Delays in Construction Project : A Review

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Abstract. Delays in construction projects schedule is one of the most noticed problems. Delays may be caused by several project parties and further categorized into excusable non-compensable delays (EN) caused by many factors beyond parties' control, excusable-compensable delays (EC) caused by the owner, and non-compensable delays (NE) caused by the contractor. Another issue is concurrency in delays. The result of concurrent delay often leads the project parties into complicated situations. Thus, understanding the causes and identifying the types of delays are essential to be done before executing the delay analysis methods in order to allocating the liability of each party. This study concludes that some existed schedule delay analysis methods produce different results, therefore, the practitioners or schedule delay analyst should understand the anticipated results that can be accepted by all construction projects parties.

1. Introduction

Some problems commonly occur during construction project execution. Schedule delay is one of the most noticed problems that sometimes causes time-cost overrun, disputes, litigation, and also leads to abandonment construction projects [1]. Delay can be described as a situation when a project runs into overtime either beyond the contract date or beyond date that agreed by the parties. Since a project consists of more than one party, a delay that caused by a party might not always impact to another party [2]. Delays can be caused by several parties, owner, contractors or other parties. Therefore, identifying delay responsibility among parties is required to be achieved. Concurrency in delay sometimes occurs and lead the parties into complicated situations. The purpose of this study is to present the information of schedule delay types and methods for dealing with it.

2. Causes of Delays

Researchers have interested in inspecting many causes of delay in construction industries. Odeh and Battaineh [3] study in Jordan stated that contractor's financial problems, change of order, and poor planning – scheduling of the project are the major causes of delay. Majid and McCaffer [4] also indicated the major causes of delays, effects of delays, and methods of reducing construction project delays in Aceh, Indonesia. A total of fifty-seven delay factors are recognized and grouped into eight; contractor-related delays; equipment-related delays; client-related delays; material-related delays; finance-related delays; consultant-related delays; external-related delays; and manpower-related delays. The results also showed that time overrun and cost overrun were the most common effects.

A case study research in Egypt listed eighty-four delay factors that classified into nine major groups; materials, financing, project changes, contractual relationships, rules and regulations, manpower, scheduling and control, equipment, and environmental factors [5]. Long [6] also compiled effects of delay in construction project and mentioned increased material handling, loss of productivity, and additional mobilization as some of the causes.

3. Types of Construction Delay

In order to identify the delay responsibility among parties, the practitioners must determine whether the delay is critical or noncritical. Schedule delays can be organized in several ways. Braimah [7] as shown at figure 1, presented basic delay classification based on responsibility, excusability/compensability, and timing. Based on responsibility, owner-caused delays, contractor-caused delays, and third party are included. Concurrent delay and non-concurrent delay are listed under the timing-based delay. While excusable non-compensable and excusable non-compensable and non-excusable delays are listed under excusability/compensability.

