Controlling Schedule of Fiber to the Home (FTTH) Project Using Critical Path and Crashing Method

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Abstract

This research is about the project of FTTH in Bandung, West Java. One of The FTTH projects that located in Padalarang, West Java has been identified that the project was delayed by 7.8% on day 11th. This delay happened because there's some lack of managerial project in implementation, controlling, and monitoring project work during the execution.
The aim of this research is to monitor and control the project by analyzing actual project performance using Earn Value Method (EVM) approach. The compression schedule is performed using Crashing Program on the activities that are critical, which has been identified before through Critical Path Method (CPM).
The result of this research is to make the project will be completed in 23 days, the same amount of days according to the initial target planning even though on the 11th day the project is delayed. It is found that the activity of cable distribution could be accelerated from 4 days to 2 days by adding 4 workers and the cost slope is Rp465.224. While on the activity of installation ODP and Splitter could be accelerated from 3 days into 2 days with cost slope of Rp332.533 and the amount of additional work required is 1 person who is an expert technician/jointer.

Keywords
FTTH, EVM, CPM, and Crashing Program

1. Introduction

A company that works in the field of telecommunications often provides a variety of communication services that must be supported by the speed of fast internet access in order to meet the customer needs. Nowadays, fast internet access could be done using fiber optic network as the transmission medium. Based on this condition, FTTH project was initiated to expand the fiber optic network cable to whole Indonesia. FTTH (Fiber to the Home) is fiber optic network is distributed to the customer's home using fiber optic cable as its transmission media (Fitriyani, 2015). Distribution of fiber optic cable is intended for users to have fast internet access network and have digital data service with big bandwidth capacity and very low interferences.

One of the FTTH project work was located in Bandung. It was found that the completed progress up to the day 11th was 37,31% while the project should have reached 45,11%. This indicated a delay on the schedule in project execution. To avoid project delays, continuous monitoring and controlling are required throughout the project execution (Ibrahim & Kaka, 2008).

Based on the obtained data of the this FTTH Project, project monitoring and controlling was performed by analyzing actual project performance. This performance analysis could be done by using Earn Value Method (EVM) approach. EVM is a control method used to control the cost and time of project work in an integrated manner (Dewi, et. al, 2015). The EVM method was used to measure the amount value of completed job at a time by comparing it to the amount of budget provided for the job (Witjaksana & Reresi, (2012). After the delay has been identified, Crashing Program was used to accelerate project duration in order to avoid delay by reducing the duration of the activities that

are affecting the project completion time, which were activities on the critical path (Saputra, 2017). The critical path is the sequence of activities that represent the longest path through the project, by determining the shortest project duration (Project Management Institute, 2017). To know the critical path of the project, can use Critical Path Method (CPM). The purpose of this research is to know the schedule performance during the project and to know the estimated total time to complete the project based on estimation through CPM and Crashing method approach. This research was done to assist the project manager in making decisions as one of the considerations.

2. Basic Theory

2.1 Project Management

Management is the process of planning, organizing, leading, and controlling the activities of members and resources available to achieve the goals of the organization (company) that has been determined. While project management is the process of planning, organizing, leading, and controlling resources of the company to achieve short-term goals that have been determined, and using a system approach and hierarchy (flow of activities) vertical and horizontal (Kezner, 1982).

2.2 Project Schedule Management

Scheduling is an activity to determine time required for the construction of a project along with a sequence of activities that describes when the project can be completed (Wulfram, 2004). Scheduling is the process of analyzing the sequence of activities, durations, resource requirements, and schedule constraints to create a project schedule model. Project scheduling will provide detailed plans that illustrate how and when the project will produce products, services, or outcomes that are defined within the scope of the project. The main benefit of this process is that by incorporating an activity schedule, timeframe, resources, resource availability, and logical connections to the scheduling tool, it will produce a schedule model with the planned dates to complete the project activities (Project Management Institute, 2017).

2.3 Control Schedule

Control Schedule is the process of monitoring the project status to update the project schedule and manage changes to the baseline schedule (Project Management Institute, 2011). The main benefit of this process is that the baseline schedule will be maintained along with the project (Project Management Institute, 2017). Fig. 1 shows the inputs, tools and technique, and outputs of the control schedule.

