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Analysis of Construction Project Cost and Time Using the Earned Value Method

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Abstract:

This study aims to analyze the cost and time performance of the renovation project of Arwana Restaurant The Laguna Resort and Spa Nusa Dua by applying the Earned Value method. The data used in this study include the Cost Budget Plan (RAB), project implementation schedule, weekly project progress reports, and project expenditure reports. The calculation is done by calculating the value of ACWP (Actual Cost of Work Performed), BCWS (Budgeted Cost of Work Schedule), BCWP (Budgeted Cost of Work Performed), CV (Cost Variance), SV (Schedule Variance), CPI (Cost Performance Index), SPI (Schedule Performance Index), ETC (Estimate to Complete), ETS (Estimate Time to Complete), EAC (Estimate at Completion), and EAS (Estimate at Schedule). The results of the analysis show that at the beginning of the project the performance was good, but other things began to decline from the 11th week to the 23rd week. At the end of the project, performance improved again as indicated by a CPI value of 1.07 and an SPI of 1 indicating lower costs and time according to plan. The estimated total final project cost (EAC) of Rp2,947,878,984.57 was lower than the Cost Budget Plan (RAB) of Rp3,143,852,000, resulting in a profit of Rp195,973,015.43. The estimated total final project time (EAS) was in accordance with the planned schedule, which was 27 weeks. In conclusion, overall the project performance was quite good even though it had declined in the middle of the project implementation.

Keywords: earned value, cost performance, time performance, construction projects

1. Introduction

Construction projects are activities that have been planned to be completed within a certain time with a certain cost allocation [1]. The development of the construction industry in Indonesia has continued to increase in recent years. This is supported by the attention government, growth strong economy, and investment large infrastructure. This condition is estimated will Keep going to be continued remember Still Lots opportunity for developer construction in Indonesia. In the implementation project construction often happen deviation from plan Good from side time and also cost.

This is due to Because existence change design from owner projects and changes in working methods from contractor implementer. As a result, often happen delay settlement projects and additions cost from plan early [2]. Delays and swelling cost of course just detrimental to all parties related. Therefore, it is necessary effort control project so that its implementation is in accordance with the plan beginning. Control project important done to avoid deviation significant costs and time [3].

One method that can used is a value method results (*earned value*) [4]. This method can used to do evaluation performance project from side cost and time in a way integrated [5]. Some study previous has apply the earned value method to various project construction and provide results evaluation performance project. However, the application of this method is still seldom done on the project renovation restaurant. Meanwhile, the project This type is vulnerable experience delays and swelling cost Because existence change design and working methods.

Therefore, this study aims to evaluate performance project renovation restaurant Arwana the Resort and Spa Nusa Dua from side cost and time by applying the earned value method. Evaluation done

every week during project ongoing. It is expected results evaluation can give information about estimation cost and time settlement project. Thus, this method can give contribution for party related in do action corrective if happen deviation plan so that objective project still achieved. Research results expected can enrich study application of earned value method to projects renovation restaurant.

2. Methods

Project construction is activities that have been planned to be completed in time certain with allocation cost certain. In the implementation project construction often happen deviation from plan Good from side time and also costs. Therefore, it is necessary effort control project so that its implementation is in accordance with the plan beginning. One of the methods that can used is a value method results (earned value). This research uses a quantitative method with a quantitative approach. studies case study. Quantitative methods chosen Because This research will do quantitative data calculation and analysis in the form of cost and time data implementation project.

Whereas approach studies case used Because This research focuses on one case project construction that is project renovation restaurant Arowana the Resort and Spa Nusa Dua. The selection of this method is supported by several study previously applied similar methods to projects construction [6]. This research will do evaluation performance project renovation restaurant the from side cost and time by applying the earned value method. Cost and time data current implementation project obtained from report weekly contractor implementer. The data Then analyzed using the earned value method to calculate variance cost and time as well as index performance.

