Legal implications of adopting Building Information Modeling (BIM)

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Abstract

Building Information Modeling (BIM) is an innovative approach to design and construct buildings, which has changed the practices within the construction industry. Different categories of stakeholders, such as architects, construction companies, professional associations, academia and even the policymakers, who have defined national policies and strategy documents to facilitate the BIM adoption, have been interested to understand BIM and its implications for the business environment. The legal implications of adopting BIM in construction projects represent one of the most recently discussed issues, which is still not fully understood and not followed by concrete risk mitigation actions. The paper intends to underline some of the legal implications of adopting BIM, mainly in relation to the procurement and contract strategies. The paper concludes that it is expected that BIM will bring more transparency in the construction project implementation and will enable a more comprehensive audit trail leading to fewer legal disputes.

Keywords: *Building Information Modeling (BIM), contract, procurement, standards.*

JEL Classification: K23, K25

1. Introduction

In our days, the construction industry considers the technological innovations as a mean for rapid advancements in production and sustainable development. According to the Navigant Construction Forum (2016)[3], the construction industry shows a growing interest for 3D printing technologies, Augmented Reality (AR), 4D Building Information Modeling (BIM) and Virtual Design and Construction (VDC). For construction industry, the digital future includes: higher definition surveying and geolocation, next generation 5D building information modeling, digital collaboration and mobility, the internet of things and advanced analytics, drones, geospatial technologies, radio frequency identification technologies, reality capture technologies and robotics. It is considered that implementing this kind of technologies, the different categories of stockholders

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[3] Navigant (2016), Trends in construction technology – the potential impact on project management and construction claims a research perspective issued by the Navigant Construction Forum™, Navigant Consulting, Inc.

could benefit from the increased productivity, costs reduction, human and environmental safety. But, the KPMG report issued in 2016 concludes[4] that the construction industry still adopts the new technologies too slowly.

As a digital representation of a building, BIM serves as a common knowledge resource, which enhances communication and the decision making. By using BIM, information is better visualized, and the perception/understanding level of the decision makers is increased. The Sattineni's research[5] reveal that the reasons for adopting BIM by the American construction companies are: visualization functions, architectural design/ modeling, collision detection, time and costs estimation, marketing and scheduling.

The main foreseen advantages of the BIM adoption are the following[6]:

- A better design, more complete and free of errors/omissions, and allowing changes;
- Shared design concepts between different categories of stockholders;
- Accurate estimation of time and costs in the construction projects;

Recent reports forecast that BIM adoption could reduce the wastes in the global infrastructure market with 15–25% by 2025[7].

Some of the main challenges when adopting BIM could be the following:

- Unclear or lack of modeling responsibilities
- Loss of the modeling data
- Inadequate version control
- Dilution of the design ownership. In order to be legally responsible for the design, the architect or engineer designer must have control over the design development. But when different design and construction parties develop and revise the BIM, the design responsibility becomes vague.

The BIM standards were in order to improve usage of BIMs. As a relevant example of BIM standard, we can mention the *National BIM Standard-United States® (NBIMS-US™)*, which was issued by the National Institute of Building Sciences, in 2015[8].

The legal implications of adopting BIM in construction projects represent one of the most recently discussed issues, which is still not fully understood and not followed by concrete risk mitigation actions. The paper intends to underline some of the legal implications of adopting BIM, mainly in relation to procurement and contract strategies. First, some background concepts about BIM are introduced. Then, the legal issues, such as: claims, disputes and litigations in connection with BIM are discussed in more details. Two relevant case studies are discussed. The paper concludes that it is expected that BIM will bring more transparency in the

[4] KPMG (2016), Global Construction Survey: Building a technology advantage.
[5] Sattineni, A. & Bradford R. (2011), Estimating with BIM: A survey of US construction companies. *Proceedings of the 28th ISARC, Seoul, Korea*, 564-569.
[6] C. L. Nutter (2016), Common challenges associated with design and construction delivery using building information modeling (BIM), Navigant Consulting Inc.
[7] WEF, Shaping the Future of Construction, 2016.
[8] https://www.wbdg.org/ (last consulted on 1.11.2017).

construction project implementation and will enable a more comprehensive audit trail that could result in fewer legal disputes.