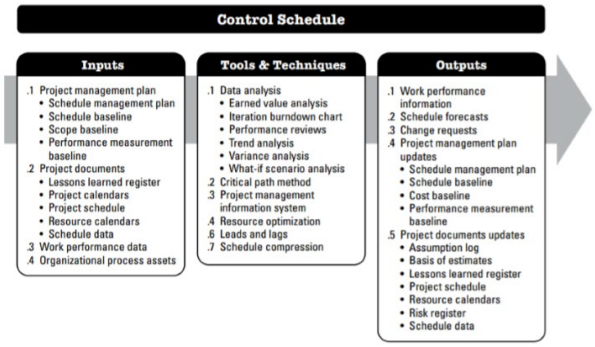

Figure 1. Control Schedule Data Flow. (Source: PMBOK 2017)

2.4 Earned Value Method

Earned value analysis is a method used for measuring project performance values by integrating scope baseline with cost baseline along with schedule baseline. Earned Value Analysis develops and monitor three key dimensions for

every work package and account control, they are: planned value, earned value, actual cost. Variance analysis is used to review the differences or variance between planned performance and actual performance. Variance analysis includes estimation of duration, cost, resource utilization, resource rates, technical performance, and other metrics. Variance analysis can be done by comparing the cost planning budget with actual cost expenditure to identify the differences between cost baseline and actual performance project.

2.5 Critical Path Method

Critical Path Method (CPM) is a method used to determine critical path. CPM is presented in the form of a network diagram which represented by nodes that show the relationships and dependencies of the project activities (Satyanegara, 2017). CPM is for projects that are made up of a number of individual "activities." If some of the activities require other activities to finish before they can start, then the project becomes a complex web of activities (Göksu and Ćatović, 2014). In each activity node, there are information of five parameters that are used to determine the critical path such as the duration of project activity, earliest start, earliest finish, latest start, latest finish, and slack time of the activity (Zareei, 2016).

2.6 Crashing Method

Schedule Compression is used to shorten or accelerate the schedule duration without reducing the project scope in order to meet schedule constraints, specified dates, or other schedule objectives. One of the ways to do a schedule compressing is to use crashing program.

Crashing is a technique used to accelerate the duration of the schedule by incurring the least additional cost because it adds the amount of the resources. Examples of such crashing include approving overtime, bringing in additional resources, or paying more to expedite delivery to activities on the critical path. Crashing can only be used for activities on the critical path where additional resources will accelerate the activity duration. Crashing doesn't not always produce a viable alternative and may result in increased risk and/or cost.

3. Research Model

Research model is framework of work that illustrates relationship or linkages between variables that are used in this research in order to solve the problem systematically. Fig. 2 shows the research model of the control schedule that contained in the project schedule management that used in this FTTH Project research.

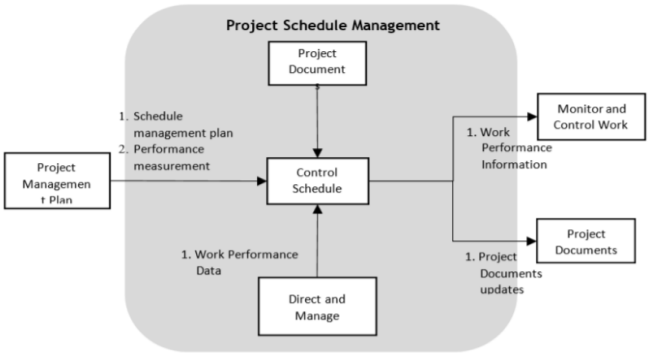

Figure 2. Research Model

The research model on Fig.2 shows some process needed to do control schedule, called Direct and Manage Project Work. And the inputs needed to do control schedule are Project Management Plan and Project Documents. On control schedule, the first tools and technique used on this research is by performing data analysis using Earned Value Analysis (EVA) and Variance Analysis. The results of the analysis can be used to determine the project deviations that occur. With such deviation, Critical Path Method (CPM) is used as tool and technique to find the critical path of the project using network diagram. From the critical path and the calculation of deviations that have been obtained before,

schedule compression is used as the tool and technique to do control schedule. Schedule compression is used to restore the lagging of project progress according to schedule planning. On this research, schedule compression is done by using crashing method. The final result of control schedule is work performance information and project documents updates as the output. Work Performance Information provides performance information to support decision making. And project documents contain updates about the project schedule that has been updated after schedule compression.

