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Implementation Guideline to Solve Obstacles in Construction Delay Analysis: An Empirical Study of Indonesia

Pedoman Pelaksanaan Untuk Mengatasi Kendala dalam Analisis Keterlambatan Proyek Konstruksi: Studi Empiris di Indonesia

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Abstract

Construction projects commonly suffer from schedule delays and consequent claims. To overcome schedule delay difficulties, certain schedule delay analysis methodologies have been developed, but project practitioners are habitually not familiar with conducting required data collation and delay analysis. This research aims to provide an implementation guideline of using schedule delay analysis approaches to solve the obstacles of the analysis and uses Indonesia construction practitioners as an example to examine the proposed guideline. Interviews were performed with domain experts in Indonesia to collect existing obstacles, suggestions, and opinions to create an implementation guideline. The proposed guideline with the required documents is suitable for solving the obstacles identified in Indonesia. The proposed guideline covers three implementation phases: before, during, and during/after construction. Before construction, the guideline helps to identify key issues in a contract. During construction, identifying and categorizing schedule delay types are strongly suggested. Besides that, arranging the schedules (as-planned and as-built) and delaying time types to one comparison table is necessary during or after the construction. The proposed guideline with required documents is a reference for project practitioners in performing delay analysis systemically.

Keywords: *Delay Analysis; Implementation Guideline; Empirical Study; Indonesia.*

Abstrak

Keterlambatan jadwal pada proyek konstruksi sangat mungkin terjadi dan dapat mengakibatkan klaim-klaim. Untuk menyelesaikan permasalahan-permasalahan yang terjadi akibat keterlambatan jadwal, beberapa metode analisis jadwal telah dikembangkan meskipun banyak praktisi proyek konstruksi yang masih sangat awam dalam proses pengumpulan data dan analisisnya. Penelitian ini bertujuan untuk memberikan pedoman pelaksanaan analisis keterlambatan jadwal guna mengatasi kendala-kendala dalam analisis yang akan dilakukan dengan melibatkan praktisi konstruksi di Indonesia untuk mengkaji pedoman yang diusulkan. Wawancara dengan para praktisi berpengalaman telah dilakukan untuk mengumpulkan kendala, saran, dan pendapat guna menyusun pedoman pelaksanaan yang baik. Pedoman pelaksanaan yang diusulkan mencakup tiga fase implementasi, yakni sebelum, saat, dan saat/paska konstruksi. Pada fase sebelum konstruksi, identifikasi isu-isu penting terkait keterlambatan harus jelas tertulis di kontrak. Saat masa konstruksi, identifikasi penyebab keterlambatan dan pengelompokannya sesuai dengan tipe keterlambatan sangat disarankan untuk dilakukan. Selain itu, penyusunan penjadwalan (as-planned dan as-built) dan pembuatan tabel waktu dan tipe keterlambatan jadwal juga sangat penting dilakukan pada masa saat dan paska konstruksi. Pedoman yang diusulkan dengan informasi terkait data-data yang diperlukan ini diharapkan dapat menjadi rujukan bagi praktisi proyek di Indonesia dalam mengimplementasikan analisis keterlambatan jadwal proyek secara sistematis.

Kata Kunci: Analisis Keterlambatan Proyek; Pedoman Pelaksanaan; Studi Empiris; Indonesia

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INTRODUCTION

During the execution, it is common for construction projects to face complicated and challenging situations that lead to problems in completing construction works punctually. It also suffers schedule delays that could occur either simple or complex, caused by one or more project participants, which might increase project duration, cost, and liability disputes among the participants. The definition of a delay in the construction projects is an extension of the project's completion time (Shah & Apte, 2015).

Due to the number of participants in a construction project, the phenomenon of concurrent delay makes solving delay problems more complicated. Concurrency in delays occasionally happens and can impact the total duration of a project. As a result, it may also increase the claim for dispute liability and lead the contract parties into confusing situations because of the difficulty in identifying their own liability for project delays. All aspects of the occurred delays in a project have to be considered when analyzing the construction project's concurrent delay (Zetta Rasullia Kamandang & Casita, 2018).

