Compliance of Standard Forms of Construction Contracts and Protocols with BIM-Adopted Construction Sector in USA and UK

Ramazan SARI,
Antalya Bilim University, Department of Architecture
ramazan.sari@antalya.edu.tr

Mehmet Koray Pekeriçli, Ali Murat Tanyer,
Middle East Technical University, Department of Architecture
koray@metu.edu.tr, tanyer@metu.edu.tr

After increase in efforts in science and technology during the 20th century, cultural memory that a nation or civilization take benefits on daily practices solidified as civil institutions and get started a standard way of agreements in between project participants. There are two initial implications and thus two different approaches of standard contracts published in USA and UK by American Institutes of Architects (AIA) and Institution of Civil Engineers (ICE). Architecture, Engineering and Construction (AEC) industry widely take benefits from these standard versions of contracts. These efforts are supported by some technological solutions at late of 20th century by involvement of digital design and drafting tools and internet. Later, these solutions are provided by development and introduction of Building Information Modelling (BIM) to AEC industry, which is totally in conflict with traditional contract bodies. On the other hand, although BIM provide various benefits and try to integrate all disciplines and project participants in a project life-cycle, there is still differences in standard way of contracts and contract addendums in published BIM protocols in USA and UK. In this study, it is aimed to uncover compliance of these released contracts and protocols with AEC industry needs.

Key Words*: BIM Protocols, Traditional Contracts, Standard Contracts,*

Introduction

Variety among contracts and effort for a common understanding and ground in the Architecture, Engineering and Construction (AEC) industry led the way to the release of standard versions of contracts. The first standard construction contracts in modern times was published by American Institute of Architects (AIA) in 1911 with the name of "A201 – 1911 Standard Forms of Contract Documents". Following the first standard release in United States, the study to release a standard version of contract yielded an outcome after the World War II in United Kingdom. The Institution of Civil Engineers (ICE) in United Kingdom published a standard version of construction contract named as "General Conditions of Contract and Form of Tender, Agreement and Bond" in 1945. Both of the contract bodies share relatively common provisions, although there are over thirty years differences between their publication years. However, there

are still significant difference among these contracts that due to the social and cultural background differences of United States and European countries.

The search for successful project delivery led the AEC industry to establish fragmented working methods in which the prevailing motivation of regulations comes from conflict of interests (Lee, Chong, & Wang, 2018). Fragmentation leads to specialization, which bring the industry a variety of standard construction contract releases, starting from AIA E201 series contracting ending with FIDIC books. Each of these standard documents are successful versions of working with conflict of interest. However, in the last decades, the traditional design and construction delivery methods could not fulfill the industry needs, leading to sector looking for different options to increase the quality of service while decreasing the cost and time overruns. At the beginning of 21st century, Building Information Modelling (BIM) with Integrated Project Delivery (IPD) methods were introduced as new design and construction project delivery concepts. BIM is a process and system for enabling active contribution of all project participants in a project life-cycle and IPD is the project delivery approach allowing the work of these project participants in same platform. These concepts encourage the collaboration of disciplines, promoting risk and award sharing instead of conflict of interest and fragmented work, which is conceptually in conflict with traditional project delivery approach. Thus, adoption of BIM in AEC industry not only shifts the working practices but also the understanding of project delivery. Due to differences, BIM brings both theoretical and practical problems which become a handicap for adoption in the firms. These are new terminologies that are new in industry and new working methods that are not yet successfully implemented and tested in the field.

Problem Statement

Both in United States and United Kingdom, BIM protocols are provided to be used as addendum in contracts. There is an ongoing search for a new contract fully covering the project delivery process for BIM concept instead of being only an addendum for existing contracts. However, there are numerous problems that exist in the current standard versions of contracts that prevent the BIM concept for fully covering design and construction stages in the contract bodies.