4. Result & Discussion

4.1 Statement of Work (SOW)

The Statement of Work (SOW) is a narrative description of a result delivered by the project. Table 1 shows the SOW of the FTTH project used in this research.

Table 1. Statement of Work

Statement of Work (SOW)		
Company background	XYZ Company is a company that works in construction development field and manages infrastructure network services. One of XYZ Company efforts to meet the customer needs is by expanding the fiber optic network all over Indonesia through FTTH projects.	
Project description	This FTTH project will distribute FO cable until it connects directly to customer's device at their home.	
Project location	This project is located in Padalarang, West Bandung - Indonesia	
Project start date	April 16th 2018	
Project end date	May 8th 2018	
Budget plan	Material cost	Rp48,974,000
	Operational cost	Rp10,840,000
	Total cos	Rp59,814,000

4.2 Work Breakdown Structure (WBS) & WBS Dictionary

Work Breakdown Structure (WBS) is a decomposition/ description of scope work that will be done to achieve the project objectives with the expected results as the output. Fig. 3 shows the WBS of this FTTH Project on this research.

In order to understand the existing charts in the WBS, a WBS Dictionary is required. The WBS Dictionary is a document that provides detailed information about each of the components in the WBS such as list of the activities and the job description.

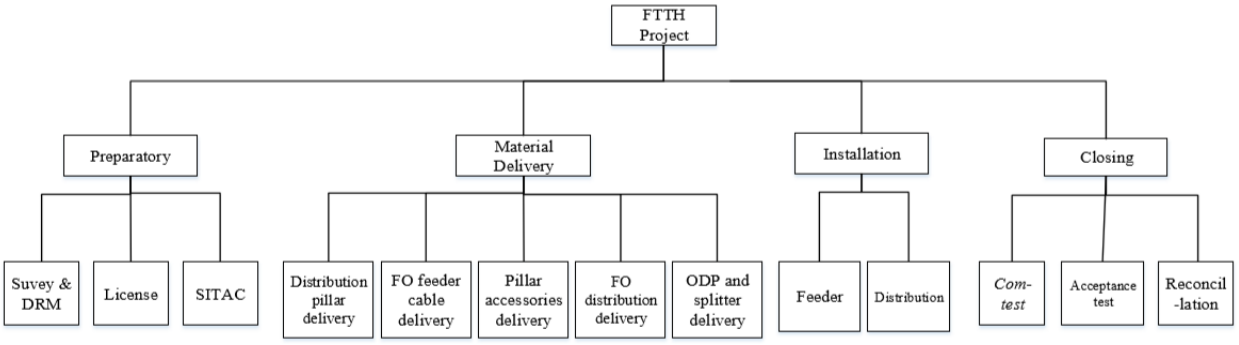

Figure 3. Work Breakdown Structure

4.3 Value and Variance Analysis

Earned value analysis is a method that can be used to measure the value of project performance. Variance analysis can be used to see the differences/variance between planned performance and actual performance (Project Management Institute, 2017). The differences between performance can be presented in the form of the S curve. Fig. 4 shows the S curve of the progress planning and also the progress of the actual project work up to the 11th day of this FTTH project. This S curve could be used to review the performance completion project based on earned value and planned value project.

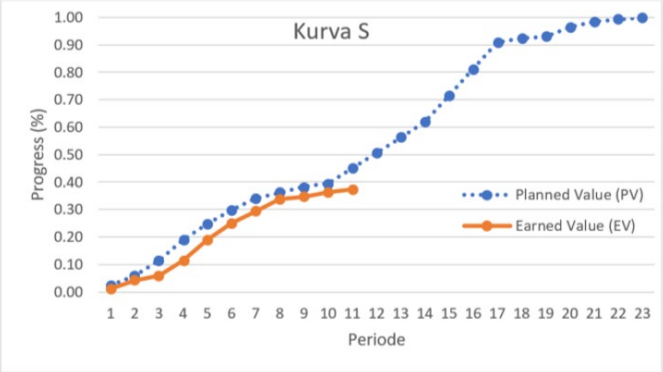

Figure 4. S curve

4.4 Critical Path Method (CPM)

In this FTTH project, there are several activities, such as preparatory work, material delivery, Installation including feeder and distribution, and closing work.

