Article

Model Ownership and Intellectual Property Rights for Collaborative Sustainability on Building Information Modeling

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Abstract: The concept of building information modeling (BIM) requires multidisciplinary collaboration and generates the problem of intellectual property protection for the creator of the model element. Therefore, this research aimed to determine the model ownership factors and intellectual property rights (IPRs) for collaborative sustainability on BIM practices in Indonesia. This research used the qualitative approach of primary data, and questionnaires were distributed to parties involved and experienced with BIM-based projects in Indonesia. The research adopted descriptive and inferential statistics to analyze data obtained from respondents. The results showed that the party that produces the model element is the main factor that owns the model and the IPRs. Meanwhile, the employer will have the right to own the model of BIM in the form of a license, with limited use only for operations, maintenance, and marketing, and they do not have the right to reuse the model for the construction of future projects. This research is expected to contribute to the body of knowledge and provide recommendations for policymaking in construction contracts to better manage BIM-based projects.

Keywords: BIM; model ownership; intellectual property rights; IPRs; collaborative design; policy

1. Introduction

The Architecture, Engineering, Construction, and Operations (AECO) industry is considered to have poor productivity with low efficiency due to its fragmented processes [1–3]. This has driven the AECO industry to adopt building information modelling (BIM), which is recognized as being able to optimize processes across the construction value chain [4] by conducting simulation processes including energy [5], cost [6], and more accurate and efficient than conventional methods, as well as improving collaboration between project participants [7]. Although the benefits of BIM have been recognized and widely published in reputable journals [8–13], BIM and its implementation cannot be separated from obstacles [14–16] and problems that lead to violations of the law [17].

The collaborative nature of building information modeling (BIM) requires many contributions from various project participants with different scientific backgrounds [18]. Therefore, the output of BIM can be said to be a collaboration product [19]. According to [20], in entering a new era of digital-based design involving many participants in the design process, the issue of ownership may become more complicated. A more collaborative process in design has the potential to cause more problems with design intellectual property ownership. If the database of a building model is developed together, for example, which starts from the architect creating the initial building element, then the engineer adding the element to the model, while in the implementation of the project, the contractor also adds a model element, then at the end of the project comes the question as to who made and owns the model. The model referred to in this study is a digital representation of the physical and functional characteristics of a facility and contains product information related to the facility.
BIM centralizes project-related information in digital platforms and requires massive transmission and access to datasets during design to construction work [21]. Therefore, the data will be widely accessible to the project participants involved, and project participants can also utilize the model, including updating, inserting, extracting, or modifying information during the BIM process [18]. Moreover, when compared to 2D (paper-based) drawings and information, BIM contains a large amount of electronic information, which is easily extracted and reused. Therefore, the final model of the project has significant value for owners to be reused in improving facility management [19]. This may cause the party using the model of the other party may inadvertently infringe the intellectual property rights of the other party. Thus, this collaborative product has the risk of intellectual property infringement by others that is accidental or intentional when using the model. Therefore, it requires intellectual property protection so as not to cause conflicts and legal problems at the end of the project.

Almost half a century of BIM technology has evolved [14], and research on BIM has also been highly developed. However, it is only focused on technical matters, often without considering the socio-organizational aspects, processes, and laws. The issue of model ownership and intellectual property rights is much-overlooked in research [20] even though it is a very critical issue and requires scientific attention. Therefore, the purpose of this study was to determine the priority factors of model ownership and intellectual property rights of BIM practices in Indonesia. We utilized a structured literature review process and statistical generalization with factor analysis to investigate the appropriate owner of the model for the sustainability of the collaboration in BIM.

2. Literature Review

2.1. Issues and Needs for IPRs in BIM

Traditional delivery methods are still practiced in the AECO industry, where the flow of information delivery is still fragmented. Each submission completed by one party will then be forwarded to the next party. For example, after the owner details, each requirement will be continued by the design team for the planning and design process. Although this working model (without collaboration) can be executed with BIM, the benefits will not be obtained to the maximum. Even [18] stated that it would only scratch the surface of its capabilities. Multidisciplinary collaboration is a key function of BIM, as it allows disciplines to effectively integrate their work [22]. Therefore, the effectiveness of BIM implementation depends on collaboration [18].

