A Preliminary Contractual Framework for BIM-enabled Projects

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ABSTRACT

Building Information Modeling (BIM) has entered into another phase of maturity, especially in countries that have been actively adopting and using BIM including in the Republic of China, Taiwan. An effective management in BIM has increasingly becoming one of the demanding features in Taiwanese architecture, engineering, construction and operation industries, particularly in dealing with the legal issues associated with BIM implementation. Therefore, the research aims to develop a preliminary contractual framework for BIM-based contract administration. Two objectives underpin the research, namely: (a) to identify the potential legal aspects need to be considered in BIM-enabled projects; and (b) to determine the related contract provisions required in BIM contracts. Questionnaire survey method was adopted through a selective sampling approach in Taiwan. Thirty-six valid and completed questionnaires were analyzed. The results identify twenty-one related contract provisions that could potentially be used in BIM contracts. Following a thorough analytical discussion, these contract provisions were then incorporated into the developed contractual framework. Whilst paving the way for a robust contractual mechanism for BIM-enabled projects in the future, the research contributes into the body-of-knowledge for BIM-based contract administration.

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Background and Introduction

From the international perspective, various Building Information Modeling (BIM) contract protocols have been established for administrating contracts. For example, the American Institute of Architects (AIA) has published Document E203 TM -2013 – BIM and Digital Data Exhibit (AIA, 2013), and ConsensusDocs has published ConsensusDocs 301—Building Information Modeling addendum (ConsensusDocs 301 2013). Also, there are AEC BIM Protocol and CIC BIM Protocol in the United Kingdom (AEC 2012; Construction Industry Council 2013). BIM has also incorporated and considered in the Complex Construction Contracts (Chartered Institute of Building 2013). However, the protocols only serve as a guideline in contract administration and appeared to provide an 'average performance' in overcoming the legal issues associated with BIM implementation (Al-Shammari 2014). Moreover, many construction personnel are still unaware of the existence of BIM standard form documents or protocols (ConstructionPro Week 2012). Thus, despite the fact that BIM itself is gaining momentum, the use of the standardized BIM protocols remains low.

Previous studies were mostly review papers, which were reviewing potential legal implications of BIM (Oluwole 2011), BIM's legal issues and considerations in contract (Joyce and Houghton 2014), contractual arrangements for BIM in Australia (Kuiper and Holzer 2013) and BIM's legal risks in Taiwan (Hsu et al. 2015). Some preliminary empirical studies were also conducted such as, qualitative analyses from interviews on potential legal issues in BIM (Arensman and Ozbek 2012) and intellectual property rights for BIM's copyright and ownership (Fan 2013). A questionnaire survey was also conducted in United Kingdom for a preliminary investigation on the significant legal issues stifling BIM implementation (Eadie et al. 2015). From these, it can be concluded that the related works on BIM and legal issues were still at an exploratory stage due to limited empirical data across the architectural, engineering, construction and facility management/operation (AECO) industries. Thus there is a need for a comprehensive study to address the potential legal issues, especially from the contract administration perspective.

Therefore, the research aims to develop a preliminary contractual framework for BIM-based

contract administration. The research is underpinned with two objectives: (a) to identify potential legal aspects generally required in BIM-enabled projects; and (b) to determine the related contract provisions required in BIM contracts. A questionnaire survey was utilized to obtain the empirical data of the potential legal aspects and contract provisions. The scope of this research focuses on a country that has actively adopted and used BIM, namely the Republic of China, Taiwan due to the proactive implementation of BIM to the level of its local governments in their public projects (Chien et al., 2014). The proposed contractual framework will provide a contemporary analysis on the potential legal aspects and contract provisions that are practical and feasible for future uses in BIM-based contract administration.

Legal Aspects Associated with BIM Implementation

Various legal issues have been forecasted in BIM-enabled projects in the AECO industries. This section of the paper intends to elaborate and organize the legal issues and questions raised from the related literatures, which were then included in a questionnaire survey to identify potential legal aspects that could be considered as contract provisions in future BIM contracts. Following a thorough literature review, the legal aspects have been categorized into three classifications, namely, (a) contract structure and policy, (b) contractual relationships and obligations, and (c) BIM model and security.

