buildings

MDPI

Article

Integrating BIM in Construction Dispute Resolution: Development of a Contractual Framework

Rabiah Muhammad and Abdur Rehman Nasir *

Department of Construction Engineering and Management, School of Civil and Environmental Engineering (SCEE), National University of Sciences and Technology (NUST), Islamabad 44000, Pakistan
* Correspondence: abdur.nasir@nit.nust.edu.pk

Abstract: Building information modeling (BIM), through its data-rich digital representation of building elements, has revolutionized the architecture, engineering, and construction (AEC) industry. Facilitating the process of its implementation, several legal aspects of BIM have been discussed and standardized in the published contract systems, but legal provisions for dispute resolution through BIM are yet to be established. With more enhanced use of BIM, there is a need for a dedicated protocol for utilizing BIM in construction dispute resolution. This study aims to identify, analyze, and classify the potential legal aspects for integrating BIM into the construction dispute resolution process and thereby determine the corresponding provisions required in BIM-enabled contracts. Potential legal aspects were extracted through an analysis of published literature, including research papers, FIDIC contracts, and standard BIM contract documents. A questionnaire survey involving 140 respondents was conducted from which the 24 identified legal aspects were validated to be incorporated in BIM contracts as contract provisions. The proposed BIM-DRes framework maps the legal aspects and finalized contractual provisions with the phases of a construction project and highlights the main stakeholders associated with or affected by these aspects. The developed framework was further validated by three experts from the construction industry. This research explores this overlooked area and expands the body of knowledge on BIM-based dispute resolution, setting the ground for the extension of BIM-enabled contracts.

Keywords: building information modeling; BIM; dispute resolution; construction; contractual framework

Citation: Muhammad, R.; Nasir, A.R. Integrating BIM in Construction Dispute Resolution: Development of a Contractual Framework. *Buildings* **2022**, *12*, 1828. https://doi.org/10.3390/buildings12111828

Academic Editor: Filiberto Chiabrando

Received: 30 June 2022
Accepted: 4 October 2022
Published: 31 October 2022

1. Introduction

The construction industry is getting complex due to the increasing diversity of projects and competing demands of its stakeholders, mainly the client, contractor, and designer [1,2]. With this increasing complexity, construction disputes have also become complex and increased in number. These dynamics, coupled with the utilization of innovative techniques, emerging technologies, new standards, contracting, and delivery methods [3], not only increase the number of claims and disputes but have also made them complex [4]. Current dispute resolution processes, with a high dependence on manual and outdated methods, do not accommodate the increasing complexity of disputes in construction projects [3,4].

To address the fragmented management of dispute resolution processes, a dynamic approach dealing with complexity is required. BIM possesses the necessary characteristics and checks all the essential boxes in this regard [5,6]. It provides a three-dimensional digital demonstration of a building that involves a set of interacting policies, processes, and technologies, instigating a "practice to manage the essential building design and project data in digital format throughout the building's life cycle" [7]. It is a platform to share knowledge and data and improve communication between project participants [8].

The capabilities of BIM, such as storing a lot of data, increased and improved coordination through a common data environment (CDE), 3D visualization, etc., enable the facilitation of forensic engineering and stimulate significant advances in traditional dispute

resolution procedures [3]. However, the implementation of BIM in dispute resolution is currently facing a lot of challenges and limitations, some of which include a lack of BIM knowledge, costly implementation, reluctance to innovate in traditional construction practices, and a non-serious attitude toward dealing with claims [3,4,9], but the absence of contractual protocols in BIM contracts concerning dispute resolution processes is a major hurdle in BIM-driven dispute resolution [5]. Therefore, legal aspects of BIM implementation in dispute resolution need to be considered and accommodated within the contractual frameworks of projects. Internationally, some standard forms of BIM contract protocols have been developed, and some examples include Consensus DOCs 301 BIM Addendum, the American Institute of Architects' (AIA) E-202 and E-203 protocol exhibits, the AEC protocol, the Construction Industry Council's (CIC) BIM protocol, PAS 1192-2, ISO 19650-1, etc. [10–15]. However, research in this domain concludes that these protocols lack information on several aspects, for example, protection of intellectual property, professional liability of shared information, legal validation of design, legal aspects of the BIM model, security, etc., and hence do not adequately facilitate the BIM-based project delivery [5,7,16].

Moreover, in order to highlight the neglected aspects and explore them further, plenty of research has gone into investigating the legal aspects associated with BIM along with the required modifications in traditional contracts [16]. For instance, Olatunji [17] reviewed the potential legal implications of BIM. Likewise, Jo et al. [18] studied BIM's legal issues and concerns in the contracts, whereas Kuiper and Holzer [19] highlighted contractual arrangements for BIM in Australia. Some preliminary empirical studies were also reported. For example, Arshad et al. [7] investigated the contractual risks of BIM whereas Chong and Zin [16] explored the administrative contractual provisions for BIM-enabled projects. A recent study by Fan et al. [20] utilized the social network analysis approach (SNA) to investigate the latent legal aspects associated with BIM contracts. These studies highlighted a number of areas that should be considered in BIM contracts. However, the research has not come full cycle, and in case things do not turn out to be as expected, the way that the stakeholders can utilize the potential of BIM to resolve disputes is not clear, since the contractual provisions required for BIM-based dispute resolution have not been investigated. Thus, the need for a comprehensive study to address the potential contractual issues of BIM, particularly from the dispute resolution perspective, cannot be emphasized enough.

Based on this motivation, to address the gap in the literature and respond to the critical requirement of a dedicated dispute resolution protocol identified by Greenwald [5], this study develops a preliminary contractual framework for BIM-based dispute resolution. The framework is customized to the design-build (DB) project delivery method since it enhances the overall project quality under BIM [21]. Whereas several methods are in use for dispute resolution, the current study focuses on dispute boards, as they are widely used and are effective in dispute prevention and resolution [22–24]. The study is grounded on two main objectives: (1) to identify and analyze potential legal aspects for integrating BIM in dispute resolution processes; and (2) to determine the corresponding contract provisions required in BIM contracts. These objectives are aimed at answering the research question of how BIM can play an effective role in the BIM construction dispute resolution process. To achieve this, expert opinions from the industry were obtained through a questionnaire survey. The findings of this research will add value to the body of knowledge and industry practices by offering a detailed analysis of potential legal aspects of BIM implementation in the dispute resolution process and will provide dedicated contractual provisions that are feasible and practical for future incorporation.

2. Literature Review

2.1. Need for Advancements in the Dispute Resolution Process

The increasing complexities in construction projects cause disputes, making them an integral part of the project lifecycle [2,25,26]. When disputes are not settled promptly, they become very expensive due to opportunity costs, personnel, finances, and time [1]. The National Research Council stated that each year approximately USD 4 billion to USD 12 billion

is spent as a direct cost for settling disputes on construction projects [27]. Correspondingly, conflict contributes to about 27 percent of the variance in project performance [28]. Perceiving this, there is a growing realization that construction projects need to turn to some advanced methods of dispute resolution to enhance overall efficiency.

2.2. BIMing Disputes

BIM can be considered an efficient process that incorporates all disciplines, aspects, and arrangements of a facility within a single inclusive digital model [7]. There are a number of characteristics of BIM that can facilitate disputes and claims settlements. BIM is realized as an information-rich model [15,29], as it utilizes the precise geometrical and associated details of building components to establish a database of information [30]. A building information model describes the geographic information, geometry, spatial relationships, quantities and features of building elements, material inventories, schedule of performance, and cost estimates, ultimately expressing the entire building life cycle [31]. Consequently, scopes of work can be easily isolated and defined. Systems, assemblies, and sequences can be seen at a relative scale with the whole facility or group of facilities. The construction documents such as the drawings, procurement details submittal processes, and other specifications can be easily interrelated [8]. Accordingly, the information quantity, quality, and accessibility through BIM make it a truly useful decision-supporting tool [32].

