Study of labor cost escalation in delay projects

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Abstract. Timeliness of implementation is one of the variables in the implementation of construction projects. Evaluation and acceleration of delays projects will generally affect the use of project resources. Project delays can be overcome by making efforts, among others, with the Crashing Method which will affect various alternative costs resulting from Crashing. This study aims to understand that the delay in the construction project schedule will have an impact on the new schedule and the impact of costs that occur due to the acceleration carried out so that the project life is in accordance with the plan. Furthermore, it was analyzed for the need for additional workforce groups or only to maintain the addition of overtime. This research was conducted with descriptive analytic method, which is a research that will explain the conditions in the field in detail about project schedule delays by analyzing the magnitude of escalation of labor costs due to the acceleration of the duration of each activity so that the project schedule returns to the plan age.

1. Introduction

In the contract between the project owner and construction services it has been agreed that the length of time in the construction project and the fine that must be paid by the construction service if it delays. Project progress monitoring can be carried out every period that is reviewed so that the project life and the costs incurred can be predicted. By knowing the performance of a construction project that has delay, the next effort is to reschedule the project schedule and then accelerate the duration of each job.

Evaluation and acceleration of projects that experience a delay in duration will generally affect the use of project resources, including project costs or labor, the need for a pattern of labor control if the project is delayed or accelerated. Project delays can be overcome by the Crashing Method which will affect various cost alternatives resulting from crashing. This study aims to understand that the delay in the construction project schedule will have an impact on the new schedule and the impact of costs that occur due to the acceleration carried out so that the project life is in accordance with the plan. Furthermore, it was analyzed for the need for additional workforce groups or only to maintain the addition of overtime.

The results of this study are expected to provide an alternative solution to the project schedule that is delay by planning a new schedule of the remaining duration of each activity and financing alternatives that occur, so that construction service providers can make decisions about their performance. This research was carried out with descriptive analytic method, that is research that would explain the conditions in the field in detail about project schedule delays by analyzing the amount of escalation of labor costs due to the acceleration of the duration of each activity so that the project schedule returned to the plan age.
The data used is secondary data including project scheduling data and cost budget plan data. Primary data is done to get about the factors that cause project delays. The research was carried out on the railway bridge construction project in Cilegeh Kadongkangabus with a project plan age of 80 (eighty) calendar days.

2. Construction project scheduling
Project scheduling is one of the elements of planning results that can provide information about the plan schedule and project progress in terms of the performance of resources in the form of costs, labor, equipment and materials as well as the planned time to complete the project. Scheduling is the allocation of available time by carrying out each job to complete a project so that optimal results are achieved by considering the limitations that exist. The monitoring and updating process is always carried out to get the most realistic scheduling so that the allocation of resources and determination is in accordance with the goals and objectives of the project.

2.1. Construction project scheduling method
Project scheduling is one of the elements of planning results that can provide information about the plan schedule and project progress in terms of the performance of resources in the form of costs, labor, equipment and materials as well as the planned time to complete the project. Scheduling is the allocation of available time by carrying out each job to complete a project so that optimal results are achieved by considering the limitations that exist. The monitoring and updating process is always done to get the most realistic scheduling so that the allocation of resources and determination is in accordance with the goals and objectives of the project.

A very diverse project scheduling method that is often used in the field is bar chart along with S curves and network diagrams. The scheduling method is made to achieve high effectiveness and efficiency from the resources used during the construction project. Components used for planning productivity time and costs are labor, materials and equipment.

Bar chart is a set of activities that are placed in a vertical column, while time is placed in horizontal rows [1]. Estimated start and finish times can be determined from the horizontal time scale at the top of the chart.

The S curve is a graph made with the vertical axis as the cumulative value of costs or the progress of activities and the horizontal axis as time [2]. The S curve can show the ability of the project based on the activity, time and weight of the work represented as the cumulative percentage of all project activities. S curve visualization provides information about the progress of the project by comparing the plan schedule. Critical Path Method (CPM) is a scheduling technique that consists of critical paths and non-critical paths in a series of work items. Critical lane is a path that consists of activities that if late will result in delays in the completion of the overall project.

