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RESEARCH ARTICLE

# An investigation of comparison and evaluation of official BIM documents released in the USA, UK and Turkey

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### **Abstract**

Architecture, engineering and construction (AEC) industry is in the midst of BIM transition across the world. In parallel, Turkish architecture and engineering firms are also experiencing such BIM transition. Regarding the sector wide change in the world; governments release standards, regulations and best practice guides to support not only the governmental institutions but also private sector firms on BIM transition. The United States of America (USA) and United Kingdom (UK) are two countries providing a continuous stream of official documents to support BIM transition with respect to the country perspectives, however; there are no such official documents released in Turkey yet. Therefore, current BIM practices executed in Turkey are in compliance with existing architectural and engineering practice documents in Turkey, which are dated and insufficient. This situation brings a question for the authors of this research that what kind of regulative shortcomings and deficiencies exist in BIM transition practices of Turkish architectural and engineering firms when compared with counterparts in USA and UK. The research question is tried to be answered by comparing and evaluating official BIM documents released in the USA and UK with Turkish architectural and engineering service specification document by using key BIM terms collected from best practice guides released in USA and UK. The selected key BIM terms are addressing potential legal issues in a BIM practice that in case of being not referenced, it is likely to be confront with claims and conflicts among project participants. The overall study has significant potentials on addressing not only common shortcomings of BIM implementation but also discovery of regulative gaps and challenging issues for the BIM implementation practices in Turkish AEC industry practitioners.

### Keywords

BIM Transition in Turkey; BIM Protocols; Official BIM Documents; BIM Implementation in Turkey

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### 1. Introduction

There is an ongoing transition to Building Information Modelling (BIM) in the Architecture, Engineering and Construction (AEC) industry experiences Building Information Modelling (BIM) transition in all over the world [3, 4]. Considering the failures deficiencies and defects in design,

construction and operation phases of building projects that AEC industry suffer from, BIM provides various advantages to project participants [5-12]. As a result of these industry wide benefits, there is a continuous spread of BIM adoption in all over the world [4].

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In order to prevent claims and disputes while increasing the quality of the services, the countries release standards and regulations to define and describe the roles, responsibilities and content of the given services in a specific working field. Implementation of BIM is no different, there is a need for standards and regulations. The first BIM standards were prepared and published by National Building Information Modelling Standards -United States (NBIMS-US) in 2007 [13]. The release of standard of services were followed by BIM protocols to be used as addendum for construction contracts by introduction of American Institute of Architects (AIA) E201 - 2007 Digital Data Protocol Exhibit and AIA E202 - 2008 Building Information Modelling Protocol Exhibit. The standard construction contracts have not included BIM services, therefore; these protocols are required for defining and describing roles, responsibilities and other necessary terms and terminologies in order to execute BIM services without any problem. Same approaches have appeared in the United Kingdom AEC industry. Although they have been changed to another standard document after 2010s, UK government introduced Publicly Available Standards (PAS) to define and describe BIM services in 2007. Following that, in 2013, BIM protocols were released to be used as addendum to standard construction contracts. Current state on BIM

documentation reveals that there still no standard form of construction contract exists fully include BIM services.

Regarding the trends world-wide, Turkish firms have also started to experience BIM adoption and Turkish academic field has focused on studies related with BIM and BIM implementation practices as illustrated in Table 1. Furthermore, necessity of BIM implementation and tendency of the technical consultancy firms to BIM adoption in the upcoming future were mentioned in governmental reports in Turkey [14, 15]. In contrast to increased attention of academic field to BIM, same attention has not been given yet by official institutions in Turkey.

BIM implementation in avant – garde countries such as USA and UK have been introduced for taking benefit from advantages and potentials of BIM by eliminating waste in various project lifecycle stages [16-18]. Thus not only BIM implementation has been followed by release of official BIM documents but also BIM adoption of the firms has been mandated by the governments in these countries. This is due to fact that existing construction contracts have not yet included BIM services and the industry has not fully discovered and taken benefit from BIM. Therefore, within these working conditions, BIM practices require official guiding and regulative documents to be successfully implemented.

**Table 1.** Academic studies published in Turkey and their area of interest

| Key Words  | Reference |
|--|-----------|
| BIM Adoption, BIM Implementation, BIM Transition             | [19-44]   |
| BIM in Production, Manufacturing                             | [45, 46]  |
| BIM – GIS  | [47]      |
| Standards, Protocols, Contractual, Content                   | [48-55]   |
| BIM Software, Tools  | [56, 57]  |
| Energy Efficiency, Sustainability, Green Building Strategies | [58, 59]  |
| BIM related Institutions                                     | [60]      |
| Waste Management   | [61]      |
| Facility Management  | [62]      |

While BIM implementation has been regulated in some countries, currently there is no any official study existent in Turkey. Furthermore, it has been demonstrated that academic interest were provided for mainly BIM implementation researchs. As stated in Table 1, majority of the academic studies, on the other hand; give their attention on BIM implementation practices. Researches about BIM implementation and transition are followed by evaluation of BIM standards, protocols and contractual items released in other countries. The remaining studies investigate (i) BIM in production and manufacturing industry, (ii) characteristics and opportunities of BIM tools, (iii) waste management with BIM and Lean Principles, (iv) facility management with BIM and (v) opportunities of BIM and GIS integration. Trends in academic studies in Turkey address the challenges of AEC industry practitioners in Turkey. However, there are regulative and legal problems appeared and in order to eliminate and solve potential claims and disputes, necessary standards, regulations and guidance are needed to be provided.