Contract Structure and Policy

The traditional legal frameworks have been designed to govern fragmented practices and conventions in construction projects (Chong and Phuah 2013). However, BIM enables and promotes a collaborative working platform for all project stakeholders. The existing BIM contract protocols are mainly used as supporting document; yet they are generally used as an addendum to the original contract. There is still a lack of clarity over the changing roles and legal responsibilities required for BIM's project requirements (Redmond et. al. 2010). This creates the need for an alternative contract structure to accommodate the construction procurement (O'Connor et al. 2016), and contracting methodologies including progress payments (Kuiper and Holzer 2013) and project financing options (Lu et al., 2016). Integrated Project Delivery (IPD) procurement system has been

proposed associated with BIM implementation. Building Smart (2012) contends that standard contracts need to be developed for this procurement system. Yet, IPD might not offer the sole solution for the procurement system (Holzer 2013). IPD contracts are generally drafted on an ad hoc basis, which will inhibit their widespread uses in the industry (Smith, 2014). The complexity of IPD system also been perceived to cause slow adoption and hence its unpopularity in BIM-enabled projects.

As a result, some potential legal aspects can be initiated to address above legal issues, or can be predicted to accommodate unknown situations associated with BIM implementation. These aspects will formulate the fundamental principles in the contract as shown in Table 1:

Table 1 Potential Legal Aspects for Contract Structure and Policy

Contractual Relationships and Obligations

All project stakeholders work collaboratively in BIM-enabled projects. BIM Execution Plan will be developed to provide the necessary checklist and guidance for the successful BIM implementation. Although this document is generally not a part of the contract (Hardin and McCool 2015), the stakeholders' roles and project scopes need to be well defined and governed. If there are no contractual relationships, their participations may not give rise to the legal liability (McAdam 2010), including pure economic loss (Simonian and Korman 2010). Hence, the clear contractual relationships of the key stakeholders (including BIM manager) will help to regulate the required responsibilities or functions in the BIM Execution Plan (Lowe and Muncey 2009). This situation also raises another legal question on the need for additional insurance, particularly for the design liability on the BIM model (Enegbuma and Ali 2011).

Besides, when certain liabilities or obligations have been identified and made clear in the contract, the standard of care should be the next matter that needs to be clarified (Hsieh et al. 2012). Privity of contract and Spearin doctrine should be considered. For example, the use of a collaborative system should reduce the likelihood for a designer to claim the lack of privity of contract in a legal defense (Simoniam and Korman 2010). As for the Spearin doctrine, it can be used by contractors as a defense to an owner's claim of defective and nonconforming work (Barthet 2010).

Following the review, Table 2 shows the potential legal aspects can be considered for the contractual relationships and obligations associated with BIM implementation.

Table 2 Potential Legal Aspects for Contractual Relationships and Obligations

BIM Model and Security

Security and privacy issues will likely impede widespread adoption of BIM (Mahamadu et al. 2013). The BIM's information is digitized and parameterized, which the information can be easily extracted and reused in whole or in part (Fan 2014). Therefore, it raises a new problem about how the business knowledge can be protected. A common Quick Response Code (QR-Code) has been successfully integrated with BIM for optimizing the BIM model's information flow (Lorenzo et al. 2014). It can be considered for prevention of any infringements or copyrights issues on the drawings and documents in the BIM-enabled projects. A data management policy is needed for all project development stages to avoid exchanging the unnecessary and incorrect information in BIM-enabled projects (Greenwood et al. 2010). The data management policy should also address common interoperability issues from different software (Lopez et al. 2015), although the Industry Foundation Classes (IFC) data modelling format has been referred to and used in the model development (Steel et al. 2012).

Apart from that, the development of BIM model can be seen as a joint effort by multiple parties. There is a possibility of an infringement claim from a third party. The intellectual property rights need to be defined at the early stage of project development. The available BIM contract protocols (e.g., ConsensusDOCS 301 BIM Addendum and AIA Document E202) suggest that each party owns all rights to its own contribution and also to comply with local statutory law or regulations in relation to data privacy and security (Fan 2014). Therefore, all digital data should be well-kept and controlled. The indemnity may be considered in the BIM model to protect the client's interest. Table 3 shows the potential legal aspects in governing the technical aspects of the BIM model and the related copyright and data management issues.

