Analysis of Project Cost Management Indicators at Residential Buildings (Case Study: Building Construction Project in Rusun Penggilingan Jakarta)

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Abstract. Indonesia's economic growth is growing along with the growth of the construction industry against increasing construction projects. The performance of a construction project requires serious management to achieve maximum results. Delays occur, quality is not in accordance with contract specifications, and costs that sometimes occur overbudget. Some studies show that the dominant factors causing overbudget in construction projects consist of: cost estimation factors, performance management factors, resource mobilization factors, control factors of timing performance, incomplete project information data, increasing material prices, and financial policies from government. In overcoming these dominant factors, project cost management is needed. Construction projects can be managed with project cost management. Project cost management includes the stages of planning, scheduling and controlling which are important steps to be taken to achieve the objective of project performance. Project cost management involves cost budgeting and cost control. Cost budgeting aims to generate a cost baseline to ensure project performance and project needs. A cost baseline is a time step from the budget used by the project manager to ensure and monitor costs. Cost control is used to monitor costs based on the cost baseline.

Project control systems can be seen through project performance. Project performance can be done by comparing cost performance over time. Costs from the time period can be analyzed by variance analysis. Variance analysis involves actual project performance with planned performance. Value technique is used to analyze trend whether a performance is improving or deteriorating by comparing planned performance with actual performance. EVA (earned value analysis) is one of method using for project control. EVA method can be used to measure project performance which applied as a tool to integrate between cost and time aspect.

1. Introduction

An industry of construction is an industry that continues to grow along with economic growth in an area. This condition can be seen from the growing number of high-rise buildings in major cities for offices, education, shopping centers, hospitals, hotels, apartments, residences and others that tend towards vertical buildings. This project includes a project with a fairly high complexity, because it is one of the DKI Jakarta Regional Government projects that are prioritized to be completed by the end of 2017 as compensation for the policies of the regional government of DKI Jakarta in curbing illegal settlements built on land owned by the Regional Government of DKI Jakarta. Construction of high-rise buildings is usually a large project that requires project management. Complex problems during project work lead to many projects that are not completed with initial planning. Delays occur, quality is not in accordance with

contract specifications, and costs that sometimes occur overbudget [1], [2], [3] . Some studies show that the dominant factors causing overbudget in construction projects consist of cost estimation factors, performance management factors, resource mobilization factors, time control performance factors, incomplete project information data, material price increases, and government financial policies. In overcoming these dominant factors, project cost management is needed [4], [5]. Project cost management includes the processes involved in estimating cost budgeting and cost control. Cost budgeting is a process for making cost allocations for each activity from the overall costs that arise in the estimation process. From this process, the baseline cost is used to assess project performance [6]. Cost baseline is used as a benchmark for controlling project costs. Project cost control is one of the most important management that contributes to the success of the project. Excessive costs often occur in almost all construction projects. Cost control must be measured continuously to avoid irregularities that occur in the planning stage. Significant cost and time deviations indicate poor project management. Cost control is expected to help project performance to be in accordance with the planned time [7], [8] .

To find out the performance of the project in a period, we can forecast the achievements of the project against the earned value analysis [9], [10], [11], [12], [13]. The earned value method is a method to calculate the amount of costs according to the budget in accordance with the work that has been completed or implemented. This method can also be used to detect as early as possible in the event of cost overruns or delays that might occur in project performance, so that the parties involved in this project can overcome obstacles that can affect the course of project activities.

This research aims to find out indicator of cost budgeting, cost control and analysis of project cost management with EVA method on Building Construction Project in Rusun Penggilingan Jakarta.

2. Research Method

Analysis cost budgeting of project construction includes direct cost, indirect cost and tax cost. Analysis of cost control is performed to detect whether the actual cost of project performance is approriate with cost planning. The costs of project construction need to be grouped in EVA method.

EVA integrates between budget performance, schedule, and project activities as indicator of progress [14], [15] . This method also provides information of project performance status in a reporting period and provides required estimated cost and time to complete all project works.

The EVA method is also able to find out about the occurrence of project delays from the planned schedule against the actual schedule with the result that the project can be completed as expected [16], [17].