Although there is a significant number of studies that focus on various aspects of BIM implementation in Turkey, none of them address the issue of official regulative documents. Therefore future problems and challenges are also

not investigated. However, Olatunji (2011) and Arrensman (2015) state that legal problems are one of the major obstacles of BIM transition in all over the world [1, 2]. Nonexistence of official documents making clear statement on the issues causing claims and disputes are the root causes of the ongoing situation. Although the same situation is valid for Turkey, without any reference and mentioning, there is an increasing degree of interest from both practice and research parties towards BIM. Fig. 1, illustrates the research part of the interest that number of research studies in last years are significantly increased. Considering the gap in the literature, this study focuses on investigating deficiencies and challenges of Turkish architectural and engineering firms on BIM implementation practices without following any official BIM documents.

#### 2. Problem statement

Although Turkish architectural and engineering firms adopt BIM without following any official guide and regulations, the research question of this study focuses on BIM implementation terminologies and practices that are not existent in the sector creating a potential to cause claims and disputes.

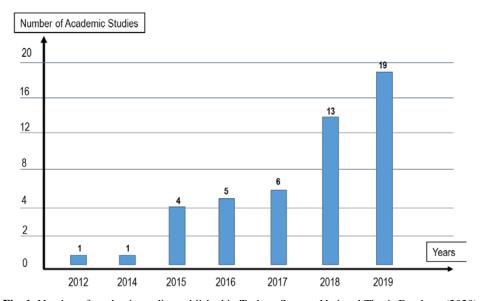


Fig. 1. Number of academic studies published in Turkey. Source: National Thesis Database (2020)

### 3. Aim and objectives

The aim of the study is unveiling the current state of BIM practices in order to address the regulative gaps and potential disputes. Objective of the study has been stated as follows:

- Evaluation of official BIM implementation documents in USA and UK.
- Comparing the official BIM implementation documents of USA and UK with Turkish architectural and engineering service specification documents.
- Evaluating the characteristics of BIM practices represented in USA, UK and Turkey
- Collection of key BIM terms causing claims and disputes from best practice guides
- Unveiling the gaps, deficiencies and challenges of BIM practices in Turkey

#### 4. Research method

The research has started with overview of history and characteristics of existing official BIM documents released in USA and UK. After the purpose, content and application area of these documents were explained, the equivalent documents were searched in Turkey. Then regarding the best practice guides released in USA and UK, the key BIM terms that are needed to be included in official BIM service documents were collected. Later, the existing conditions of these key BIM terms were searched and discussed among USA, UK and Turkish BIM service documents. As a result of the overall process, the gaps, differences

and challenging issues for Turkish BIM implementation practices were unveiled. Overall research framework has illustrated in Fig. 2.

#### 5. Literature review

### 5.1. The review of official BIM documents in USA

The available official BIM documents published in USA can be classified into three categories as illustrated and explained in Table 2. These are digital practice documents, BIM standards and best practice guides. Digital practice documents provide protocols for defining and describing procedure, method, roles and responsibilities for creating, storing, transmitting and sharing digital data and building information models. These protocols give reference to BIM standards where information exchange in BIM services are defined. Best practice guides support the AEC industry practitioners for the preparation of BIM project execution plan. However, special attention was provided for owners. As presented in Table 2, BIM implementation and usage in not only design and construction but also in operation phase of the project were introduced for owners. This is due to fact that owners request for BIM services are key factor on achieving and advancing on high level BIM maturity. Otherwise AEC industry practitioners cannot provide BIM services when there is no demand from client/owner. Thus, there are guides to increase the awareness of BIM usage in all life-cycle phases of project as much as possible.