However, the AECO industry is currently experiencing problems related to BIM implementation and collaborative work [17]. Table 1 presents the problems in collaborative work with BIM.

| Table 1. Challenges in collaborative work with BIM. |
|-----------------|-----------------|-----------------|-----------------|-----------------|
|                  | Challenges in Collaborative Work | Sub-Items | References |
| Item             | Copyright violation | Ownership of data/model elements | Intellectual property rights | [17,20,23] |
| Legal aspects    | Disagreements arising from BIM practices | The allocation of responsibility and liability exposure | Lack of BIM standard | [15] |
| Contractual aspects | Complexity in adopting collaboration tools | Lack of compatibility between software | Distraction | [7,15,17,26] |
| Technical        | Discrepancies between interested parties regarding the definition of BIM | Different organizational structures in multidisciplinary teams | Lack of clarity on roles and responsibilities | [17] |
It can be said that BIM and collaboration are one package that can provide tremendous value to the project. However, behind the benefits provided, there is also the accompaniment of many problems and challenges. It can be illustrated with the phrase “the higher the value to be achieved, the more challenges must be faced”. These challenges or problems not only come from technical and organizational areas, but the legal and policy aspects are still much debated and tend to still be ignored. In this case, intellectual property rights are the main issue [19]. The statement was also supported by [20], in that copyright issues are a much-overlooked issue in the AECO industry.

Ownership of models and intellectual property rights in BIM is very important because the concept of BIM is to centralize project-related information into digital platforms that require transmission and access to datasets during design to construction work. Therefore, the data will be widely accessible and used by all project participants involved [18]. Khosrowshahi [28] illustrated the transition process, starting with traditional delivery methods that have been widely criticized for exchanging data between multidisciplinary actors in conventional file-based projects, often resulting in loss of data integrity and major errors [28]. The process of exchanging data from one actor to another results in a large amount of exchanged data, as well as versioning problems that complicate tracking data together [29]. With BIM, the work of project participants will be centered on a collaborative platform. All stakeholders can share project-related information and can add components and elements to collaborative project models more efficiently and in a more integrated manner. The collaborative nature of BIM at the end of the project can cause debate and conflict about who created the model and who has the final model.

Working and exchanging digital data in a collaborative platform can cause problems related to intellectual property [30]. The issue of ownership is not just about who makes it and who owns it—it is also related to potential violations of the law that arise. For example, the final model of the project has significant value for the owner to reuse in improving facility management [19]. However, is it true that the intellectual property in BIM project data can be fully transferred to the owner [22], or will it remain to its contributors [21,31,32]? Furthermore, BIM strives to enable collaboration between all stakeholders from different stages of the project life cycle and enables stakeholders to update, include, extract, or modify information during the BIM process [21]. According to [19], it may cause one party to use the model of the other party may inadvertently infringe the intellectual property rights of the other party. Therefore, we must consider the importance of intellectual property rights to be protected and clearly defined in the early stages of the development of BIM-based projects [31] to avoid conflicts and legal problems.

According to [30], if the issue of copyright violation of models and intellectual property has entered the court process, it will pose a great financial risk and can cause project delays that will result in losses to the project [20]. Therefore, the authors of [33] assert that, before a BIM-based project is implemented, there needs to be a clear understanding not only of who owns the model, but also who is responsible for the model. Then, we must consider who are the actors who have the potential to have the collaboration product for its sustainability? Therefore, it is necessary to conduct a review and synthesis of the related studies to identify the model ownership and IPRs.

2.2. Related Studies

According to [34], it is important to conduct a review of previous studies, because a study must be based on existing studies. Therefore, in this study, after the conceptualization stage of research, we reviewed previous studies that discuss the ownership of models and the IPR model of BIM. The literature review process that was established in this study was adopted from several previous studies, including those by [35–37]. The stages of literature review in this study can be seen in Figure 1 below.
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Figure 1. Stages of literature review.

2.2.1. Stage 1: Data Collection

The initial process is compiling articles using a search engine including Web of Science and Scopus, as well as the use of several publishers including the American Society of Civil Engineers (ASCE), Elsevier, Emerald Group Publishing Ltd., MDPI, Springer, and Taylor and Francis. The keywords used were “intellectual property rights of BIM, “BIM IPRs”, and “BIM ownership”. To make it easier to browse and obtain good quality articles, we set criteria of publication or limitation of publication used in reviewing previous research, including:

1. Articles published in the last 10 years (2011–2021).
2. Articles published in reputable journals of either or at least Q3 indexed Scopus and listed on Web of Science (WoS).

The next stage is preliminary stage screening with abstract content analysis in previous research, with the result of stage 1 being in the form of compiling articles that fit the research topic with at least 100 articles.

2.2.2. Stage 2: Screening

Upon investigation, 100 suitable scientific articles were discovered, which were filtered and classified based on their contents. This is to ensure that the articles are appropriate with this study. In the second stage, the screening process is to read the entire content of the articles (abstract, introduction, literature review, methods, result and discussion); from the process of analysis of the entire content, we performed elimination of articles that did not fit the criteria or topics of research. From the process of elimination of articles, we obtained 17 articles relevant to this study. Table 2 presents the journal quality level of articles that passed the second stage of screening. From Table 2, we see the American Society of Civil Engineers (ASCE) as the publisher of the most published journals and articles selected in this study. Meanwhile, the Journal of Construction Engineering and Management is a journal that published the most articles selected for this research, with a total of five articles.
Table 2. The quality level of the selected journals and the number of articles.

