in a productive manner (Williams, 2007). BIM tools brought novel approaches that changed the way the Architecture Engineering Construction (AEC) industry is working and it enhances the collaboration among project team (Weygant, 2011). Different stakeholders have different uses of BIM and with it they get the capability of analyzing and predicting outcomes throughout different phases (Reddy, 2012).

BIM implementation is a social act and it is not just loading and running of a software (Deutsch, 2011), with the problems of the computer software, it will lead to unexpected results if the required information

* Corresponding Author: E-mail-thilinal.dissanayake@gmail.com

is not provided on time by all the participants (Jayasena and Weddikkara, 2013). Furthermore, Succar (2008) expressed that BIM policy is one of the interlocking BIM fields of activity which has to interact with the technological and process fields for a successful BIM framework. Even when developing a non proprietary interoperable schema like Industry Foundation Classes (IFC) will require policy field to identify “rules for decision making” while interacting with the technological Field of BIM.

When BIM level changes from team creating their own model to where all team members can access, the legal relationships will change, thus will occur legal uncertainties which needed to be answered in order achieve the original goal of BIM (Glover, 2013). Meanwhile, Wickersham (2009) explained that in addition to the legal concerns in the non BIM construction industry, other technological and policy issues inherent to BIM platform will affect the workflow once BIM is implemented and that these legal questions need to be remedied soon before it affects the future projects.

3. RESEARCH METHODOLOGY

The philosophy for the research included in this paper, was identified to be more towards the social-constructionism and the research approach was identified to be the qualitative inductive approach. Firstly the literature review was carried out using law texts and research articles to identify the legal environment which affects the delivery of construction projects. Here it was focused only on law of torts (professional negligence, contributory negligence, and vicarious liability). Thereafter, the tentative hypothesis was built based on a legal perspective where the general legal research methodology of analyzing the statutes in legislation and case laws was adopted. The research process was followed by the semi standardized open ended interviews with the experts with the priori codes developed by the tentative hypothesis. Moreover, appropriate data analysis method was found to be content analysis using Nvivo software and followed up by qualitative analysis to identify the suitable legal framework.

4. THE LEGAL ENVIRONMENT

A legal environment is established to ease the workflow and bring professionals with different mindsets to exist without affecting their counterparts in the construction project delivery. The parties to fulfilling certain obligation to another need not necessarily be agreed upon by a contract, but they hold a social responsibility to perform their duties with due care. Following is a brief of the legal environment where the design team has to work.

4.1. THE DESIGN TEAM IN THE LEGAL ENVIRONMENT

In the construction village client is expected to protect the design team values (Russell, 2006) but they are still in a quest and in expectation that design team will fulfil their non expressed feelings as well (Kamara *et al.*, 2002). On the other hand Bender and Septelka (2002) was in the view that design team has to work with team qualities and with an encouragement for cooperation. The duties of the design team are defined in legislation and by case laws. Moreover they have to adhere to the expectations, otherwise as Bender and Septelka (2002) mentioned not only disputes will arise, but it will also create an unpleasant environment where the project can no longer continue.

4.2. LIABILITIES OF THE DESIGN TEAM

Designing is an iterative process with incessant refinements and this is because of the changing mind of the client and the designer(s) (Tolson, 2007). These changes do affect the construction and create conflicting situations. Therefore, it is necessary to determine the category where the problem fits in so that the legal ramifications become clearer (White, 2008). Holyoak (1992) stated that “negligence” and “carelessness” are too broad categories to form a meaningful legal discussion. It is necessary to decide whether the defendant is proved guilty on the three sub-division’s duty of care, breach of duty and damages (Donoghue v Stevenson, 1932).

4.3. BIM AS AN ADVANCED OVERWRITE

In an instance where construction is the slowest to advance in technology of all other fields (Bock, 2014), BIM will act as technological catalyst which changes the construction industry with productivity and efficiency while giving recognition to the information of the facility in addition to the facility itself (Jordani, 2008). BIM is a process change rather than a technological change where the documentation is also done in a virtual format and used in the traditional construction process. Succar (2008) in his implementation framework suggested that technology, process and policy fields needs to interact and knowledge transference among these fields is essential for a conflict free delivery of a facility. His framework was also in suggestion that the liabilities of the BIM players will change and with this influence and thus necessary policies need to be developed.