One method of implementing project control and schedules is known as the earned value method. This concept is a concept of calculating the cost of the budget in accordance with the budget that has been completed. The concept of results value combines work costs, schedules and progress. This concept measures the amount of work completed at a time and assesses the amount of budget provided for the work. This method presents three dimensions, namely Budget Cost of Work Scheduled (BCWS), namely the costs allocated based on a time-compiled work plan, Budgeted Cost of Work Performed (BCWP), namely the value received from the completion of the work for a certain period of time, and Actual Cost of Work Performed (ACWP) which is the actual amount of work that has been carried out. Of these three dimensions, the concept of yield value can be linked between cost performance and time derived from the calculation of cost and time variants [1].

2.2. Crashing program
The purpose of acceleration is to shorten the schedule for completing activities or projects with a minimal increase in costs.

CPM uses an estimate number for the time period of each activity with the use of resources at a normal level. The process of speeding up the time period is called Crashing Program. In analyzing process are assumptions that:
• The amount of available resources is not an obstacle. This means that in analyzing project acceleration, the alternative to be chosen is not limited by the availability of resources.

• If the time for completion of the activity is faster with the same environment, then the resource requirements will increase. This resource can be in the form of labor, material, equipment or other forms stated in a number of funds.

CPM assumes that the project life can be shortened by the addition of labor resources, equipment, capital for certain activities. If there are no other provisions, then the implementation time of the activity is considered to be in normal conditions. The execution time in normal conditions is called (Tn). The cost of carrying out an activity under normal conditions is called the normal cost (Cn). Additional labor or overtime can reduce normal time. The addition of labor means additional costs.

Normal time (Tn) is usually the longest time for an activity while the normal cost is the cheapest. If all resources owned by the company are deployed, so that an activity can be completed as quickly as possible, the activity is said to be Crashing. Crashing conditions are not only related to the fastest time, but also to the biggest cost. In the Crashing condition, the time for the implementation of activities is Tc, and for the costs is Cc.

3. Case analysis
The research was carried out on the railway bridge construction project in Cilegah Kadongkangabus with a project plan life of 80 (eighty) calendar days.

Observations in the fifth week there were delays in some of the critical paths that were not implemented, this was due to the late delivery of material which had the effect of not carrying out activities and influencing other activities. The first week until the fifth week is only carried out activities that are not affected by delays in the delivery of materials.

• Project Duration : 80 days
• Direct Costs (BAC) : IDR 5,313,149,392
• Indirect Costs : IDR 5,122,000 / day
• Total Project Costs : IDR 5,722,909,392

Based on the bar chart in the attachment of the fifth week, weekly progress analysis project plans, realization, and deviations are 25.88%, 2.368%, and 23.512%.

In the fifth week, project performance analysis of time and cost are:

• BCWS = Cumulative Plan Weight x Total Plan Cost
  = 25.88% x IDR 5,313,149,392
  = IDR 1,375,043,063

• BCWP = Cumulative Actual Weight x Total Plan Cost
  = 2.368% x IDR 5,313,149,392
  = IDR 125,823,830

• ACWP = IDR 130,044,000

• CPI = BCWP / ACWP
  = IDR 125,823,830 / IDR 130,044,000
  = 0.968 < 1, then the project expends larger than project acceptance up to the fifth week

• SPI = BCWP / BCWS
  = IDR 125,823,830 / IDR 1,375,043,063
  = 0.092 < 1
  the project delays from the plan schedule
With bar chart and S curve in the attachment it can also be known that the project has been delayed, but cannot show the effect of real acceptance (ACWP) with work progress revenue (BCWP), with the CPI and SPI values, then this railway project to schedule plans will experience delays and the project has experienced a cost deficit due to real spending greater than its revenue.

