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EARNED VALUE ANALYSIS METHOD AS A COST AND TIME PERFORMANCE ANALYSIS (Case Study LAU SIMEME DAM Construction Project KSO Between PT. Wijaya Karya Persero.Tbk and PT. Bumi Karsa)

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ABSTRACT

Project construction is a series of activities that must be completed in accordance with a project contract and also at a pre-agreed cost. The important point for project completion is the accuracy in accordance with the estimate, the use of costs according to the budget while maintaining quality. However, project implementation often encountered obstacles so that the completion time stalled. The impact of late completion of this project is not only in terms of time, but has an impact on the use of costs which ultimately erodes the profit margin of a project. This is what is being faced in the Lau Simeme Dam Development Project which is an Operational Cooperation (KSO) between PT Wijaya Karya (Persero) and PT Bumi Karsa. This project costs Rp. 733 billion which began on December 22, 2017 and is estimated to be completed on April 7, 2022. The research data was taken as of December 2020, where according to the plan the project should have been completed 52.90%, but in fact it was only 13.92% completed. Based on this phenomenon, researchers conducted a research in order to solve the problem of delays and budget waste using the Earned Value Analysis approach. The results showed that there was a delay in project construction resulting in a setback in project completion with an estimated addition (Estimated Completion Date) of 1,294 days. Due to the delay in project completion, there was an additional cost of 1.760 billion or in other words, the project cost was Rp. 665 billion while the RAB is only 663 billion. This cut the previously planned margin of 70.051 billion to 68.290 billion. In order to overcome delays in project completion, it can be done by holding work shifts,

Keywords: ***Earned Value Analysis, Lau Simeme Dam Project, Operational Cooperation, PT Wijaya Karya, PT Bumi Karsa.***

1. INTRODUCTION

1.1.Research Background

Indonesia is currently intensively building infrastructure to accelerate national development. Infrastructure development includes roads, bridges and reservoirs. One of the infrastructure developments initiated by the Central Government or one of the President's Nawacita of the Republic of Indonesia for the construction of the PSN (National Strategic Project) project, in this case through the Ministry of Public Works and Public Housing, Directorate General of Water Resources, Sumatra II River Basin Office, namely the construction of dams Lau Simeme Package 1 (MYC) Deli Serdang Regency. This project is a National Strategic Project (PSN). The construction

of this dam has been initiated for a long time, but can be realized in 2018. The reservoir construction project was carried out by PT. Wijaya Karya (Persero) Tbk together with PT. Karsa Earth.

Project work is a series of activities that must be completed in accordance with the work contract and also with a pre-agreed fee. Time and cost are important elements in project management control. Of course all contractors who get project work hope that the project they are working on is in accordance with the estimated time, this besides fulfilling the work contract it also has an impact on the projected profits obtained by the contractor. Projects that are completed on time certainly generate profit margins according to plan or it could be higher than projects that are completed not on time or late.

The next problem that is often faced by contractors as project executors is cost. Tightening of expenses must be in accordance with the Budget Plan (RAB) that has been prepared beforehand. The RAB contains an estimated cost plan that must be incurred from time to time. In addition to time and cost issues, contractors must also not ignore the quality aspect. Overall, the project must be completed by the contractor according to quality, on the other hand the contractor is facing how to complete the project on time and maintain and control costs in accordance with the planned RAB.

PT. Wijaya Karya (Persero) Tbk together with PT. Bumi Karsa as the implementing contractor for the Lau Simeme Dam construction project also experienced time and cost problems in completing the project. Project financing is divided into 2 (two) major parts, namely Direct Costs and Indirect Costs as shown in the following chart:

Figure 1.1 Project Cost Components
Source: Secondary Data Processing, 20
20

A project is said to be successful if it is able to manage budget, schedule and also quality. These three things are important parameters for project organizers who are often associated as project objectives (Soeharto, 1999).