Table 3 Potential Legal Aspects for BIM Model and Security

Methodology

BIM has not been mandated in Taiwan but many government sectors have proactively implemented and initiated BIM in their projects. Therefore, there are a very high degree of adoption and use rate of BIM in the AECO industries in Taiwan, which are suitable for a quantitative analysis like this, i.e. to capture a wide spectrum of responses on the matter. Hence, a structured questionnaire survey method was adopted to investigate and identify the potential legal aspects in BIM-enabled projects based on the thirty-four variables. Meanwhile, the same variables were surveyed to determine their appropriateness as contract provisions in BIM contracts excluding the variables A1, A2, A3, A4, A15 and A16, these variables were related to the legal aspects that must be considered or incorporated in BIM contracts.

Selective sampling was used in the questionnaire survey method in this exploratory study. Most of BIM-enabled projects were initiated and funded by the local governments in Taiwan, so the contacts of the respondents were collected from organizations and/or individuals that had engaged works with the local authorities. However, the practice of BIM is not yet fully mature, so the selective sampling technique has been conducted properly to include only those respondents who are with appropriate understanding and knowledge in BIM.

The questionnaire was organized into two sections, namely Section A was asking for demographics of the respondents; whereas Section B was asking for the agreement on the potential legal aspects and most of them require two answers. The first answer was to indicate to what extent of the agreement (on a scale of 1-5) with the potential legal aspects. The second answer was an indication of how appropriate (on a scale of 1-5) of the legal aspects to be incorporated as contract provisions into the BIM contracts. The means and standard deviation (SD) were analysed based on the 5-points Likert scale.

The analysis of the questions involving 5 point Likert scale (ranging from Strongly Disagree to Strongly Agree) was conducted by representing the points in weighting (w) with values of -2, -1, 0, 1, and 2 respectively. The mean ($\bar{x}$) of the number of samples (n) is then calculated as follows:

$$\bar{x} = \frac{\sum_{i=1}^{n} w_i}{n}$$

The means were then grouped into three simple categories for ease of analysis, especially when

clarifying with complicated legal issues, namely,

- 'Agree' = 30.50 ⩽ means ⩽ 52.00
- 'Undecided' = 2-0.50 ⩽ means < 30.50
- 'Disagree' = 0-2.00 ⩽ means < 2.5- 0.50

For instance, if the appropriateness variables fell within the range of the "agree" category, the variables could be then serve as the related contract provisions in BIM contracts.

Results and Analysis

About fifty potential respondents were identified and asked to participate in the questionnaire survey; but thirty-six valid questionnaires were responded and collected. This sample size is sufficient by referring to Central Limit Theorem, which is to approach the approximate normal sampling distribution for analyzing the means scores as required in the research (Serfling 2009). The majority of the respondents have received a post-graduate level of study (61%) and have had more than ten years working experience in the construction industry (67%). They are mainly working as contractors (22%), architects (33%) and consultants (28%). Meanwhile, the rest of the respondents are with the academic institutions (11%), developer (3%) and government sector (3%). The majority group (67%) or twenty-four respondents have worked and involved directly in BIM-enabled projects. Some respondents have not directly involved in the BIM-enabled projects; but they were filtered in the selective sampling process, who with a good understanding and knowledge in BIM. For instance, the professors who have actively involved in consultations or research in relation to BIM.

Two reliability tests were carried out on thirty-four dependent variables (potential legal aspects) and twenty-eight dependent variables (appropriateness as contract provisions) based on Cronbach's alpha test. This Cronbach's alpha is a measurement of internal coefficient, which is to measure the internal consistency among the variables (Vogt 2007). The results show the inter-correlation scores were of 0.83 and 0.89 respectively for the two sets of variables. The scores were above the acceptable threshold value of 0.7. This can be concluded that the variables are acceptable in terms of internal consistency. Besides, the normality tests were also carried out, where both Kolmogorov-Smirnov and Shapiro-Wilk analyses show the significance value below 0.05 for

all dependent variables. In other words, the results indicate that the samples were not normally distributed and nonparametric tests should be used for subsequent analyses.

Table 4 shows a combination of analyses on the variables. All the variables were analyzed using the means and SD. The variables were then grouped into the predetermined three categories. Spearman's rho correlation was adopted to measure the relationships between the legal aspects' variables and appropriateness variables. This non-parametric test is to measure the strength of association between the variables based on their correlation coefficient (Sheskin, 2003). The results show all of them were above the significant p-value of 0.05. It means there is a linear relationship between the variables in terms of the agreement scores rated by the respondents.