Aim of the Study

The aim of this study is to investigate the compliance of existing standard forms of contracts and BIM protocols with AEC industry needs in their current state

Research Method

For presenting and discussing basic provisions of existing standard contracts and BIM protocol releases in United States and United Kingdom, an extended literature review was conducted to collect necessary contract provisions to be included in construction contracts. Then, by using the collected necessary provisions, the content of existing standard contracts and BIM protocols

were evaluated and existence of these provisions in these standard releases were identified. The research method is demonstrated in **Figure 1.**

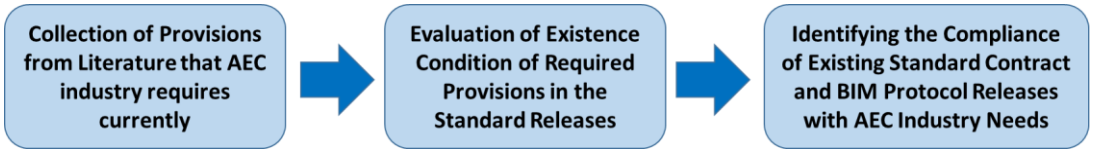

Figure 1. The illustration of research method

Literature Review

Şenkaya in 2018 generated a chronological schema of construction contracts and BIM protocols as presented in **Figure 2**. The authors of this paper discussed the contribution of BIM protocols to these standard versions of contracts. Regarding the existing standard forms of contracts, the paper will continue with an overall explanation considering the general conditions of contracts to establish a background for comparison part of contract bodies of USA and UK

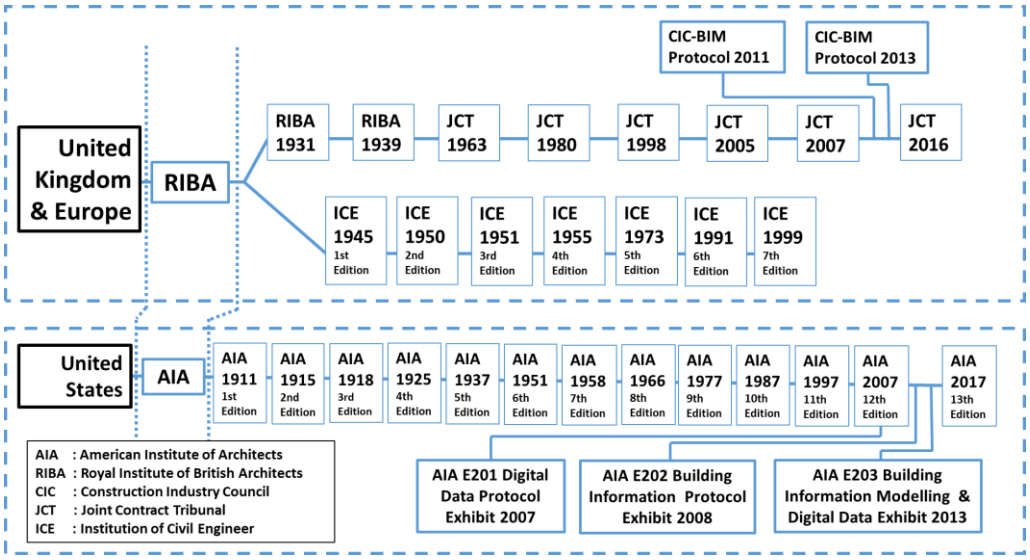

Figure 2. Chronological schema of construction contracts and involvement of BIM protocols released in USA, UK and Europe. Adopted and Updated from: (Şenkaya, 2018)

Standard Forms of Construction Contracts in the United States

As illustrated in **Figure 2**, starting from 1911, AIA released 10x and 20x (i.e., AIA 101, AIA 201) series of standard contracts. Among these, A201 series are related with general conditions of construction. At the beginning of 21st century, by the active involvement of BIM to the AEC industry, AIA E201 – 2007 BIM protocol and later AIA E203 – 2013 BIM & Digital Data Exhibit were published and introduced for the use of the industry. As a cultural background in the United States, architect controls and manages the construction work on behalf of owner.

For this aim, necessary authorizations are provided to the architect in the general obligation part of contract. **In Table 1**, the general conditions stated in the contract and the role and responsibilities of architect are presented. AIA E203 – 2013 BIM & Digital Data Exhibit document where the provisions and content of provisions are stated in **Table 2,** is used as addendum for A201 – 2017 General Conditions of Construction Contract. Furthermore, Building Information Modeling and Digital Data are used as term and taken place in the remaining provisions of AIA A201 – 2017.