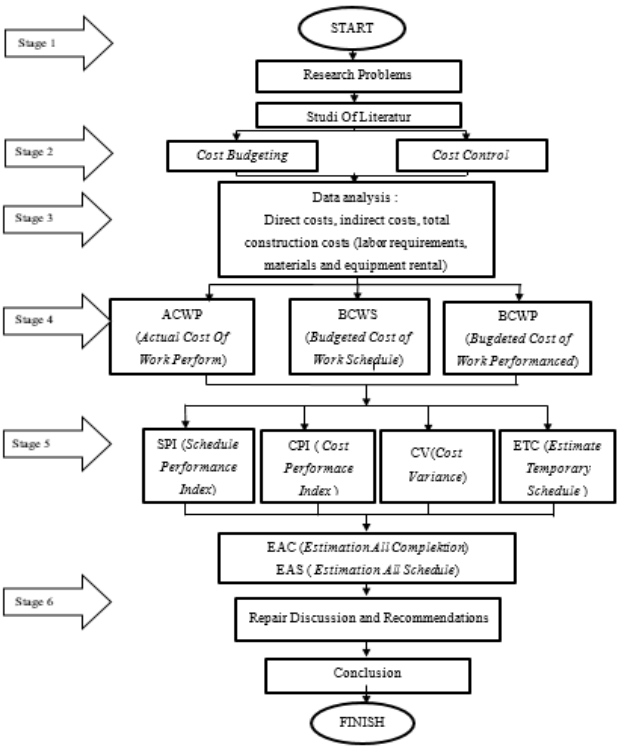
The following are EVA analysis indicators:

a. Actual Cost (AC) or Actual Cost of Work Perfomed (ACWP) is the actual amount of expenditure of funds (absorbed funds) used to carry out work in a certain period of time.
b. Earned Value = EV or Budgeted Cost of Work Performed (BCWP) is the value of completed work on the budget provided to carry out the work.
c. Budget Schedule (Planned Value = PV) or Budgeted Cost of Work Schedule (BCWS) shows the budget for a work package that is compiled and linked to the performance schedule.
d. Cost Variance (CV) = EV - AC or CV = BCWP - ACWP
e. Variant Schedule / Schedule Variance (SV) = EV - PV or SV = BCWP - BCWS
f. Cost Performance Index (CPI) = EV / AC or CPI = BCWP / ACWP

g. Schedule Performance Index (SPI) = EV / PV or SPI = BCWP / BCWS
h. Estimate Temporary Complete (ETC) = BAC-BCWP / CPI
i. Estimation All Completion (EAC) = ACWP + ETC
j. Estimation Temporary Schedule (ETS) = Time Remaining / SPI
k. Estimation All Schedule (EAS) = Finish Time + ETS

Estimation analysis of project completion consists of two cost estimates, namely Estimate at Completion (EAC) and Estimate Time To Complete (ETC). EAC is used to find out the final cost, while ETC is used to find out the end time of the project.

The following is the research stages presented in Figure 1.1:



3. Analysis and discussion

3.1. Cost Budgeting Analysis

The method of cost allocation that is carried out includes direct costs, indirect costs and tax costs. This direct costs include the costs incurred for the materials, labor, equipment and subcontractor's services for the performance of the project in accordance with the plan and specifications within the scope of work. The subcontractor's work is a work package consisting of services and materials provided by subcontractors. The following is the calculation of direct costs in the 60th week, with the cost of preparatory work amounting to IDR 12,592,214,539, the cost of lower structural work amounting to IDR 5,213,191,385, the cost of structural work amounting to IDR 17,023,383,565, the cost of architectural work amounting to IDR 39,881,654,873, the cost of MEP (Mechanical Electrical Plumbing) amounting to IDR 41,359,465,126, the cost of utility building work amounting to IDR 2,650,650,650, the cost of site development amounting to IDR 1,039,925,277, the cost of connection fees amounting to IDR 3,844,611,792, the cost of material amounting to IDR 9,942,204,781 and the cost of rental equipment amounting to IDR 95,110,333. Thus, the total direct costs from 1st week until 60th week are amounting to IDR 133,572,512,000 (rounding amount).

Meanwhile, the calculation of indirect costs and total construction costs can be calculated by summing the direct costs and indirect costs of the project. The calculation of indirect costs consist of the cost of employee amounting to IDR 4,668,234,778, the cost of project rental vehicles amounting to IDR 697,200,000, the cost office administration amounting to IDR 90,500,000, the cost of office equipments amounting to IDR 543,962,531, the cost of project contract arrangement amounting to IDR 132,805,358, the cost of term of payment arrangement amounting to IDR 23,213,900. Thus, the total indirect costs are amounting to IDR 6,155,917,000. Indirect costs are called overhead costs which consist of field overhead cost and office overhead cost. Thus, the total project costs can be calculated with summing the direct cost and indirect cost with the result amounting to IDR 139,728,429,000. The tax cost is calculated as 10% of the total construction costs with the result amounting to IDR 13,972,842,900.

3.2. Cost Control Analysis

Cost control is performed to detect whether the actual cost of project performance is appropriate with project planning. Project construction costs need to be grouped in the EVA method. The cost of project performance in the 60th week, 14th month can be calculated as follows:

BAC (Budget at Completion) = IDR 147,643,580,000; BCWS (Budgeted Cost of Work Scheduled) = IDR 135,373,180,000; BCWP (Budgeted Cost of Work Performed) = IDR 135,452,320,000; ACWP (Actual Cost of Work Performed) = IDR 136,144,560,000.