| Publisher | Journal Name                                      | SJR  | Q Category                                                                 | Number of Papers |
|-----------|--------------------------------------------------|------|---------------------------------------------------------------------------|------------------|
| ASCE      | Journal of Construction Engineering and Management | 1.039| Q1 Building and Construction; Q1 Civil and Structural Engineering; Q1 Industrial Relations; Q1 Strategy and Management | 5                |
| ASCE      | Journal of Legal Affairs and Dispute Resolution in Engineering and Construction | 0.234| Q3 Civil and Structural Engineering; Q2 Engineering (miscellaneous); Q2 Law; Q3 Safety, Risk, Reliability, and Quality | 4                |
| Elsevier  | Journal of Building Engineering                  | 0.901| Q1 Architecture; Q1 Building and Construction; Q1 Civil and Structure Engineering; Q1 Mechanics of Materials; Q1 Safety, Risk, Reliability, and Quality | 2                |
| Elsevier  | Automation in Construction                      | 1.690| Q1 Building and Construction; Q1 Civil and Structural Engineering; Q1 Control and Systems Engineering | 1                |
| Springer  | International Journal of Civil Engineering      | 0.410| Q2 Civil and Structural Engineering                                        | 1                |
| Springer  | Requirements Engineering                         | 0.755| Q1 Information System; Q2 Software                                         | 1                |
| Taylor and Francis Ltd. | International Journal of Construction Education and Research | 0.354| Q2 Building and Construction; Q3 Education                                  | 1                |
| Taylor and Francis Ltd. | Journal of the Chinese Institute of Engineers | 0.197| Q2 Engineering (miscellaneous)                                             | 1                |
| Emerald Group Publishing Ltd. | Engineering, Construction and Architectural Management | 0.682| Q1 Architecture; Q1 Building and Construction; Q1 Business, Management, and Accounting (miscellaneous); Q2 Civil and Structural Engineering | 1                |

2.2.3. Stage 3: Data Analysis

The last stage of the literature review process is the theoretical mapping of 17 articles that passed the screening stage. The results of theoretical mapping can be seen in Table 3, presenting mapping of research goals and how to own models and IPRs from BIM.

Table 3. Theoretical mapping of previous studies.

| Authors                                | Years | Research Goal                                                                 | Model Ownership and IPRs of BIM                                                                 |
|----------------------------------------|-------|-------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
| [30]                                   | 2021  | Mapping the Terms of Hong Kong BIM Contract and compare with CIC BIM UK protocol and American BIM AIA | 1. The employer is the owner of intellectual property  
2. At the time of construction of intellectual property owned by the contractor  
3. The copyright of all drawings belongs to the architect  
4. The project team owns the copyright |
| [27]                                   | 2021  | Identify a list of risk priorities related to BIM implementation in Brazil    | Ownership of BIM data and lack of specific regulations on its ownership                           |
| [25]                                   | 2021  | Identify legal issues and determining factors for success to implement BIM in construction projects in Vietnam | To protect the IPRs of the contractor, it is necessary to write down the contract clauses         |
### Table 3. Cont.

| Authors | Years | Research Goal | Model Ownership and IPRs of BIM |
|---------|-------|---------------|---------------------------------|
| [21]    | 2020  | Comparing BIM provisions of the standard national construction contracts: AIA (AIA Document E203-2013/BIM and Digital Data Exhibit), (G202-2013/Project BIM Protocol Form), and ConsensusDocs (301 BIM addendum) | 1. The receiving party is the copyright holder and IPRs 2. IPRs belongs to the party that makes the model 3. The contributed party owns the copyright |
| [38]    | 2020  | Evaluating the differences between Taiwan and China regarding legal aspects and conditions of potential contracts for projects supports BIM | Designers own the copyright of the model and they may provide their intellectual property rights to the parties to the project |
| [20]    | 2020  | Know how digital-based design can be protected from unauthorized use | Architects need to register the copyright of the design |
| [24]    | 2020  | Identify BIM-related contract issues and propose a contract framework | The copyright will remain with the respective designers |
| [39]    | 2019  | Explore contract practices between BIM consultants and employers in detail | 1. The creator of the model owns the copyright 2. Ownership of the BIM model from the receipt of tender documents to the awarding of contracts must be owned unconditionally by the contractor |
| [29]    | 2019  | Propose a contract framework for BIM under DBB | 1. Ownership of the model must remain with the designer or developer 2. Copyright and any information collected will remain in A/E |
| [26]    | 2018  | Explore issues during team collaboration and identify BIM governance solution requirements | Successful collaboration strategies should pay attention to permissions, ownership, and IPRs |
| [18]    | 2017  | Reviewing issues in contracts for BIM practices | 1. The result of collaboration and intellectual property underlying the model belongs to the distributor 2. Model makers have the rights to their products as a whole, and model makers are required to provide non-exclusive licenses to project owners |
| [17]    | 2017  | Developing BIM governance framework (G-BIM) | Collaboration issues in BIM-based projects including data ownership, copyright, intellectual property, and interoperability |
| [31]    | 2017  | Developing a preliminary contractual framework | 1. Each party has the right to its contributions 2. The designer who developed the model owns the copyright when the model is created 3. Employers may use, access, and reproduce the model if it has requested permission from the copyright owner |
| [32]    | 2016  | Develop scenarios of conflicts that may arise from BIM practices and propose conceptual models that will help resolve disputes | The intellectual property ownership underlying BIM project data are owned by each discipline. |
| [19]    | 2014  | Reviewing ownership rights of BIM and how to avoid violations of model ownership | The final result of BIM does not belong to the employer or designer, but rather it is the case that each model element maker holds copyright ownership of its model elements |
| [23]    | 2013  | Propose a BIM partnering-based public procurement framework | Participants who contribute in the model will be at risk for their contributions |
| [40]    | 2012  | Provide an overview of legal issues in BIM | Employers as model owners are not entitled to use the model for future projects because there is IPRs from architects and contractors |