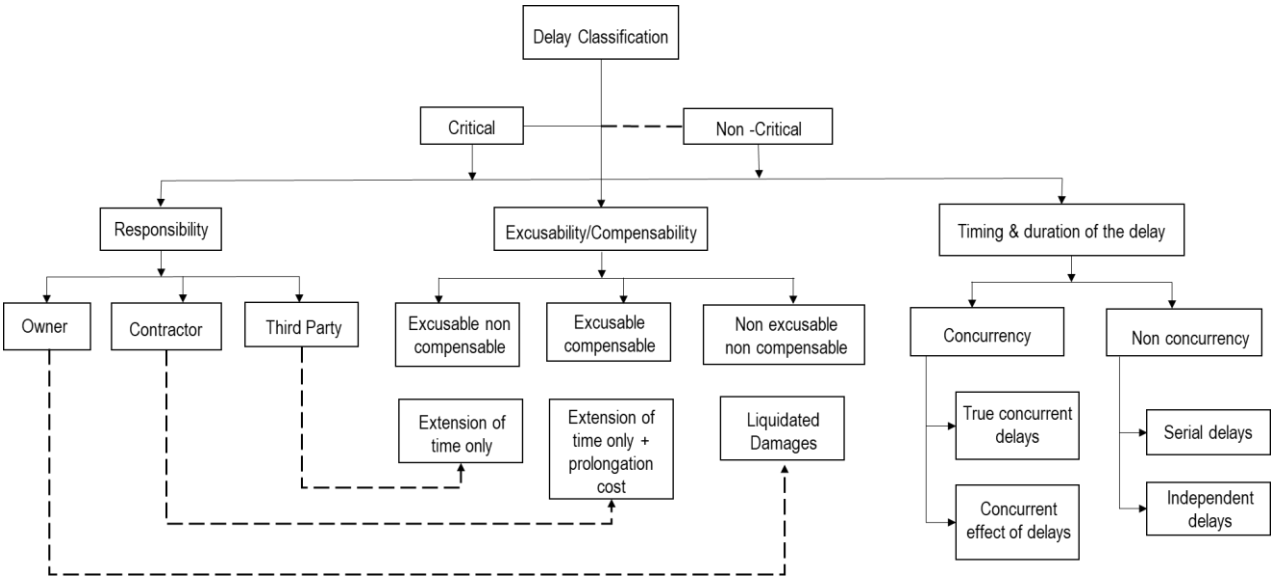

Figure 1. Classification of Project Delays [7]

3.1. Excusable and Non-Excusable Delays

In definition, excusable delay can be described as a delay caused by unforeseeable event beyond the control of construction project parties. Furthermore, excusable delay is categorized into two; Excusable Non-Compensable delays and Excusable Compensable delays.

3.1.1. Excusable Non-Compensable Delays (EN)

These delays are caused by many factors beyond control of the contractor, owner or other construction parties. Acts of God, force majeure, unforeseen underground site conditions, and labor – material shortages beyond expectations of construction parties at the time of contract agreement are examples of this type of delay [8, 9]. In this condition, the contractor is allowed to extend the construction time period (EOT) without any delay liquidated damages.

3.1.2. Excusable-Compensable Delays (EC)

Excusable-compensable delays are caused by owner or his/her representatives. These delays are including caused by site access failure preparing, variation/change orders, differing site conditions

and/or incomplete drawings and specifications [10]. Due to these delays, the owner entitles the contractor a time extension (EOT) and financial damages. However, if a "no-damage-for-delay" clause written in contract form, a probable determination of compensability can be seriously challenged. The identification of which delays are owner's responsibility counts significantly upon the contract language itself [11].

3.1.3. Non-Excusable Delays (NE)

The contractor or its subcontractors' fault and negligence are causing this type of delays. The consequence of these delays is the contractor has to be liable to any damages to owner according to the contract agreement. The examples of these causes of delays are insufficient manpower, lack of resources, material distribution problems, equipment-related delays, financial problems and etc.

3.2. *Critical and Non-Critical Delays*

Critical path is known as the longest distance of the project start date and finish date. If a delay occurs in activities of critical path, it obviously affects the project completion date. Some projects might be have more than one critical path(s) and it leads into a dispute over the occurred delays. However, non-critical delays do not affect the project completion date but it has to be noticed that a delay near critical path can affect the completion date if it consumes out of the available float.

3.3. *Concurrent Delays*

Concurrent delays are widely known as two or more delays caused by different parties at the same time which can affect the project completion date. Arditi and Robinson [10] explained that two or more delays occur concurrently and caused extension time in the overall project, must be occurring in the same time period and must be able to affect the overall project duration independently of each other. Concurrent delay is the most challengeable type of delay because both parties will use this delay to against the other party. Owners will use this delay to collect liquidated damages while contractors will use it to waive their inexcusable delays and avoid damages entitlements [8]. In terms of definitions and apportionment of concurrent delays, the practitioners, researchers, and court law are generally inconsistent [12].

Kraiem and Diekmann [13] proposed different rules which shall be called as "Easy Rule" and 'Fair Rule". The difference of those rules is lie on the apportioning of liquidated damages. In "Easy Rule", liquidated damages apportionment is not accepted, instead, the contractor is allowed to have an extension of time and each party suffering its own losses. Table 1 shows the summarize of remedies from concurrent delays.