Table 1. An overview of general conditions in AIA A201 – 2017 Construction Contract

Provisions (AIA, 2017)	Content of Provisions
General Provisions	Basic definitions related with term and terminology used in the contract
Owner	Definition of Owner, the responsibilities and rights of owner, evidence of the Owner's financial arrangements, owner's right to stop and carry out the work
Contractor	Definition of Contractor, review of contract documents and field conditions by contractor, supervision and construction procedure, labour and warranty, taxes, permits, fees, notices, and compliance with laws, concealed or unknown conditions, allowances, superintended, contractor's construction and submittal schedules, documents and samples at the site, shop drawings, product data and samples, use of site, cutting and patching, cleaning up, access to work, royalties, patents and copyrights, indemnification
Architect	The definition, role, responsibilities and authorization of architect
Subcontractors	Definition of subcontractors, awarding process and roles and responsibilities of subcontractors
Construction by Owner or by Separate Contractors	Owner right to awarding more than one contractor
Changes in the Work	Definition of change, issues and conditions required changes in the work and process of change order
Time	Include progress, completion issues related with delay and extension of construction time
Payments and Completion	Process, step and method of payment before, during and after completion of construction
Protection of Persons and Property	Health and safety regulations and issues
Insurance and Bonds	Insurance and bonds provided by contractor and owner
Uncovering and Correction of Work	Inspection of failure and mistake by architect and correction by contractor
Miscellaneous Provisions	Governing law, successors and assign of parties, test and inspections
Termination or Suspension of Contracts	Owner and contractor right to termination or suspension of contract
Claims and Disputes	Process, stages, rights and responsibilities on claims and disputes
The Role of Architect	Supervising Construction, Recording and Informing Construction Progress to Owner, Inspecting Construction, Advising the Client, Preparation of Change Order and Construction Change Directives, Initial Decision Maker

Table 2. An overview of general conditions stated in AIA – E203 – 2013 Building Information Modeling and Digital Data Exhibit

Provisions	Content of Provisions
Definitions	The definition of term and terminologies used in the Protocol
Priority of Contract Documents	This protocol is an addendum for agreements. Thus, in case of conflict existing with items in agreement, the items in this protocol will stated as prevail.
Obligations of the Employer	Employer obligations are arranging the protocol, ensuring the continuous update of the Information Requirements (IR) and Model Production and Delivery Table (MPDT) until the end of project and appointment of Information Manager
Obligations of the Project Team Member	Project Team Member obligations are production, control, and deliver of models in accordance with MPDT and IR and ensuring being in compile with the sub-contracts with this protocol
Electronic Data Exchange	Define and describe the role, liability and warranty of parties provided for electronic data exchange
Use of Model	Define and Describe the rights, permission and ownership of parties related with copy, use and deliver of models
Liability in Respect of a Model	Define and describe the liabilities of parties in case of change, modification and amendment in original model after transmitted to other parties
Termination	Describe the conditions that require termination of the protocol by parties

Standard Versions of Construction Contracts in the United Kingdom

Institution of Civil Engineers (ICE) and Royal Institute of British Architects (RIBA) in the UK has released standard forms of construction contracts which are illustrated in **Figure 2**. Based on the concept and approaches provided by RIBA, later ICE, JCT and FIDIC families were published later to be used in more specialized cases of construction contracts. The involvement of BIM in these standard forms of contracts are also illustrated in the **Figure 2**. The construction

process are controlled and monitored by a civil engineer on behalf of owner/client in United Kingdom. Therefore, the role, responsibilities and authorization are given according to the engineering perspective of work to the employer representative. The provisions and content of provisions provided in JCT 2017 and CIC BIM protocol are illustrated in **Table 3 & 4**

Table 3. An overview of general conditions presented in Joint Contract Tribunal (JCT) – 2011

Provisions (JCT, 2011)	Content of Provisions
Client Control	Assignment of client representative to control the construction site
Design Responsibilities	Description of contractor responsibility related with fully or partly completion of design, and defining ground conditions at contractor risk
Commencement and Completion	Identifying sections of work, describing issues requiring time extension, taking over the completed parts of the project
Selection of Sub-Contractor	Sub-letting subcontractors
Variations	Describing the issues requiring variations (change order)
Testing and Opening Up	Testing and Inspecting the building, systems and code of practice
Fluctuations	Fluctuations on cost and prices and arrangement of formula
Payment	Payment process including advance payment, bonds and retention
Insurance	Detailed descriptions of provisions for new buildings insured by employer and contractor
Warranties	Description of third party rights and collateral warranties
Dispute Resolution	Describing and signing arbitration agreement
The Role of Engineer	Advising the Client, Designing the Works, Supervising the Construction, Certifying the Payment, Adjudication in Case of Dispute

Table 4. An overview of content presented in Construction Industry Council (CIC) Building Information Modeling (BIM) Protocol