The result used to make forecast cost and time settlement project. Evaluation done every week during project ongoing. Evaluation results served in form tables and graphs to view trend performance project. It is expected results evaluation can give information important for contractors and consultants supervisor to do action corrective if happen deviation plan. Thus, the application of the earned value method to the project renovation This restaurant can give contribution knowledge about control project construction.

3. Results

Research conducted to study about implementation Project Renovation the Laguna Resort Restaurant and SPA Renovation with Design Budget Cost (RAB), total cost budgeted for the project the is Rp. 3,143,852,000. Implementation development set counted start January 2, 2023 to June 11, 2023. On the project renovation repeat this, evaluation data performance cost served in period weekly or every seven day works. Evaluation done for 27 weeks and for budget data got from amount presentation the weight of work required achieved at the time evaluation multiplied by the plan budget cost project.

ACWP (Actual Cost for Work Performed)

Planned and used as guidelines for expenditure cost No over budget the costs provided to achieve the quality and standard of work is in accordance with the specifications that have been determined. By calculating the volume of work in carefully and knowingly amount material needs and price in a way details, wages, labor work, for each work unit, then can arranged Plan Budget Implementation a project. Besides that, it also has to be taken into account equipment that must be used with all details cost good cost procurement and also cost its operations

Table 1Renovation Data

No	Week	Cost	
		Month (Rp)	Cumulative (Rp)
(1)	(2)	(3)	(4)
1	Week to 1	Rp0.00	Rp0.00

2	Week to 2	Rp0.00	Rp0.00
3	Week to 3	Rp0.00	Rp0.00
4	Week to 4	Rp0.00	Rp0.00
5	Week to 5	Rp30,068,016.81	Rp30,068,016.81
6	Week to 6	Rp110,249,394.97	Rp140,317,411.79
7	Week to 7	Rp92,765,727.69	Rp233,083,139.48
8	Week to 8	Rp79,513,480.88	Rp312,596,620.36
9	Week to 9	Rp94,179,060.67	Rp406,775,681.03
10	Week to 10	Rp70,634,295.50	Rp477,409,976.54
11	Week to 11	Rp102,940,338.52	Rp580,350,315.06
12	Week to 12	Rp133,156,484.09	Rp713,506,799.15
13	Week to 13	Rp154,028,399.54	Rp867,535,198.70
14	Week to 14	Rp166,864,099.51	Rp1,034,399,298.20
15	Week to 15	Rp182,033,563.10	Rp1,216,432,861.30
16	Week to 16	Rp250,296,149.26	Rp1,466,729,010.56
17	Week to 17	Rp200,236,919.41	Rp1,666,965,929.97
18	Week to 18	Rp166,864,099.51	Rp1,833,830,029.48
19	Week to 19	Rp120,189,750.27	Rp1,954,019,779.74
20	Week to 20	Rp129,435,115.67	Rp2,083,454,895.42
21	Week to 21	Rp140,221,375.31	Rp2,223,676,270.73
22	Week to 22	Rp202,185,688.14	Rp2,425,861,958.86
23	Week to 23	Rp121,159,393.40	Rp2,547,021,352.26
24	Week to 24	Rp111,062,777.28	Rp2,658,084,129.54
25	Week to 25	Rp77,275,209.29	Rp2,735,359,338.84
26	Week to 26	Rp180,308,821.68	Rp2,915,668,160.52
27	Week to 27	Rp32,210,824.05	Rp2,947,878,984.57

BCWS *(Budgeted Cost of Work Schedule)*

The numbers that indicate budget for one work packages, but arranged and linked to the schedule implementation. Here timetable fusion between cost, schedule and scope Work where in every elements of work have been given allocation costs and schedules that can be become reject measuring in execution of work. Calculation Budget Cost According to the Schedule (BCWS) obtained by calculating the weight of the work that must be done achieved every reporting multiplied by the total budget in the RAB.