### 2.3. Conceptual of Model Ownership and IPRs from Previous Studies

From the process of identification and synthesis of concepts from previous studies related to model ownership and IPRs, in this study, we found six variables related to ownership, namely, (1) architect/engineer [20,29–31,40], (2) contributed parties in the model [18,19,21,23,24,31,40], (3) contributed disciplines [32], (4) contractors [25,29,30,40], (5) employer [30,39,40], and (6) project participants [29,30].
2.3.1. Architect/Engineer

Architect/engineer, also known as a design professional, is a party or design company that designs construction projects that are generally architectural or engineering-related, or often a combination of the two. Therefore, in this study, we used the term architect/engineer who completed the design based on a contract with the owner [41]. Regarding the ownership of the model at the end of the project, the architect will submit the model to the owner to be used for operation, maintenance, and marketing, through a license. However, the architect only provided the model, and the information was not included with his intellectual property. Therefore, the owner does not have the right to reuse the model for to develop other projects because there is an element of IPRs of the architect [40]. The architect here is the copyright owner of all drawings [30], models, and intellectual property and will act as a central entity in case of a dispute [29].

Model developer designers own copyright when models are created [31], mitigating intellectual property-related risks it is emphasized that models should remain with designers or model developers [29]. Therefore, according to [39], designers who develop or create models become owners of rights to models. Reference [39] also provided a similar statement that the owner must have the final BIM model, while the intellectual property rights belong to the consultant (the project designer is the model copyright owner of BIM).

2.3.2. Parties Contributing to Model Elements

According to [19], BIM is a collaboration product and the end result does not belong to employers or designers, but belongs to anyone who makes or contributes to model elements. The statement is supported by [31,40] in that if the model is designed and contributed to by the team, each party has all rights to its own contribution. The contributing parties reserve the right to their contributions to use, modify, or transmit models within the scope of the project, and shall be responsible for their contributions and actions resulting from accessing the model [21].

Various specialties such as architects, MEP subcontractors, structural steel subcontractors, and others have developed their models, which are often later combined into a so-called federation or composite models, allowing various designers to evaluate how different design elements coordinate with each other to identify and resolve potential clashes and conflicts that arise at the beginning of the design process [19]. Either party using the other party’s model may inadvertently infringe the IPRs of the other party. Therefore, each party requires the consent of fellow modelers to use, modify, or transmit such models [19].

2.3.3. Disciplines That Contribute

Effective implementation of BIM depends on collaboration [18]. According to [22], multidisciplinary collaboration is BIM’s primary function as it allows disciplines to effectively integrate their work with each other. Therefore, ownership of the intellectual property rights underlying BIM project data is owned by each discipline in which the contribution originated [32], and each party shall be responsible for the contribution given to the model and activities carried out when accessing the model [18].

2.3.4. Contractors

According to [40], ownership of the BIM model, starting from receipt of tender documents to awarding contracts, must be owned unconditionally by contractors. At the construction stage, all intellectual property rights of the model constructed by contractors belong to contractors [30]. The same is stated in the chartered institute of building (CIOB). Copyright and any information taken will remain the property of the contractor [29].

Similarly to the architect, regarding the issue of ownership of the model at the end of the project, the contractor will submit the model to the employer through a license that will be used by the employer for operations, maintenance, and marketing. However, the contractor simply submits the model, and the information is not included with the intellectual property of the contractor. Therefore, the employer does not have the right to reuse.
such models for the development of other projects [40]. According to [25], contractors need to write policies on contractual clauses regarding ownership rights and the responsibility for using models to protect their intellectual property rights.