The establishment of a common data environment (CDE) is an added characteristic of BIM in which data are communicated, shared, and reused efficiently [13]. Enhanced collaboration and communication through this feature make related processes efficient [15]. Furthermore, as BIM models are created to scale in a 3D space, all major systems can be visually checked. In this way, visualization of claims can also be conducted with the help of a model, as highlighted by Khoshnava et al. [33]. All of the aforementioned characteristics can help resolve disputes more effectively [34].

In developed countries, there are examples where disputes have been settled with the help of this technology. One such utilization of BIM for forensic investigation purposes was at the collapse of the I-35 W Mississippi River bridge in Minnesota in 2007. In this project, the BIM assisted the parties to catalog and access existing information on every element of the truss bridge and enabled communication between the clients and the investigation team [35]. Another case where BIM was practiced in forensic investigations was the facade examination of the Manhattan and Metrodome roof deflation in Minnesota. The challenge of collecting and managing the substantial amount of historical and new data in the project was the main motive for implementing BIM in facade examinations [36].

Furthermore, Al Shami [4] highlighted that BIM upholds high potential in dealing with the matters associated with avoiding, presenting, and analyzing disputes while providing the ultimate benefits of cost and time savings, fewer change orders, and less rework. To investigate the effects of utilizing a BIM model for the claim and dispute resolution process, Koc and Skaik [37] indicated that BIM, through its capabilities of data storage and visualization of the changes, activities, periods, and planned and actual sequences, makes the dispute resolution processes more efficient.

2.3. Legal Framework for BIM

Advancement in the dispute resolution system through technology demands changes in existing standard form contracts [7,19]. Significant literature indicates that certain advantages of innovations such as BIM can only be realized when their legal frameworks are well-defined and implementable [17,38]. A well-structured, well-defined, and clear set of contractual protocols and guidelines helps enhance and ease BIM usage for a certain part of the project [39]. However, a lack of clarity about BIM contractual guidelines can lead to legal disputes on a project [40]. Similarly, research by Fischer et al. [41] on BIM adoption in China also emphasized the establishment of a well-defined set of guidelines for BIM. Responding to this demand, various standardized BIM contract protocols have been developed to administer BIM-enabled projects [42]. Some of the commonly known examples include

Consensus DOCs 301 BIM Addendum, the American Institute of Architects' (AIA) E-202 and E-203 protocol exhibits, the AEC protocol, the Construction Industry Council's (CIC) BIM protocol, PAS 1192-2, ISO 19650-1, etc.

All these documents establish protocols for modeling methodology, information exchange, interoperability, security, development of a BIM execution plan, resolving issues of intellectual property, and assigning liability [7], but still lacks establishing standards for several areas associated with BIM implementation [38]. Considering the same for dispute resolution, Greenwald [5] also proposed the development of a comprehensive, project-specific Dispute Resolution Plan Addendum (DPRA) to be utilized on BIM-enabled projects for helping solve disputes in a quick, goal-oriented, proper, and professional manner.

2.4. Legal Aspects of BIM in Dispute Resolution

Various legal aspects associated with the implementation of BIM in dispute resolution need to be addressed [5]. These aspects were categorized under three themes following a systematic methodology, containing two main steps. The first step was the identification of potential legal aspects and the development of related contractual clauses and the second step was distributing and allocating these aspects under the themes. For this purpose, three types of documents were explored during the review of the literature: (1) published research; (2) FIDIC contracts and international dispute board rules; and (3) BIM contract documents.

In the first step, this exercise resulted in the identification of potential legal aspects with exclusive reference to BIM and dispute resolution. Due to a lack of studies on the subject of "legal aspects for dispute resolution through BIM", published research related to "legal aspects of BIM" was explored. The aim was to perceive which of these legal aspects can be addressed by virtue of their relativeness, to be a part of a contract for dispute resolution through BIM. Afterward, FIDIC contact forms and dispute board rules [43–45] were analyzed to observe provisions related to dispute resolution and procedural rules for dispute boards. This resulted in the determination of provisions that require modifications for incorporating BIM. Accordingly, the provisions were modified to develop specific clauses to integrate BIM into dispute resolution. Contrarily, earlier mentioned BIM contracts were investigated to find the clauses in which elements of the dispute resolution could be merged. These clauses were also revised as potential contract clauses. All of these practices were conducted considering the DB method of delivery. The reason to focus on the DB method is that BIM is mostly utilized with the DB contracting method for more advantages, as compared to the traditional project delivery method. When BIM is used in DB projects, it showcases its ability to shrink schedules, decrease costs, and enhance overall project quality. This is on account of DB's ability to increase the collaboration between the design and construction teams. At its core, BIM is a collaborative process, providing a perfect environment for the DB team to evaluate, present, and document ideas [21].

The next step was to identify the main domains to be considered for the contractual protocols related to dispute resolution using BIM. For this purpose, previously mentioned documents were reviewed to identify the main themes under which clauses exist. Figure 1 synthesizes the identification of relevant common themes in the reviewed documents. Contract structure and policy, procedural rules of dispute boards, and roles and obligations were found to be common themes that are treated as domains for this study. The main reason behind the development of clauses in the first step followed by the identification of relevant domains was to avoid limiting this study to particular areas, which may have resulted in neglecting clauses that do not fall under those specified areas. Interestingly, all the clauses fall under the three identified domains and subsequently were divided on a characteristic basis. The domains, along with their potential legal aspects, are discussed in the following sections.

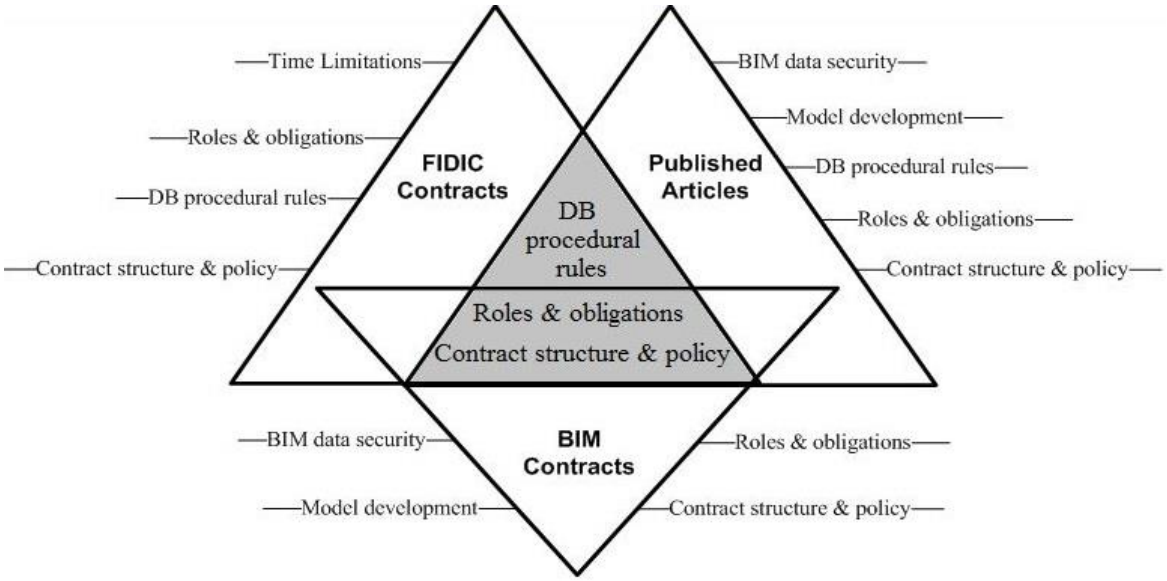

Figure 1. Categories' selection for legal aspects.

2.4.1. Contract Structure and Policy

BIM enables and stimulates a collaborative working platform for all participants in a construction project [9]. The traditional contracts, which were structured to administer fragmented working conventions and practices, lack in dealing with a collaborative environment established by BIM [42]. The development of specific contractual provisions and guidelines for BIM-enabled projects became necessary to overcome the deficiencies in conventional contracts [19]. Acknowledging this need, numerous contract protocols have been established to deal with BIM and its associated information. These protocols offer new perspectives on governing project participants and dealing with BIM technology [20]. However, there are still undecided policies and protocols in the dispute resolution domain.