Various ways are used to measure the effectiveness of project implementation. The method that is often used is the earned value. The concept of "earned value" is one of the tools used in project management that integrates cost and time. The concept of earned value presents three

dimensions, namely the physical completion of the project (the percent complete) which reflects the planned cost absorption (budgeted cost), the actual costs that have been incurred or what is known as actual cost and what is obtained from the costs that have been incurred or what is called earned values. From these three dimensions, the concept of earned value can be linked between cost performance and time derived from calculating the variance of costs and time (Flemming and Koppelman, 1994).

2. LITERATURE REVIEW

2.1.Definition of the project

The following describes some opinions about the project. According to Gittinger (1993) a project is an investment activity as part of a program that uses production factors to produce goods or services that are expected to generate profits within a certain period. According to this definition, a project has the following characteristics:

1. The project has the objective of producing goods and services;
2. Projects require input in the form of scarce resources such as capital, labour, land and leadership
3. Projects have a starting point and an ending point
4. In time after the project is completed, start to generate benefits

According to Suharto (1999) a project can be interpreted as a temporary activity that takes place within a limited period of time, with an allocation of certain resources and is intended to produce a product or deliverable whose quality criteria have been clearly outlined Project Management

Project management according to Lewis (2002) is planning, scheduling and monitoring of project activities to achieve performance, cost and time objectives, for the scope of work that has been given by using resources efficiently and effectively. Meanwhile, according to Suharto (1999) project management is planning, organizing, leading, and controlling the company's resources to achieve predetermined short-term goals. Furthermore, project management uses a vertical and horizontal hierarchical (activity flow) system approach.

According to Ervianto (2005) in project management all planning, implementation, control and coordination of a project from the beginning (idea) to the end of the project is structured to ensure project implementation is on time, on cost and on quality. However, in practice, there are still many problems such as errors in calculating project time and project cost estimates due to the calculation of project time and costs based on estimates. Delays in carrying out project work result in the project not being completed in accordance with the scheduled time, resulting in increased project costs due to additional project processing time.

2.2.Financial Feasibility Analysis of the Project

Financial Feasibility Analysis is an analysis in a project to find out whether an investment in a certain period of time provides benefits or not. Financial feasibility analysis in a project generally uses the Net Present Value (NPV) indicator to measure financial internal returns. A project can be carried out if the project is financially and socio-economically feasible.

2.3.Cost and Time Control

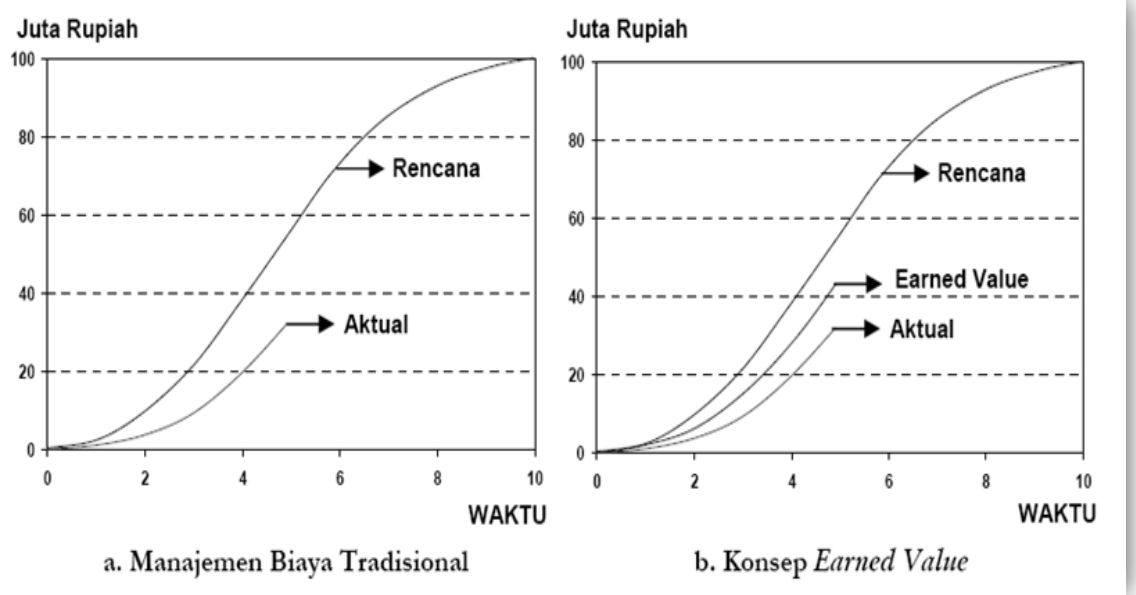
Definition

Control efforts are the process of measuring, evaluating, and correcting project performance. For construction projects, there are three elements that need to be controlled and measured, namely: progress achieved compared to contract agreements, financing against budget plans, and quality of work results against technical specifications according to Dipohusodo (1996).