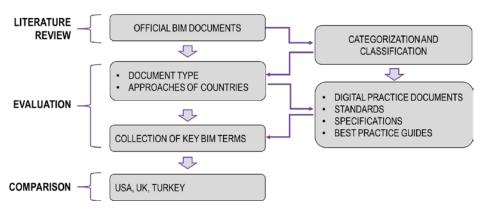


Fig. 1. Research framework

Table 2. Official BIM Documents released in USA

| Document Type           | Document   | Scope and Content   |
|-------------------------|--|---|
|                         | C106–2007, Digital Data Licensing Agreement (Retired) [63]   | A licensing agreement between two parties for the use and transmission of digital data. When C106 – 2013 published, this document expired.  |
|                         | C106–2013, Digital Data<br>Licensing Agreement [63]  | <ul> <li>Defines digital data as information, communications, drawings, or designs created or stored for a specific project in digital form.</li> <li>C106 allows one party to grant another party a limited</li> </ul>   |
|                         |  | non-exclusive license to use digital data on a specific project,  Set forth procedures for transmitting the digital data,   |
|                         |  | and  • Place restrictions on the license granted.   |
|                         |  | • Allows the party transmitting digital data to collect a licensing fee for the recipient's use of the digital data.  |
| Digital Practice        | E201–2007, Digital Data<br>Protocol Exhibit (RETIRED)<br>[63]  | Define and describe the procedure, method, roles and responsibilities for creating, using, storing, sharing and harvesting digital data. This document expired when E203-2013 and G201-2013 has published   |
| Documents               | E202–2008, Building Information Modeling Protocol Exhibit (Retired) [63]   | Define and describe the procedure, method, roles and responsibilities for creating, using, storing, sharing and harvesting Building Information Models. This document expired when E203-2013 and G202-2013 has published  |
|                         | E203–2013, Building Information Modeling and Digital Data Exhibit [64]   | Describe the procedure, method, roles and responsibilities for creating, using, storing, sharing and harvesting digital data and building information models. Furthermore E203-2013 give reference to usage of G201-2013 and G202-2013 for define and describe digital data protocols and building information modelling protocols in detail. |
|                         | G201–2013, Project Digital Data<br>Protocol Form [64]  | Regarding the agreed upon items stated in E203-2013, G201-2013 gives further detail for use, share, store and harvest digital data.   |
|                         | G202–2013, Project Building<br>Information Modeling Protocol<br>Form [64]  | Regarding the agreed upon items stated in E203-2013, G202-2013 gives further detail for use, share, store and harvest building information models.  |
| BIM Standards           | NBIMS – US v1 Standard (2007)<br>[13]<br>NBIMS – US v2 Standard (2012)<br>(NBIMS, 2012)<br>NBIMS – US v3 Standard (2015)<br>[65] | Define and describes standards of BIM services based upon information exchange  |
|                         | National BIM Guide for<br>Owners by NBIMS [66]   | Defines an approach to creating and fulfilling Building Information Modeling (BIM) requirements for a typical project from the Owner's standpoint. The document includes the process, infrastructure and standards and BIM execution.   |
| Best Practice<br>Guides | BIM Implementation: An<br>Owner's Guide to Getting<br>Started by CURT (2010) [16]  | This publication serves as a practical guide to help owners develop a BIM implementation process that best suits each owner's situation and needs. The document covers the subject into three categories in terms of project life-cycle as project pre-planning, design & construction and operation & maintenance                            |
|                         | BIM Project Execution Planning Guide – Version 2.0 by CICRP (2010) [17]  | The document serves as a practical guide to help AEC industry practitioners for creating and implementing BIM project execution plans   |

### 5.2. The review of official BIM documents in UK

The available official BIM documents in UK can be divided into four category as demonstrated in Table 3. These are BIM standards, BIM specifications, digital practice documents and best practice guides. BIM standards define and describe code of practices including use of Industry Foundation Classes (IFC), collaboration, library objects, asset management, design management, briefing for design construction information and and management for design and construction. BIM specifications, on the other hand; set parameters and dynamics for information management, security of digital data, building information models, assets and collaborative sharing and use of hazard and risk information for health and safety studies. Digital practice documents identify the roles, responsibilities and procedure for BIM protocols and information management roles. Best practice guides support AEC industry practitioners transition to ISO standards. Furthermore, similar with the USA case, there are guides for owners/clients to increase the awareness and usage of full potential of BIM as much as possible. Moreover, guidance for usage of BIM protocol is also provided for the AEC industry practitioners.

# 5.3. The Review of official architectural and engineering service documents in Turkey

In the aforementioned sections, official BIM documents released in USA and UK has been explained. As illustrated in Table 4, the existing regulative and practice documents in Turkey are related with standardizing the output of the architectural and engineering works such as submitted drawings and presentations. Furthermore, the scope and use of the documents differ from institution to institution. For example, Ministry of Environment and Urbanism (MEU) requires a specification document while Bank of Provincse requires another specification document. Moreover, Union of Chambers of Turkish Engineers and Architects (UCTEA) has released a standard for both drawing and presentation of architectural design projects, still different governmental institutions require different project drawing and presentation formats. However, the case in USA and UK has reached to a maturity point where instead of delivered outputs, the technology, process and policy that is being adopted during BIM transition are regulated and standardized. According to the current status in Turkey, the documents listed in Table 4 are valid documents to be used and referenced in agreements between owner and architect. Thus, although these documents are not presented for supporting the AEC industry for BIM transition, these documents regulating and giving reference standardizing the given services in AEC industry in Turkey. Due to not having any BIM related official documents, officially these documents are still used for agreements and contracts among project participants even when the project participants practicing with BIM concepts. There are two types of documents available for architectural and engineering services. These are service specification documents and standards for architectural project drawing and presentation. The architectural and engineering service specification document is originated from a government report published in 1985 by that era's Ministry of Construction and Settlement [72]. Although updated and revised version of the service specification document is provided by Chamber of Architects of Turkey (CAT) in 2011, officially CAT has no authority to provide specific service specification document independent from the government report published in 1985. This is due to fact that according to the regulations in Turkey, Chamber of Architects of Turkey has no authority to provide such services [73]. Thus, at the introduction of the CAT service document, updated project phases and other parts has explained by giving reference to the government report. Architectural project drawing and presentation standards document provide standards for not only drawing and drafting but also presentations of architectural design project. Especially the content of the document provides reference items for making the Computer Aided Design (CAD) practices in Turkey almost equivalent with international practices.