To address the legal issues associated with BIM implementation in dispute resolution, some potential legal aspects can be instigated, with an aim to formulate the elementary principles in the contract, as shown in Table 1.

Table 1. Potential legal aspects/contract provisions for contract structure and policy.

Variables	Description	Selected References
V1	All evidence, i.e., supporting documents and digital data derived from BIM, should be deemed admissible and have a legal basis in dispute board proceedings.	[7,42]
V2	Provision implying "BIM integration in dispute resolution" should be explicitly mentioned in BIM contract documents.	[7]
V3	Protocols and operating procedures for "BIM integration in dispute resolution" should be included in BIM contract documents.	[7,42]
V4	While providing digital data as evidence, certain constraints may be implemented for its security and privacy.	[7,42,46]
V5	Considering the expeditious functioning of BIM, the time limit for the dispute board's decision may be reduced subsequent to an agreement with the dispute board and both parties.	[24,47,48]
V6	The dispute board members should have BIM knowledge.	[47,48]
V7	If dispute board members possess BIM knowledge, their remuneration may be increased accordingly.	[7,47,48]
V8	If dispute board members do not possess BIM knowledge, a dispute-specific BIM coordinator may be hired; or	[24,47,48]
V9	If dispute board members do not possess BIM knowledge, the services of the project's BIM manager may be utilized.	[24,47,48]

2.4.2. Dispute Board's Procedural Rules

Defining procedural rules is a formal requirement for the implementation of a dispute board [49]. The procedural rules fulfill the dual purpose of formalizing the operation of dispute boards between the contracting parties and defining the operational procedures that the members are required to follow [50]. The World Bank, International Chamber of Commerce (ICC), FIDIC, Institution of Civil Engineers (ICE), and Dispute Board Federation have issued standard procedures for dispute boards that allow the dispute board to embrace whatever procedure it considers essential to conduct its business efficiently and fairly [24].

While incorporating BIM in dispute resolution, BIM's collaborative and digitalized attributes call for changes in conventional dispute board procedures. Consequently, some potential procedural rules can be instigated in traditional proceedings that can eventually provide the dispute board with a set of guidelines to follow while resolving disputes of BIM-enabled projects. These aspects are given in Table 2.

Table 2. Potential legal aspects/contract provisions for procedural rules of dispute board.

Variables	Description	Selected References
V10	The dispute board members should be made aware of the implementation of BIM as soon as the board becomes functional.	[10]
V11	A complete briefing regarding project progress in BIM should be provided to dispute board members at every scheduled meeting.	[7,24,47,48]
V12	All letters or notifications, site visit reports, and decision reports from the dispute board should be sent to parties through the common data environment; or	[13,15]
V13	The dispute board should submit letters or notifications, site visit reports, and decision reports in physical form.	[47,48]
V14	For facilitating the meetings apart from site visits, the common data environment should be used as a platform; or	[15,51,52]
V15	All the dispute board meetings other than site visits should be through conventional methods (call, video conferencing).	[51]
V16	During the hearing, BIM representatives from both parties should be present.	[47,48]
V17	In case of any discrepancy, 2D drawings derived from 3D model data should prevail over 2D CAD drawings; or	[10,42]
V18	In case of any discrepancy, 2D CAD data should prevail over 2D drawings derived from the BIM model.	[10,42]

2.4.3. Roles and Obligations

BIM adoption requires a change to most if not all relationships on a project. In the case where contractual relationships are not appropriately defined, BIM-based collaborated work may give rise to legal liabilities [53]. Hence, a clear definition of the contractual roles and obligations of key stakeholders will assist in regulating the defined responsibilities mentioned in the BIM execution plan [20]. Many countries, industry bodies, individual organizations, and research alliances have introduced standards and guides for BIM implementation, which often entail definitions of the key roles essential for successful BIM implementation [54].

This obligates that effective implementation of BIM in dispute resolution will require predefined roles and responsibilities. Table 3 highlights the potential legal aspects that can be considered for the contractual roles and obligations related to the implementation of BIM in dispute resolution.

Table 3. Potential legal aspects/contract provisions for roles and obligations.

Variables	Description	Selected References
V23	The BIM manager should define and ensure compliance with protocols for integrating BIM in dispute board proceedings, in mutual agreement with the board and parties.	[15,54]
V24	The BIM manager should make the dispute board members aware of the implementation of BIM as soon as the board becomes functional.	[10,15]
V25	The BIM manager should provide a complete briefing regarding project progress in BIM to dispute board members at every scheduled meeting.	[10,15]
V26	A standard of care should be applied by all parties submitting evidence via BIM.	[7,42]
V27	When evidence is provided from any specific discipline (MEP, structure, or architecture), the design manager of the respective disciplines should be responsible for the authenticity of the information.	[7,15,42]
V28	The BIM manager should arrange for BIM data security during data usage in dispute board proceedings.	[7,15,42]

3. Materials and Methods

To effectively meet the objectives of the study, a stepwise research methodology was adopted. The details are described in the following sections.

3.1. Initial Study

Initially, a broad set of the latest published articles related to the "incorporation of BIM in dispute resolution" was explored. Consequently, a gap in research was realized in the form of weak contractual support for the implementation of BIM in dispute resolution. Because of this limitation, the objectives of the study were defined concerning required contractual protocols for BIM implementation in dispute resolution in construction projects procured through the DB delivery method.

3.2. Literature Review

To fulfill the defined objectives of the study, an extensive literature review was carried out. Published articles, FIDIC contracts, and standard BIM contract documents were consulted and investigated for this purpose. In the case of published research, articles were explored using online sources ASCE, ScienceDirect, Scopus, Google Scholar, Taylor & Francis Online, and Emerald Insight, through the keywords "BIM", "Dispute resolution", "design-build" and "Contracts". These keywords were used in conjunction with the word "construction" and joined by Boolean operators AND or OR to create the search strings. Moreover, the search areas were restricted to social science and engineering only and further linked to civil and construction engineering only to retrieve construction-focused articles. This exercise resulted in 157 articles, from which 62 articles were found to be irrelevant when read, as their focus was not construction projects, so these were removed. The remaining articles were then evaluated and reviewed in detail to ensure that they contained information regarding legal aspects of BIM or legal aspects of BIM in dispute resolution. This exercise resulted in a focused selection of 54 articles for further analysis. As a result, 28 potential legal aspects were identified, as previously described in Tables 1–3.

3.3. Survey Development

Next, to obtain and investigate the industry perspective and expert opinion on potential legal aspects identified through the literature, a questionnaire survey approach was utilized. An online questionnaire was produced in Google Forms inquiring about respondents' opinions on all 28 aspects identified through the literature. The targeted participants

for the survey were experts from academia, industry professionals, including engineers; and contract and BIM managers working with contractors and consultants, as these are the main personnel with knowledge regarding BIM and disputes in the construction industry. The survey was conducted globally to achieve favorable representativeness and reliability. The survey targeted over 500 potential respondents. Experts were located firstly via online searching of the construction companies practicing BIM and then by looking at their BIM experts from the company profile. These experts were then contacted through official emails. Secondly, experts were also tracked and contacted through professional networks such as LinkedIn and Opportunity, and research networks such as Academia and ResearchGate. The questionnaire included two main sections. In the first section, respondents were asked for demographics and professional information related to their organizational position, experience, country of practice, etc. The second section was related to the assessment of the potential legal aspects, employing two questions. The first question was related to the extent of a respondent's agreement (on a scale of 1–5, ranging from strongly disagree to strongly agree) with the potential legal aspects. The second was associated with the appropriateness (on a scale of 1–5, ranging from strongly disagree to strongly agree) of the legal aspects to be incorporated as contract provisions in the BIM contracts.