2. BIM definition

"BIM is the development and use of a computer software model to simulate the construction and operation of a facility. The resulting model, a BIM, is a data-rich, object-oriented, intelligent and parametric digital representation of the facility, from which views and data appropriate to various users' needs can be extracted and analyzed to generate information that can be used to make decision and improve the process of delivering the facility. The process of using BIM models to improve the planning, design and construction process is increasingly being referred as Virtual Design and Construction".[9]

In order to ensure a clear understanding of the expected levels of competencies and their supporting standards, a BIM maturity model was proposed by Mark Bew and Mervyn Richards (figure 1), consisted of four Levels of design based on CAD and BIM[10,11].

Level 0 contains any kind of paper documentation, created by hand or with the aid of CAD programs. Level 1 is related to the collaboration using 2D and 3D documentation in the form of digital files without use of a detailed database. The starting level of building information modelling is considered as being Level 2. Beside the collaboration based of digital files, this level is based on the library management. But the essence of BIM is a project database shared among the stakeholders, allowing to build a complete project documentation. Level 3 – intelligent BIM (iBIM) - of the maturity model has the target to put all projects in BIM making construction management possible throughout life cycle of the design.

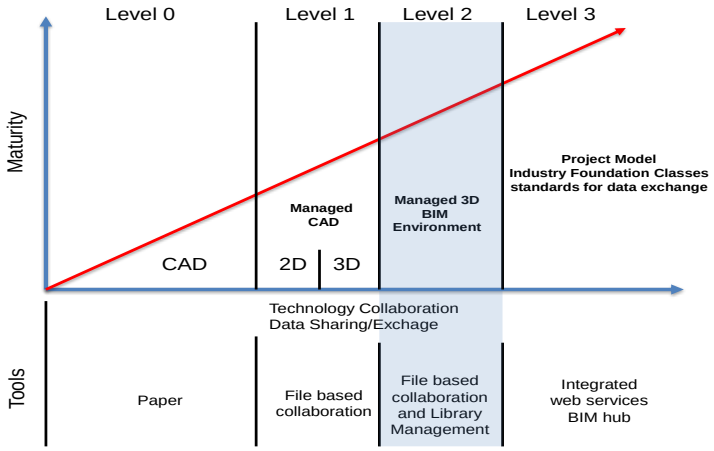

Figure 1. The Bew-Richards BIM Maturity Model

[9] AGC Guide to BIM, First Edition, Associated General Contractors of America, 2006.

[10] A report for the Government Construction Client Group Building Information Modelling (BIM) Working Party Strategy Paper, Department of Business, Innovation and Skills, First Published, July 2011.

[11] The Structural Engineer – 11/2013 – Volume 91.

3. Implications of BIM adoption in claims, disputes and litigations

Many professionals consider disputes as part of the construction projects. Legal conflicts between owners, general contractors, and subcontractors represent an important aspect in the construction industry. The construction claims occur for different reasons, including but not limited to inadequate design, poor contract management, conflicts and external barriers in the construction project implementation. Table 1 presents examples of the construction claim types, forms, and damages, as they were introduced by Jason M. Dougherty[12].

The Arcadis Contract Solutions Group annually reviews the disputes occurring in the construction projects and analyses them on the following five key areas: the length of disputes, average value, common causes, most popular resolution methods and region specific nuances. In their latest report[13], the identified reasons for disputes are mainly related to the human behavior, and not to the technical issues. "Many project participants know what they need to do to resolve a dispute, but fail to do so and enter into the same pitfalls". The report mentions that in 2016, the global average value of disputes was 42.8 million USD and the global average length of disputes dropped to 14 months. The main cause of the construction disputes remained the poor contract administration, followed by: the poorly drafted or incomplete and unsubstantiated claims, the employer/ contractor/ subcontractor poor understanding/comply with its contractual obligations, the errors and/or omissions in the contract document and incomplete design information or employer requirements (for design-build and design & construction).