4.4. IMPROVEMENT OF COOPERATION AND COLLABORATION

The increasing diversification and complexity of construction projects requires trust between different project partners and cooperation and coordination, and to achieve this optimization the information systems established has to facilitate the sharing of diverse types of information not only accurately but in a timely manner (Anumba *et al.*, 2008; Maunula, 2008). When BIM exceeds the existing practice in terms collaboration and communicating different characteristics there should be a process of documenting (Lee, 2008). According to Nemtschek Vectorworks (2014) the collaboration between parties are restricted by the lack of coordination, lost of information during data conversion, misinterpretation, limited utilization of building data created by others, other coordination issues and lack of detailed model for construction. BIM enables a situation where the workflow has to change for it to be properly implemented (Hardin, 2009). The new streamlined project delivery is an integrated system and the design liabilities will increase with the design phase extends till the construction phase (American Institute of Architects, 2007).

4.5. THE HUMAN AS A DRIVING FORCE IN BIM

With the implementation of BIM, it is necessary to manage the model and assign authority to access the model and ensure that the data entered is well structured to avoid conflicting situations. This new position is referred to as a BIM manager where he is expected to manage information process more than the design coordination. With the creation of special duties with BIM it is understood that the human factors is the most vital, when implementing BIM the people-oriented factors are the greatest challenge than solving the software, business or technical problems of BIM (Deutsch, 2011). Even then there is a high risk in sharing of the BIM model due to mistakes and misunderstandings of the collaborating design team (Autodesk, 2008). The working mindset is divided into two as lonely BIM and Social BIM (Tocci, 2008). Social BIM is the mindset to be achieved not only to provide benefit but to enhance collaboration with team members. It was clearly identified that sharing of information and collaboration of professionals are symbiotic factors in BIM which differentiates it with the conventional practice. Therefore it was concluded that change in legal position is evident with the implementation of BIM and need to be remedied.

5. THE ANALYSIS OF LAW WITH THE CHANGE IN SCENARIO

It was identified in the tentative hypothesis that original liabilities of the traditional practice exists but it may change with the BIM environment and assigning of new roles. When it comes to the professional negligence it is strict in BIM due to the virtual creation of the model depends on a collaborative workflow. Therefore, the designers are expected to have an understanding of the information behaviour in the model. In the BIM platform contractors can also be considered as liable for contributory negligence with their involvement with the project from the inception stage. Furthermore, for the legal issues at construction will be an error due to the professional negligence of the contractor, even if it would be a design error of the design team according to contributory negligence their claim will get reduced.

Since BIM manager and coordinators hold the strategic and management level of BIM they have to be aware of the fact of vicarious liability, the designer(s) fault will be BIM management team's vicarious

fault as they too owe a reasonable duty of care over the design. BIM also has to answer the joint liability for the matter of fact client seeks legal service for the negligence of the design team. It becomes much complicated in a BIM environment where a faulty design can paralyze the flow of the project. The case become even worse since the level of responsibility is not clear in the BIM platform. The preventive remedy for the complication is to keep records on the level of responsibility and keep the design team informed on what is expected by them.

The tentative hypotheses derived from the legal analysis mentioned above were converted to priori codes as given in the table 1 below.

Table 1: Priori Codes from Tentative Hypothesis

Area of Law	Acts and Case Law	Priori Codes by the Tentative Hypothesis
1. Design Liability And Professional Negligence	Hedley Byrne & Co Ltd Vs. Heller & Partners Ltd (1964)	1-1 Negligent conduct and awareness in decision making.
	Caparo Industries plc Vs. Dickman (1990)	1-2 Casual replies and mis interpretation.
	Greaves & Co (Contractors) Ltd Vs. Baynham Meikle and Partners (1975)	1-3 Adhering to professional definitions of duty of care.
2. The Contributory Negligence	The Law Reform (Contributory Negligence) Act 1945 (UK)	2-1 Negligent act by the injured party
	Forsikringsaktieselskapet Vesta Vs. Butcher and Others HL (1989)	
	Barlays Bank Plc Vs. Fairclough Building Limited (1994)	
3. Vicarious Liability	Hewitt Vs. Bonvin (1940)	3-1 Test of right of control and delegation of authority.
	Morgans Vs. Lunchbury (1973)	3-2 Position of the employee or the design team
	Gomien Vs. Wear-Ever Aluminum, Inc., (1971)	3-3 Selection of professionals and their conduct
	Morren Vs. Swinton and Pendlebury Borough Council, (1965)	
	Lister Vs. Romford Ice and Cold storage Co. Limited (1957)	
4. The Joint and Several Liabilities	Civil Liability (Contribution) Act 1978 (UK,1978)	4-1 Level of responsibility
	Zimmer Vs. City of Milwaukee (1992)	4-2 Law of tort and breach of contract.