Table 3. Official BIM Documents released in UK

| Document Type                 | Document Name  | Scope and Content  |  |
|-------------------------------|--|--|--|
|                               | BS 1192: 2007  | Replaced by BS EN ISO 19650  |  |
|                               | BS 1192: 2007 + A1 2015  | Replaced by BS 1192:2007+A2 2016.  |  |
|                               | BS 1192:2007+A2 2016   | Collaborative production of architectural, engineering and construction information. Code of practice.   |  |
|                               | BS 1192-4: 2014  | Collaborative production of information Part 4: Fulfilling employer's information exchange requirements using COBie – Code of practice   |  |
|                               | BS 8541: 2011 to 2015  | Library objects for architecture, engineering and construction.  |  |
|                               | BS ISO 16739: 2013   | Industry Foundation Classes (IFC) for data sharing in the construction and facility management industries  |  |
|                               | BS ISO 55000: 2014   | Asset management - Overview, principles and terminology  |  |
| BIM Standards                 | BS 7000-4: 2013  | Design management systems. Guide to managing design in construction.   |  |
| [67]                          | BS 8536-1: 2015  | Briefing for design and construction – Part 1: Code of practice for facilities management (Buildings infrastructure)   |  |
|                               | BS 8536-2:2016   | Design and construction: Code of practice for asset management (Linear and geographical infrastructure)  |  |
|                               | BS ENISO 19650-1: 2018   | Organization of information about construction works - Information management using building information modelling. Part 1: Concepts and principles  |  |
|                               | BS ENISO 19650-2: 2018   | Organization of information about construction works - Information management using building information modelling. Part 2: Delivery phase of assets   |  |
|                               | Uniclass 2015  | Enable consistent classification of buildings, engineering, landscape and infrastructure.  |  |
| BIM<br>Specifications<br>[67] | PAS 1192-2: 2013   | Specification for information management for the capital/delivery phase of construction projects using building information modelling  |  |
|                               | PAS 1192-3: 2014   | Specification for information management for the operational phase of construction projects using building information modelling   |  |
|                               | PAS 1192-5: 2015   | Specification for security-minded building information modelling, digital built environments and smart asset management  |  |
|                               | PAS 1192-6: 2018   | Specification for collaborative sharing and use of structured hazard and risk information for Health and Safety  |  |
|                               | CIC BIM Protocol (2013) [68]   | Standard Protocol for use in projects using Building Information Models.   |  |
| Digital Practice<br>Documents | Outline Scope of Services for<br>the Role of Information<br>Management (2013) [69] | Define and describe standards for role of information management   |  |
|                               | Guidance Part 1: Concepts (Second Edition) (2019)                                  | It explores the general requirements of the ISO 19650 series alongside the case for building information modelling and digital transformation.   |  |
| Best Practice<br>Guides [67]  | Guidance Part 2: Processes for   | Explore the requirements of ISO 19650-2 in increasing detail.  |  |
|                               | Project Delivery (Third Edition) (2020)  | Content considering the purpose and requirements of the BIM execution plan and information requirements  |  |
|                               | PD 19650-0:2019 Transition<br>guidance to BS EN ISO 19650<br>(2019)                | This transition guidance has been prepared specifically to help the existing users of BS 1192 and PAS 1192-2 understand any changes made between the UK's existing standards, and the ISO documents which are to replace them. |  |
|                               | Government Soft Landings (2013)  | Guidance for smooth transition from construction to operation. Targeting the delivery of high performing assets contributes to effective environmental, social, security and economic outcomes.                                |  |
|                               | The AEC (UK) BIM Protocol (2013) [70]:   | Guide for Implementing UK BIM Standards for the Architectural, Engineering and Construction industry.  |  |
|                               | Employer's Information<br>Requirements (2013) [71]                                 | Core Content Guidance Notes  |  |

**Table 4.** Official architectural and engineering service documents released in Turkey

| Document<br>Type         | Document   | Scope and Content   |
|--------------------------|--|---|
|                          | Architectural and Engineering<br>Services Specification [74]   | It is published in 1985 to define roles and responsibilities in Architectural and Engineering Services and calculation methods for cost of the services   |
|                          | Architectural Service Specification and Least Cost Calculation [75]                                    | This document is a working update for architectural services including further detailed project phases and service cost specifications using as basis the Architectural and Engineering Service Specification Document published in 1985                                  |
| Service<br>Specification | Essentials for Preparation of<br>Architectural Design Project<br>(1979) [76]                           | For the delivery to Governmental projects, the necessary submission and presentation format has been described. This document is limited to be used for governmental project deliveries. This document is replaced by several times and last update is presented at 2018. |
|                          | Essentials for Preparation of<br>Architectural Design Project<br>(2018)                                | For the delivery to Governmental projects, the necessary submission and presentation format has been described by Ministry of Environment and Urbanism (MEU). This document is limited to be used for governmental project deliveries.                                    |
|                          | Technical Specification for<br>Preparation and Submission of<br>Architectural Design Project<br>(2013) | For the delivery of architectural design projects to Bank of Provinces company of the Government, the necessary submission and presentation format have been described. This document is limited to be used for delivery of projects to Bank of Provinces.                |
| Standards                | Architectural Project Drawing<br>and Presentation Standards<br>(2012) [77]                             | This document provides standards for not only drawing and drafting but also presentations of architectural design project.  |

However, still there is no any description related with BIM, BIM implementation and BIM practices. A specification for preparation and presentation of architectural design projects was released by MEU in 1979. However, use of this document is obligatory for only projects that will be delivered to MEU. Bank of Provinces also has released a specification for preparation and presentation of architectural design projects in 2013. Similar with the MEU document, the use of this document is also limited by only projects that will be submitted to Bank of Province. Different than these documents, UCTEA has published a standard at 2012 for preparation and presentation of architectural design project in compliance with the architectural service specification document released in 2011. Although it is a standard rather than a specification, neither MEU nor Bank of Provinces give reference to this standard.