Regarding delay claims in construction projects, Al-Gahtani et al. (2016) stated that float ownership is one of the arguable issues. The amount of time between an activity's early start and late start, or early finish and late finish, that can be added to it without changing the project's completion date is known as float or slack. In solving the disputes of delay liability that involve project participants, concurrency in delay and float ownership have crucial roles. Also, the results of the analysis have to be accepted by all participants.

To determine the source and effect connections of time-related disputes in a construction contract, schedule delay analysis is frequently utilized. Many well-known delay analysis methods have been developed and are widely utilized in practice (Livengood & Kelly, 2013). These methods have different analytical approaches and require considerable diversified data. An ideal technique contributes to a fair and accurate delay analysis result that increases the possibility of acceptance by contract parties and professional schedule analysts. In construction projects, as-planned and as-built schedules are usually achievable. Project participants may use those schedules as the basic information in recognizing and solving disputes and claims related to delay (J. Bin Yang & Kao, 2012).

Schedule delay analytical approaches have been frequently observed in research studies, however, most construction participants are still not familiar with the application and requirements of conducting the approaches. The required data and the analytical process have been uncommonly recognized by the construction projects participants; therefore, the dispute problems are generally solved in a court. Even so, the dispute still encounters the problem of lacking the required data that has to be collected during construction. Each of schedule delay analysis method has different applicability and required data, but no process flowchart can be followed by project participants in preparing required data, conducting a comprehensive schedule delay analysis, and producing an acceptable result. Therefore, this study targets to provide a guideline in terms of solving delay disputes based on schedule delay analysis approaches.

RESEARCH METHODOLOGY

General situation of project delays in Indonesia

A construction project consists of several activities, in general, that might delay activities themselves and sometimes concurrently occurs and impact project completion date. Researchers around the world have been interested in studying many causes of delays in the construction industry. Majid and McCaffer (1998) identified the key causes of delays, the impact of delays, and ways for eliminating delays in Aceh, Indonesia construction projects. A total of 57 causes that contributed to the delays were identified. Some researchers identified similar delay causes, including Kaming et al. (1997), Alwi et al. (2002), and Soekiman et al. (2011). The results of the above analyses showed that time overrun, and cost overrun were the two most common effects of delays in construction projects in Indonesia. The previous three researchers all revealed comparable delay factors. According to the findings of the preceding research, time and

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cost overruns were the two most prevalent consequences of delays in Indonesian building projects. Based on the literature, the construction industry in Indonesia mainly solves delay problems after they happen. It is a reactive approach. This study tries to provide an implementation guideline of using schedule delay analysis approaches to overcome the obstacles in construction delay analysis in Indonesia. That is a proactive approach.

Types of Construction Delay

Delays in construction projects' schedules can be categorized in several ways. Braimah (2008) offered a simple delay categorization based on responsibility, excusability/compensability, and time. Yang (2005) presents delay classification in a distinct presence in his work. As a result, depending on the specific scenario and context in which the terms are employed, any delays may be classed as excusable, compensable, criticality, or concurrency. Furthermore, Kamandang and Casita (2018) defined excusable delay as a delay induced by an unanticipated incident outside of the control of construction project participants. Additionally, excusable delays are divided into two types: excusable non-compensable delays and excusable compensable delays.

Excusable non-compensable delays (EN) are caused by a variety of causes outside the contractor's, owners, or other construction parties' control. Acts of God, unusually severe weather, intervention by outside agencies, lack of action by government bodies, such as building inspection, and unanticipated subsurface site conditions are examples of this sort of delay (Ravisankar et al., 2014). In this case, the contractor is permitted to extend the construction time (EOT) without incurring any liquidated damages for the delay.

The proprietor or its representatives cause delays that excusable-compensable (EC). Numerous things, including poor site access, variation/change orders, variable site conditions, and/or insufficient drawings and specifications, contribute to these delays. The contractor is entitled to a time extension (EOT) and financial damages as a result of these delays, according to the owner. A likely decision of compensability can, however, be significantly disputed if a "no-damage-for-delay" condition is inserted in the contract form. The contract language itself has a key role in determining whether delays are the owner's responsibility.