3.4. Data Collection and Analysis

The target respondents for this study were industry experts, consultants, and contract and BIM managers. Cronbach's alpha test was performed on the collected data to measure the reliability and internal consistency among the variables [55], and Shapiro–Wilk and Kolmogorov–Smirnov tests were conducted to analyze the distribution of the sample population [56]. For further analysis, the mean values were evaluated based on the 5-point Likert scale. The analysis of the questions presented on the 5-point Likert scale (ranging from strongly disagree to strongly agree) was carried out by presenting the points in weighting (w) with values ranging from 1–5, respectively. The mean (x) of the number of samples (n) was calculated using Equation (1).

$$x = \frac{\sum_{i=1}^{n} wi}{n} \quad (1)$$

The means were then categorized into three groups for ease of analysis, as also executed by Chong et al. (2017). These categories included:

- Agree = $3.5 \leq$ means ≤ 5;
- Undecided = $2.5 \leq$ means < 3.5;
- Disagree = $1 \leq$ means < 2.5.

This implies that, if the variables fall within the agreement range, they can be included in BIM contracts.

3.5. Framework Development

After the examination of data, potential legal aspects and contract provisions were assimilated to develop a contractual framework that operates within the DB project delivery method and maps the legal aspects and contract provisions under the phases of a typical project lifecycle for ease of understanding. The framework also allocates all the identified potential legal aspects to the three main stakeholders (client, BIM manager/contractor, dispute board) who are associated with or affected by these aspects. In the end, the framework was verified by 3 experts in the construction industry possessing more than 5 years of experience with BIM and contract management to enhance its reliability.

4. Results

Through wide-ranging contact with industry experts, 140 valid responses were received. This sample size is statistically adequate according to Dillman et al. [57]. The demographics of the respondents are summarized in Table 4.

Table 4. Demographic information of respondents.

Options	Responses (%)	Options	Responses (%)
The primary function of the organization		**Years of experience with BIM**	
Consultant	47	1–5	53
Contractor	21	6–10	32
Architect	11	11–15	11
Client	6	Above 15	4
Academia	5		
Others	10		
Role in the organization		**Years of experience with contract administration**	
BIM manager	34	1–5	69
BIM coordinator	21	6–10	12
BIM specialist	11	11–15	7
Contract manager	9	Above 15	12
Project manager	10		
Others	15		

Most of the responses were recorded from Asia, as shown in Figure 2. A study by Jung and Lee [58] reported the worldwide status of BIM adoption and highlighted that BIM adoption in Asia is no less than in other developed continents. This explains the reason behind the large percentage of survey participants in the current study.

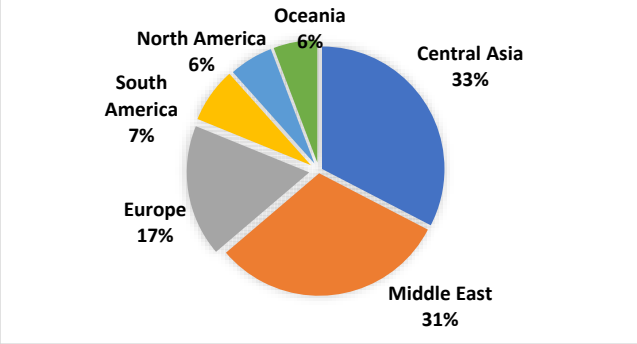

Figure 2. Regional distribution of respondents.

Most of the responses were gathered from professionals affiliated with consultant and contractor organizations. As mentioned by Ahankoob et al. [59], consultants and contractors are generally most familiar with BIM characteristics. Further, the majority of the respondents held a key position as BIM managers. It is worth noting that the BIM manager is an organizational role that possesses the fundamental expertise to deal with BIM-related matters [60].

The current study was concerned with both BIM and contracts and required input from experts in both fields. Since BIM is a comparatively new technology for human resources [61], personnel with relevant experience with BIM do not possess much expertise in contract management. Similarly, respondents with high experience in contract management have less experience with BIM. In short, these two areas of professional expertise seem to operate in mutual exclusivity. Due to this, it is more probable that the joint experience in BIM and contract management will stay on the less experienced side. In the survey results, 85% of the participants fell in the less than 10 years of experience level. However, there was a substantial representation of several BIM-related roles. Thus, these statistics advocate the quality of the sample and the reliability of the results of this study.

While analyzing data, the intercorrelation scores from Cronbach's alpha test were found to be 0.93 (potential legal aspects) and 0.91 (potential contract provisions) for the

two sets of variables. As the threshold value for this test stands at 0.70, this shows that the variables are reliable in terms of internal consistency [55]. Moreover, in the case of normality tests, significance values for all variables were less than 0.05 from both Shapiro–Wilk and Kolmogorov–Smirnov. This indicates that the samples were not normally distributed and the non-parametric test should be conducted for further analysis. Therefore, Spearman's rho correlation was conducted to assess the strength of the relation between the variables [56]. The results indicate that the significant correlation (*p*-value) for all variables was above 0.05. This implies that according to agreement scores, there is a linear relationship among the variables. Data related to analyses conducted on the variables are presented in Table 5. All the variables were evaluated using the mean score values and were then grouped into three predetermined categories, namely agree, undecided, and disagree.

Table 5. Analyzed variables of legal aspects/contract provisions.

Legal Aspects	Mean Value	Contract Provisions	Mean Value	*p*-Value	Categories
LA1	4.05	CP1	4.10	0.546	Agree
LA2	4.22	CP2	4.28	0.616	Agree
LA3	4.32	CP3	4.21	0.623	Agree
LA4	4.16	CP4	4.21	0.421	Agree
LA5	3.72	CP5	3.76	0.536	Agree
LA6	3.91	CP6	3.97	0.518	Agree
LA7	3.88	CP7	3.85	0.607	Agree
LA8	4.15	CP8	4.05	0.616	Agree
LA9	4.08	CP9	4.01	0.660	Agree
LA10	4.07	CP10	4.02	0.609	Agree
LA11	4.05	CP11	3.94	0.569	Agree
LA12	4.10	CP12	4.13	0.547	Agree
LA13	3.21	CP13	3.37	0.585	Undecided
LA14	4.10	CP14	4.03	0.573	Agree
LA15	3.34	CP15	3.23	0.628	Undecided
LA16	4.30	CP16	4.18	0.671	Agree
LA17	3.80	CP17	3.88	0.601	Agree
LA18	3.03	CP18	3.20	0.719	Undecided
LA19	3.72	CP19	3.80	0.661	Agree
LA20	2.95	CP20	3.02	0.761	Undecided
LA21	3.81	CP21	3.82	0.674	Agree
LA22	3.75	CP22	3.72	0.704	Agree
LA23	4.25	CP23	4.16	0.485	Agree
LA24	4.15	CP24	4.11	0.591	Agree
LA25	4.15	CP25	4.03	0.622	Agree
LA26	4.32	CP26	4.29	0.639	Agree
LA27	4.30	CP27	4.14	0.686	Agree
LA28	4.25	CP28	4.22	0.677	Agree

5. Discussion

5.1. Shortlisted Legal Aspects and Contract Provisions

The respondents were asked to indicate the variables that had the potential to be a legal aspect and a contract provision. Interestingly, the accepted variables, which were agreed upon as legal aspects, were also approved by the respondents to be incorporated as contract provisions in BIM contracts. Therefore, for a better understanding, all the approved variables, which were first addressed with short-form V, will now be discussed as contract provisions, short-form CP, per their defined categories in the following section.

5.1.1. Contract Structure and Policy

The provision of the admissibility of BIM documents for dispute resolution (CP1) is critical and rightly supported by the published literature. It is argued that due to the increasing trend of the utilization of digital technologies such as BIM in construction projects, it has become necessary that digital data from BIM should have legal standing

and be treated as a part of contract documents [7,42]. Published contracts have not yet addressed this aspect whereas some custom contracts have tried to fulfill this deficiency by letting the digital data be admissible in certain formats [7]. The survey results with a mean value of 4.10 concur with the literature argument. In the same way, a written agreement between parties is also essential when applying a new concept or technology to a project [62]. Considering this need, Jiang et al. [63] also recommended legalizing BIM implementation on a project under a contract. This led to a provision for "BIM integration in dispute resolution" (CP2) in a contract. The survey results showed a mean score value of 4.28, which implies a high agreement of respondents on the said aspect.