# 6. Comparison and evaluation of official BIM documents in USA, UK and Turkey

In the previous sections, official BIM documents released in USA, UK and architectural and engineering service documents released in Turkey were listed and explained. Although there are no official BIM documents released in Turkey, the practice documents listed in Table 4 are taken into account. This is due to fact that the BIM adopted firms in Turkey are still required to use and give reference to these documents. The first step of the research is comparison and evaluation of document type and approaches of countries to BIM practices. Thus regarding the listed and explained documents in Table 2, 3 and 4, a comparison study has prepared and presented in Table 5. It has been indicated in Table 5 that USA approach consist of digital practice documents, BIM standards and best practice guides to support the digital practice documents and BIM standards while UK approach includes also BIM specifications.

| <b>Table 5.</b> Comparison and Evaluation of document types released in USA and UF | Table 5. | Comparison | and Evaluation | n of document ty | pes released in | USA and UK |
|--|----------|------------|----------------|------------------|-----------------|------------|
|--|----------|------------|----------------|------------------|-----------------|------------|

|               | USA                       | UK                        |
|---------------|---------------------------|---------------------------|
| Document Type | Digital Practice Document | Digital Practice Document |
|               | BIM Standards             | BIM Standards             |
|               | No Equivalent Document    | BIM Specifications        |
|               | Best Practice Guides      | Best Practice Guides      |

Existence of specifications reveal that BIM practices in UK has country specific cases while USA BIM practices has more generic cases due to the practices in USA are regulated by standards. On the other hand, there is no any equivalent document in Turkey when compared with USA and UK BIM practice documents. This situation demonstrates that Turkey is still officially not supporting and regulating BIM practices in AEC industry.

# 7. Regulative gaps of BIM implementation in Turkey

The USA and UK officially publish BIM documents to regulate the BIM practices and provide guidance to practitioners to efficiently use the BIM. Still BIM has not fully implemented in any of the countries. BIM implementation has divided into three capability stages as Level – 1, Level – 2 and Level – 3 [78]. The avant – garde countries in BIM implementation such as USA and UK has still experienced Level – 2, however, Level – 3 stage has taken place in future targets of the government programs [18]. Thus, the undiscovered nature of BIM has its own not only practical but also regulative challenges. In the following phases

of the research study, regulative gaps of BIM implementation in Turkey has been investigated by regarding the case in the USA and UK. For this purposes, key BIM terms and terminologies that are advised to be taken place in regulative BIM documents has been collected from best practice guides released in the USA and UK and are presented in Table 6. These are (C1) model development and responsibilities of parties involved, (C2) model sharing and model reliability, (C3) interoperability / file format, (C4) model management, (C5) intellectual property rights, (C6) requirement for BIM execution planning, (C7) BIM project reviews and (C8) model element authorship. According the best practice guides, when any of the mentioned items are not taken place in a BIM practice, it is liable to confront with claims and disputes. Thus these items must be referenced and clearly explained by either digital practice documents, standards or specifications. Regarding this fact, in the following phases of the study, existing conditions of these items in USA, UK and Turkey were evaluated within the official documents and approaches of the countries were compared.

Table 6. Key BIM Terms and Terminologies

| Key | BIM Terms  | References   |
|-----|--|--------------|
| C1  | Model Development and Responsibilities of Parties Involved | [17, 70]     |
| C2  | Model Sharing and Model Reliability                        | [17]         |
| C3  | Interoperability / File Format                             | [17]         |
| C4  | Model Management   | [17]         |
| C5  | Intellectual Property Rights                               | [17, 70]     |
| C6  | Requirement for BIM Execution Planning                     | [16, 17, 70] |
| C7  | BIM Project Reviews  | [70]         |
| C8  | Model Element Authorship                                   | [70]         |

# 8. Comparison of USA, UK and Turkish architectural and engineering service BIM implementation practices

Comparison study was represented in Tables 7-14 where each of the comparison criteria were discussed and evidences collected from related documents were explained. Regarding the Table 7, there is no statement related with model development and responsibilities of parties. The current statement in architectural service specification document are based on pre-BIM phase project delivery approaches where 2-D drawings are developed and shared with other project participants. With respect to this situation, item 7-1

to 7-16 provide a comprehensive description of project development phases. However, both AIA and CIC BIM protocols provide clear statements on how the model will be developed and what will be the responsibilities of parties on this procedure.

Similar with the case in C2, existing project progress is based on pre-BIM methods. Thus there is no statement related with model sharing and model reliability. However, model reliability is one of the legal handicaps of BI M transition [1, 2]. Thus, both AIA and CIC BIM protocols provide descriptions on not only explaining model sharing protocols but also responsibilities of parties to provide guaranties on transmitted model.