Non-Excusable delays (NE) are being caused by the contractor's or its subcontractors' carelessness and negligence. As a result of these delays, the contractor is obligated to pay any damages to the owner under the terms of the contract. Delays can be caused by a lack of people, a lack of resources, material delivery issues, equipment-related delays, financial issues, and so on (Zetta Rasullia Kamandang & Casita, 2018).

In terms of critical and non-critical delays, if there is a delay in critical path activities, it affects the project completion date. Some projects may have more than one critical path(s), resulting in a disagreement over the resulting delays. Non-critical delays, on the other hand, do not affect the project completion date; nevertheless, it should be noted that a delay along the critical path might influence the completion date if it uses all of the available float (Zetta Rasullia Kamandang & Casita, 2018).

Float Ownership

Float ownership is one of a disputable issue in the litigation of delay claims. Float, also known as slack, is defined as the amount of time that an activity may be postponed without compromising the project's completion schedule, and it is determined based on the difference between an activity's early start and late start or early finish and late finish. Several solutions for dealing with float ownership difficulties have been developed during the last several decades.

Float is commonly used to help the project stay within the scheduled completion duration. The project parties will consume the float and keep the progress on schedule. According to the important role of float in overcoming delays, it is necessary to discuss float and its ownership clearly as a clause to provide a fairer contract for the parties. Unfortunately, most of construction project contracts has never discussed about float or its ownership. In the contract that commonly applied in Indonesia, float ownership is something new to bring up. There is no further information about managing the float or identifying its owner.

Delay Resolution Terms in Construction Contracts

Project delays often cause a major source of claims since they often result in time and/or cost overruns. Extension of time (EOT) is critical for all contracting parties. EOT will be used by the contractor to avoid having to pay liquidated damages and to finish the project promptly. EOT for the employer or owner would prevent time from being rendered "at large," where the contractor just needs to finish the project in a fair amount of time (Heap-Yih Chong, 2012).

According to previous researchers, (Braimah, 2014; Marzouk et al., 2018; Shen et al., 2017) a construction industry agreement controlling the damages under a delay claim is routinely employed. This agreement often includes a claim for longer home and field office overheads, additional financing expenses, and other time-related things. The Conditions of Contract (COC), which are usually a standard part of the construction project contract documents, play a significant role in regulating the process of claiming for an EOT and/or recovering damages under commonly used contract forms such as FIDIC (The International Federation of Consulting Engineers) and JCT (Joint Contract Tribunal). Some versions of contracts are presented in different types of scope regarding solving claims. Furthermore, Palaneeswaran and Kumaraswamy (2008) argued that the present contract forms' processes for managing delay claims are not fully established and are open to various interpretations.

Delay resolutions is a mandatory subject in construction contracts. A contract with strong agreement in order to solve delay claims has the capability to gratify every party in the project, thus the contract would be fair and gain for the parties. Delay itself as discussed before can be categorized into types that actually able to help the project to identify whose responsibility, how the resolution, what the applicable clause and how the sanctions and fines are executed. In Indonesia, delay resolutions clause which should be fair to parties but in reality, it gives more responsibilities to contractor. All risks due to delays that would happen in the project will belong to contractor with force majeure as exception. If the contractor is unable to finish the construction punctually, it is written that the contractor has to pay 1 ‰ from its contract value for each day of delay. The situations that can be included as force majeure are fire, war, strike, sabotage, political chaos, epidemic, and natural disasters but if the condition directly and substantially affects the ability of the affected party in order to accomplish the duties. Moreover, in the case of the contractor is deemed unable to complete the work within the stipulated time, the owner has the right to cancel the contract unilaterally and transfer the work to the third party by imposing a complete cost to the contractor, unless the cause of the inability is not the contractor's. If the proposed work unit price cost by the third party is higher than the unit price which is mentioned in the contract attachments, then the price differences will be the contractor's. Furthermore, there is no article that discusses how sanctions and fines should be applied if the owner causes delay.