6. THE TESTING OF THE TENTATIVE HYPOTHESIS

The tentative hypothesis was tested with 12 experts from the construction industry. The selection of the experts was done based on the knowledge they possessed on construction law and/or arbitration and/or BIM. Approximate average experience was 25 yrs/ Expert, 4 of them had knowledge on Construction Law, 9 of them had experience as arbitrators and 7 of them had knowledge about BIM, its process as researchers and as BIM professionals.

During the analysis, it was found that experts had expressed their views as general opinions and BIM specific opinions. Similar value had to be given for both, since general opinions cannot be set aside since a new introduction always has to be compared with the existing when identifying a suitable legal framework. The main understandings of the experts were that it is necessary to facilitate the BIM environment, so that the errors are reduced rather than making a strict rule over the design team. Out of the opinions a legal position was also found to be important since the premier intentions of BIM, information sharing and collaboration cannot be achieved without a smooth work flow. Additionally, fruitful suggestions were received which were also found to be of immense importance for the identified legal framework.

7. THE IDENTIFIED LEGAL FRAMEWORK FROM THE ANALYSIS

The identified legal framework will be as in the Figure 1 below, human factor will drive this framework. As they try to work in the BIM environment issues will arise and that has to be processed and identified to which category it falls into. Accordingly, actions will be taken and the decision will be evaluated. Originally formulated suggestions and new improved areas can be fed into the BIM environment and the decision making process to achieve the intended objective.

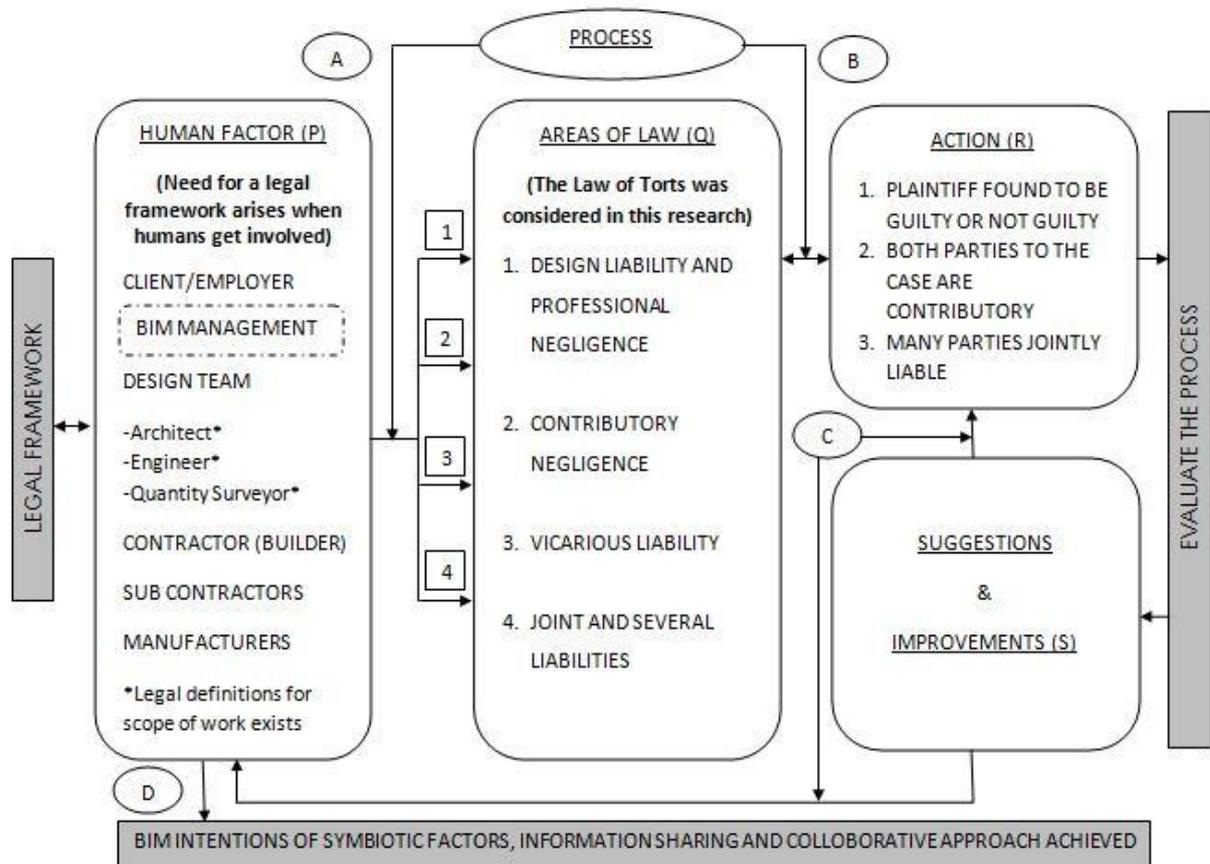


Figure 1: The Identified Legal Framework

7.1. THE HUMAN FACTOR IN THE BIM ENVIRONMENT

Human factor is considered as the drivers of this proposed legal framework, and following table 2 below will be the deductions in relation to the rounded rectangle names as “P”.