Table 7. C1 – Comparison and evaluation of model development and responsibilities of parties involved

AIA Document E203-2013 Building Information Modeling and Digital Data Exhibit anticipate the model development and responsibilities of parties. Furthermore, G202-2013 Building Information Modeling Protocol is giving opportunity to parties to establish further detailed descriptions of model development and responsibilities of parties

Appendix 1 and Appendix 2 of CIC BIM Protocol (2013) clearly describe the procedure of model development and role and responsibilities of parties by providing "Model Production and Delivery Table (MPDT)" and "The Information Requirements (IR)" respectively. Furthermore, Clause 4 obligate the parties to comply their working procedure with MPDT and IR [68].

There is no statement related with model development in the specification. However, in section 4, item 16 and 17 clearly describe the duty, liability and rights of the both architect and employer/owner during the project phases. Furthermore, in section two, item 7-1 to 7-16 provide a comprehensive description of the project phases.

Table 8. C2 – Comparison and evaluation of model sharing and model reliability

AIA Document E203-2013, section 4.5 - model protocols lead the parties to prepare and establish G202-2013 Building Information Modeling Protocols. In accordance with the agreed upon G202-2013 Building Information Modeling Protocol, section 4.6 of E203-2013 provide parties to develop, use, and rely on the model. Section 4.7.2 of E203-2013 stated that in case of inconsistent authorized uses of model identified in the modeling protocols, all of the risk shall be owned by the party using or relying on the model.

The CIC BIM Protocol in standard form does not give any liability to the project team member in terms of integrity of any electronic data delivered to the other parties. Furthermore, project team member, as having the intellectual property rights of the model have no liability to rely on the model after it is transmitted by project team member to the other parties.

There is no statement related with model sharing and reliability, However, Section 4, item 16-2 - duty and responsibility of architect to the employer/owner states that architectural services provided by architect to Employer/Owner required to be accurate and complete [75]. Thus, it is possible to say that the drawings and data depicted in the drawings submitted by architect to the employer/owner required to be reliable. On the other hand, in case of conflict arising due to lack of collaboration during the project execution between other project participants that assigned by employer/owner with permission of architect, architect has a kind of responsibility, however; architect is not responsible from the failures arising from those related with project participant's field of profession [75].

AIA

CIC

CAT

**Table 9.** C3 – Comparison and evaluation of interoperability/file format

File formats and digital data transmission method take place in G201-2013 Section 3.1 that AIA parties and project participants have to clearly describe the file format and interoperability options.

CIC File format and the versions of the necessary software take place in detail in Appendix 2 - Information Requirements Clause 3 - Employer's Information Requirements item 3.2 and 3.3.

CAT There is no description related with interoperability/file format in the specification.

## Table 10. C4 – Comparison and evaluation of model management

AIA Document E203-2013, section 4.8 set the roles, responsibilities and protocols of model management. This section also includes the following titles; assignment of model manager (section 4.8.1), model management protocol establishment (Section 4.8.2), responsibilities of model manager (section 4.8.3) and model achieving procedures (section 4.8.4)

CIC BIM Protocol clause 4 requires the employer to appoint an information manager from another party to take over the "Information Management Role". Information Manager is the responsible person for management of model, process and procedures throughout the project phases.

There is no definition related with model management. On the other hand, it is the architect's CAT duty to manage and control the project execution and development compile with the architectural project through the other project participants.

### **Table 11.** C5 – Comparison and evaluation of intellectual property rights

AIA Document E203-2013 propose two definition to meet the intellectual property rights: Section 1.4.5 Authorized Uses and Section 1.4.6 Model Element Author. Section 1.4.5 Authorized Uses refers to the allowed uses of digital data. Section 4.3 provide the anticipation of model authorized uses which will be further detailed in G202-2013. Section 1.4.6 Model Element Author is the entity or individual responsible for managing and coordinating the development of a specific Model Element, regardless of who is responsible for providing the content in the Model Element. Model Element Author is further be identified in Section 3.3 of G202-2013 - Model Element Table. E203-2013 Section 2.3 give rights to each party to transmit digital data to receiving party to use, modify or further transmit Digital Data in the limitation of the definitions and protocols provided by E203-2013, G201-2013 and G202-2013. Thus, it is possible to say that, AIA Document E203-2013 give partial intellectual property rights to the project participants, in a certain project phase in agreed upon with other project participants.

The standard form of CIC BIM Protocol, clause 6 set out the Intellectual Property Rights. Clause 6.2 give the copyright of the project to the "Project Team Member". If the Employer wants to own the Intellectual Property Rights of the project then the protocol should be revised. Clause 6.3 provide a license to the Employer to use the material (the electronic information contained in the model produced by the Project Team Member) for the Permitted Purpose. Clause 6.6 and 6.7 provide license and sub-license from the Employer to the Project Team Member for the information contained in the model provided by Employer for the Permitted Purpose. Permitted Purpose in here means the licensed uses of Models. Therefore, parties in this protocol provide licensed uses of Models for the information provided by vice versa. On the other hand, Intellectual Property Rights of the project is owned by Project Team Member.