Suharto (1999) provides an understanding of control where according to him, control is a systematic effort to determine standards that are in accordance with planning objectives, design information systems, compare implementation with standards, analyze the possibility of deviations between implementation and standards, then take corrective action needed so that resources are used effectively and efficiently in order to achieve the target.

2.4. Earned Value Method

Flemming and Koppelman (1994) explain the concept of earned value compared to



traditional cost management as shown in Figure 2.1 below:

Figure 2.1 Comparison of Traditional Cost Management with the Concept of Earned Value
Source:Flemming and Koppelman, 1994

Based on Figure 2.1 above, traditional cost management only presents two dimensions, namely a simple relationship between actual costs and planned costs. With traditional cost management, the performance status cannot be known. In Figure 2.1 it can also be seen that the actual costs are indeed lower, but the fact that the actual costs are lower than this plan cannot indicate that the performance that has been carried out is in accordance with the plan targets. Project Risk Mitigation

One of the important issues in project management is considering the risk aspects that arise. Good management will compile any risks that arise related to project implementation and how to overcome (mitigate) the project risks that arise. The project implementer before carrying out the project besides carrying out a feasibility analysis, also carries out risk mitigation steps, this aims to get an overview of what risks will arise and how to deal with them if these risks occur. With risk mitigation, project management can focus on project implementation and if unwanted things happen, they can deal with them through pre-arranged risk mitigation.

3. RESEARCH METHOD

Data analysis used analytical and descriptive methods. Analytical means that existing data is processed in such a way as to produce conclusive final results. While descriptive means to describe problems that already exist or appear. The concept of Earned Value Analysis examines the trend of schedule variances and cost variances over a period of time during a project. But in this study will only discuss the time variant.

3.1. Earned Value Method in Project Control

Cost control is equally important for every company, regardless of size. In general, small companies have tighter financial controls than large companies because the risk of failure of a project may not necessarily be covered by other projects it owns. Unlike large companies, which can assign a project loss to several other projects. Types of research

The type of research used is a combination of qualitative and quantitative. Combination research emphasizes quantitative aspects in analyzing data but is also combined with qualitative techniques to deepen a phenomenon (Sugiyono, 2012).

3.2. Research Locations

This research was conducted in Kuala Dekah Village, Sibiru-biru District which is administratively located in the Deli Serdang Regency, North Sumatra Province.

3.3.Data Collection Method

Data collection techniques are the methods used to obtain data. These data include:

1. *Time Schedule*or S Curve
2. Project Cost Budget Plan
3. Project Finance Monthly Report, RA-RI DIPA

3.4.Data analysis method

The concept of Earned Value Analysis examines the tendency of schedule variances and cost variances over a period of time during a project.

3.5.Stages and Research Procedures

The stages in data analysis are a sequence of steps that are carried out systematically and logically according to the theoretical basis of the problem so that an accurate analysis is obtained to achieve the author's goals. The stages in this research are as follows:

1. Stage I

   Before conducting research, it is necessary to conduct a literature study to deepen knowledge related to the research topic. Then determine the formulation of the problem up to data compilation.
2. Stage II

   Calculate direct costs, indirect costs, taxes and total construction costs. Direct costs are calculated from daily reports of projects that are cashed in and progressed. The report contains the needs of workers, tools and materials every day. Taxes are estimated at 10 percent of the total sum of direct and indirect costs.
3. Stage III

   Calculating the Financial Feasibility Analysis, in this case calculating the Net Present Value of the project, whether it is feasible or not.
4. Stage IV

   Calculates ACWP, BCWP, BCWS. ACWP is calculated from the total direct costs, indirect costs. Meanwhile, ACWP is calculated from the total direct costs, indirect costs and taxes. BCWP is calculated from the actual weight of all work against the contract value. BCWS is calculated from the weight of the work against the budget plan.