Table 2: The Human Factor in The BIM Environment

Legal Person	Explanation
Client/ Employer	Expected to be an expert client and has to be aware of the process and his responsibility for the final output will increase.
BIM management	Has to take the overall responsibility of the model and his liability would be to facilitate the design team with the BIM environment and ensure the smooth run of the overall project.
Definitions of design team	Will not change with the original definitions, same liabilities of the traditional context will apply
Contractor	Same in the traditional context will apply, additionally contractor in the BIM environment has to provide with construction details to the design team.
Sub contractors/ sub consultants	They have to be included in the model and the same conditions to the main contractor shall apply. They will hold equal liability for the final output.
Manufacturers/Suppliers	A Construction Business Model has to be created to retrieve the best manufacturer, but it has to be done by the contractor not the design team. Manufacturers in the BIM environment will hold liability to the extent of what their warranties mentioned.

7.2. PROCESS AND ENFORCEABILITY

Process and enforceability as depicted in oval named as process, will cover how each party is made liable and process of decision making for the wrongful actions they do. Oval “A” will represent the connector between human factor and the areas of law. This connection will be further described by the squares 1-4 and will cover the different viewpoints of the analyzed four areas of law which will make the human factor in the BIM environment liable. Oval “B” will represent the two way connector indicating the decision making process, and the process of feeding to the areas of law in the form of case laws. The aforementioned squares will contain provisions to enforce the identified legal framework. Following table 3 shows the provisions developed according to priori codes in table 1. The * mark represents that fact has to be answered by a technology based legal research.

Table 3: Process Enforceable Provisions for The Researched Areas of Law

Heading	Process, Liabilities and Enforceability
1-1 Negligent conduct and awareness in decision making	A professional in the BIM environment at all times shall try to solve the issues at the point of time it happened. If another professional sees that a negligent act by another professional would affect the project, he shall inform it to the legal professional indicated in the legal framework.
	The BIM manager shall not interpret information from the design team differently. Whatever happens in the BIM platform, except for the design liabilities of the design team, BIM management shall be responsible.
	Professionals have to be aware of the contractual terms with regard to the specific BIM environment addition to the implied liabilities they possess.
	Professionals shall not be liable for the faults of the software*, but they have to be aware and hold liability for the results given off by the software they use
1-2 Casual replies and mis interpretation	Contracts necessarily need not be in writing, a contract can be verbal or by conduct, following are the considerations, <ul style="list-style-type: none"> ▪ Whether a legally recognized relationship has come into existence. If so professionals shall not be relieved. ▪ Whether it was within the professionals scope of work
	Professionals are not considered independent in the BIM environment and cannot issue any authoritative decisions over an existing decision unless the party issued