Table 1. Examples of the claim types, forms and damages (Source: Dougherty, 2015)

Claim type	Forms	Damages
Acceleration	Directed Constructive	Increased hours Increased manpower
Delay	Excusable Non-excusable	Office overhead Cost of financing
Disruption		Additional manpower Labor inefficiency
Tort	Negligence Negligent misrepresentation	Economic

Cheung has grouped the dispute resolution methods into the following eight groups, based on the degree of hostility and the associated costs[14]: prevention,

[12] Dougherty, J. M. (2015), Claims, Disputes and Litigation Involving BIM, Routledge, Taylor & Francis.

[13] Arcadis (2017), *Avoiding the Same Pitfalls*, The Seventh Annual Arcadis Global Construction Disputes Report, Arcadis Contract Solutions.

[14] Cheung, Sai. (1999). Critical factors affecting the use of alternative dispute resolution processes in construction. International Journal of Project Management. 17. 189-194.

negotiation, standing neutral, non-binding resolution, binding resolution and litigations (figure 2).

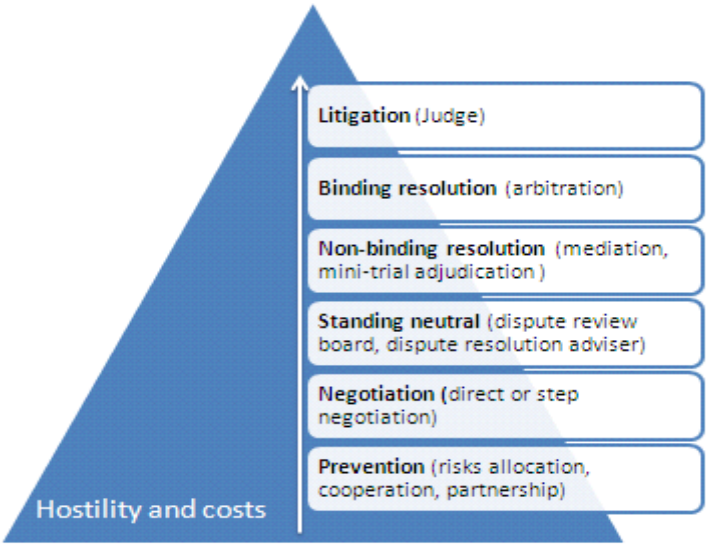

Figure 2. The dispute resolution methods applied in construction domain (Source: Cheung, 1999)

In 2016, according to the Arcadis report, the most popular methods to resolve disputes were the direct negotiation, arbitration and mediation. The most important activities in helping to avoid a dispute were: the proper contract administration, preparing accurate contract documents and assuring a fair and appropriate risk balance in the contracts.

As the complexity of the construction increases due to the adoption of new technologies, the number of disputes increase, and usage of effective methods in dispute resolution becomes more and more relevant[15].

BIM is changing the way that construction documents/drawings are developed and used, how the time and budget estimations are performed and how the fieldwork is done. Due to all these changes, the analysis of claims and disputes is also changed. The legal BIM implications can be discussed using at least two different dimensions:

- Professional/contract dimension, i.e. the legal status of the BIM model during the model development, usage and reliance. The following legal status of the BIM model are considered: binding, informational, reference and reuse;
- Technical dimension, i.e. the software version control, conversion 2D - 3D - 4D; interoperability; data archiving and preservation; data loss, copyright and intellectual property.

[15] Koc, S., Skaik S. (2014). Disputes Resolution: Can BIM Help Overcome Barriers?. CIB 2014: Proceedings of the 2014 International Conference on Construction in a Changing World, Dambulla, Sri Lanka.