Table 2Renovation Data

No	Week	WEIGHT WORK		Mark Contract	Cost	
		Per week (%)	Cumulative (%)		Per week (Rp)	Cumulative (Rp)
		1	2	3	4 = 1/100 x 3	5 = 2/100 x 3
1	Week to 1	0.00	0.00		Rp0.00	Rp0.00
2	Week to 2	0.00	0.00		Rp0.00	Rp0.00
3	Week to 3	0.00	0.00		Rp0.00	Rp0.00

4	Week to 4	0.00	0.00	Rp3,143,852,000.00	Rp0.00	Rp0.00
5	Week to 5	1.05	1.05		Rp33,010,446.00	Rp33,010,446.00
6	Week to 6	1.05	2.10		Rp33,074,818.49	Rp66,085,264.49
7	Week to 7	3.54	5.64		Rp111,318,873.23	Rp177,404,137.73
8	Week to 8	3.54	9.18		Rp111,318,873.23	Rp288,723,010.96
9	Week to 9	2.70	11.88		Rp84,761,154.61	Rp373,484,165.56
10	Week 10	2.70	14.58		Rp84,761,154.61	Rp458,245,320.17
11	Week 11	3.60	18.18		Rp113,234,372.38	Rp571,479,692.55
12	Week 12	5.51	23.68		Rp173,103,429.32	Rp744,583,121.86
13	Week 13	6.37	30.05		Rp200,236,919.41	Rp944,820,041.27
14	Week 14	6.37	36.42		Rp200,236,919.41	Rp1,145,056,960.68
15	Week 15	6.37	42.79		Rp200,236,919.41	Rp1,345,293,880.09
16	Week 16	6.37	49.16		Rp200,236,919.41	Rp1,545,530,799.49
17	Week 17	6.37	55.53		Rp200,236,919.41	Rp1,745,767,718.90
18	Week 18	6.37	61.90		Rp200,236,919.41	Rp1,946,004,638.31
19	Week to 19	5.35	67.25		Rp168,265,650.37	Rp2,114,270,288.69
20	Week 20	5.35	72.60		Rp168,265,650.37	Rp2,282,535,939.06
21	Week 21	5.35	77.96		Rp168,265,650.37	Rp2,450,801,589.43
22	Week 22	5.14	83.10		Rp161,748,550.51	Rp2,612,550,139.94
23	Week 23	4.24	87.34		Rp133,275,332.74	Rp2,745,825,472.68
24	Week 24	4.24	91.58		Rp133,275,332.74	Rp2,879,100,805.42
25	Week 25	3.44	95.02		Rp108,185,293.01	Rp2,987,286,098.43
26	Week 26	3.44	98.46		Rp108,185,293.01	Rp3,095,471,391.44
27	Week 27	1.54	100.00		Rp48,316,236.07	Rp3,143,787,627.51

Project Performance During Reporting

Project performance in week 5 was quite good reviewed from side cost and progress. Cost variance (CV) is worth positive amounting to Rp32,180,252.79 indicates that cost current lower from the budget set. In addition, the variant schedule (SV) is also positive amounting to Rp. 29,237,823.60 which shows that work progress has been beyond plan. Efficiency use cost seen from mark Cost Performance Index (CPI) of 2.07 and acceleration progress seen from the Schedule Performance Index (SPI) of 1.89. Meanwhile, in the 15th week of performance project decreased. This is reflected from Variants negative cost amounting to -Rp 255,986,075.30 and variants negative schedule of -Rp384,847,094.09. This condition indicates expenditure cost exceeds budget and delays. progress compared to the plan. The CPI and SPI values are also less of 1, 0.79 and 0.71 respectively. Project management need quick take step corrective to fix aspect cost and time completion of work. Project performance Then improved at 23 weeks. Although happen A little delay schedule (SV -Rp82,039,673.08), usage cost relatively efficient with a positive CV of Rp116,764,447.34 and a CPI value above 1 (1.05). The project team must still alert regarding the progress of the work so that it does not the more delayed from plan again. Finally on Week final project (week 27), all work can be completed appropriate time and below budget costs provided. Cost variance, cost variance schedule, CPI and SPI show results positive, which reflects success management project in complete the task efficient and effective.