Architect is the author of the project and authorship of a project could not be transferred to the other project participants even in the case of architect wishes to do [75].

AIA

CIC

CAT

Table 12. C6 – Comparison and evaluation of requirement for bim project execution planning

AIA

BIM Roles and responsibilities, data management and project milestone are taken place and anticipated in E203-2013 and then further detailed in G201-2013 and G202-2013 documents. Although these items are elements of BIM execution planning, there is no direct reference to prepare a BIM Execution Plan in the protocol.

The BIM Execution Planning is not directly mentioned in the protocol. However, preparation and implementation of BIM Execution Plan in accordance with PAS 1192-2 by information manager is advised in Employer Information Requirements (EIR) document [71]. Moreover, preparation of BIM Execution Plan is required in PAS 1192-2 [79] and the parties who signed the protocol are required to comply with PAS 1192-2. Therefore, it is possible to state that preparation and implementation of BIM Project Execution Planning is obligated.

CAT There is no description or statement related with BIM Execution Planning in the specification

**Table 13.** C7 – Comparison and evaluation of bim project reviews

CIC

CAT

AIA

Both Digital Data and Building Information Modeling Protocols are directly encouraged to review and revise the protocols in case of necessity at appropriate intervals in E203-2013 document. Furthermore, project reviews in each project development phase is regularly stated in National BIM Standards, version 3 [65].

CIC The BIM Project Reviews are not directly mentioned in CIC BIM Protocol and none of the other documents related with CIC BIM Protocols.

There is no description and statement related with BIM Project Reviews. In fact, architect described as a project author and after submission of the project to the Employer/Owner, architect relation with other project participants is described as: managing and controlling the project execution in order to provide that project is executed compiling with the architectural drawings. Thus, collaboration, communication and integration of project participants are not advised. Instead, conflict of interest among project participants is established and under these circumstances, the rights of architects are preserved.

**Table 14.** C8 – Comparison and evaluation of model element authorship

AIA Document E203-2013, Section 1.4.6 mention the model element author and draw the frame of the authorship by directing the parties to establish the Model Element Table in Section 3.3 of G202-2013.

Project Team Members own all of the copyrights of the model, and Project Team Member shall provide a license and sub-license to the Employer to copy, modify and transmit the model and data in the model to be used by taking written permission from the Project Team Member in terms of "Permitted Purpose". Thus, in the standard form of CIC BIM Protocol, model element authorship is provided to the project team members and project team members provide license to the employer to transmit the digital data to the other project participants.

There is no definition and description related with Model Element Authorship, however; authorship of project is given to the architect and it could not be transferred to other project participants, even in the case of architect wishes to do so.

Interoperability and description of file format are issues needed to be stated at the start of the project. There are various BIM tools having specific file format. Some of the file format has interoperability options while some of them not. When the parties are not agreed upon file format

during the submissions of models, there is likely to confront with problems on execution of BIM process which will cause claims and disputes. Similar with the C1 and C2, due to include pre-BIM conditions, CAT document is not giving any statement about interoperability and file formats.

Model management includes assignment of model manager, establishment of related protocols, description of role of model manager and statements on model achieving procedures. When these conditions are not stated and described, following of BIM execution plan is not guaranteed. The model manager supervises the BIM execution during the project progress. When model manager is not assigned, then owner does not have any chance to claim for the unsatisfactory services provided by design team according to CIC BIM protocol. Likewise based on the initial comparison tables, there are no statements related with model management in CAT document.

Intellectual Property Rights (IPR) is examined with two terminologies in BIM implementation: the author of model and author of project. This differentiation has been clearly addressed and explained in both AIA and CIC BIM protocols. However, there is no such differentiation that exists in CAT document. Especially for the operation phases of the project, model authorship is given to owner or operator of the building so that any use of model for operation purposes cannot create any authorship problem among project design team and other parties. Thus, for better use of BIM and save the authorship rights of project, such division has been made for practicing BIM. Similar with the initial comparison cases, there is no division exist for IPR in CAT document. Thus, what will be the right of owner or operator of the building for use of BIM model with respect to project authorship rights stated in CAT because although there is no any statement related with BIM and BIM model, IPR is given to architect in CAT document. Thus, there is a gap in CAT document on providing division to model authorship and project authorship. In case of breach of IPR due to undescribed use of BIM model during the operation phase of project in Turkey, the case can only be discussed and solved with these potential questions.

BIM execution plan is a written document setting all necessary aspects of how BIM will be practiced for the specific project. The rich content, involvement of various project participants and project stages make the use of BIM execution plan necessary to efficiently complete the project delivery. Thus, usage of BIM execution planning is directly or indirectly advised by both AIA and CIC BIM protocols. Furthermore, preparation of BIM execution plan obligates the project participants to early set and discuss of all project development procedure which is eliminating future claims and disputes. Therefore, although BIM protocols do not make the use of it obligatory, BIM standards require use of BIM execution plan. Likewise the case in initial comparison tables, there is no description taken place in CAT document.