Many disputes occur because of the poor communication and the ineffective information exchanges between involved parties. Many legal practices, especially litigation are evolving due to new digital technologies of visual communication.

The digital representations were introduced to litigation and have become popular in recent years. Considering the collateral effects of the presentation tools, which could be persuasive or could cause bias, it is a need for in depth examination of the effects of the courtroom technologies. This issue also applies to forensic engineers trying to resolve claims during trials[16].

BIM is not effectively used for the claim management and dispute resolutions. There are not some many examples in the literature of using BIM for forensic investigation purposes. One of the first example is related to the collapse of the Minnesota bridge in 2007. In this case, a 3-D model, named Forensic Information Model (FIM)[17] was used during the investigation, together with an impressive number of drawings, photos and videos, before and after the bridge collapse. Other FIMs were used for the Manhattan investigation and the Metrodome Roof Deflation in Minnesota. There is evidence that 3D and 4D visualization tools were used also in several forensic investigations of the delay claims.

Even if the visualization potential of BIM is largely acknowledged, BIM is not frequently used in courtrooms. In order to understand the reasons for this, a research was conducted by Soltani, Anderson and Kang[18]. Several face-to-face interviews with construction law attorneys and forensic engineers were conducted. Based on these interviews, the following challenges of using BIM in the resolution of disputes were identified:

- BIM novelty and complexity for forensic investigation
- Resource/costs requirements for creating 3D models.
- Reliability (BIM usage is perceived as being risky because when it is not used properly, BIM has the potential to prejudice the results of the cases).

4. Procurement and contracting in the construction projects using BIM

The procurement and legal contracting arrangements between clients and suppliers are affected by the BIM usage. In fact, there is a two ways influence between procurement and contracting arrangements and BIM, in a way that BIM

[16] Feigenson, N. & Dunn, A.M. (2003), New visual technologies in court: directions for research. *Law and Human Behavior, 27.*

[17] Brando, F. et al. (2013), Forensic Information Modeling: a new forensic tool. *Civil Engineering Magazine Archive, 83.1,* 48-53.

[18] Soltani, Z., Anderson, S., Kang, J. (2017), The Challenges of Using BIM in Construction Dispute Resolution Process, The 53rd ASC Annual International Conference Proceedings, Associated Schools of Construction, pp. 771-776.

could be also be reinforced by the procurement and the contractual procedures adopted in the construction projects.

Procurement and contracting have a critical role in the implementation of the construction projects[19]. Beside the traditional approaches, such as: Design-Bid-Build, Design-Build, Design-Build-Operate, Design-Build-Finance-Operate and Construction Management (Lahdenperä, 2008), several new methods have emerged: Cost Led Procurement, Integrated Project Insurance, Two Stage Open Book, Integrated Project Delivery and Project Alliancing[20].

The link between BIM and the procurement models and contracting arrangements was researched by Centre of Construction Law and Dispute Resolution at King's College London, starting with 2014[21], by addressing specific themes, such as: how BIM affects legal liability, how BIM is treated in standard form contracts, Contractual provisions that support BIM, the contractual status of BIM documents, reliance on BIM software, the role of the BIM Information Manager, the effect of procurement models on BIM, evidence of links between BIM, procurement and contracts, BIM and long term asset management and future BIM procurement and contract options. The main findings of this research are:

a) BIM can affect duties agreed under the contract or imposed by the law, considering the improved collaboration and efficiency when BIM is used. In this regards, appropriate legal commitments should be framed.
b) The selection of a specific form of contract to take BIM into account is a debatable issue. Some of the standard form contract publishers, like FIDIC are silent on BIM, others are not, recommending specific building contract forms. What is even more relevant than standard contract forms is the understanding of how the contract deals with the key issues affected by BIM, such as: agreement of deadlines and interfaces in respect of submission and approval of design information and other data; clash detection, early warning and risk management; intellectual property rights.
c) It is required to clarify the contractual status of all BIM documents. It is important to decide which BIM documents are part of which procurement documents and construction contracts.
d) The adopted procurement model should involve early the contractor. As it is mentioned in the research report: „If BIM is intended to support a more integrated team approach, a procurement model also needs to focus on how to obtain early enough BIM model contributions from the main contractor and from specialist contractors without causing delay or fragmenting the