Heading	Process, Liabilities and Enforceability
<p>1-3 Adhering to professional definitions of duty of care.</p>	<p>the original decision agree in writing.</p> <p>Each professional has to be responsible for their scope of work, and adhere with the legal definitions of that profession, and have a reasonable practice with care to avoid negligence.</p> <p>Professionals have to adhere to the standards of the BIM environment, Even though he adheres to the standards he will liable for the faults in the end result, if any.</p> <p>Professionals have to adhere to any liabilities imposed by the technological oriented framework[*] if there is any.</p>
<p>2-1 Negligent act by the injured party</p>	<p>Client is also liable under the contributory negligence since the client is expected to be an expert client, in the BIM environment. Client will be liable especially when,</p> <ul style="list-style-type: none"> ▪ He was negligent in delivering information on time, ▪ He declares the responsibility of the BIM model in writing, ▪ He involve with the specific design information and the extent of control he has over the design
<p>3-1 Test of right of control and delegation of authority</p>	<p>Design team shall take the responsibility of the designing and preparing the estimates and he cannot be relieved from the design negligence, if the contractor acts upon it due to the time constraints.</p> <p>Involvement of contractors from an initial stage in design shall not relieve the designers from the design responsibilities. However if the contract mentions that the contractor has to verify the design he shall carry out that task.</p> <p>Contractors are responsible for the methods in construction and on the materials they choose. Additionally in the BIM environment they may advice the design team on the methods, risk and on the actual costs. If they are negligent in these expected duties then they are liable.</p>
<p>3-2 Position of the employee or the design team</p>	<p>The client will be liable under the vicarious liability due to the following reasons,</p> <ul style="list-style-type: none"> ▪ He has to be aware of the design, ▪ Design team acts on behalf of the client, <p>Client is answerable to the third parties who get affected by the construction.</p> <p>Client shall then find who was actually responsible from the design team and may seek action to the extent that he did not maintain the retention of control over the design.</p> <p>Main contractors, main consultants are “vicariously liable” for the work done by the sub contractors and sub consultants.</p> <p>Since the professionals cannot be controlled by another professional a reasonable point of control has to be there, preferably client may authorize this power to the BIM management then they shall be vicariously liable.</p> <p>Client’s advisory team holds vicariously liability to the extent they involve with the design.</p>
<p>3-3 Selection of professionals and their conduct</p>	<p>Professionals generally owe a duty of care. Therefore they are liable for their scope of work. But the instruction flow and the intention of work will be used to determine who was actually responsible.</p> <p>Professionals cannot find, Para-professionals liable for any mistake they have done.</p> <p>BIM management shall take measures to avoid conflicts in integrating the design, while the design team will have the design responsibilities.</p>
<p>4-1 Level of responsibility</p>	<p>Client holds responsibility in selecting the professionals and he has to be knowledgeable of what they are doing, professionals shall provide timely information to the client.</p>
<p>4-1 Level of responsibility</p>	<p>The most likely responsible party has to be made liable if the evidences are clear, but if a professional continues disregarding negligence by another professional, that leads to joint and several liabilities.</p> <p>Even though professionals are working in a collaborative environment they shall not undertake another professional’s responsibility.</p>

Heading	Process, Liabilities and Enforceability
4-2 Law of tort and breach of contract.	<p>Even though Joint and several liabilities is clearly covered in the law of torts it has to be included in the contract due to the following reasons,</p> <ul style="list-style-type: none"> ▪ Appointing of sub consultants also need to be done according to the main contract ▪ The interpretation under IT environment will be different* ▪ Then it will be clear for all parties that they are covered by the Joint and several liabilities hence the negligence cases will be reduced ▪ Professionals show more concern when it is included in the contract <p>If a party clearly declares that they understand the risk of BIM and still they would go with it, then to the extent that the negligence act is due to the BIM environment, will not hold any party expect the declared party liable.</p>

7.3. AREAS OF LAW

This section is in relation with the rounded rectangle named as “Q”. The basic definitions of the legal areas are given in the Table 1. The original definitions under the legal systems in common law countries need not be changed and those original provisions apply as it is to this identified legal framework.

7.4. ACTION FOR THE NEGLIGENT ACTS

This section is in relation with the rounded rectangle named as “R”. A legal position has to be established not only to find remedy for the case at hand but to review the causes for the case and evaluate the process. Then he can feed the findings to the system and use some of them for declaring a decision when a case is brought to him. The actions have to be in accordance with the liabilities and actions as presented by the square 1-4.

7.5. SUGGESTIONS AND IMPROVEMENTS

This section is in relation with the rounded rectangle named as “S”. The framework expects this rounded rectangle to be the engine and drive the BIM environment to be a truly collaborative environment with lesser disputes among the parties. Improvements are to be the findings after evaluating the process of judgement for a particular case as mentioned in the action for the negligent acts. Oval “C” represents the connectors which will feed suggestions to the BIM environment as well as the decision making process. The proposed legal framework is to ensure the real functioning of the symbiotic factors sharing of information and collaboration. Oval “D” is considered as the output connector of the framework and final intention of parties working in the environment should be to achieve this pre determined goal.

8. CONCLUSIONS

It was clear that there are legal uncertainties when it comes to design liability in BIM will act as obstacles for its implementation. BIM will originally reduce negligent acts in design with its features but the original liabilities on the design team from the conventional practice will prevail unchanged except for exceptions as identified in the legal framework. The current legal system for the common law countries were found to be sufficient in handling design liabilities issues in the BIM environment. Nevertheless for the achievement of primary intentions of BIM this legal system has to be practiced in the form of a legal framework. The proposed legal framework will be enforced by the proposed provisions in bringing the decision against the guilty party for four areas of law as identified. The suggestions were also revealed to minimize the negligent acts because it is better to prevent than find fault once the error occurred. The legal framework proposed the mechanism of facilitating the working BIM environment of the design team and continuous self improvement with its implementation.

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