Table 1. Remedies for Concurrent delays [13]

Concurrent delay type	Remedy (for critical path)	
Any delay concurrent with excusable non-compensable	Time extension	
Excusable compensable concurrent with non-excusable non-compensable	Easy rule Time extension	Fair rule Appointment

4. Schedule Delays Analysis

4.1. Schedule Delay Analysis Methods

Different types of delays can be occurred in construction project and involving more than one party. In other that, some methods have been developed for analyzing the impact of the delays and identifying the project party liabilities. Yang and Kao [14] explained that the ideal methods should perform a fair and accurate delay analysis results and can be accepted by contract participants and professional schedule analyst.

4.1.1. *As-planned vs. As-Built Method*

This method compares the finish date of two schedules, as-planned and as-built. The obtained different numbers will be noted as delay days of the construction project. Ndekugri, Braimah [15] stated that this method is inexpensive, simple and easy to understand but it hard to identify changes in critical path and unable to managing complex construction delays.

4.1.2. Impacted As-Planned Method

This method starts with as-planned schedule and applied by inserting the delays. If the owners are willing to obtain the contractor-caused delay, they can insert numbers of contractor delay to the as-planned schedule. It also applies to the contractor that submit extension time of the project claim by adding the delay caused by owners to the as-planned schedule in appropriate sequence [16].

4.1.3. The Collapsed As-Built Method

As-built schedule is used as the baseline schedule of this method and applied twice both from owner's viewpoint and contractor's. From contractor's viewpoint, the delay caused by owner will be eliminated from as-built schedule and the given numbers of compared it to as-built schedule will be the liability of owner. From the owner and third party, the implementation is vice versa [17]. This method is commonly used nut still have some disadvantages such as concurrent delays unable to be recognized and dynamic nature of project's critical paths are not considered [18].

4.1.4. Isolated Delay Type Technique

This technique divides the project durations in as-planned schedule into several scenarios and applied based on the owner's and contractor's viewpoint. It examines delay-caused by contractor and ignore other delays caused by owner or third party when analyzing based on contractor's viewpoint [19].

4.1.5. Window But-For Technique

The owner's and contractor's viewpoint are used continuously in divided as-planned project duration scenarios. The delay caused from owner will be inserted into first scenario and the result schedule will be the new baseline. Further, the contractor-caused delay will be inserted into that new baseline and it completes the analyzing of first scenario. The result date of first scenario later becomes a new baseline of second scenario and the same analyzing will be implemented. The details of this methods process will be found elsewhere [20].

4.1.6. Isolated Collapsed But-For Method (ICBF)

Starting with as-built schedule, this method divides the project duration into scenarios. One scenario consists of all delay types and the delay will be eliminated according to the types and viewpoints. This method considers the viewpoint of owner and contractor continuously in each scenario. Further, Yang and Yin [21] explained the detail process information of this method.

4.1.7. Effect-based Delay Analysis Method (EDAM)

This method proposed by Yang and Kao [22] based on study problems of windows-based delay analysis methods. EDAM conducts delay analysis using extracted windows and delay impacts based on the delay effects on critical path. The main advantage of this method is the ability to clearly allocate liability of each party in order to solve concurrent delays problems.

***4.2.** Comparison Result*

Kamandang, Yang [23] examined seven schedule delay analysis methods above and stated that the most suitable schedule delay methods must be able to solve concurrent delay and allocate the project parties' liability. According to the previous research [23], methods that divide project schedule into scenarios and consider owner's and contractor's viewpoint continuously produce the most stable and accurate results. In order to calculate the allocation of each party's schedule delays liability, the equations are needed as presented in the EDAM [22]. However, the clear words in contract agreement

discussed concurrent delay liability are highly recommended to solve disputes that might be coming along the delays.

5. Conclusions

Delays in construction commonly occur. Delays can be caused by several parties; owner, contractors or other parties. Therefore, identifying delay responsibility among parties is required to be achieved. Concurrency in delay sometimes occurs and lead the parties into complicated situations. Thus, understanding the causes and identifying the types of delays are essential to be done. Categorized delays further could be implicated in schedule delays analysis methods in order to solve delays liability problems. The methods produce different results, therefore, the practitioners or schedule delay analyst should understand the anticipated results that can be accepted by all construction projects parties. However, a clause discussed concurrent delay liability is highly recommended to support the solving of delays in concurrency problems.

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