[19] See Purnus, A., Bodea, C. N. (2016). *Influenta conditiilor de contract FIDIC asupra managementului financiar al proiectelor de constructii*, „Revista Română de Inginerie Civilă", Vol. 7 (2016), No 1; Săraru, C.S. (2013). *Cartea de contracte administrative. Modele. Comentarii. Explicații*, Ed. C. H. Beck, Bucharest, p. 189-205; Săraru, C.S. (2016). *Drept administrativ. Probleme fundamentale ale dreptului public*, Ed. C.H. Beck, Bucharest, p. 160-165.

[20] Purnus, A., Bodea, C. N. (2014). *Correlation between Time and Cost in a Quantitative Risk Analysis of Construction Projects*, „Procedia Engineering", Elsevier Ltd, vol. 85, 436-445.

[21] Morsey, D. (2016), Enabling BIM through procurement and contracts, *King's College Centre of Construction Law and Dispute Resolution*, London.

warranties relied on by the client. Incorrect advice on procurement models can create liability for advisers. Miscalculations by bidders resulting from software errors in procurement can give rise to significant disputes"[22].

Recognized as a main driver for economic growth, the European construction sector experience now a "digital Revolution"[23]. For this reason, the EU formally publishes the European Public Procurement Directive with a reference the use of BIM in public works by public contracting authorities[24]. The Article 22 - Rules applicable to communication -, refers to BIM as following: "4. For public works contracts and design contests, Member States may require the use of specific electronic tools, such as of building information electronic modelling tools or similar. In such cases the contracting authorities shall offer alternative means of access, as provided for in paragraph 5, until such time as those tools become generally available within the meaning of the second sentence of the first subparagraph of paragraph 1." and "5. Contracting authorities may, where necessary, require the use of tools and devices which are not generally available, provided that the contracting authorities offer alternative means of access."

5. Conclusions

The fast development of Information Technology change the way the construction stakeholders collaborate and communicate. BIM, as the new trend in making construction management possible throughout life cycle of the design, affects also the contractual relations between stakeholders. The legal implications of adopting BIM in construction projects in Romania represent now an issue which has to be followed by actions for risk mitigation.

Several aspects need to be careful analyzed in the future adoption of BIM in Romania: defining the amount of BIM data to be included in a construction contract; defining appropriate clauses to incorporate BIM data and models into a construction contract; reviewing current procurement practices, approval and payment practices for works-in-progress; formulating and establishing standards or guidelines for procuring BIM services, including the scope of service, outlined deliverables at each stage, terms and conditions, fee structure and payment schedule, etc.; reviewing the legal principles governing Intellectual Property (IP) rights and how they apply to information held in a BIM environment; reviewing data and information ownership and sharing; reviewing accountability for using or updating data and information; reviewing ownership and usage as well as liability,

[22] Ibidem 20.

[23] EUBIM (2017), Handbook for the introduction of Building Information Modelling by the European Public Sector; Strategic action for construction sector performance: driving value, innovation and growth, EUBIM Taskforce, available at: http://www.eubim.eu/handbook/ (last consulted on 1.11.2017).

[24] Directive 2014/24/EU of The European Parliament and of the Council of 26 February 2014 on public procurement and repealing Directive 2004/18/EC, Official Journal of EU, L94, Volume 57, 28 March 2014.

which may affect insurance policies; developing a mechanism to control and manage an inter-disciplinary common data environment.

It is expected that BIM will bring more transparency in the construction project implementation and will enable a more comprehensive audit trail leading to fewer legal disputes.

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