Twenty-two potential legal aspects were agreed by the respondents, which the aspects should be considered in BIM-enabled projects. Meanwhile, only one potential legal aspect was excluded from being considered as contract provisions, namely, "The BIM's cost/payment should be charged according to the types of development, models and functions required for the project (A8)". The remaining twenty-one legal aspects could be used as the potential contract provisions in BIM contracts. Below are the sorted and highly agreed (above means of 1.0) legal aspects and potential contract provisions associated with BIM implementation:

- A specific BIM standard form of contract is required to cover all scopes and project requirements (A1:1.55).
- The relationship among client, designers and contractors should be clearly defined and connected in the project (A17:1.36, AP17:1.30).
- The digital data should be protected with security for its usage and data integrity (A30:1.33, AP30:1:16).
- A new BIM Manager role should be engaged in the project (A14:1.25, AP14:1.05).
- The data providers (designers or contractors) should be responsible and be liable for the inserted data in the model (A32:1.22, AP32:1.25).
- Digital data or information should be treated as a part of the contract document

(A4:1.13).

- The contract should define the roles, scopes of works for all parties involved in the project (A15:1.11).
- The contract should define the BIM's goals and quality checks for different stages of development (A16:1.11).
- The owner of the model or the client can use, access and reproduce the model if permission has been sought from the copyright owner (A28:1.08, AP28:1.05).

Table 4: Analyzed Variables

On the other hand, the non-parametric test of Kruskal Wallis test was conducted to investigate the agreed contract provisions against organizational background. The test would compare two or more independent samples (organization structure of the respondents) of different sample sizes for the analysis of variance (Hollander et al. 2013). The result shows the respondents had the same agreement on most of the legal aspects and contract provisions regardless of their organizational background. Most of the means groups rejected the null hypothesis, with the significant p-value above 0.05. Nevertheless, Table 5 shows the different view on the legal aspects and/or appropriateness variables when comparing with the respondents' organisational background. Remarks have made to articulate possible reasons of the differences or potential areas of developments in the future.

Table 5 Different views as per the respondents' background

Besides, majority of the respondents have directly involved in BIM-enabled projects; but it is still important to know if there are any different views on the agreed legal aspects and contract provisions based on their actual experience in BIM. This has a direct connection with the level of adoption and use of BIM, which will influence the results. Table 6 shows only two items with different views when comparing their actual involvement in BIM by analysing the Kruskal Wallis test. In other words, the respondents had same and consistent views on most of agreed legal aspects and contract provision. The differences were related to the design aspects of the BIM model development.

Table 6: Different views as per the respondents' actual involvement in BIM

Discussions and Contractual Framework

The potential legal aspects have been converted into two types of variables to determine their practicality and feasible use in the future BIM-based contract administration. The preliminary contractual framework is then developed to explain the analysed legal aspects and contract provisions in a systematic manner as illustrated in Figure 1. The legal aspects and contract provisions have been further categorized into certain sub-themes of contract administration. The framework provides a clear linkage of the grouped legal aspects and contract provisions throughout the contract lifecycle. For instance, the "Contract Form" will define the "Roles" and "Model Development", and subsequently the digital data from the "Model Development" will be governed by "Data Management" and "Copyright". Meanwhile, the "Payment and Penalty" will be confirmed at the post completion stage of "Data Management". Generally, the legal aspects and contract provisions under contract structure and policy are the backbone and foundation for the BIM-based contract administration. They are supported by the related contractual relationships and obligations, while the BIM model and security are extended from the governed relationships and obligations of the stakeholders. Yet, there are still many unclear legal requirements for the contract structure and policy; and the contractual relationships and obligations compared to the BIM model and security. These two categories could be further clarified and synchronized through selecting an appropriate procurement system and complying with related laws in the country. The legal requirements for BIM model and security are rather straightforward as this non-human oriented category merely needs a clear set of rules to deal with the required technical characteristics in the model.

Besides, most of the agreed legal aspects could be used and rephrased as contract provisions in BIM contracts. The determination of the contract provisions is critical as to regulate and enforce the new practice (Lu et al., 2015), which the contract is the right tool and adaptation mechanism (Schepker et al., 2014). The regulated BIM practice will provide two-fold of implications. Firstly, it will help in promoting a greater adoption and use of BIM in the AECO industries, especially for developing nations. Secondly, it will help in providing industry wide solution by standardizing and maturing the BIM-based contract administration throughout the project lifecycle.

