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# OPTIMIZATION OF PROJECT TIME AND COST IN PANDEMIC ERA BY TIME COST TRADE OFF METHOD OF UNIVERSITAS NEGERI MEDAN CASE STUDY

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***Abstract.*** The quality of project construction is constrained by the triangle model of project management, refers to the boundaries of scope, cost and time. The construction project at Universitas Negeri Medan is one of the projects that is experiencing delays and does not meet one of the limitations of triple constraints that must be met by each project. This study has aims to identify the acceleration of project duration using the Time Cost Trade Off method with alternative additions of working hours (overtime) 1 hour, 2 hours, and 3 hours as well as the addition of the number of workers by 10%, 15%, 20%, and 25% from the beginning. From the results of the analysis using this method, it was concluded that the addition of the number of workers as much as 10% from the original is more profitable, where the optimum time of acceleration of the project duration is for 171 calendar days and the optimum cost resulting from the acceleration of the project duration is Rp. 14,059,057,900.00.

**Keywords:** construction, time, cost, trade off.

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## 1. INTRODUCTION

A construction project is an activity that is temporary in nature, consisting of activities that have specific objectives with certain specifications, have a clear time limit and end, require resources, namely: costs, human labor and equipment and have limited resources (Kerzner, 2000).

A project should meet three main aspects that are interrelated with each other known as triple constraint which refers to the boundaries of scope, cost and time. When there is a change in one aspect, the other two aspects also need adjustments to meet what the client needs.

Delay is something that is often faced by contractors during the construction of a construction project. This project delay can be overcome by accelerating the project duration, but this acceleration will cause an increase in costs, so we need a method that can accelerate the project duration at an optimal cost. This delay causes a project to require a good project planning. Planning is intended to bridge the gap between the goals to be achieved and the situation or situation at the beginning (Soeharto, 1990).

This study analyzes the optimum time to accelerate the project duration and the required optimum cost due to the acceleration of project duration using the Time Cost Trade Off method, which are the dependent variables used for the construction process. These dependent variables come from the scope of project work available at the initial cost estimation. This method is a deliberate, systematic, and analytic process by examining all activities in a project

centered on activities that are on the critical path (Ervianto, 2004), as well as streamline the required resources with the most optimal increase in project costs at Universitas Negeri Medan.

## 2. METHODOLOGY

### 2.1. Project Data Collection

The data needed in this study were obtained directly from the project party in the field, namely:

a. Time Schedule and S Curve
b. Budget Plan
c. Unit price analysis
d. Project Drawing

Based on the data obtained, it can be known in advance how much the direct costs and indirect costs, as well as the total costs of the project.

### 2.2. Identify Project Conditions and Relationships Between Activities

After the necessary data is obtained, the first thing to do is to identify the project conditions and the relationship between activities and the duration of each activity using Microsoft Project. The duration of each activity and the relationship of each activity are obtained from the Time Schedule.

### 2.3. Data Analysis

The implementation of critical activities will be accelerated. The duration reduction is done by using the Crashing Program. The steps in the crashing program are to calculate the crash duration, crash cost, and cost slope for each alternative to be studied.

### 2.4. Application of The Time Cost Trade Off Method

After obtaining the cost slope value of each activity, the project duration is emphasized (compressed) on all activities that are on the critical path and starting from the activity that has the lowest cost slope. From the compression stages, the optimal time will be sought from the minimum total project cost by analyzing time and costs.

## 3. RESULT AND DISCUSSION

### 3.1. Direct Cost and Indirect Costs

Direct costs are costs that are directly related to construction work in the field on this project. Meanwhile, indirect costs include Value Added Tax (VAT). Based on the contract, the amount of VAT to be borne by the contractor is 10% of the real cost, where:

Real cost = Rp12.776.777.015,84

PPN = 10% x Rp12.776.777.015,84

= Rp1,277,677,701.58

The total cost of this project is Rp14.054.454.700,00

### 3.2. Relationships between Project Activities

Project data processing is carried out with the help of the Microsoft Project program to determine the

critical trajectory of this project that is formed in the network.