According to the information of real contract above that mostly applied in Indonesia, the contract is more like an unfair agreement that has to be obeyed by the contractor. As we discussed delays can be categorized into types, actually it is not hard to apply the knowledge into contract and produce a fairer one in order to solve delay disputes. So, the involved parties in the construction contract should be more aware of the important role of delay types and float ownership to prepare a proper contract that is able to overcome unilateral losses.

Evaluation Of Available Schedule Delay Analysis Methods

Schedule delay analysis is a process of analyzing delays using methods that have been developed in previous studies. These methods have been used in different analytical approaches and require a lot of data. There are several popular methods that have been used including as-planned vs as-built, impacted as-planned, the collapsed as-built, isolated delay types, window but-for technique, isolated collapsed as-built and critical path effect-based delay analysis method (Zetta R. Kamandang et al., 2017). The simplest schedule delay method is As-planned vs. As-built. The total length of delay is calculated by subtracting the as-built duration by the as-planned total duration.

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Impacted as-planned and collapsed as-built (but) for methods calculate the analysis based on two perspectives: owner and contractor. As its name, impacted as-planned method starting the calculation from as-planned project duration. When employing owner's perspective, the EC delays will be inserted to the schedule to calculate the owner's liability of delay. To calculate the contractor's liability, the NE delays will be inserted to as-planned schedule, which this schedule is the initial one, not the schedule affected by the previous calculation (owner's perspective). Meanwhile, collapsed as-built (but) for methods using as-built schedule as the calculation baseline. If the previous method inserting the delays, this method subtracting the EC delays from the as-built schedule to obtain owner's liability and subtracting the NE delays to determine the contractor's liability of the delay. Another method that applies a similar calculation is isolated delay type (termed IDT), but it divides the as-planned schedule into several frames/windows before submitting the EC or NE delays.

Window but-for technique, isolated collapsed as-built (termed ICBF) and critical path effect-based delay (termed EDAM) are involving two perspectives: owner and contractor continuously into their calculation. The window but-for technique starts with dividing as-planned schedule into several frames and inserting the delay's types based on their sequences. EC and NE delays are used continuously. Isolated collapsed as-built (termed ICBF) starting with as-built schedule which divided into frames before. Later it is subtracting the EC and NE delays based on their sequences. Furthermore, EDAM also divides the as-planned schedule into several frames and uses the two parties' perspectives continuously. But it also employs equations to calculate the exact number of each party liability on concurrent delays (J. Bin Yang & Kao, 2012). The last three methods are notable to obtain the number of concurrent delays, but only the EDAM which able to achieve the liability of each construction project party on concurrent delays (Zetta R. Kamandang et al., 2017). Table 1 presents the information of needed data and calculation process of each method.

Development of a Comprehensive Guide to Solve Delay Dispute in Indonesian Construction Project

Research Methodology

Interviews were performed with domain experts in Indonesia to gather information, recommendations, and opinions in order to provide a suitable guideline. The questionnaire consists of five main questions discussing schedule delay analysis methods, data providing, float ownership concepts, construction project contract and research suggestions and opinions.

The respondents of this research divided into five owners or the representative and five contractors whose experiences in construction projects for more than ten-year, both in state-owned enterprise or non-state-owned. For the owners/representatives, developer company employers and consultants were interviewed to collect some information, advice and opinions. Contractors were also interviewed to collect any information based on their perspective. The results of interviews will be processed to provide a comprehensive guideline in term of solving delay dispute using schedule delay analysis approaches.

Interviewing Results

By interviewing construction project practitioners in Indonesia, providing schedules in Microsoft Project format is achievable, 8/10 respondents claimed to be able to provide delays information, and 10/10 agreed to produce progress reports in daily or weekly depending on their capability. "Float belongs to contractor" and "float belongs to project" which is used in this research are the most implemented of float ownership concept in Indonesia. Neither float ownership nor concurrent delays issues are explained and written in construction project contract in Indonesia. Indonesia also has no any regulation regarding to float ownership and concurrent delay in construction project contract, but still, these issues are important to discuss as the basic consideration in solving the delay disputes and conducting schedule delay analyses. Construction project practitioners in Indonesia are familiar with as-planned vs as-built schedule method and use it to calculate project delay. For the rest methods which are conducted in this research, the respondents do not utterly understand and barely implement the methods before.