2.3.5. Employer

The owner of the project or building is the employer who must have the final BIM model at the end of the project. Thus, architects and contractors who developed the model will provide ownership rights to the employer through a license. However, it does not include its intellectual property rights. Therefore, employers as model owners will have limited use and be unable to develop on future projects, with models and information only being able to be used for operations, maintenance, and marketing [39,40].

However, according to [30], in the case in Hong Kong, the employer, after making a full payment, will claim ownership of the model and the intellectual property rights contained in the model, including the right to grant sub-licenses to other project participants so that they can fulfill their obligations to complete the project with BIM. However, the license granted to the employer may be revoked if it fails to meet payment obligations.

2.3.6. Project Team

According to [29], the project team must have a BIM model, and also the participant or project team guarantees that they own the intellectual property rights contained in the model, or be licensed or authorized by the intellectual property rights owner to develop the model [30]. The model developer will grant the project team a non-exclusive license to use the BIM model, including the right to give sub-licenses to sub-consultants or sub-contractors. This will reduce the additional administrative burden on model developers as the central party of all model licenses is given. However, if the project team wishes to modify the model, they must get approval from the owner [30].

3. Research Methodology

3.1. Sampling and Data Collection

The data used in this study are the primary type of data from the respondent’s perception. Non-probability sampling involves purposive sampling techniques with predetermined criteria of respondents, namely, respondents who are involved or have been involved and have an understanding of BIM and its implementation. The sampling technique is considered more proper than other sampling techniques, because BIM is not widely implemented in projects in Indonesia.

The data collection used in this study is by questionnaire survey. The measurement scale adopted from [42] uses an ordinal measurement scale of 1–5 with a scale description of 1 = strongly disagree, 2 = disagree, 3 = hesitation, 4 = agree, and 5 = strongly agree. The type of questionnaire used is a closed direct questionnaire because the respondent only provides a sign to one of the answers that are considered appropriate. Respondents were allowed to learn more about the questions on the questionnaire and fill them out.

3.2. Statistical Data Analysis

A project will involve stakeholders with variety of disciplines and backgrounds. This will cause a variation of answers from the research questions underlying this research. The findings of previous studies [18,19,31,39,40] also obtained variations of policy-related answers for model ownership and IPRs. According to [43], the two main conditions as the basis (reason) for the use of statistics are uncertainty and variation. Thus, the approach with statistics is considered the most suitable for this study. The analysis is needed to build a generalization of the research concept in answering the research question, which is the ownership of the model from collaborative BIM to support sustainability.
3.2.1. Descriptive Analysis

Descriptive statistics through mean and standard deviation (SD) are used to determine
the ranking of the most important variables of respondents’ perceptions related to the
priorities of model owners and IPRs of the model from BIM in practice in Indonesia. The
most important variables in this study were identified by considering rankings based on
respondents’ preferred scores. Variables are considered important if they have a mean score
of more than 3, which means that respondents agree that all variables are important [44].
Mean and SD are also used to provide patterns of respondent perception at the beginning
before factor analysis is performed, because in practice, every stakeholder has different
characteristics, interests, and business fields. Therefore, the patterns of respondent data
need to be described at the beginning of data processing and conducted in synthesis with
previous research.

3.2.2. Factor Analysis

Descriptive statistics relate to methods of organizing, summarizing, and describing
(presenting) data that have been collected in a more informative way [43,45]. In essence,
descriptive analysis is more to represent the state and patterns of respondents’ perceptions
of variables. Meanwhile, inferential statistics is the process of making estimates, predictions,
decisions, or concluding the population based on sample data [43]. Therefore, inferential
statistics are considered as the most appropriate approach to generalize the conclusions for
this study.

There are several methods of inferential statistics, one of which is factor analysis. In-
ferential statistics through factor analysis is used to identify several relatively small factors
(groupings) that can be used to describe a large number of interconnected variables [46]
in order to know (conclude) about a population on the basis of a sample. The grouping
in this study is intended to ease the categorization of the stakeholders, such as those who
are the owners of BIM models and IPRs, as well as the service provider (contractor, archi-
tect/engineer) or perhaps parties who accept the model (owner, project participants). The
steps for factor analysis used in this study are:

1. Kaiser–Meyer–Olkin (KMO) and Bartlett Tests

Before conducting factor analysis, Kaiser–Meyer–Olkin (KMO) and Bartlett tests were
conducted to ensure the data obtained was appropriate for factor analysis. KMO tests
are used to measure the adequacy of sampling. The KMO index determines how small a
partial correlation is relative to the original correlation. KMO indexes range from 0 to 1,
where values greater than 0.8 close to a value of 1 indicate adequate sampling, while small
KMO values mean that correlations between variable pairs cannot be explained by other
variables. A KMO value of 0.50 is considered usable for factor analysis [42]. Bartlett test is
used to ensure a significant correlation between attributes in the correlation matrix and
values received less than 0.05 (sig. < 0.05) [46].