The critical activities obtained are:

a. Embankment Beam
    1. Steel bar
    2. Formwork
    3. K-300 Concrete
b. Ring Balk
    1. Steel bar
    2. Formwork
c. Column
    1. Steel bar
    2. Formwork
d. Practical Wall & Concrete Pairing Work
    1. Pair of lightweight brick walls t = 7.5 cm
    2. Plastering mortar
    3. Mortar mixture
    4. Practical column/beam 11x11 cm
    5. Install the Galvanish Holow Frame GRC Board partition (1 face)
e. Door/Window Frame Work + Accessories & Railing
    1. Iron frame + iron plate door leaf (installed complete with accessories), type P7
f. Utility Work
g. Painting Works
h. Accessories Job

### 3.3. Implementation of Additional Working Hours (Overtime)

Additional working hours (overtime) can be made in accordance with the desired additional working hours. The greater the addition of overtime hours, it can cause a decrease in productivity. The coefficient of decline in productivity can be seen in the Table 1 below.

Table 1: Coefficient of productivity decrease (Suharto, 1997)

| Overtime hours | Decrease in productivity index | Work performance |
|---|---|---|
| 1 Hour | 0,1 | 90 |
| 2 Hours | 0,2 | 80 |
| 3 Hours | 0,3 | 70 |

### 3.4. Implementation of Increasing The Number of Workers

The calculation of the price of labor wages on the RAB by calculating the index in accordance with the

alternatives studied. This labor wage price is one of the dependent variables that is observed and measured to determine the effect caused by several alternatives that will be examined in this study. Thus, the unit price of workers' wages will also change from the normal price. Then the same calculation is carried out with the previous alternative working hours (overtime), namely crash duration, crash cost, and cost slope.

### 3.5. Analysis of Time and Cost Exchange

After getting the cost slope value of each critical activity, then the project duration is reduced starting from the critical activity that has the lowest cost slope value.

#### 3.5.1. Analysis of Acceleration Duration

With the help of Microsoft Project, it is known the total duration of projects and activities that are on a critical path after accelerating with previous alternatives, as shown in the Table 2 below.

Table 2: Project duration after acceleration

| Acceleration Alternative | Duration (Calendar Days) |
|---|---|
| Normal | 175 |
| Additional work hours (overtime) 1 hour | 174 |
| Additional work hours (overtime) 2 hours | 169 |
| Additional work hours (overtime) 3 hours | 166 |
| Addition of 10% Labor | 171 |
| Addition of 15% Labor | 166 |
| Addition of 20% Labor | 166 |
| Addition of 25% Labor | 162 |

#### 3.5.2. Time and Cost Analysis

The steps for calculating the time and cost analysis are as follows:

a. Calculating direct costs

1. Additional fee

Additional cost = cost slope x total crash (1)

2. Direct cost

Direct costs = Normal direct costs + Cumulative additional costs (2)

Where,

Normal direct costs = IDR 12,776,777,015.84

3. Total crash = Normal duration – crash duration (3)

b. Calculating the total cost

Total cost = Direct cost + Indirect cost

Where,

Indirect costs = Rp1,277,677,701.58.

Table 3: Recapitulation of project duration and costs

| Acceleration alternative | Duration (calendar days) | Total cost (Rp) |
|---|---|---|
| Normal | 175 | 14,054,455,400.00 |
| Additional work hours (overtime) 1 hour | 174 | 14,066,262,500.00 |
| Additional work hours (overtime) 2 hours | 169 | 14,089,119,600.00 |
| Additional work hours (overtime) 3 hours | 166 | 14,111,539,300.00 |
| Addition of 10% Labor | 171 | 14,059,057,900.00 |
| Addition of 15% Labor | 166 | 14,061,300,600.00 |
| Addition of 20% Labor | 166 | 14,061,727,300.00 |
| Addition of 25% Labor | 162 | 14,066,048,800.00 |

## 4. CONCLUSION

Based on the results of the Time Cost Trade Off analysis on the Universitas Negeri Medan project, it can be concluded that an additional 10% of the workforce from the original is more profitable, where the optimum time for accelerating the duration of the project is 171 calendar days and the optimum cost caused by acceleration the duration of the project is Rp. 14,059,057,900.00.

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