Provisions (AIA, 2013a)	Content of Provisions
General Provisions	The definition of term and terminologies used in the exhibit
Transmission and Ownership of Digital Data	Definitions, rights and responsibilities related with accuracy, provided warranty and ownership of digital data transmitted by the parties
Digital Data Protocols	Anticipation of potential digital data, digital data management procedure and authorization provided to the parties on digital data to use, copy and transmit
Building Information Modelling Protocols	Anticipation of potential Building Information Modelling scope and model authorized use, indication of ancillary modelling activities, establishment of modelling protocols, conditions of unauthorized uses, model management, and creation of post construction model
Special Terms and Conditions	Indication of special terms and conditions related with the project

Findings & Discussion

Collection of Evaluation Criteria for BIM Contracts and Protocols

Abirad (2015) reviewed the literature and searched the custom firm manuscripts to identify the necessary contract provisions that should be used in BIM contracts. Furthermore, to establish a framework for BIM contracting, Chong *et al.* (2017) directed a survey to the AEC industry practitioners to identify necessary contractual provisions. By using author's initial study related to the search for terms and terminologies of BIM contracts and protocols shall be included (Sarı, 2017), with Chong et al (2017 and Abirad, H., (2015) studies, the evaluation criteria presented in **Table 5.** The list of provisions in the table will be used for evaluating standard construction contracts and BIM protocols released by AIA, JCT and CIC. In **Table 5**, the JCT column includes also the following documents provided to be supportive document with JCT contract:

i) JCT - Constructing Excellence Contract (JCT, 2016a),

ii) JCT - Constructing Excellence Contract Project Team Agreement (CE/P) (JCT, 2016b) and

iii) JCT - Pre-Construction Services Agreements (General Contractor) (PCSA) (JCT, 2016c).

CIC BIM Protocol includes only CIC BIM protocols due to not advising any document with. AIA A201-2017 advises usage of AIA E203-2013 with G201-2013, Project Digital Data Protocol Form and G202-2013 – Project Building Information Modeling Protocol Form. However, in this article, to unveil the differences better, AIA A201-2017 is evaluated in a different column than AIA E203-2013 (AIA, 2013b) and G201 & G203-2013 (AIA, 2013b) documents.

Table 5. Evaluation criteria for standard construction contracts released in United States and United Kingdom collected from literature review.