Once there was an agreement on the utilization of BIM in dispute resolution, the next step was to establish specific, necessary protocols in this regard. Some standard forms of contract have established necessary protocols for dispute resolution processes and methods [47]. By following the same precedence, the study of [5] justified the need for BIM-based dispute resolution protocols in construction contracts. A well-structured, balanced, and clear set of contractual guidelines are required to manage BIM and its related information in dispute resolution processes and eventually help boost BIM use in mentioned fields. This aspect (CP3) was enquired from respondents and the mean score value of 4.21 showed the agreement of the majority.

The dedicated protocols for the integration of BIM into dispute resolution are mostly driven by and based upon the digital data that are required to be protected and secured (CP4), as considered in various existing BIM protocols [12,14,64]. The survey results with a mean score value of 4.21 suggested that the security and privacy of data, while being transmitted as a piece of evidence in the dispute resolution process, should also be catered to through contractual protocols.

While setting the protocols, another aspect that requires consideration is the possibility of reducing the time limit for the decision (CP5) due to the incorporation of digital technology. FIDIC contract documents specify realistic time limits for the dispute resolution process and also allow the parties to reduce the time limit [47]. The survey results (3.76) suggest the notion that the time may be reduced in comparison to traditional practices due to the expeditious functioning characteristic of BIM. Traditional processes involve multiple meetings and information coordination, as claims are prepared and analyzed. BIM acts as a centralized electronic hub, ensuring up-to-date information that is promptly available to all parties involved in the project. When a claim arises, all of the required information can be accessed, filtered, sorted, and reported faster than traditional paper-based or unmanaged electronic information.

Another important aspect that needs attention is the acquisition of BIM knowledge by dispute board members. The adoption of innovative and administrative technologies, such as BIM, requires the involved personnel to acquire basic knowledge [65]. It is also considered effective for the members of the dispute board to have related expertise [24]. This accentuates that DB members may also have some basic knowledge regarding BIM (CP6), as they are in continuous connection with the project through site visits and meetings. The survey results (3.97) encouraged the members of dispute boards to have knowledge and understanding of BIM. Correspondingly, if a dispute board member possesses BIM knowledge as an additional qualification, their remuneration may be increased accordingly (CP7). In traditional practices, contracts also specify a higher amount for the chair of the board in comparison to the other members due to his/her higher experience and expertise [48]. This fact is supported by the survey result (3.85) that encourages a higher remuneration for a board member possessing BIM knowledge as additional expertise. On the contrary, in case the dispute board members do not possess any additional relevant expertise, contracts allow the board to utilize the services of experts [48]. Considering this, the survey respondents were given two scenarios inquiring about the services utilization of the BIM coordinator (CP8) or project BIM manager (CP9) to assist the dispute board. Interestingly, the mean score values for both options were nearly equal (CP8:4.05 and CP9:4.01), thereby giving parties a choice to opt for any suitable option.

5.1.2. Dispute Board's Procedural Rules

Apart from contract structure and policy, certain protocols are required to be established concerning dispute board procedural functioning on the project. For instance, the members of the dispute board, after getting appointed, usually get an orientation about the tasks and activities of the project [24]. As BIM is a technological entity that brings changes in the traditional ways of doing business, the involved personnel must be provided with sufficient training or orientation [8]. The AEC BIM protocol [64] also suggests conducting a BIM kickoff meeting for the project members. This leads to the concept of educating the dispute board members regarding BIM through an orientation (CP10) and the mean value of 4.02 indicates the agreement of respondents over this aspect.

Similarly, there is a requirement for dispute board members to regularly visit the project site to get briefed about the progress of the project [24,51]. Inspired by this concept, CP11, stating that a complete briefing regarding project progress in BIM should be provided to dispute board members at every scheduled meeting, was proposed. The survey results (3.94) also validate this concept.

Correspondingly, board members are also required to submit a report regarding site visits [24]. Moreover, they also submit different letters or notifications to parties from time to time. As information sharing and data transmission have become much easier through BIM [26], utilizing this feature, the experts were asked about the concept of data sharing through CDE (CP12). The survey results support the utilization of CDE through a higher mean score value of 4.13, rather than traditional methods (CP13), which obtained a lower score of 3.37.

BIM through its CDE, provides video and web conferencing facilities, messenger systems and instant chat, online meeting spaces, and portals that help the stakeholders collaborate digitally [66]. Standard contract documents are emphasizing its use as a communication platform [13,15]. The respondents were asked if CDE can be utilized for electronic meetings and collaboration (CP14) and the mean value of 4.03 shows their agreement in comparison to traditional approaches (CP15). This highlights that respondents had a high level of awareness regarding CDE and were eager to turn toward digitalization.

At times, a disputed matter leads to a hearing, during which it is essential to have representation from both parties [24]. Additionally, experts from a particular field may also be called upon as expert witnesses when needed [48]. Keeping this in view while utilizing BIM in the dispute resolution process, the presence of BIM representatives in the hearing (CP16) may result in a smooth and efficient process. The results indicate that the majority of experts (4.18) responded in agreement with this provision.

Further, while evaluating the evidence, there comes a situation where the dispute board needs to decide about the preference of one document or information over the other. For example, Consensus Docs [10] provides two options regarding the production of 2D drawings: from the 3D model or 2D CAD drawings. Inspired by this, CP17 and CP18 asked the respondents to highlight the appropriate methods, respectively, in case of disagreement. The results indicate a mean score value of 3.88 for CP17 and 3.20 for CP18. This shows a high preference of respondents for the 3D model over the 2D CAD for the production of drawings.

Similarly, in case of any conflict between model contribution and a portion of the design generated in 2D medium (CP19,20), Consensus Docs (2008) provides two options for parties to agree upon: model contribution (CP19) or 2D drawings (CP20). The survey results (CP19:3.80, CP20:3.02) suggest that model contribution should take precedence over 2D drawings.

Another aspect related to hearings is the submission of digital data. Arshad et al. [7] discussed that a non-editable version of files must be produced for third parties. Considering this, respondents were asked about a suitable design format to be submitted to the dispute board for review through CP20 and CP21. The survey results indicate the mean score values of 3.82 and 3.72 for CP21 and CP22, respectively. Since both options are agreed upon, it is up to the parties to go with their suitable selection.

5.1.3. Roles and Obligations

Davies et al. [54] suggested that the BIM manager, who is the most aware person regarding BIM activities, should be responsible for the development and delivery of the BIM execution plan, and for setting BIM protocols for the project. In this context, CP23 was developed to undertake the opinion of industry experts, and they also responded in favor of this provision (4.16).

In CP10 and CP11, respondents agreed to brief the dispute board on BIM. A BIM manager is considered to be a suitable person to schedule and manage BIM-related meetings [10]. The opinion of the survey respondents in this perspective was requested through CP24 and CP25. The mean values of 4.11 and 4.03, respectively, highlight that experts also agree to put these responsibilities on the BIM manager.

Arshad et al. [7] and Chong et al. [42] discussed that to run the project in a smooth progression, the standard of care (CP28) should be applied by all involved parties. The survey results (4.29) support this provision.

Next, in the domain of intellectual property, the published contracts emphasize the discipline design manager to assume responsibility for its data input. Likewise, the same is maintained in the survey results, which suggest that in case of evidence from any specific design discipline (CP27), the discipline design manager would assume responsibility for the provided data (4.14).

As discussed previously in CP4, respondents suggested that certain measures are required to be taken for the security and privacy of BIM data. To specify responsibility for this task, Consensus Docs [10] states that the BIM manager should establish and maintain encryption, access security measures, and also undertake information system scans to maintain model security. Davies et al. [54] also discussed that the BIM manager is responsible for secure information exchange. The survey results for CP28 showed an agreement of respondents (4.22) in appointing the BIM manager responsible for the job.