Figure 1: Contractual Framework

Apart from that, three limitations or concerns require further explanations by considering the ongoing developments of BIM and the use of Kruskal Wallis tests. BIM is evolving and integrating with other advanced technologies for its better uses and development in the industries. The related

legal aspects and contract provisions might need modifications to accommodate the technological innovations in the BIM practice. This is a rather different perspective in contract administration as construction contracts are usually revised to accommodate the updated and developed laws. This different perspective is practical for BIM in the AECO industries by considering innovation theories, which is to integrate the technological innovations with the required administrative aspects (Daft, 1978).

Next, Kruskal Wallis tests were conducted against the independent variables of organizational background and actual experience of BIM. Apparently, Mann Withney U test should be carried out to investigate the details of the independent variables; however the limited number of sample size for each paired sub-variables would create unstable results. Nevertheless, the results from Kruskal Wallis were able to draw a clear and detailed comparison on the agreed legal aspects and contract provisions against the independent variables based on its group means analysis. The implications of the comparison are significant and relevant as to uphold a true collaborative platform in BIM-enabled projects without targeting into certain groups or sub-variables in this situation. Hence, some agreed legal aspects (A11, A17 and A27) and contract provisions (AP11, AP, 17, AP27 and AP33) require further research and investigation. The client who is the paymaster should always take an initiative to create a common goal under a well-balanced risk and profit-sharing system with the project stakeholders (Chong et al., 2016).

Although the majority of the respondents are highly educated and have had more than ten years working experience; they may not have the decision-making abilities in the contract administration process. Their responses were mainly based on their practices and desires in the BIM-enabled projects. Nevertheless, this concern should serve as a limitation of the research, where the future research should investigate from the perspective of decision makers in the contract administration. This will enhance the correlation the between the needs of field personnel and top managerial team when incorporating the necessary contract provisions into BIM contracts.

Conclusion

The research has identified a total of thirty-four potential legal aspects under three main categories, such as (a) contract structure and policy, (b) contractual relationships and obligations, and (c) BIM model and security. Twenty-two of them are relevant and should be considered in BIM-enabled projects as per the analysis of the questionnaire survey. Meanwhile, twenty-one of the legal aspects could be used as contract provisions required in BIM contracts. Subsequently, a preliminary

contractual framework has been developed by referring to the analyzed legal aspects and contract provisions. The proposed framework connects all the related sub-themes and provides insightful references for future development of BIM-based contract administration.

The key contribution of this research lies on the extension of the existing BIM contract protocols and the related body-of-knowledge for BIM-based contract administration. It has determined numerous new and potential contract provisions required in BIM contracts under three categories as described in the proposed framework. The findings from this research can be used to help promoting and standardizing the future BIM-based contract administration in the AECO industries.

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List of Tables

Table 1 Potential Legal Aspects for Contract Structure and Policy

Variables of Legal Aspects	**Descriptions**
A1	A specific BIM standard form of contract is required to cover all scopes and project requirements; or
A2	An addendum is sufficient to cover certain BIM's scopes and requirements.
A3	The BIM's scopes and requirements should not be enforced with legal implications; or
A4	Digital data or information should be treated as a part of the contract document.
A5	Two-dimensional (2D) drawings will prevail three-dimensional (3D) drawings for any discrepancies in all circumstances; or
A6	3D drawings will prevail 2D drawings for any discrepancies from the fully developed or high level of details BIM Model.
A7, A8, A9, A10	The BIM's cost/payment should be charged according to (a) a fixed percentage of the overall project cost, (b) the types of development, models and functions required for the project, (c) progress payment on the work done, or (d) completion of the models and functions required in the project.
A11	The established standards/guidelines should be applied or followed throughout BIM model development.
A12	The use of collaborative project delivery approach is needed in BIM-enabled projects, such as IPD, partnering, etc.
A13	The cost for model development should be clarified including the penalty and rewards involved, if any.

Table 2 Potential Legal Aspects for Contractual Relationships and Obligations

Variables of Legal Aspects	Descriptions
A14	A new BIM Manager role should be engaged in the project.
A15	The contract should define the roles, scopes of works for all parties involved in the project.
A16	The contract should define the BIM's goals and quality checks for different stages of development.
A17	The relationship among client, designers and contractors should be clearly defined and connected in the project.
A18	A loss due to the negligent cause of action by the design team should be recovered by the injured party or third party. The design team is not responsible for it.
A19	Disclaimers are prohibited for excluding design responsibilities for the developed BIM model.