Provisions		**Existence Condition as: "Fully", "Partly", and "Not Any"**			
References: [1]: (AEC-(UK)-Initiative, 2012), [2]: (CICRP, 2010), [3]: (CURT, 2010), [4]: (Abdirad, 2015), [5]: (Chong, Fan, Sutrisna, Hsieh, & Tsai, 2017), [6]: (Poirier, Staub-French, & Forgues, 2015), [7]: (Hamdi, 2014)		**JCT**	**CIC BIM Protocol**	**AIA A201-2017**	**AIA E203-2013**
P1	Model Development and Responsibilities of Parties involved [1], [2], [7]	*Not Any*	*Fully*	*Not Any*	*Fully*
P2	Model Sharing and Model Reliability [2], [7]	*Not Any*	*Fully*	*Not Any*	*Fully*
P3	Interoperability / File Format [2], [4], [7]	*Not Any*	*Fully*	*Not Any*	*Fully*
P4	Model Management [2]	*Not Any*	*Fully*	*Not Any*	*Fully*
P5	Intellectual Property Rights [1], [2]	*Not Any*	*Fully*	*Not Any*	*Fully*
P6	Requirement for BIM Execution Planning [1], [2], [3]	*Not Any*	*Partly*	*Not Any*	*Partly*
P7	BIM Project Reviews [1], [2]	*Fully*	*Not Any*	*Not Any*	*Fully*
P8	Model Element Authorship [1], [2]	*Not Any*	*Not Any*	*Not Any*	*Fully*
P9	Corruption of Files [4]	*Not Any*	*Not Any*	*Not Any*	*Not Any*
P10	Data Confidentiality [4]	*Fully*	*Not Any*	*Not Any*	*Fully*
P11	Data Misuse [4]	*Not Any*	*Not Any*	*Not Any*	*Not Any*
P12	Obligation to have BIM staff on-site / co-location of BIM staff [4]	*Not Any*	*Not Any*	*Not Any*	*Not Any*
P13	BIM Staff Competencies [4]	*Not Any*	*Not Any*	*Not Any*	*Not Any*
P14	Provisions for use of Laser Scanners as BIM tools (As-Built Models) [4]	*Not Any*	*Not Any*	*Not Any*	*Not Any*
P15	Communication and conferencing tools for BIM coordination [4]	*Not Any*	*Not Any*	*Not Any*	*Not Any*
P16	BIM Quality Assurance in BIM Execution Plan [4]	*Not Any*	*Not Any*	*Not Any*	*Not Any*
P17	BIM Training Requirements and Programs [4]	*Not Any*	*Not Any*	*Not Any*	*Fully*
P18	Requirements to furnish lists of any required clearances for model components [4]	*Not Any*	*Not Any*	*Not Any*	*Not Any*
P19	Special modelling for clearance spaces [4]	*Not Any*	*Not Any*	*Not Any*	*Not Any*
P20	Defining Coordination System Priorities [4]	*Not Any*	*Not Any*	*Not Any*	*Fully*
P21	Developing information/model for facilities management requirement, developing BIM based asset matrix [4], [7]	*Not Any*	*Not Any*	*Not Any*	*Fully*
P22	Defining BIM quality control parameters [4]	*Partly*	*Not Any*	*Not Any*	*Not Any*
P23	Integration of the team's IPD methodology plan to BIM Execution Plan (BEP) [4]	*Not Any*	*Not Any*	*Not Any*	*Not Any*
P24	Landscaping and site requirements [4]	*Not Any*	*Not Any*	*Not Any*	*Not Any*
P25	Develop, record and analyze metrics to improve the BIM delivery process [4]	*Partly*	*Not Any*	*Not Any*	*Not Any*
P26	Future model development & model authors/users (e.g. to update facility in-use models) [4]	*Not Any*	*Not Any*	*Not Any*	*Fully*
P27	Requirement for BIM based function analysis / validation [4]	*Not Any*	*Not Any*	*Not Any*	*Not Any*
P28	The BIM's cost or payment should be charged according to a fixed percentage of the overall project cost, the types of development, models and functions required for the project and completion of the models and function required in the project [5], [7]	*Not Any*	*Not Any*	*Not Any*	*Not Any*
P29	Established standards or guidelines should be applied or followed throughout BIM model development [5], [6]	*Not Any*	*Fully*	*Not Any*	*Fully*
P30	Use of collaborative project delivery approach is needed in BIM-enabled projects such as IPD and partnering [5]	*Fully*	*Not Any*	*Not Any*	*Fully*
P31	Cost for model development should be clarified including the penalty and rewards involved, if any [5], [7]	*Fully*	*Not Any*	*Not Any*	*Not Any*
P32	New BIM manager role should be engaged in the project [5]	*Not Any*	*Not Any*	*Not Any*	*Not Any*
P33	Contract should define the roles and scopes of works for all parties involved in the project. [5]	*Partly*	*Fully*	*Not Any*	*Fully*
P34	Contract should define the BIM's goals and quality checks for different stages of development. [5]	*Fully*	*Partly*	*Not Any*	*Fully*
P35	Relationship among the client, designers, and contractors should be clearly defined and connected in the project. [5]	*Partly*	*Partly*	*Not Any*	*Fully*
P36	Standard of care should be applied and upheld by all parties who contribute to or use the BIM model. [5]	*Partly*	*Not Any*	*Not Any*	*Partly*

Table 5 Continued

P37	QR-Code should be adopted to prevent any infringements or copyrights issues on the drawings and documents. [5]	*Not Any*	*Not Any*	*Not Any*	*Not Any*
P38	When avoiding interoperability issues, the development of the BIM model should work in advance in all project development stages, and produce a construction-ready BIM model before the construction stage. [5]	*Not Any*	*Not Any*	*Not Any*	*Not Any*
P39	Designers develop the model own the rights of copyright when the model is created. [5]	*Partly*	*Partly*	*Not Any*	*Fully*
P40	Owner of the model or the client can use, access, and reproduce the model if permission has been sought from the copyright owner. [5]	*Partly*	*Fully*	*Not Any*	*Fully*
P41	Digital data should be protected with security for its usage and data integrity. [5]	*Not Any*	*Not Any*	*Not Any*	*Not any*
P42	Certain constraints should be implemented to prevent data loss and privacy. [5]	*Not Any*	*Not Any*	*Not Any*	*Partly*
P43	Data providers (designers or contractors) should be responsible and liable for the inserted data in the model. [5], [7]	*Not Any*	*Fully*	*Not Any*	*Fully*
P44	The party who hosts the model should include the use and access, record keeping, and warranty, and preserve the model for the agreed duration. [5]	*Partly*	*Partly*	*Not Any*	*Fully*
P45	Indemnity is required to protect the client's interest for any errors or technical issues from tools or software in the project. [5]	*Fully*	*Not Any*	*Not Any*	*Partly*
References For JCT: (JCT, 2011, 2016a, 2016b, 2016c), For CIC BIM Protocol: (CIC, 2013), For AIA A201-2017: (AIA, 2017), For AIA E203-2013: (AIA, 2013b)					