5.2. BIM-Dres—A Proposed Contractual Framework

Following the data analysis and discussion, a preliminary contractual framework was formulated to describe the examined legal aspects and contract provisions systematically. The framework portrays two concepts, i.e., (1) it distributes the legal aspects and the contract provisions into particular phases of the project lifecycle, and (2) it allocates liabilities of all the legal aspects and the contract provisions to the relevant stakeholders. Figure 3 portrays the proposed framework along with the legends. In the proposed framework (Figure 3, left), the inner circle represents the title of the framework, "BIM-DRes", which implies BIM incorporation in dispute resolution. In the next level, the annulus represents the four phases of the project with reference to dispute management. The four phases include (i) contract development, (ii) formulation of a dispute board, (iii) project execution (except dispute period), and (iv) project execution (dispute period). In the final level, the annulus represents the contract provisions by their IDs, distributed based on their relativity to a particular phase. IDs are the numbers assigned to provisions in related tables. For example, number two on the figure (in the contract development phase) refers to provision number two provided in Table 1, and so on. Some legal aspects are related to more than one phase and are hence placed in multiple instances accordingly. At the same level, the annulus also allocates the liabilities of the contract provisions to three main stakeholders of a design-build project: client, BIM manager/contractor, and dispute board members, as well as to their different combinations mentioned in the legends.

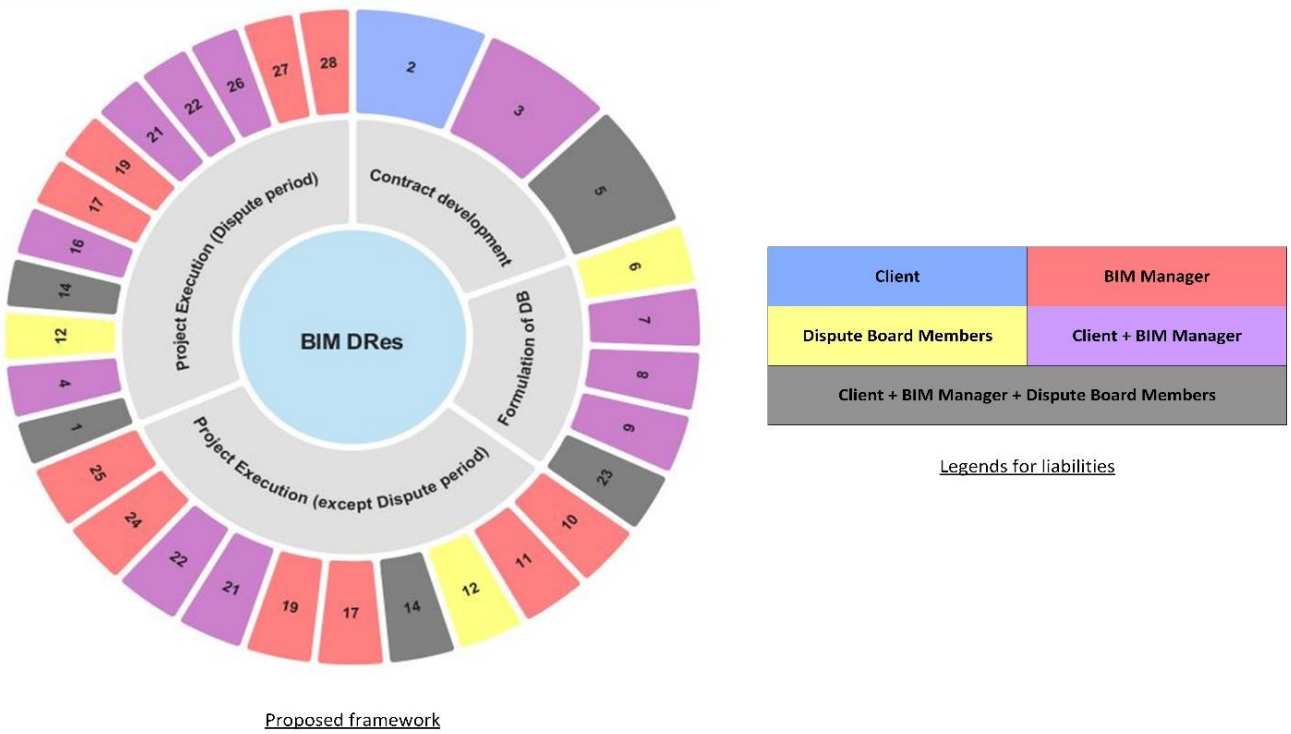

Figure 3. Framework for BIM incorporation in dispute resolution (BIM-DRes).

The legends (Figure 3, right) represent the liable stakeholders through color codes. For example, blue represents the client whereas purple represents both the client and the BIM manager liable to a certain legal aspect. So, in an overall instance, number five represents CP5 and its gray color represents that all three parties, i.e., client, BIM manager/contractor, and dispute board members, are liable to this provision.

Next, to get a critical review of the applicability and soundness of the framework, three experts from the industry were consulted. One of the experts, offering an encouraging response, highlighted that the identified legal aspects and contract provisions are adequate and assist to ease the process of dispute resolution through BIM. Another BIM expert, while appreciating the sound basis of the framework, suggested that both the client and the BIM manager are to be liable for CP9 (if the dispute board members do not possess BIM knowledge, the services of the project BIM manager should be utilized). The third expert suggested that CP17 (in case of any discrepancy, 2D drawings derived from 3D model data should prevail over 2D CAD drawings) and CP19 (in case of any discrepancy, 2D CAD drawings data should prevail over 2D drawings derived from the BIM model), which were earlier placed only in phase four, also apply to the third phase. The suggestions of the experts were duly incorporated into the BIM-DRes framework shown in Figure 3.

In the domain of dispute resolution incorporating BIM, Greenwald [5] suggested the creation of a comprehensive, uniform, project-specific dispute resolution plan addendum. The proposed framework of this study can be considered an advanced version, as it not only describes the important areas but also provide detailed protocols for the appropriate incorporation of BIM into the dispute resolution process. Moreover, as mentioned previously, there are examples present in the literature where BIM is utilized for dispute resolution [35,37]. BIM-DRes provides a way forward to this concept, as it will ease and systemize dispute resolution through the relationship development of a particular provision to a specific phase of the project. The framework also assigns liabilities to stakeholders, thus making them aware of their responsibilities for effective proceedings.

6. Conclusions

BIM is gaining significant recognition as a dispute-resolution tool in the AEC industry and practitioners are tending toward the utilization of this characteristic of the technology. To contribute to this domain, this study recognized 28 potential legal aspects related to BIM integration in dispute resolution through a detailed analysis of published research and contract systems. These aspects were distributed into three core classifications: (1) contract structure and policy, (2) procedural roles and operations of the dispute board, and (3) roles and obligations. Analysis of the questionnaire survey indicated 24 significant legal aspects that can be considered in BIM-enabled dispute resolution processes. Afterward, a preliminary contractual framework was formulated for the analyzed legal aspects and contract provisions. The proposed BIM-DRes framework demonstrates all the legal aspects and the contract provisions on project phases concerning dispute resolution alongside allocating the liabilities of these aspects to their related stakeholders. The key contribution of this study is an extension of the current BIM contract protocols. It specifies numerous new and dedicated contractual provisions required in BIM contracts under the theme of dispute resolution that are practical and feasible for use in the industry. Thus, it can assist the use of technology through the adoption of BIM in dispute resolution. It also encourages researchers, construction professionals, and legal bodies to contemplate the contractual uncertainties in BIM-based dispute resolution to facilitate the uptake of BIM in this domain. Nevertheless, this study is limited by its respondents' lack of experience in both BIM and contracts, which future studies may improve. This study revolves around the dispute board as a dispute resolution method and design-build as a project delivery method. Future studies focusing on other dispute resolution and project delivery methods are also recommended.

Author Contributions: Conceptualization, R.M. and A.R.N.; Data curation, R.M.; Formal analysis, R.M.; Investigation, R.M.; Methodology, R.M. and A.R.N.; Project administration, R.M. and A.R.N.; Resources, R.M. and A.R.N.; Supervision, A.R.N.; Validation, R.M.; Visualization, R.M.; Writing—original draft, R.M.; Writing—review and editing, A.R.N. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the National University of Sciences and Technology (NUST), Islamabad, Pakistan.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Informed consent was obtained from all respondents involved in the study.

