

CASE STUDY OF DELAY IMPACT ANALYSIS OF LOST PRODUCTIVITY IN CONSTRUCTION PROJECTS

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ABSTRACT: Schedule delays commonly appear in construction projects and result in delay claim progressively. Several studies have proposed various schedule delay analysis methodologies; however, most of the studies focus on the analysis of surface data (as-planned and as-built schedules), few of them on evaluating the effects of root causes, such as the problem of lost productivity. Lost productivity, one essential delay cause, is usually experienced by a contractor while accomplishing its works less than planned rate of production. For analyzing the situations of schedule impacts caused by lost productivity, this study discusses a case of delay analysis with lost productivity in Taiwan. Through the study case, this study has proposed an approach to calculate schedule impact from lost productivity. The study results will be a basis for developing a comprehensive delay analysis method considering lost productivity.

Keywords: *Lost Productivity, Construction Projects, Case Study, Delay Analysis*

1. INTRODUCTION

In a construction project, a contractor usually suffers certain damages by loss of productivity caused by the owner or the third party. Productivity is lost on a project when the contractor's actual amount of labor or equipment hours is greater than the hours planned in its bid [1]. Loss of productivity, resulting from some action with owner's or third party's responsibility, may not be easily detected. How to calculate the schedule impact by lost productivity plays a key role for solving a delay claim with lost productivity. Although various lost productivity calculation methodologies exist, a contractor suffering the problem might have no appropriate method to solve it. How to calculate the schedule impact by lost productivity plays a key role for solving a delay claim with lost productivity. For analyzing the situations of schedule impacts caused by lost productivity, this study discusses a case of delay analysis with lost productivity in a road construction project in Taiwan. Through the investigation on a delayed activity, this study tries to propose an approach to calculate schedule impact from lost productivity.

2. PREVIOUS STUDIES

Based on a comprehensive review on delay analysis methodologies, professional project management software and commercial delay analysis software, a previous study concludes that available techniques and tools cannot deal with the problems of schedule delay with lost productivity appropriately [2]. Although Lee *et al.* [3] have proposed a method consisting of converting the lost productivity into the delay duration and analyzing its impacts on the construction schedule delay, schedule analysts cannot easily calculate schedule delay impact of lost productivity. For assisting delay analysts in estimating lost labor productivity in construction claims, complete causes of lost productivity are collected in a report of ACE International Recommended Practice [4]. The common causes of lost productivity include acceleration (directed or constructive), adverse or unusually severe weather, cumulative impact of multiple changes and rework, site or work area access restrictions, site conditions, untimely approvals or responses. Notably, in a delay claim, delay causes can be identified; however, a contractor should

clearly prove the delay liability of loss productivity is not caused by him and whether the delay event extends the project completion.

3. CASE INFORMATION

Table 1 shows the case information. The study case is one of the Taichung Metropolis Road construction projects in Taiwan. The project has contract duration of 1,218 calendar days and a contract price of NT\$ 2,598,000,000 (about US\$ 86.6 millions). Because some of construction sites are located in downtown, the activities of movements of existed facilities/obstacles are complicated. Up-to-date the study case has encountered two situations for extension of time. One is the movement of existed trees and pipelines.

Table 1 Case information.

Feature	Data
Project Name	AAA Road Construction Project
Location	Taichung, Taiwan
Contract Price	NT\$ 2,598,000,000
Construction duration	1,218 calendar days
Penalty rate for delay	1/1000 of contract price per day
Identified delay event	Typhoon, movement for existed trees and pipelines

4. DELAY ANALYSIS OF LOST PRODUCTIVITY

During the investigation for a delay claim, the contractor for the study case found that his construction plan did not have complete productivity data, i.e., required labor, equipment and materials for each activity. This situation results in the contractor's inability of proving lost productivity is caused by the others.

To prove the impact of lost productivity on activity duration, this study collected real productivity data for two similar activities. One is executed normally; the other is influenced by the activity of movement of existed pipelines. The comparison between normal and abnormal activities provides the basis for further delay calculation. After obtaining the amount of lost productivity on duration, this study determines a clear liability allocation for the study

activity based on the methodology of as-planned expanded delay analysis method.

5. CONCLUSIONS

Previous studies have tried to solve the problem of schedule delay with lost productivity; however, schedule analysts cannot easily calculate the impact of lost productivity on schedule delay. For analyzing the situations of schedule impacts caused by lost productivity, this study discusses a case of delay analysis with lost productivity in Taiwan. Through the study case, this study has proposed an approach to calculate schedule impact from lost productivity. The study results will be a basis for developing a comprehensive delay analysis method considering lost productivity.

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REFERENCES

- [1] Exponent Inc. (2011), "Productivity loss, disruption and inefficiency analysis," Retrieved March 16, 2011 from http://www.exponent.com/productivity_loss/.
- [2] Yang, J. B., Huang, K. M., and Lee, C. H., "Evaluation of Delay Analysis Methodologies on Lost Productivity in Construction Projects", *International Symposium on Automation and Robotics in Construction 2010 (ISARC 2010)*, June 25-27, 2010, Bratislava, Slovakia.
- [3] Lee, H. S., Ryu, H. G., Yu, J. H. and Kim, J. J., "Method for Calculating Schedule Delay Considering Lost Productivity", *Journal of Construction Engineering and Management*, 131(11), 1147-1154, 2005.
- [4] AACE International, Inc., *Estimating Lost Labor Productivity in Construction Claims*, AACE International Recommended Practices No. 25R-03, 2004.