Table 3Project Performance Status and Estimates Cost and Time Required to Complete

Earned Value Method	Calculation	Calculation Results	Information
CV (Cost Variance)/ Cost Variance	CV = BCWP – ACWP = Rp. 62,248,269.60 – Rp. 30,068,016.81	=Rp. 32,180,252.79	CV positive show cost lower from budget
SV (Schedule Variance) / Integrated Schedule Variance	SV = BCWP – BCWS = Rp. 62,248,269.60 – Rp. 33,074,818.49	= Rp. 29,173,451.11	SV positive show more work fast from plan
CPI (Cost Performed Index) / Index Performance Cost	= BCWP/ACWP = Rp. 62,248,269.60/Rp. 30,068,016.81	= 2.07	CPI more from 1 shows expenditure smaller from budget
SPI (Schedule Performed Index) / Index Schedule Achievements	= BCWP/BCWS = Rp. 62,248,269.60/Rp. 33,074,818.49	= 1,886	SPI more from 1 indicates work is ahead of plan
ETC (Estimate to Complete) / Estimate Cost for Remaining Work	= (BAC-BCWP)/CPI = (Rp. 3,143,852,000 – Rp. 62,248,269.60)/2.07	= Rp1,488,518,690.82	Estimation cost remaining more from plan budget project
EAC (Estimate at Competition) Cost Completion Project	= ACWP + ETC = Rp. 30,068,016.81 + Rp. 1,488,518,690.82	= Rp1,518,586,707.63	Estimation cost bigger from plan budget
ETS (Estimate Temporary Schedule) / Estimated Schedule for Remaining Work	= (remainder time)/SPI = 22 / 1.88	= 11,667	Reporting every week same as plan project until completion, namely 27 weeks, then can concluded that in reporting week 27 the project was completed right on schedule duration beginning project.
EAS (Estimate All Schedule) / Estimated Schedule Until End of Project	= ETS + Reporting Time = 11,667 + 5	= 16,667	Completion end project from deviation planning namely 27 weeks and implementation which is 27 weeks and can concluded that the project was completed on time.

Estimation Cost and Completion Time Project

From the calculation Estimate to Complete (ETC) which is estimation costs to complete the remaining work, obtained largest ETC value was in the 13th week at Rp2,949,161,671.94. This figure shows the magnitude addition costs required if rate absorption budget until This 13th week continues to be continued until end project. Estimate at Completion (EAC) or estimated total cost projects also tend to increase from Rp3.09 billion in the 11th week to reach the highest of Rp4.01 billion in the 16th week. However, at the end of project EAC fee successful lowered up to Rp2.95 billion, lower from budget beginning amounting to Rp3,143,852,000.00. This shows effort efficiency cost by team project so that

in the end project experience cost underrun, namely expenditure lower compared to budget. Temporary from side time, ETS or estimate duration completion of remaining work highest is in the 13th week, which is 18.51 weeks. If you add it up with the time 13 weeks reporting, then EAS (Estimate at Schedule) or estimated total time settlement reached 31.51 weeks. However, again in the implementation Week Lastly, the team project capable finish all the work is right time in 27 weeks, according to schedule the initial set.

4. Discussion

In generally overall, project renovation Arowana the Resort and Spa Nusa Dua can it is said success Because capable done well, right cost, and right time. This is reflected from results calculation Variants cost (CV), variant schedule (SV), index performance costs (CPI), and index performance schedule (SPI) which shows number positive at the end project. This condition indicates that the total expenditure cost lower compared to budget (cost underrun) and work progress is 100% according to the set schedule which is 27 weeks. However Thus, it is necessary noted that performance project had time experience drop in the middle implementation, namely in the range week 11 to 21st week. This is indicated by negative CV and SV values. and CPI and SPI below number 1.

Condition the hinting existence swelling outside costs budget and progress delays compared to the timeline that has been set approved. Fortunately team project capable control the state of doing various efficiency and acceleration so that in the end all targets can achieved. Therefore, the results evaluation performance project through approach Earned Value Management can become learning valuable for planning and execution project similar in the future. Aspects like forecast costs and terms time settlement based on historical data can become reference for compiling more budget and schedule accurate. Thus, risk delays and swelling cost can minimize in the future.

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