Data Availability Statement: The data are available with the first author and can be shared upon reasonable request.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Farooqui, R.U.; Masood, F.; Saleem, F. Key Causes of Construction Disputes in Pakistan. In Proceedings of the Third International Conference on Construction in Developing Countries, Bangkok, Thailand, 4–6 July 2012; pp. 72–79.
2. Béquin, M. Building Information Modelling's Impact on Claims in Construction Projects. *PM World J.* **2018**, *7*. Available online: https://pmworldlibrary.net/wp-content/uploads/2018/05/pmwj70-May2018-Bequin-bim-impact-on-claims-in-construction-projects-student-paper.pdf (accessed on 30 September 2022).
3. Soltani, Z.; Anderson, S.; Kang, J. The Challanges of Using BIM in Construction Dispute Resolution Process. In Proceedings of the ASC Annual International Conference, Seattle, WA, USA, 5–8 April 2017; pp. 771–776.
4. Al Shami, K. Investigating the Use of Building Information Modeling (BIM) in Managing Construction Claims. *PM World J.* **2018**, *7*, 1–17. Available online: https://pmworldlibrary.net/wp-content/uploads/2018/02/pmwj67-Feb2018-Al-Shami-use-of-BIM-for-managing-construction-claims-featured-paper.pdf (accessed on 30 September 2022).
5. Greenwald, N. A Creative Proposal for Dispute Systems Design for Construction Projects Employing BIM. *J. Leg. Aff. Disput. Resolut. Eng. Constr.* **2013**, *5*, 2–5. [CrossRef]
6. Al Hawary, A.N.; Nassar, A.H. The Effect Of Building Information Modeling (BIM) On Construction Claims. *Int. J. Sci. Technol. Res.* **2016**, *5*, 25–33.

7. Arshad, M.F.; Thaheem, M.J.; Nasir, A.R.; Malik, M.S.A. Contractual Risks of Building Information Modeling: Toward a Standardized Legal Framework for Design-Bid-Build Projects. *J. Constr. Eng. Manag.* **2019**, *145*, 04019010. [CrossRef]
8. Masood, R.; Kharal, M.K.N.; Nasir, A.R. Is BIM Adoption Advantageous for Construction Industry of Pakistan? *Procedia Eng.* **2014**, *77*, 229–238. [CrossRef]
9. Marzouk, M.; Othman, A.; Enaba, M.; Zaher, M. Using BIM to Identify Claims Early in the Construction Industry: Case Study. *J. Leg. Aff. Disput. Resolut. Eng. Constr.* **2018**, *10*, 05018001. [CrossRef]
10. ConsensusDocs. ConsensusDocs 301: Building Information Modeling (BIM) Addendum. 2008. Available online: http://unh.edu/purchasing/CD301%20-%20BIM%20Addendum.pdf (accessed on 12 April 2021).
11. AIA. E202—2008 Building Information Modeling Protocol Exhibit. 2008. Available online: https://www.scribd.com/document/390933747/AIAE202 (accessed on 14 April 2021).
12. AIA. E203—2013 Building Information Modeling and Digital Data Exhibit. 2013. Available online: https://zdassets.aiacontracts.org/ctrzdweb02/zdpdfs/aia-e203-2013-free-sample-preview.pdf (accessed on 14 April 2021).
13. BSI. PAS-1192-2. Specification for Information Management for the Capital/Delivery Phase of Construction Projects Using Building Information Modeling. 2013. Available online: https://www.hfms.org.hu/joomla/images/stories/PAS/PAS1192-2-BIM.pdf (accessed on 17 April 2021).
14. CIC. Building Information Model (BIM) Protocol. 2018. Available online: cic.org.uk/uploads/files/old/bim-protocol-2nd-edition-2.pdf (accessed on 10 April 2021).
15. *ISO 19650-1*; Organization and Digitization of Information about Buildings and Civil Engineering Works, Including Building Information Modeling (BIM)—Information Management Using Building Information Modeling- Part 1: Concepts and Principles. ISO: Geneva, Switzerland, 2018.
16. Chong, H.Y.; Zin, R.M. Selection of Dispute Resolution Methods: Factor Analysis Approach. *Eng. Constr. Archit. Manag.* **2012**, *19*, 428–443. [CrossRef]
17. Olatunji, O.A. A Preliminary Review on the Legal Implications of BIM and Model Ownership. *J. Inf. Technol. Constr.* **2011**, *16*, 687–696.
18. Jo, T.M.; Ishak, S.S.M.; Rashid, Z.Z.A. Overview of the Legal Aspects and Contract Requirements of the BIM Practice in Malaysian Construction Industry. In Proceedings of the International Conference on Civil, Offshore & Enviromental Engineering, Kuala Lampur, Malaysia, 13–14 August 2018; p. 02011.
19. Kuiper, I.; Holzer, D. Rethinking the Contractual Context for Building Information Modelling (BIM) in the Australian Built Environment Industry. *Constr. Econ. Build.* **2013**, *13*, 1–17. [CrossRef]
20. Fan, S.L.; Chong, H.Y.; Liao, P.C.; Lee, C.Y. Latent Provisions for Building Information Modeling (BIM) Contracts: A Social Network Analysis Approach. *KSCE J. Civ. Eng.* **2019**, *23*, 1427–1435. [CrossRef]
21. Kalach, M.; Srour, I.; Abdul-Malak, M.A. Envisioned Roles of BIM for Design Delivery Under Design-Build Projects. In Proceedings of the Construction Research Congress, New Orleans, LA, USA, 2–4 April 2018; pp. 552–561.
22. Harmon, K.M.J. To be or not to be—That Is the Question: Is a DRB right for your Project? *J. Leg. Aff. Disput. Resolut. Eng. Constr.* **2011**, *3*, 10–16. [CrossRef]
23. Agdas, D.; Ellis, R.D. Analysis of Construction Dispute Review Boards. *J. Leg. Aff. Disput. Resolut. Eng. Constr.* **2013**, *5*, 122–127. [CrossRef]
24. Chern, C. *Chern On Dispute Boards: Practise And Procedure*, 4th ed.; Routledge: Abingdon, UK, 2019.
25. Gardezi, S.S.S.; Shafiq, N.; Khamidi, M.F.B. Prospects of Building Information Modeling (BIM) in Malaysian Construction Industry as Conflict Resolution Tool. *J. Energy Technol. Policy* **2013**, *3*, 346–350.
26. Charehzehi, A.; Chai, C.; Yusof, A.M.; Chong, H.Y.; Loo, S.C. Building Information Modeling in Construction Conflict Management. *Int. J. Eng. Bus. Manag.* **2017**, *9*, 1–18. [CrossRef]
27. National Research Council. *Advancing the Competitiveness and Efficiency in the U.S. Construction Industry*; NAP: Washington, DC, USA, 2009. [CrossRef]
28. Al-Sibaie, E.Z.; Alashwal, A.M.; Abdul-Rahman, H.; Zolkafli, U.K. Determining the Relationship Between Conflict Factors and Performance of International Construction Projects. *Eng. Constr. Archit. Manag.* **2014**, *21*, 369–382. [CrossRef]
29. NBS, N.B.S. National BIM Report. 2011. Available online: https://www.thenbs.com/knowledge/nbs-national-bim-report-2011 (accessed on 15 March 2021).
30. Charehzehi, A.; Yusof, A.M.; Chai, S.C. Conceptualizing Building Information Modeling: In Construction Conflict Management. In Proceedings of the 26th International Business Information Management Association Conference on Innovation Management and Sustainable Economic Competitive Advantage: From Regional Development to Global Growth, Madrid, Spain, 11–12 November 2015; pp. 1337–1358.
31. Bazjanac, V. Virtual Building Environments (VBE)- Applying Information Modeling to Buildings. In Proceedings of the 5th European Conference on Product and Process Modeling in the Building and Construction Industry (ECPPM), Istanbul, Turkey, 8–10 September 2006; pp. 41–48.
32. Chen, K.; Lu, W. Bridging BIM and Building (BBB) for Information Management in Construction: The Underlying Mechanism and Implementation. *Eng. Constr. Archit. Manag.* **2019**, *26*, 1518–1532. [CrossRef]