Based on the calculation of the critical path method, there are some activities that are included in the critical path. Activities on the critical path are activities that must be considered the most because the delay on these activities on the critical path will affect a delay in overall project completion.

4.5 Crashing Program

The use of crashing method can be done to accelerate the completion of project work by adding the additional human resources/resource needed on the critical path. By Using crashing method to accelerate project time will increase the expenditure of direct cost on activities that are on the critical path (Project Management Institute, 2011). To Determine the critical path can be done by using Critical Path Method (CPM).

Based on the calculation using CPM, there are some activities that are included in the path critical. After updating the progress work result up to day 11th, obtained that the remaining activities on the critical path that could be reduced its duration are activity of pulling out the distribution cable and activity of ODP and Splitter installation

4.5.1 Crashing on Activity of Pulling Out Distribution Cable

Known from the obtained data that the activity of pulling out distribution cable along 997 meters will be done for 4 days with the amount of resource needed is a team of 4 people with a service wages to complete of Rp3,721,801. So, it can be assumed that every single worker has a productivity of 25% of pulling out cable activity. To know the crash cost of the activity, previously required a calculation of daily productivity before and after crashing and also the calculation of completion time before and after the crash (Saputra, 2017) (Stefanus, 2017).

Normal daily productivity is calculated by dividing the value of the activity weights that have been obtained before with the amount of completion time planning. After that, the calculation of daily productivity after crash needed to be done to calculate the acceleration duration on the pulling out distribution cable activity.

Table 2 shows the result of normal daily productivity, daily productivity after crash, completion time, wages/day, crash cost/person, crash cost, and cost slope for crashing on pulling out distribution cable activity.

Table 2. Crashing on Pulling Out Distribution Cable

Item Calculated	Calculation Result
Normal daily productivity	0.0560
Daily productivity after crash	0.1121
Completion time	2 days
Wages/day	Rp930,450
Crash cost/person	Rp232,611
Crash cost	Rp4,652,249
Cost slope	Rp465,225

4.5.2 Crashing on Activity of ODP and Splitter Installation

Known from the obtained data that the activity of ODP and splitter installation as many as 13 units will be completed for 3 days with the amount of resource needed is a team of 2 people with a service wages to complete of Rp1,995,201. So, it can be assumed that every worker has a productivity of 50% of ODP and splitter installation activity.

Normal daily productivity is calculated by dividing the value of the activity weights that have been obtained before with the amount of completion time planning. After that, the calculation of daily productivity after crash needed to be done to calculate the acceleration duration on the ODP and splitter installation activity.

Table 3 shows the result of normal daily productivity, daily productivity after crash, completion time, wages/day, crash cost/person, crash cost, and cost slope for crashing on ODP and splitter installation activity.

Table 3. Crashing on ODP and splitter installation activity

Item Calculated	Calculation Result
Normal daily productivity	0.0970
Daily productivity after crash	0.1456
Completion time	2 days
Wages/day	Rp665,067
Crash cost/person	Rp332,553
Crash cost	Rp2,327,734
Cost slope	Rp332,534

5. Conclusion

Acceleration of project schedule that are conducted on this FTTH project is done by using crashing method. Schedule compression is performed on monitoring and controlling phase by comparing the progress of actual implementation project with progress planning project. From the comparison, it could be identified that the project experienced a delay of 7.8% from planning at the day 11th.

To avoid delay in project completion time, acceleration schedule is performed using crashing method on the remaining activities on critical path. Obtained that the pulling out distribution cable activity can be accelerated to 2 days with cost slope in the amount of Rp465,225. While the duration of ODP and splitter installation activity can be accelerated from 3 days to 2 days with cost slope equal to Rp332,534.

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