Early and continuous participation of project participants to project is key factor on successfully deliver a BIM project. BIM project reviews eliminate various potential reworks in project. Thus elimination of reworks correlated with decrease of claims and disputes in a construction project. With respect to this fact, AIA BIM protocol strongly advice regular project meetings while this situation is mentioned in BIM standards and specifications in UK case instead of BIM protocol. Likewise initial comparison studies, BIM project reviews are not mentioned. In fact, project phases and services described in CAT are based on traditional project delivery approaches. Fragmented and diverse work of disciplines are encouraged in traditional project delivery approaches where full potential of BIM appears when collaboration and integration of disciplines have achieved.

As mentioned in C5 table, IPR is divided as project authorship and model authorship. Model element authorship is owning of the model element included into the model or owning of the complete model. competency require BIM stages collaboration and integration project participants. Thus the models created by different project participants are overlapped or integrated with each other. Traditional IPR approach cannot provide fear right distribution for this situation. Thus model element authorship as a terminology has created and rights and responsibility of model element authorship has set. Both AIA and CIC BIM protocol has clear statements for model element authorship while there is no reference provided in CAT document. In case of confront with claim and disputes related with breach of IPR or model element authorship, who the case can be solved is a problem in Turkey, considering the existing gap.

### 9. Discussion

The summary of the comparison study were stated in Table 15. Existence conditions of the key BIM terms were completely available in USA while model sharing and model reliability were partly existent and requirement for BIM execution planning and BIM project reviews were not existent in UK. The comparison and evaluation study has demonstrated that although there were three key BIM terms have resemblance in terms of applications in Turkish practice, actually none of them directly related with BIM practices. In case of occurrence of conflict and disputes related with key BIM terms, there will be no reference to justify the case. The content of these items prepared for fulfilling the requirements of architectural and engineering services in traditional delivery method regarding the needs occurred in late 1980s. Nevertheless the partly existence of the key BIM terms were because of similarity of the practices. For example, although there is no direct reference about model development and responsibilities of parties in Turkish practice, development and content of project phases and responsibilities of parties were clearly stated. Thus, regarding this kind of background conditions resembles, there are only three key BIM terms available. These are model development and responsibilities of parties,

model management and intellectual property rights. Still, these three resemblances cannot provide proper statement for the cases.

### 10. Conclusion

In conclusion, official BIM documents released in USA, UK and architectural and engineering service documents released in Turkey have been compared and evaluated. The regulative gaps existing among USA and UK with Turkey have been demonstrated. Parallel with the wide implementation of BIM has started to bring legal issues among project participants. This is due to fact that BIM is a new concept and brings new terms and working practices to the industry. These new terms and practices are needed to be clearly set by official practicing and regulating documents in order to eliminate the occurrence of claims and disputes. Accepting that BIM implementation occurs without following any official BIM documents, potential legal problems waiting for BIM practitioners in Turkey has been investigated. To achieve this purpose, the key BIM terms are collected from best practice guides released in USA and UK. A comparison study has conducted including USA, UK and Turkey to demonstrate the regulative gaps exist in BIM implementation in Turkey. The comparison study has unveiled that, not only that there are no key BIM terms existent in official practice documents in Turkey but also there is no indirect reference for them. There are two factors at background.

Table 15. Existence conditions of key BIM terms in USA, UK and Turkish BIM practice documents

| Key BIM Terms                                     |       | Existence Condition in |         |  |
|---|-------|------------------------|---------|--|
| Rey DIW Terms                                     | USA   | UK                     | Turkey  |  |
| Model Development and Responsibilities of Parties | Fully | Fully                  | Not Any |  |
| Model Sharing and Model Reliability               | Fully | Partly                 | Not Any |  |
| Interoperability / File Format                    | Fully | Fully                  | Not Any |  |
| Model Management                                  | Fully | Fully                  | Not Any |  |
| Intellectual Property Rights                      | Fully | Fully                  | Not Any |  |
| Requirement for BIM Execution Planning            | Fully | Partly – Indirectly    | Not Any |  |
| BIM Project Reviews                               | Fully | Partly – Indirectly    | Not Any |  |
| Model Element Authorship                          | Fully | Fully                  | Not Any |  |

Firstly, the architectural and engineering service documents were published in 1985 considering that time's need and requirements. Secondly, there is no guiding document and governmental described for encouraging the not only governmental but also civil institutions to prepare guiding and regulatory documents to support the Turkish AEC industry. The nonexistence of any of key BIM terms in official practice documents in Turkey has potential to cause claims and conflicts in which there will be no solution due to nonexistence of standards and regulations in these fields. These potential claims and disputes are investigated by some researchers and it has been concluded that in order to eliminate the disputes and claims, the key BIM terms are needed to be clearly set and identified among project participants at the beginning of the project [1, 2].

Regarding the document types released in USA and UK, the following document types are needed to be officially prepared and published in Turkey: (i) digital practice documents, (ii) BIM standards and specifications, and (iii) best practice guides. The further detailed descriptions of content and working field of these documents are further research topics being addressed in this study. An immediate action to prepare and officially release the necessary BIM documents is needed to avoid the confrontation with legal problems in BIM transition practices in Turkey.

By completing a comparison study about official BIM documents among USA, UK and Turkey, general shortcomings of Turkish architecture and engineering services in their endeavor of BIM transition were tried to be clarified by demonstrating the regulatory gaps. It was hoped that this study will guide not only researches but also governmental authorities to immediately focus on preparation and publish of BIM documents to support Turkish AEC industry practices.

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