Provision	JCT & CIC BIM Protocol	AIA A201-2017 & E203-2013
P1	Fully	Fully
P2	Fully	Fully
P3	Fully	Fully
P4	Fully	Fully
P5	Fully	Fully
P6	Partly	Partly
P7	Fully	Fully
P8	Not Any	Fully
P9	Not Any	Not Any
P10	Fully	Fully
P11	Not Any	Not Any
P12	Not Any	Not Any
P13	Not Any	Not Any
P14	Not Any	Not Any
P15	Not Any	Not Any
P16	Not Any	Not Any
P17	Not Any	Fully
P18	Not Any	Not Any
P19	Not Any	Not Any
P20	Not Any	Fully
P21	Not Any	Fully
P22	Partly	Not Any
P23	Not Any	Not Any
Yellow: Existent in Both,	Grey: Non-Existent in Both,	Light Blue: Existent in either one

Provision	JCT & CIC BIM Protocol	AIA A201-2017 & E203-2013
P24	Not Any	Not Any
P25	Partly	Not Any
P26	Not Any	Fully
P27	Not Any	Not Any
P28	Not Any	Not Any
P29	Fully	Fully
P30	Fully	Fully
P31	Fully	Not Any
P32	Not Any	Not Any
P33	Partly / Fully	Fully
P34	Fully / Partly	Fully
P35	Partly	Fully
P36	Partly	Partly
P37	Not Any	Not Any
P38	Not Any	Not Any
P39	Partly	Fully
P40	Partly / Fully	Fully
P41	Not Any	Not any
P42	Not Any	Partly
P43	Fully	Fully
P44	Partly	Fully
P45	Fully	Partly
Yellow: Existent in Both,	Grey: Non-Existent in Both,	Light Blue: Existent in either one

Figure 3. Existence condition evaluation of contracts and protocols together

Regarding findings stated in **Figure 3**, it is clear that although thinking the contracts with protocols together, there are still inadequacies to fulfill the needs of construction sector. When AIA BIM & Digital Data Exhibit and CIC BIM Protocol compared with each other, it is stated that AIA's BIM & Digital Data Protocol fulfills much more provision than CIC BIM Protocol, while transversely, JCT contract document cover more provision than AIA contract document. Thus, it can be said that the shortages of CIC BIM protocol were fulfilled with provisions taken place in JCT contracts. When the contracts and protocols regarded as couples and compared with its capabilities, as it is shown in **Figure 3**, there are 17 provisions (illustrated as grey) that is not taken place in the contract and protocol couples while there are 19 provisions (illustrated as yellow) that partly or fully taken place in couples and there are 9 provisions (illustrated with light blue) that is taken place in one of the couples and is not taken place in other contract and protocol couples. Thus, this condition increase the effective use of contract and protocol together although in total it is not adequate to cover 45 provisions fully. Furthermore, when both of the contract and protocol couples compared with each other, AIA A201-2017 & E203-2013 contract and protocol combination cover more provisions than JCT & CIC BIM Protocol togetherness. Therefore, it is possible to state that for this evaluation, AIA A201-2017 & E203-2013 combination is more successful than JCT & CIC BIM Protocol combination.

Conclusions

As a result of this study, it was demonstrated in discussion and findings session that, regarding the provisions collected from literature, there are still 17 provisions among 45 provisions which is nearly half of total provision number that is not taken place any of the construction contract and BIM protocol couples released in USA and UK. This situation requires further study and improvement on current standard form of construction contracts and BIM protocols. It is expressed that the shortcomings in these standard forms of contracts and protocols are related with generally practical issues related with BIM implementation. The authors of this study hope that this paper will guide the researchers and experts by stating the deficiencies in the current standard forms of contracts and BIM protocols to improve and use them efficiently and successfully in BIM-adopted AEC industry

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