A20	Spearin doctrine should be applied and upheld, where the contractor will not be liable for the loss, caused by the insufficient information that he received or followed solely for the project.
A21	The designers will be responsible for the negligence towards the third party regardless of Privity of Contract.
A22	The contractor cannot make a claim from the design errors by the designers including pure economic loss.
A23	Standard of care should be applied and upheld by all parties who contributes to or uses the BIM Model.
A24	Additional insurance covers are required to insure all risks and liabilities involved in BIM models, software, hardware, etc.

Table 3 Potential Legal Aspects for BIM Model and Security

Variables of Legal Aspects	**Descriptions**
A25	QR-Code should be adopted to prevent any infringements or copyrights issues on the drawings and documents
A26	When avoiding interoperability issues, the development of BIM model should work in advance in all project development stages, and produce a construction-ready BIM model before the construction stage.
A27	The designers who develop the model own the rights of copyright when the model is created.
A28	The owner of the model or the client can use, access and reproduce the model if permission has been sought from the copyright owner.
A29	If the model is designed and contributed by a team, each party owns all

	rights to its own contribution
A30	The digital data should be protected with security for its usage and data integrity.
A31	Certain constraints should be implemented to prevent data loss and privacy.
A32	The data providers (designers or contractors) should be responsible and be liable for the inserted data in the model.
A33	The party who hosts the model should include the use and access, recordkeeping, warranty and preserve the model for the agreed duration.
A34	Indemnity is required to protect the client's interest for any errors or technical issues form tools or software in the project.

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502 Table 4: Analysed Variables

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Legal Aspects' Variables	**Means**	**SD**	**Appropriateness Variables**	**Means**	**SD**	**Correlation**	**P-Value***	**Categories**
A1	1.55	0.55	nil	-	-		-	Agree
A2	-0.63	1.15	nil	-	-		-	Undecided
A3	-0.19	1.06	nil	-	-		-	Disagree
A4	1.13	0.83	nil	-	-		-	Agree
A5	-0.69	1.26	AP5	-0.94	1.19	0.83	0.00	Undecided
A6	0.13	1.24	AP6	0.02	1.13	0.63	0.00	Undecided
A7	0.61	1.15	AP7	0.69	1.09	0.65	0.00	Agree
A8	0.50	1.05	AP8	0.41	1.10	0.88	0.00	Agreed/Undecided
A9	-0.72	1.27	AP9	-0.86	1.17	0.85	0.00	Undecided
A10	0.66	1.01	AP10	0.77	0.86	0.63	0.00	Agree
A11	0.66	0.89	AP11	0.83	0.91	0.73	0.00	Agree
A12	0.83	0.97	AP12	0.91	0.90	0.71	0.00	Agree
A13	1.11	0.88	AP13	0.94	0.92	0.70	0.01	Agree
A14	1.25	0.76	AP14	1.05	0.86	0.71	0.00	Agree
A15	1.11	0.78	nil	-	-		-	Agree
A16	1.11	0.82	nil	-	-		-	Agree
A17	1.36	0.86	AP17	1.30	0.70	0.36	0.03	Agree
A18	-0.16	1.13	AP18	-0.58	1.27	0.72	0.00	Disagree
A19	0.16	1.40	AP19	0.13	1.29	0.77	0.00	Undecided
A20	0.36	1.35	AP20	0.22	1.33	0.91	0.00	Undecided
A21	0.33	0.98	AP21	0.25	0.99	0.84	0.00	Undecided
A22	0.30	0.98	AP22	0.22	1.01	0.78	0.01	Undecided
A23	1.11	0.82	AP23	0.97	0.84	0.675	0.00	Agree
A24	0.38	1.17	AP24	0.47	1.15	0.71	0.00	Undecided
A25	0.69	0.88	AP25	0.55	0.87	0.89	0.00	Agree
A26	1.11	1.00	AP26	0.97	1.02	0.86	0.00	Agree
A27	1.05	1.09	AP27	0.97	1.05	0.856	0.00	Agree
A28	1.08	0.84	AP28	1.05	0.75	0.60	0.00	Agree
A29	0.08	1.25	AP29	0.36	1.19	0.84	0.00	Undecided
A30	1.33	0.75	AP30	1.16	0.87	0.83	0.00	Agree