Project Cost Analysis that will occur:

- The estimated to complete is the remaining estimated work costs.
  
  \[ \text{ETC} = \frac{(\text{BAC} - \text{BCWP})}{\text{CPI}} \]
  
  = IDR. 5,361,310,044

- Estimate All Cost (EAC)
  
  \[ \text{EAC} = \text{ACWP} + \text{ETC} \]
  
  = IDR 5,491,354,044

Project Schedule Analysis that will occur:

- Estimate Temporary Schedule (ETS)
  
  The ETS value is the remaining duration of the project estimate due to delays if no treatment is carried out on the project.
  
  \[ \text{ETS} = \frac{\text{SAC}}{\text{SPI}} \]
  
  \[ \text{SAC} = 80 \text{ days} - 35 \text{ days that have been done} \]
  
  = 45 days
  
  \[ \text{ETS} = \frac{45}{0.092} \]
  
  = 492 days

- Estimate of All Schedule (EAS)
  
  The EAS value is the estimated duration of the entire project due to delays if no treatment is carried out on the project.
  
  \[ \text{EAS} = 35 \text{ Days} + 492 \text{ Days} \]
  
  = 527 days

Total Cost:

\[ \text{Total Cost} = \text{Direct Cost} + \text{Indirect Cost} \]

\[ = \text{IDR 5,491,354,044} + \text{IDR 5,122,0000 x 492} \]

\[ = \text{IDR 8,011,378,044} \]

It is necessary to reschedule and accelerate the age of the project so that the project can be completed on schedule.

The project's new schedule is based on the logic of the relationship between the work consulted with the Construction Service Provider and Construction Service User. New Schedule uses Critical Path Method (CPM), the duration of each activity used is the remaining duration with the project life being 108 days, 28 days longer than the plan.

- Total Cost = Direct Cost + Indirect Cost
  
  \[ = \text{IDR 5,201,261,992} + \text{IDR 5,122,0000 x (108-35)} \]
  
  \[ = \text{IDR 5,575,167,992} \]
The duration acceleration is done to reach the project age according to the 80 days plan analyzed its effect on the occurrence of overtime duration on each activity. The duration acceleration with the project age of 88 days is the maximum age that occurs if only using overtime work is 3 hours/day. In this process all work overtime duration is smaller than the duration of the acceleration.

Acceleration costs are costs obtained from the calculation of overtime labor costs and the addition of team work. The price of the material does not change or equals the calculation price of the contractor. Pay overtime costs according to the Minister of Labor No. KEP. 102/MEN/VI/2004 clausal 11, namely for the first overtime hours to be paid a labor of 1.5 times an hour’s labor cost and for every hour of overtime must be paid 2 times.

At the age of 88 days the project is the limit where all work group schedules have overtime only, where overtime is smaller than the duration of the acceleration so without the need for additional work groups. The amount of overtime and labor at the acceleration duration of the 88-days project period is IDR 634,147,861.

If the project schedule is 80 days according to the age of the plan, 13 jobs with the addition of 1 work group and 7 groups of work with overtime duration, 2 occupational groups have the same duration as the initial duration and 1 job is a lump sum. The total labor for 80 days is the labor cost for 7 occupational groups that have overtime pay and 13 groups with the addition of labor groups, and 2 occupational groups with a fixed duration of IDR 970,439,656.

Provisions regarding penalties delay in the procurement of goods or services are very much taken into account in this study. Fines will apply if project has experienced a delay in the duration of the plan. The amount of the penalty that must be paid by the contractor is 1/1000 of the contract value.

Construction service providers have 3 alternative solutions to project delays that affect the costs incurred. At the age of 108 days, at the time of the initial schedule, the costs and penalties amounted to IDR 5,315,224,035. At the age of 88 days, the additional project costs and fines amount to IDR 5,038,938,255. If you maintain the 80-day project life, the project cost will be IDR 5,329,446,775. From the three alternatives, the lowest cost is to complete the 88-day project period.

4. Conclusion
From the evaluation process and the acceleration carried out after rescheduling and the impact on costs can be concluded as follows:

- The age of the project is re-schedule using the remaining duration and method of implementation and work groups based on 108 days.
- If only the additional working hours are added, the project life will be 88 days.
- The costs and penalties that occur on the 108-days schedule is IDR 5,315,224,034.72.
- The costs and penalties that occur on the 88-days schedule that is by adding overtime hours is IDR 5,038,938,255.
- Costs without penalties that occur on an 80-days plan schedule is IDR 5,329,446,775.

References
[1] I Widiasanti and L Lenggogeni 2013 Construction Management (Bandung: Remaja Rosdakarya)
[2] I. Soeharto 1998 Project Management: From Conceptual to Operational (Jakarta: Erlangga)