Table 1. Schedule delay methods data and process information

No.	Methods	Required Data	Calculation Process	
			Perspective of Owner and Contractor	Schedule Periods
1	As-planned vs. As-built	As-planned schedule, delays information	-	-
2	Impacted As-planned	As-planned schedule, delays information	Considered separately into calculation	-
3	The Collapsed As-built (But-For) Technique	As-built schedule, delays information	Considered separately into calculation	-
4	Isolated Delay Type	As-planned schedule, delays information	Considered separately into calculation	Dividing schedule into time periods (frames, windows)
5	Window But-For Technique	As-planned schedule, delays information	Two perspectives are considered continuously and be used in calculation	Dividing schedule into time periods (frames, windows)
6	Isolated Collapsed But-For	As-built schedule, delays information	Two perspectives are considered continuously and be used in calculation	Dividing schedule into time periods (frames, windows)
7	Critical Path Effect Based Delay Analysis (EDAM)	As-planned schedule, delays information	Two perspectives are considered continuously and be used in calculation	Dividing schedule into time periods (frames, windows)

RESULTS AND DISCUSSION

Proposed Implementation Guideline

Providing guideline in term of solving delay dispute using schedule delay analysis approaches to Indonesia construction project is one of this research objectives. The guideline wording is based on this analysis research contain of process and suggestions to conduct a comprehensive schedule delay analysis and provide more factual results. In term of presenting the guideline that can be followed by the practitioners in Indonesia, the process is divided into three phases: before, during and during/after construction. Figure 1 presents the guideline.

Principles Before Construction

At the beginning of the construction, the project parties prepare the contract that covers all of the issues related to the project. Since the concurrent delay and float ownership problems might cause dispute among parties and impact the total duration of the project, the agreement that discussed about these issues should be written in the contract. The writing about those issues is better done before bidding and after the contractor wins the bid, an intensive discussion among owner and contractor has to be held while forming the contract project clauses.

Furthermore, there are at least three types of delay in construction project; EN, EC and NE that should be discussed earlier in the contract to determine the delays which might be occurred later. The delay types of clauses in the contract would be advantageous to project parties to complete the schedule delay analysis later. Schedule delay analysis starts with project schedule either as-planned or as-built that is commonly known. However, most of the analysis use the as-planned as a starting point to complete the analysis. Therefore, as-planned schedule has a significant role and preparing a comprehensive as-planned schedule is mandatory.

Principles During Construction

During a construction project, the contractor will prepare a progress report which can be presented in a weekly or daily format. To conduct a comprehensive schedule delay analysis, the daily progress report is more acceptable than weekly. The daily progress report presents a detailed project progress record so which able to support the delay analysis process. From the daily progress report, a temporary as-built schedule can be conducted.