5. Stage V

   Calculating CV, CPI, SPI, ETC. CV is calculated from the difference between BCWP and ACWP. CPI is calculated from the comparison between BCWP and ACWP. SPI is calculated from BCWP / BCWS. ETC is calculated from the difference between BAC and BCWP divided by CPI.

4. RESULTS AND DISCUSSION

4.1.Project Functions / Objectives

The aims, objectives and targets to be achieved from the construction of the Lau Simeme Dam are:

1. Availability of a continuous supply of raw water for the daily needs of the people of Medan City.
2. Medan city flood control.
3. Increase the electricity supply by 2.80 MW.
4. Supporting tourism development in Deli Serdang Regency.
5. Opportunities for the Development of inland fisheries for communities in the Downstream Reservoir

4.2.Scope of Work

The scope of work that will be bound in the contract is the construction of the Lau Simeme Dam, Deli Serdang Paket-1 (MYC).

Details of the scope of work/contract as follows:

1. Preparatory work consists of work items:
   a. Mob-Demob Equipment, Facilities, Clean Water, Electricity Lighting, Communications, Geological Investment – Land, Video and Photo
2. Entrance Work
   a. Entrance Road (Road improvement from the Sibiru-biru T-junction to the Dam Location)
   b. Road Inspection (New Road Work to Power House and Jetty)
   c. Road Improvement from Dam to Quarry (Mardinding)
3. Major Dam Works
   a. Dewatering Work
   b. Main Cofferrdam Works
   c. Main Dam Works
   d. Embankment and Pavement Works
   e. Drainage Work
   f. Drilling and Grouting work
   g. Jetty Jobs and Trash Boom
   h. Dam Instruments
   i. OP support equipment
   j. Other jobs

4.3.Financial Feasibility Analysis

Calculation of Financial Feasibility Analysis in this study using the calculation of Net Present Value (NPV). NPV is used to see the feasibility of the project whether it can be followed up or not. The NPV calculation is done by taking into account the difference between the present value of the investment and the present value of income during the investment period.

How to obtain NPV according to Umar (2003) is as follows:

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$$NPV = \sum_{t=1}^{n} \frac{Ct}{(1+r)^n} - Co$$

Where:
Ct = cash flow per year in period t,m
Co = Initial investment in year 0
r = Interest rate (discounted rate)
n = number of years of development plan

While the financial feasibility assessment of the acquisition of NPV is as follows:

- If NPV > 0, then the project proposal can be accepted
- If NPV = 0, the value of the company remains that the project proposal returns to the company's management policy whether it is continued or accepted.
- If NPV > 0, then the project proposal is rejected

The initial investment in this project is Rp. 733,519,090,909,-. NPV calculation to find out whether the company's investment in the future is feasible to be followed up or not. The estimated construction time for the project is ±4 years, or in this case it is rounded up to 4 years. The following is the cash flow data for the Lau Simeme dam construction project:

Table 4.2 Cash Flow Data for the Lau Simeme Dam Construction Project

Year	cash flow		
	Cash In	Cash out	Cash Flow Balance
2018	IDR 19,548,258,343	(Rp 20,760,086,540)	(Rp 1,211,828,196)
2019	IDR 43,303,007,938	(Rp 48,433,052,651)	(Rp 5,130,044,713)
2020	IDR 93,156,897,336	(Rp 47,683,405,273)	IDR 45,473,492,062
2021	IDR 125,488,894,153	(Rp 129,198,983,563)	(Rp 3,710,089,410)
2022	IDR 228,555,550,830	(Rp 263,387,518,810)	(Rp 34,831,967,979)

Source: Internal Data Processing, 2021

Next, information is sought from data from the Central Statistics Agency, what is the value of investment interest rates by looking at the average investment interest rate in Indonesia for the 2020 period as shown in Table 4.3 below:

Table 4.3 Bank Investment Interest Rates in Indonesia for the 2020 period

Bank Group	Rupiah Credit Interest Rate by Bank Group (%)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec*	Annual
state-owned banks	9.70	9.66	9.57	9.26	9.12	9.12	9.08	9.06	8.97	8.95	8.94	-	9.22
Government Bank	11.02	10.98	10.90	10.87	10.73	10.66	10.62	10.57	10.36	10.27	10.29	-	10.66

National Private Bank	10.021	9.989	9.981	9.957	9.943	9.942	9.928	9.920	9.911	9.903	8.897	-	9.944
Foreign Banks and Mixed Banks	8.479	8.476	8.452	8.444	8.439	8.424	8.408	8.400	7.958	7.951	7.943	-	8.416
commercial banks	9.987	9.983	9.970	9.945	9.932	9.93	9.921	9.916	9.906	9.901	8.896	-	9.935
	Average Investment Interest Rate for 2020												*9.37 %*

*Investment Interest Rate is still being calculated
Source: Central Bureau of Statistics Data Processing, 2021

Based on the data in Table 4.3, it is found that the average Investment Interest Rate for the Bank group in Indonesia is 9.37% and this is used as the basis for interest rates (r) in this study. Thus, the NPV values obtained for the total investment for the Lau Simeme Dam Development project are as follows:

Table 4.4 Calculation of NPV for the Lau Simeme Dam Development Project

Information		7th year	Cash Flow (in thousand)	*Present Value*(in thousands)
Interest rate	9.37%	0	(Rp 733,519,090)	(Rp 733,519,090)
Total Investment (in thousands)	IDR 733,519,090	1	(Rp 1,211,828)	(Rp 1,108,008)
		2	(IDR 5,130,045)	(Rp 4,288,691)
		3	IDR 45,473,492	IDR 34,758,712
		4	(Rp 3,710,089)	(Rp 2,592,934)
		5	(Rp 34,831,968)	(Rp 22,258,042)
			TOTAL	IDR 4,511,037
			NPV	**(Rp 729,008,053)**

Source: Internal Data Processing, 2021

Based on the data in Table 4.4, the NPV is negative (Rp. 729,008,053) which is the result of reducing the total investment with the total PV of Cash Flow for the Lau Simeme Dam Development project. As the calculation above, the NPV value is negative, this indicates that the project is not feasible to continue.

4.4. Research Data Analysis

Work on the Lau Simeme Dam construction project began in early December 2017. Research data collectors cut-off in December 2020. During its journey, the construction of the Lau Simeme Dam did not go as it should. There were obstacles and challenges faced by KSO which resulted in KSO management carrying out several revisions to the Work Schedule simulation, until December 2020 it was recorded that it had made 5 (five) revisions. In order to get in-depth results,

this study uses research data based on observational data (actual realization data) coupled with Simulation Data V (revision of the Job Schedule simulation data which was last used as of December 2020). The detailed data for the construction of the Lau Simeme Dam can be seen as follows:

1. Contract value : Rp.733,519,090,909,-
2. WED : Rp. 663,468,017.727 ,-
3. Margin Plan : Rp.70,051,073,182,-
4. Percent margin : 9,550
5. Beginning of the Project : 22December 2017
6. Project Final Estimation : April 07, 2022
7. Monitoring Time : 31December 2020
8. Estimated Working Days : 1,567days or ± 224 weeks
9. Work Day Realization : 1.105days or ± 158 weeks
10. Remaining Working Days : 462days or ± 66 weeks
11. Initial Cumulative Progress Plan: 52.90%
12. Cumulative Realization
    (Observation Data) : 13.93%
13. Cumulative plan
    (Amendment Data V) : 15.97%

4.5.Description of Research Data

Observation of project supporting data for calculating earned value in research is from June 2020 to December 2020, with details shown in Table 4.5 below:

Table 4.5 Composition of Project Data

Current Month Period	Total Construction Cost Up To	Cumulative Progress Plan (Observation)	Cumulative Progress Plan (Amendment 5)	Realization of Cumulative Progress
June 2020	IDR 69,772,106,512	37.78%	10.30%	10.27%
July 2020	IDR 73,045,654,559	39.97%	11.16%	10.72%
August 2020	IDR 76,904,941,498	42.07%	11.94%	11.08%
September 2020	IDR 79,729,289,110	44.17%	12.76%	11.50%
October 2020	Rp 82,653,043,529	46.20%	13.82%	11.93%
November 2020	Rp 87,645,963,578	49.76%	14.90%	13.22%
December 2020	Rp 92,599,792,728	52.90%	15.97%	13.92%

Source: KSO Internal Data, 2021

Based on the data in Table 4.5, it shows that there is a difference in the Cumulative Progress Plan, where the Observation Data taken based on the actual plan shows that 52.90% has been running which is then revised to 15.97% compared to the progress plan at 13.92%. Based on this, KSO management revised the plan through the 5th amendment to 15.97%. Calculation of this amendment so that there are no major deviations at the end of the project day.

The results of the study show that if the management of the KSO Lau Simeme Dam Project Development is able to optimize the use of the budget properly, then the Earned Value Analysis results also show positive results. The same thing will also happen if the KSO management of the Lau Simeme Dam Project Development is able to optimize the time properly. In the Earned Value

Analysis "Amendment Reschedule V" calculation, the work is completed faster than the December 2020 timeline,

4.6.Managerial Implications

Referring to the calculation of the actual timeline (December 2020 with a work progress of 13.92%), delays in project execution were obtained and it was also costly compared to the budget. In order to overcome delays in project work, several alternatives can be carried out which the authors present based on observations and interviews in the field, including through:

1. work shifts

   When the authors made observations in the field, the authors found several workers with a small workload, while some workers had quite a high workload. This provides an option for KSO management to utilize a workforce that does not have a high workload. This job shift (shifting) can be temporary until workers who have a high workload reach a reasonable workload.

   This high and low workload is caused by the type of work, where in general the workforce that has a high workload is those in the field, while the workload that is not high is the administrative group. If the disbursement of DIPA goes smoothly, it is certain that administrative class workers also experience the same workload as workers in the field.
2. Extend working time

   The next alternative could be by extending working hours or adding workers overtime. It's just that it needs proper conditioning in arranging the overtime schedule, so that workers don't have to work overtime every day. Workers who do overtime every day can actually reduce productivity, due to the fatigue factor experienced by employees. The addition of working hours is done mainly for job positions that require longer working hours.

In addition to being useful for the KSO between PT Wijaya Karya (Persero) Tbk and PT Bumi Karsa in the Lau Simeme dam construction project, it can also serve as a reference and benchmark for the work of other development projects, especially those facing the same problems related to cash flow and/or accuracy of work execution.

5. CONCLUSIONS AND SUGGESTIONS

5.1. CONCLUSION

Based on the research objectives, it can be concluded:

1. Based on Earned Value Analysis calculations, the estimated project will be completed:
   a. By using the Observation Data benchmark (December 2020) as the monitoring time, it is obtained that the completion time requires an additional 1,294 days.
   b. By using the Amendment V Data benchmark as monitoring time, it is obtained that the completion time requires an additional 68 days.
2. The cost for the remaining work using the Earned Value Analysis calculation, an estimate of Rp. 572,628,603,306, - both using Observational Data and Amendment V Data.
3. The amount of the total cost by using the calculation of Earned Value Analysis, then obtained an estimate of Rp. 665,228,396,034, - either using Observational Data or Amendment V Data.
4. The amount of cost deviation from the budget by using the Earned Value Analysis calculation, then obtained an estimate of Rp. 1,760,378,307, - either by using Observational Data or Amendment V Data.

5.2. SUGGESTIONS

The suggestions according to the results in this study include:

1. The KSO for the Development of the Lau Simeme Dam Project needs to think about efforts to accelerate project completion which can be done, among others: by holding work shifts, extending work time, adding tools or technology that can speed up work, using materials that are easier to work with. And a social approach to society.
2. While mitigation efforts from a cost perspective, the company needs to make efficiency of the costs that will occur to complete the project.

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