2. Anti-Image Matrices

MSA values indicate sample adequacy [47]. MSA values range from 0 to 1, and
values below 0.50 are not acceptable. A value becoming closer to 1 indicates the variable is
perfectly predicted without error by another variable and the variable can be factored [47].
Reference [46] suggested that values below 0.50 should be removed by removing the
lowest MSA values and recalculating factors until the overall MSA value of the variable
is acceptable.

3. Factor Extraction

The extraction method used in this study is principal component analysis (PCA)
to simplify the components of many variables into smaller groups of variables [46]. The
proportion of variants described by each extracted factor is called communality, with values
ranging from 0.0 to 1.0. If the value gets closer to 1.0, it means the greater the percentage of
variance described from a variable [42]. However, [48] states that there is no agreement on
the minimum threshold for communality value, but the communalities value below 0.3
needs to be reconsidered. Attributes with communality values below 0.5 are recommended to be removed and not included for factor analysis.

4. Factor Rotation

Rotation of factors needs to be performed so that the loading of each variable on the extracted factor can be maximized and the imposition on other factors can be minimized. Orthogonal rotation (varimax) was used as a rotation factor in this study. Loading factor is a correlation between variables and factors—the value of the loading factor is said to be significant if above 0.5; if the loading factor is increasing, then the more important it is in interpreting the matrix of factors. The end result is the determination of each variable against a factor on the basis of the largest correlation value of the formed factor [46].

The next stage is the reliability test. Cronbach’s $\alpha$ is applied to examine and confirm the results of factor analysis. Cronbach’s $\alpha$ values ranging from 0 to 1 with values greater than 0.70 indicate the group is considered consistent and reliable. However, for exploratory research, the value of cronbach’s $\alpha$ could be lowered to >0.60 [49].

4. Results

Respondent data obtained is categorized based on business/organization, current position in the company/organization, work experience, recent education, and level of understanding of BIM and its implementation. Table 4 presents information and background from respondents who have contributed to the main survey in this study.

Table 4. Background of respondents.

| Item                              | Sub-Items                      | N  | (%) |
|-----------------------------------|--------------------------------|----|-----|
| Corporate/organizational business | Employer                      | 5  | 11.4|
|                                   | Consultant                     | 13 | 29.5|
|                                   | General contractor             | 23 | 52.3|
|                                   | Others                         | 3  | 6.8 |
|                                   | Sub-Coordinator PUPR           | 2  | 4.5 |
|                                   | Top management                 | 4  | 9.1 |
|                                   | Technology development manager | 1  | 2.3 |
|                                   | Project management officer     | 1  | 2.3 |
|                                   | Project manager                | 2  | 4.5 |
|                                   | Site manager                   | 1  | 2.3 |
|                                   | Project engineering manager    | 2  | 4.5 |
|                                   | Revit manager                  | 1  | 2.3 |
|                                   | BIM manager                    | 4  | 9.1 |
|                                   | BIM coordinator                | 4  | 9.1 |
|                                   | BIM specialists                | 1  | 2.3 |
|                                   | BIM expert and revit instructor | 1  | 2.3 |
|                                   | BIM infrastructure expert      | 1  | 2.3 |
|                                   | BIM junior expert              | 1  | 2.3 |
|                                   | BIM engineer                   | 13 | 29.5|
|                                   | BIM modeler                    | 1  | 2.3 |
|                                   | Quality control officer        | 1  | 2.3 |
|                                   | Civil and structure engineer   | 1  | 2.3 |
|                                   | Lecturer                       | 2  | 4.5 |
| Working experience                | <5 years                       | 16 | 36.4|
|                                   | 5–10 years                     | 12 | 27.3|
|                                   | 10–15 years                    | 9  | 20.5|
|                                   | 15–20 years                    | 6  | 13.6|
|                                   | >20 years                      | 1  | 2.3 |
| Level of understanding of BIM     | Excellent                      | 8  | 18.2|
| and its implementation            | Good                           | 28 | 63.6|
|                                   | Average                        | 8  | 18.2|

4.1. Profile of Respondents

From Table 4 can be known in this study most of the respondents came from the general contractor (GC) with as much as 52.3%, and the discipline of the company respondents worked the most is multidisciplinary 79.5%. BIM engineer is the most contributed position in this study with 29.5%. From the length of work experience <5 years to the most by 36.4%,
as well as the level of respondents’ understanding of BIM and its implementation is at the level of “good” with a percentage of 63.6%.