A31	1.05	0.95	AP31	0.91	0.99	0.78	0.00	Agree
A32	1.22	0.95	AP32	1.05	0.98	0.77	0.00	Agree
A33	1.08	0.93	AP33	0.86	0.99	0.56	0.00	Agree
A34	0.86	1.17	AP34	0.86	0.99	0.82	0.00	Agree

*Spearman's rho correlation – linear relationship between the legal aspects' variables and appropriateness variables

Table 5 Different views as per the respondents' background

No.	Variables	Sig.	Remarks
1.	The relationship among client, designers and contractors should be clearly defined and connected in the project (A17).	0.04	The unclear relationship is mainly referred to the current working relationship among client, designers and contractors. The designers seem reluctant to have additional legal obligations throughout the BIM model development that is full of uncertainties. Yet, the respondents agreed to clarify this unclear relationship as a contractual relationship to enforce and govern the interests and risks involved in the project.
2.	The designers who develop the model own the rights of copyright when the model is created (A27 and AP27).	0.01, 0.01	There is yet a commonly accepted guideline to calculate the appropriate proportion of rights for the developed model from the designers' perspective. It creates certain doubts on whom and what should be claimed for the copyright in the model. Therefore, a transparent and well-defined copyright policy should be explained and enforced at the beginning of the contract.
3.	The party who hosts the model should include the use and access, recordkeeping, warranty and preserve the model for the agreed duration (AP33).	0.03	Data security is a critical issue especially dealing with BIM's digital data. The possible different view on this contract provision is the unclear and additional responsibility and expertise required in handling the digital data. The party who hosts the model could work with another specialised computing company who would provide the required server and data security throughout the project lifecycle.

Table 6: Different views as per the respondents' actual involvement in BIM

No.	Variables	Sig.	Remarks
1.	The established standards/guidelines should be applied or followed throughout BIM model development (A11, AP11).	0.02, 0.03	The level of familiarity on the established standards/guidelines will be subject heavily to the actual and hand-on experience in BIM development. The stakeholders and contracting parties should agree in advance for some established standards/guidelines, such as the required level details for the BIM model as per Level of Development (LOD), format for exchanging the digital data using IFC, specification for facility management as per Construction Operations Building Information Exchange (COBie) so on and so forth.
2.	The designers who develop the model own the rights of copyright when the model is created (AP27).	0.04	The different view could be due to the unclear contributions made by the designers in the BIM model. The designers require making clear the scopes of the model development at the outset of the project. It will avoid any confusion in terms of claiming the model's copyright.

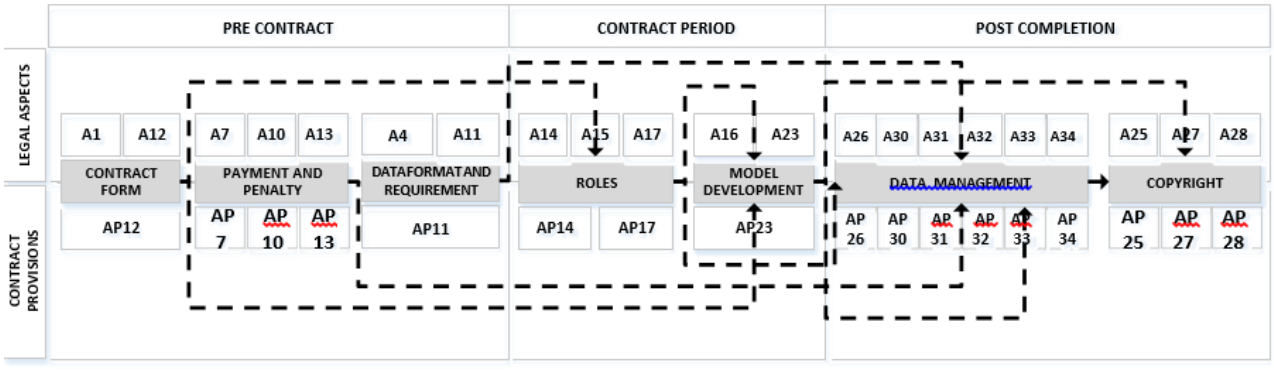

Figure 1 Contractual Framework

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