Cost variance (CV) and schedule variance (SV) are calculated as follows:

CV = BCWP - ACWP

CV = IDR 135,452,320,000 - IDR 136,144,560,000

CV = - IDR 692,240,000

SV is calculated from the difference between BCWP and BCWS

SV = BCWP - BCWS

SV = IDR135,452,320,000 - IDR135,373,180,000

SV = IDR 79,140,000

The CV result indicates cost overrun, while the SV result indicates the project occurred ahead schedule.

The cost performance index can be calculated as follows:

CPI = BCWP/ACWP

CPI = IDR 135,452,320,000 / IDR 136,144,560,000

CPI = 0.9949 <1

The CPI result < 1 means that the costs incurred are greater than the budget cost

The schedule performance index (SPI) can be calculated as follows:

SPI = BCWP/BCWS

SPI = IDR 135,452,320,000 / IDR 135,373,180,000

SPI = 1,001> 1

The SPI result > 1 means that the timing of project performance are faster than the schedule (ahead schedule).

The estimation temporary cost (ETC) is calculated using the formula as follows:

ETC = (BAC-BCWP) / CPI

$$ETC = \frac{(IDR\ 147,643,580,000 - 135,452,320,000)}{0.9949}$$

ETC = IDR 12,253,375,415

The estimation all completion (EAC) is calculated using the formula as follows:

EAC = ACWP + ETC
EAC = IDR 136,144,560,000 + IDR 12,253,375,415
EAC = IDR148,397,935,000
Based on the calculation, the EAC result is above the BAC. It indicates that the estimation project costs at completion exceed the budgeted project cost. Then, schedule aspect can be calculated using the formula as follows:
Budget Deviation = BAC - EAC
= IDR 147,643,580,000 – IDR 148,397,935,000
= - IDR 754,355,000
The estimation temporary schedule (ETS) to complete the project can be calculated using the formula as follows:
ETS = (The period of construction – The remaining period of construction) / SPI
ETS = (434 days - 14 days) / 1,001
ETS = 415.84 days
ETS = 416 days
The estimation all schedule (EAS) is calculated as follows:
EAS = The remaining period of construction + ETS
EAS = 14 days + 416 days
EAS = 430 days
The EAS is 430 days, which means the project has accelerated for 4 days from the planned schedule of 434 days.

3.3. Analysis of project cost management with EVA Method
The result of cost control analysis consists of BCWP, BCWS, and ACWP, can be observed in the following figure 1.2:

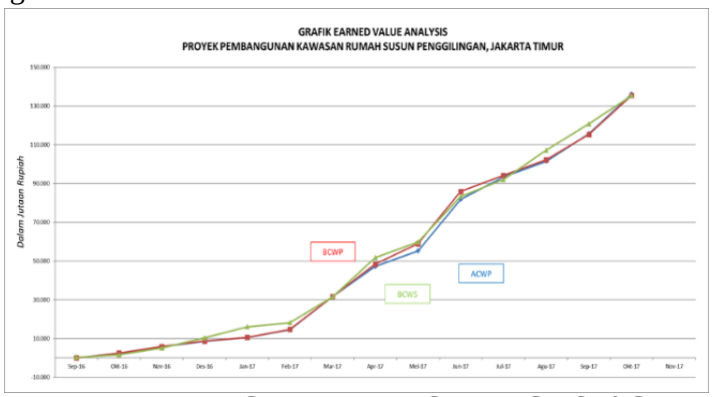


Figure 1.2. Comparison BCWP, BCWS, ACWP

Figure 1.2 shows that the BCWP chart is mostly coincide with the BCWS chart and at the end both graphs are meeting each other. This chart shows that the BCWP value is always getting near to the BCWS value due to some unfinished project works based on time schedule.
The value of EAS shows that the evaluation in the 60th week, project was performed in accordance with initial plan of the project and the project has been completed during 430 days. EVA can be used to control project performance thus the early action can be performed when the project is not accordance with the project planning.

4. Conclusion and Reccomendation

The indicator of cost budgeting analysis consists of direct costs amounting to IDR 133,572,512,000, indirect cost amounting to IDR 6,155,917,000 and tax cost amounting to IDR

13,972,842,900.The indicator of cost control analysis concludes that the BCWP value is always getting near to the BCWS value due to some unfinished project works based on time schedule. The CV result indicates cost overrun, while the SV result indicates the project occurred ahead schedule. This research also find out that the EAC result is above the BAC. It indicates that the estimation project costs at completion exceed the budgeted project cost. Other than that, The value of EAS shows that the evaluation in the 60th week, project was performed in accordance with initial plan of the project and the project has been completed during 430 days.
EVA can be used to control project performance thus the early action can be performed when the project is not accordance with the project planning.
This research suggest for project owners to do properly calculation of cost budget including calculation of the duration of project in accordance with planning. This research also suggest for contractors to arrange an evaluation when issue occurs in project field including availability of equipments, materials and manpowers.

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