33. Khoshnava, S.M.; Ahankoob, A.; Preece, C.; Rostami, R. Potential Application of BIM in Construction Dispute and Conflict. In Proceedings of the Management in Construction Research Association Post graduate Conference, Kuala Lumpur, Malaysia, 5–6 December 2012; pp. 178–184.
34. Jalal, M.P.; Roushan, T.Y.; Noorzai, E.; Alizadeh, M. A BIM-based Construction Claim Management Model for Early Identification and Visualization of Claims. *J. Smart Sustain. Built Environ.* **2020**, *10*, 227–257. [CrossRef]
35. Brando, F.; Cao, A.I.L.; Malsch, E.A.; Panariello, G.; Abruzzo, J.; Pinto, M.J. Forensic Information Modeling: A New Forensic Tool. *Civ. Eng. Mag.* **2013**, *83*, 48–53. [CrossRef]
36. Karanci, E.; Nagata, R. A New Method for Managing and Presenting Façade Investigation Data. In Proceedings of the 6th Congress on Forensic Engineering, San Francisco, CA, USA, 31 October–3 November 2012; pp. 861–870.
37. Koc, S.; Skaik, S. Disputes Resolution: Can Bim Help Overcome Barriers? In Proceedings of the International Conference on Construction in a Changing World, Dambulla, Sri Lanka, 4–7 May 2014; pp. 1–15.
38. Jamil, A.H.A.; Fathi, M.S. Enhancing BIM-based Information Interoperability: Dispute Resolution from Legal and Contractual Perspectives. *J. Constr. Eng. Manag.* **2020**, *146*, 05020007. [CrossRef]
39. Eadie, R.; McLernon, T.; Patton, A. An Investigation Into the Legal Issues Relating to Building Information Modelling (BIM). In Proceedings of the RICS COBRA AUBEA, Sydney, Australia, 8–10 July 2015.
40. Olatunji, O.A. Constructing Dispute Scenarios in Building Information Modeling. *J. Leg. Aff. Disput. Resolut. Eng. Constr.* **2016**, *8*, C4515001. [CrossRef]
41. Fischer, T.; Herr, C.M. BIM Adoption Across the Chinese AEC industries: An Extended BIM Adoption Model. *J. Comput. Des. Eng.* **2019**, *6*, 173–178. [CrossRef]
42. Chong, H.Y.; Fan, S.L.; Sutrisna, M.; Hsieh, S.H.; Tsai, C.M. Preliminary Contractual Framework for BIM-Enabled Projects. *J. Constr. Eng. Manag.* **2017**, *143*, 04017025. [CrossRef]
43. ICE. ICE-Dispute-Board-Procedure. 2012. Available online: https://myice.ice.org.uk/ICEDevelopmentWebPortal/media/Documents/Disciplines%20and%20Resources/09-3-ICE-Dispute-Board-procedure-2012-04-30.pdf (accessed on 28 April 2021).
44. JICA. Dispute Board Manual. 2012. Available online: https://www.jica.go.jp/activities/schemes/finance_co/procedure/guideline/pdf/DisputeBoardManual_201203_e.pdf (accessed on 2 May 2021).
45. CIArb. Ciarb-Dispute-Board-Rules. 2014. Available online: https://www.ciarb.org/media/3934/ciarb-dispute-board-rules-practice-standards-committee-august-2014.pdf (accessed on 2 May 2021).
46. Huang, Y.F.; Mat Ya'acob, I.A.; Mohd Rahim, F.A.; Zainon, N.; Tan, K.W.; Ling, L.; Leong, K.H. Risk in Implementing Building Information Modelling (BIM) in Malaysia Construction Industry: A Review. *E3S Web Conf.* **2018**, *65*, 03002. [CrossRef]
47. FIDIC. Conditions of Contract for Construction. 1999. Available online: https://lauwtjunnji.weebly.com/uploads/1/0/1/7/101171621/fidic_-_conditions_of_contract_for_construction_for_building_and_engineering_works_designed_by_the_employer_(1999).pdf (accessed on 1 April 2021).
48. FIDIC. Conditions of Contract for Plant & Design-Build. 2017. Available online: https://fidic.org/books/plant-and-design-build-contract-2nd-ed-2017-yellow-book (accessed on 1 April 2021).
49. Gould, N. An Overview of the CIArb Dispute Board Rules. In Proceedings of the 7th Annual IBC Construction Law: Contracts and Disputes Conference, London, UK, 1 July 2015.
50. Charrett, D. Dispute Board and Construction Contracts. 2009. Available online: https://fidic.org/sites/default/files/3%20charrett09_dispute_boards.pdf (accessed on 5 May 2021).
51. ICC. Dispute-Board-Rules. 2018. Available online: https://iccwbo.org/content/uploads/sites/3/2015/09/icc-dispute-board-rules-english-version.pdf (accessed on 2 May 2021).
52. Dougherty, J.M. *Claims, Disputes and Litigation Involving BIM*; Routledge: Abingdon, UK, 2015.
53. McAdam, B. Building Information Modelling: The UK Legal Context. *Int. J. Law Built Environ.* **2010**, *2*, 246–259. [CrossRef]
54. Davies, K.; Wilkinson, S.; McMeel, D. A Review of Specialist Role Definitions in BIM Guides and Standards. *J. Inf. Technol. Constr.* **2017**, *22*, 185–203.
55. Taber, K.S. The Use of Cronbach's Alpha When Developing and Reporting Research Instruments in Science Education. *Res. Sci. Educ.* **2017**, *48*, 1273–1296. [CrossRef]
56. Sheskin, D. *Handbook of Parametric and Nonparametric Statistical Procedures*, 5th ed.; Taylor Francis: Newyork, NY, USA, 2011.
57. Dillman, D.A.; Smyth, J.D.; Christian, L.M. *Internet, Phone, Mail, and Mixed-Mode Surveys: The Tailored Design Method*, 4th ed.; Wiley: Hoboken, NJ, USA, 2014.
58. Jung, W.; Lee, G. The Status of BIM Adoption on Six Continents. *Int. J. Civ. Environ. Eng.* **2015**, *9*, 512–516. Available online: https://publications.waset.org/10001095/pdf (accessed on 1 April 2021).
59. Ahankoob, A.; Manley, K.; Abbasnejad, B. The Role of Contractors' Building Information Modelling (BIM) Experience in Realizing the Potential Values of BIM. *Int. J. Constr. Manag.* **2019**, *22*, 588–599. [CrossRef]
60. Barison, M.B.; Santos, E.T. An Overview of BIM Specialists. In Proceedings of the International Conference on Computing in Civil and Building Engineering, Nottingham, UK, 30 June–2 July 2010; pp. 141–146.
61. Gerges, M.; Austin, S.; Mayouf, M.; Ahiakwo, O.; Jaeger, M.; Saad, A.; Gohary, T.-E. An Investigation Into the Implementation of Building Information Modeling in the Middle East. *J. Inf. Technol. Constr.* **2017**, *22*, 1–15.
62. Chen, Y.; Wang, W.; Zhang, S.; You, J. Understanding the Multiple Functions of Construction Contracts: The Anatomy of FIDIC Model Contracts. *Constr. Manag. Econ.* **2018**, *36*, 472–485. [CrossRef]

63. Jiang, Y.; Ma, P.; Zhang, S. Contractual Governance of BIM-Enabled Projects: Where are we? *Int. J. Arch. Eng. Constr.* **2018**, *7*, 1–10. Available online: http://journals.iasdm.org//index.php/ijaec/article/view/502 (accessed on 11 April 2021). [CrossRef]
64. AEC, A., Engineers and Contractors. AEC (UK) BIM Protocol. Available online: https://aecuk.files.wordpress.com/2015/06/aecukbimtechnologyprotocol-v2-1-1-201506022.pdf (accessed on 11 April 2021).
65. Garcia, A.J.; Mollaoglu, S.; Syal, M.G.M. Implementation of BIM in Small Home-Building Businesses. *J. Pract. Period. Struct. Des. Constr.* **2018**, *23*, 04018007. [CrossRef]
66. Stefan, M. *Implementation of a Common Data Environment*; AECOM: Edinburgh, UK, 2018.