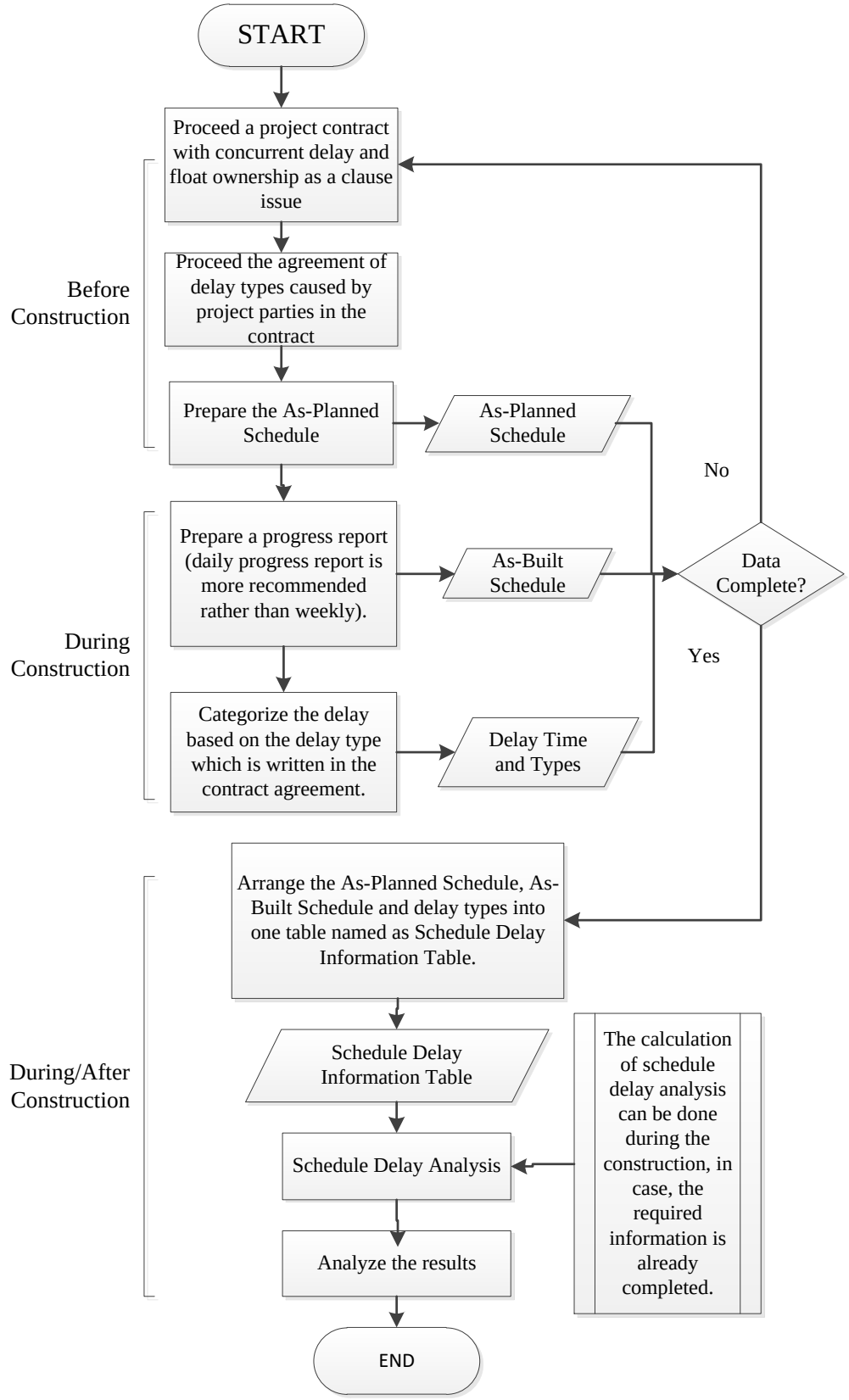

Figure 1. Guideline in term of solving delay dispute using schedule delay analysis approaches for Indonesia construction project

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No.	Task Name	Predecessor	Note	Date / Duration (Week)	February W1	W2	W3	W4	March W5	W6	W7	W8	W9	April W10	W11	W12	W13
					2/1	2/8	2/15	2/22	2/29	3/7	3/14	3/21	3/28	4/4	4/11	4/18	4/25
					2/7	2/14	2/21	2/28	3/6	3/13	3/20	3/27	4/3	4/10	4/17	4/24	5/1
A	ARCHITECTURE																
1	Ground Floor		As - Planned	3													
			As - Built	4				EC	NE								
2	First Floor	A1 (SS) + 1W	As - Planned	3													
		A1 (SS) + 2W	As - Built	5				NE	NE								
3	Second Floor	A2 (SS) + 1W	As - Planned	4													
		A2 (SS) + 1W	As - Built	5					EC	NE	NE						
4	Third Floor	A3 (SS) + 1W	As - Planned	4													
		A3 (SS) + 2W	As - Built	5										EC	EC		
5	Fourth Floor	A4 (SS) + 1W	As - Planned	4													
		A4 (SS) + 1W	As - Built	4													
6	Fifth Floor	A5 (SS) + 1W	As - Planned	4													
		A5 (SS) + 2W	As - Built	4													

Figure 2. An example of a schedule delay information table

When delays occur in the project, the project parties should categorize it into delay types based on the contract agreement. Categorizing delay types during construction will help the project parties to record information straightway and minimize failures that can be caused by incomplete information or human error.