4.2. Result of Distributing Data

Respondents consisting of employers, consultants, contractors, construction management, academics, and others have given their perspective of the attributes derived in the questionnaire through indicators and operational definitions. Table 4 presents the average level of respondents’ understanding of BIM and its implementation is “good” with a percentage value of 63.6% that meets the criteria of respondents in this study. The most important variables related to BIM financing actors in this study were identified by considering the rating based on the respondent’s preferred score. Table 5 presents the distribution of data using mean and standard deviation for six variables in this study. From the acquisition of mean and standard deviation, the analysis obtained a mean value of more than 3 for the mean value of six variables ranging from 3.1364 to 4.3068, which means respondents agree that all variables are important [44]. However, the interests of each of these variables were perceived differently by each respondent of each project stakeholder. Furthermore, Table 5 presents a rating of the perspectives of the respondents on the basis of business fields, including employers, consultants, and contractors.

As shown in Table 5, it was found that the respondents agreed that the employer is the owner of the model and IPRs of BIM at the end of the project, with a mean value of 4.307. In the preliminary survey, respondents from employers argued that employers are the rights owners of the models and IPRs contained therein because service providers have been paid based on a contract. Employer as the recipient of the model will use the model for operational and maintenance needs for the future. The contractor also provided a similar comment, in that the model and IPRs belong to the employer, because the employer paid all stakeholders in the project and the initial idea started from employers, consultants, and engineers. Respondents’ findings and opinions in this study are supported by previous studies e.g., [30], which discusses how in Hong Kong, the employer (owner) demands copyright ownership after full payment is made. On the other hand, according to [40], models of the work of architects and contractors are made for employers, and therefore all models belong to the owner.

However, the consultants have different perceptions. Where according to the consultant if the employer wants to add another project, for example, designing one tower, which is then copied into three twin towers. Herein, the employer/owner must pay royalties to the creator. The opinion of the consultant is strengthened by previous research, where according to [40] related to the issue of ownership of the model at the end of the project, the contractor and architect will hand over ownership of the model to the employer through a license. However, employers have limited use, only for operations, maintenance, and marketing. Employers do not have the right to use models for other projects, as there is an
element of intellectual property rights of architects and contractors (only providing models and information, not intellectual property). The same is true in China, where according to [39] employers must have a final BIM model while intellectual property rights belong to consultants (project designers are copyright owners of BIM models).

4.3. Factor Analysis Results

From the results of variable data processing, we obtained KMO and Bartlett test values of 0.560 with a significance of 0.000. In this case, KMO and Bartlett testing met the minimum criteria. The MSA value for the anti-image correlation test identified as having one variable with a value below 0.50 was an X5 variable (employer), obtaining a value of 0.440. Therefore, the X5 variable must be ejected and a second-round anti-image correlation test is performed. In the second round, the anti-image correlation test with the result obtained that all diagonals were above 0.5 (between 0.515 and 0.628). The MSA value of the variable anti-image correlation test is shown in Table 6.

Table 6. Anti-image matrices.

| Anti-image Correlation | X1  | X2  | X3  | X4  |
|------------------------|-----|-----|-----|-----|
| X1                     | 0.628a | -0.246 | 0.007 | -0.359 |
| X2                     | -0.246 | 0.555a | -0.574 | -0.142 |
| X3                     | 0.007  | -0.574 | 0.515a | 0.121 |
| X4                     | -0.359 | -0.142 | 0.121  | 0.569a |

From the test results above can be identified that the data has met the criteria for factor analysis. Table 7 below presents the results of a factor analysis consisting of two groupings of factors.

Table 7. Factor analysis results.

| Code | Variable                           | Communalities | Varimax-Rotated Loading Factor |
|------|-----------------------------------|---------------|--------------------------------|
|      |                                   |               | 1                | 2                |
|      | X2 Parties contributing to model elements | 0.791         | 0.841            | -                |
|      | X3 Disciplines that contribute     | 0.833         | 0.912            | -                |
|      | X1 Architect/engineer              | 0.679         | -                | 0.788            |
|      | X4 Contractor                      | 0.750         | -                | 0.866            |
|      | Eigenvalues                        | -             | 1.904            | 1.149            |
|      | % of variance                      | -             | 47.611           | 28.713           |
|      | Cumulative %                       | -             | 47.611           | 76.324           |
|      | Cronbach’s α                       | -             | 0.610            | 0.797            |

Table 7 presents the communality values of the whole variable extraction meeting the minimum value criteria of above 0.5 (between 0.679 and 0.833). Loading factor values were above 0.5 (between 0.788 and 0.912), which means they were significant in interpreting the matrix of factors. On the basis of the correlation value, we formed two grouping factors, namely, factor 1 grouping variables X2, X3, and factor 2 grouping variables X1, X4. The value of each attribute was reliability tested using Cronbach’s α with the minimum receiving a value limit of >0.6. Table 7 shows factor 1 with the value of Cronbach’s α of 0.610 and factor 2 with the value of Cronbach’s α of 0.797. Therefore, the factors formed are reliable and considered consistent. Validation from previous studies is necessary to investigate suitable title and meaning of the groups. Thus, factor 1 was named as “the party that created the model element” and factor 2 was named “the party that designed the initial model”.

5. Discussion

Two groupings of factors were obtained and further conceptual synthesis was conducted from previous research for the naming of factors. From conceptual results, we determined that factor 1 is the party that created the model element, and factor 2 is the party that designed the initial model. Both factors have a value of Cronbach’s α above 0.6, which means the factors formed can be said to be reliable and considered consistent.

5.1. The Party That Created the Model Element

The implementation of BIM on the project in addition to causing technical problems also poses contractual problems [33], one of which is related to the ownership of the model and the right to property of the model at the end of the project. According to [21], if the database of a building model is developed collaboratively, then at the end of the project comes a question as to who made the model of the building. Therefore, copyright and IPRs must be addressed in a contractual policy before a project begins so that at the end of the project, there are no legal issues related to copyright infringement.

In this study, the party that created the model element was an important factor of the ownership of the model and the IPRs of the model at the end of the project, with a variant percentage of 47.611%. This factor consists of attributes of the party that contributes to the model elements and the disciplines that contribute. This factor is supported by previous research, in which [21] stated that ownership of copyright is the party that makes or produces model elements of BIM. The output of BIM is a collaboration product—the result does not belong to the employer or designer, but each party that makes the model element has the copyright of the model element, and each party that creates the model element has the right to use, modify, or submit the model within the scope of the project. Moreover, the model element maker must take full responsibility for its contribution to the model and the actions resulting from access to the model.

Respondents who are categorized as employers/owners argued that the owner or employer, as the recipient of the model of BIM, will use the model for operational and maintenance needs, as well as marketing for the future. However, the consultant stated that employers have the right to use the model for business development, but if the model is used for the construction of the next project then the employer must pay royalties to the creator. For example, if employers wanted to add another project by designing one tower, and then they copied this into three twin towers, then employers must pay royalties to the creator.

The interesting findings are supported by [40], which relate to the issue of model ownership at the end of the project. The designer is the initial party who contributed to the model at the conceptual stage towards the design, and the contractor is the party who contributed in the model at the construction stage and will submit the model to the employer/owner through a license that will be used for operations, maintenance, and marketing. However, the owner does not have the right to reuse the model for other projects, because in the model there are IPRs of contractors and designers. In essence, the model maker only provides models and information, not intellectual property. The two sides between employer and model-makers can negotiate further to purchase additional licenses for the use of the model in the next projects.

5.2. The Party That Designed the Initial Model

The second factor of model ownership and IPRs of BIM is the party that designed the initial model, with a variant percentage of 28.713%. This factor consists of the attributes of architect/engineer and contractor. According to [30], in order to mitigate risks related to intellectual property claims, the standard contract emphasizes that the model should remain on the designer or the party that designed the initial model. Meanwhile, according to [29], in his research, it shown that the majority of respondents (44%) stated that copyright and any information derived from the BIM model must remain owned by the developer or
designer of the model, and the model developer will act as a central entity in the event of a dispute regarding the BIM model.

6. Conclusions

The implementation of the BIM concept requires many contributions from various project participants with different scientific backgrounds. Therefore, the output of BIM can be said to be a collaboration product, wherein at the end of the project comes a question of who has the right model of collaboration results for its sustainability. The collaborative nature of BIM also poses intellectual property protection issues, as BIM centralizes project-related information into a collaborative platform that is widely accessible, modified, and added by all project participants, requiring intellectual property protection of the model. The issue of ownership and intellectual property rights models, if not addressed with proper policymaking, can lead to conflicts and legal problems at the end of the project. Therefore, it is necessary to have a clear definition of the priority of model ownership and intellectual property rights of BIM. This is driven by the question of who has the right model of collaboration for its sustainability. This study aimed to identify factors of model ownership and intellectual property rights within the scope of BIM practices in Indonesia.

The results of the synthesis of respondent data and previous studies obtained the conclusion that the factor that makes the model element is the main factor that involves the model and IPRs. If the model is designed and contributed by the team, each party and the discipline that contributes will have all rights to its contribution. The employer will have the model ownership rights of BIM in the form of a license, but with limited use only for operations, maintenance, and marketing, and do not have the right to reuse the model for the construction of the next project because there is an intellectual property right of the party that makes the model elements contained therein. For the employer to use the model for the construction of other projects, the employer and the parties who create the model can negotiate further to purchase additional licenses to use the model on future projects.

The limitations of this study include sample sizes that are too small for factor analysis. This research focuses on model ownership and intellectual property rights, but for further work, there are opportunities to identify the roles and responsibilities of each party and how to avoid copyright infringement. Therefore, the question of this research is not only who owns and who is responsible, but also how to avoid the issue of copyright infringement from collaborative work in BIM. This research provides managerial implications in providing recommendations for policymaking in construction contracts to better manage BIM-based projects in Indonesia.

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