Schedule delay analysis may be performed during construction using the data information given; as-planned schedule, temporary as-built schedule, and delay time-types, which will subsequently be grouped in a single table called the schedule delay information table. The schedule delay information table serves as a starting point for the schedule delay analysis. An example of the table is presented in Figure 2.

Principles During/After Construction

In order to accomplish schedule delay analysis, providing comprehensive data from the beginning of the project is essential. As-planned and as-built schedule, delays information (covering time, causes, and types of delays) and progress report are the main required data. Arranging the schedules and delay time types into a single table can be done before or after construction. During the construction, the used as-built schedule is a temporary one which covers the real progress at the time delay analysis will be conducted. For the as-built schedule which is obtained at the end of the project, it covers all information from the beginning of the project. The schedule delay information table is a starting point to start the analysis.

After completing the schedule delay analyses, the result can be obtained and will be used to solve the delay liability claims among project parties. Some methods which use both owner's and contractor's perspectives continuously in one calculation process and divide the project schedule into several periods can cover the concurrent delays issue and project parties' liability of delay (Zetta R. Kamandang et al., 2017). Table 1 presents the important issues and documents regarding to the guideline.

Evaluation of Proposed Principles

Before construction begins, this study suggests construction project practitioners to proceed a clause/agreement discussed about concurrent delay and float ownership, by interviewing Indonesia project practitioners, 10/10 respondents agreed that the suggestions can be conducted in construction contract in the future. During the construction, 10/10 respondents agreed to produce progress reports daily or weekly depending on their capability and 9/10 claimed that categorizing delays into delay types is a possible action to be done in the project. Categorizing delay types is necessary for preparing the needed documents to conduct a comprehensive schedule delay analysis.

To choose the most suitable analysis method(s) and produce the most stable and accurate results, this study suggests the practitioners in Indonesia to involve both owner's and contractor's perspectives continuously to one calculation process and divide the project schedule into several time –

Table 2. Guideline issues and documents

Phase	Important Issues	Documents
Before Construction	Float ownership clauses	Contract
	Concurrent delay clauses	
	Delay types categorizing clauses	
	A comprehensive as-planned schedule	Contractor's, approved by owner
During	Progress report	Contractor's
	As-built schedule (temporary)	Contractor's, based on progress report, approved by owner
	Delay types categorizing	Contractor's, following the contract clause
During/After	As-built schedule	Contractor's, based on progress report, approved by owner
	Forming schedule delays information table	
	Schedule delay analysis	

periods. All respondents agree that the suggestions are reasonable and possible to be implemented in Indonesia.

CONCLUSION

Providing guidelines for solving delay disputes using schedule delay analysis approaches to construction project practitioners is essential. The guideline is divided into three phases, before, during and during/after construction. At the beginning of the construction, the project parties prepare the contract that covers all of the issues related to the project. Because concurrent delay and float ownership are critical concerns in completing the schedule delay analysis, the project parties should reach an agreement on these topics, which should be explicitly defined in the contract. Furthermore, categorizing delay types also should be discussed earlier in the contract to determine the delays which might be occurred later. The schedule delay analysis results would be more accurate if the parties had a clear clause/agreement on these problems.

During the construction, the contractor will prepare a progress report in daily/weekly format and also categorize schedule delay types. Arranging schedules (as-planned and as-built) and delay time-types into one table can be performed during or after the construction. After arranging the schedule delay information table, the schedule delay analysis can be started. The practitioners can choose the suitable methods depending on the expected results to solve the delay liability claims among project parties.

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